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SOLUBILITY DATA SERIES

Volume 5/6

HYDROGEN AND DEUTERIUM

SOLUBILITY DATA SERIES

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Robert Maxwell
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SOLUBILITY DATA SERIES

Volume 5/6

HYDROGEN AND DEUTERIUM

Volume Editor

COLIN L. YOUNG
University of Melbourne
Parkville, Victoria, Australia

Evaluators

RUBIN BATTINO
Wright State University
Dayton, Ohio, USA

H. LAWRENCE CLEVER
Emory University
Atlanta, Georgia, USA

DENIS A. WIESENBURG
Texas A & M University
College Station, Texas, USA

Compilers

R. W. CARGILL
Dundee College of Technology
Dundee, UK

ARDIS L. CRAMER
Emory University
Atlanta, Georgia, USA

M. ELIZABETH DERRICK
Valdosta State University
Valdosta, Georgia, USA

J. CHR. GJALDBAEK
Royal Danish School of Pharmacy
Copenhagen, Denmark

SUSAN A. JOHNSON
Emory University
Atlanta, Georgia, USA

PATRICK L. LONG
Emory University
Atlanta, Georgia, USA

E. S. THOMSEN
Royal Danish School of Pharmacy
Copenhagen, Denmark

D. G. T. THORNHILL
Leicester Polytechnic
Leicester, UK

E. WILHELM
University of Vienna
Austria

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SOLUBILITY DATA SERIES

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

IUPAC Secretariat: Bank Court Chambers, 2-3 Pound Way,
Cowley Centre, Oxford OX4 3YF, UK

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 sufficient 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 1980, 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 users of this volume will find (1) the experimental solubility data of hydrogen, hydrogen deuteride and deuterium gas in liquids as reported in the scientific literature (2) evaluations and tables of tentative or recommended solubility data when two or more laboratories have reported consistent solubility data over the same range of temperature and pressure for a system. (3) general evaluations of groups of related systems when more detailed comments on individual systems are not possible. In some instances users have the option of using the experimental values, either directly, or in their own smoothing equations, or of using the smoothed values prepared by the compilers and evaluators.

A fairly liberal interpretation of the terms, "gas", "liquid" and "solubility" has been taken. In particular virtually all two phase equilibria have been considered as "solubility" when one component is hydrogen even at high pressures. The "gas" being the less dense phase and the "liquid" being the more dense phase. The two phase equilibria between isotopes of hydrogen has been excluded. The helium and hydrogen mixtures are considered in the volume on helium.

The literature has been, in general, covered up until the end of 1979 although some papers published during 1979 in journals not readily available may have been omitted. Some 1980 papers are cited.

Some words of explanation are required with respect to units, smoothing equations, auxiliary data and data sources, and other points. In general the experimental data are presented in the units found in the original paper. In addition, the original data are often converted to other units.

Only in the past 15 years have experimental methods for the determination of the solubility of gases in liquids developed to the point where 0.5 per cent or better accuracy is attained. For hydrogen the corrections for non-ideal behaviour and for expansion of the liquid phase on dissolution of the gas are small for pressures below 200 kPa and well within the normal experimental error. Thus such corrections were not made for the gas solubility of hydrogen at low pressures.

Most gas solubility measurements carried out near armospheric conditions are measured at a total pressure near one atmosphere with the gas saturated with the solvent vapor. Usually the actual partial pressure of the gas is not known. In most cases the Ostwald coefficient is the directly measured coefficient. The Bunsen coefficient and the mole fraction gas solubility at one atmosphere gas partial pressure are calculated from the Ostwald coefficient assuming the Ostwald coefficient is independent of pressure. The assumption may not be true, especially if the gas is at a partial pressure well below atmospheric, if the solvent has a high vapor pressure or if the gas is soluble enough to change the solvent properties measureably from their pure liquid properties. This problem, which becomes important for more soluble gases, is one which evaluators will need to pay more attention to as the precision of solubility measurements increases in the future. The Bunsen coefficients and mole fraction solubility values calculated from Ostwald coefficients in this volume need to be used with the above caution in mind.

The lack of high accuracy is also the reason that only a two-constant equation is used to smooth and evaluate most of the gas solubility data. A Gibbs energy of solution equation linear in temperature is used

$$\Delta G^\circ/\text{J mol}^{-1} = -RT \ln x_1 = A + BT$$

or in alternative form

$$\ln x_1 = -\Delta G^\circ/RT = -A/RT - B/R$$

where A is ΔH°, B is $-\Delta S^\circ$, x_1 is the mole fraction solubility at a gas partial pressure of 101.325 kPa (1 atm) and R is 8.31441 J K^{-1} mol^{-1}. The constants A and B require five digits to reproduce the mole fraction solubility to three significant figures. Although the constants are given to five digits it is not intended to imply that the values of the changes in enthalpy and entropy of solution are significant to more than two or three digits.

An inconsistency, which we believe is justified, is found with respect to the solubility data in water. A recommended equation and table of values is given for the solubility of hydrogen in water. However, for systems which contain water and other solvent compounds such as electrolytes or water miscible polar organic compounds, the experimental gas solubility in water from the paper is given, even when it is at variance with the recommended values. These data are presented because the author's ratio of gas solubility in water to the solubility in the aqueous solution may be more accurate than the solubility itself.

Solvent density data were often required in making conversions from Ostwald coefficients to mole fraction solubilities. Where the density data were not referenced, as in other volumes in this series, the main sources of density data were:

Circular 461 of the U.S. National Bureau of Standards
American Petroleum Research Project 44 Publications
The International Critical Tables, Volume III (E.W. Washburn, Editor) McGraw-Hill Co., 1931
Smow Table, *Pure and Applied Chemistry*, 1976, *45*, 1-9.
Thermodynamic Properties of Aliphatic Alcohols, R.C. Wilhoit and B.J. Zwolinski, *J. Phys. Chem. Ref. Data*, 1972, *2*, Supplement No.1.
Organic Solvents, J.A. Riddick and W.B. Bunger, Technique of Chemistry, Volume II, A. Weissberger, Editor, Wiley-Interscience, New York, 1970, 3rd Edn.

Chemical Abstracts recommended names and registry numbers were used throughout. Common names are cross referenced to Chemical Abstracts recommended names in the Index. There is a registry number index.

The Editor would appreciate users calling errors and omissions to his attention.

The Editor gratefully acknowledges the advice and comments of members of the IUPAC Commission on Solubility Data, the help and hard work of Professor Larry Clever and the efforts of the typist, Carolyn Dowie, Lesley Flanagan, Peggy Tyler and Joy Wall. The help of Kerri Hubbard in obtaining copies of papers not available in Melbourne was appreciated.

Acknowledgement is made to the University of Melbourne for a Travel Grant for Research which considerably aided the completion of this volume.

Colin L. Young

Melbourne, Victoria

THE SOLUBILITY OF GASES IN LIQUIDS

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

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 recommended and in some cases a smoothing equation suggested 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.

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, 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 and inevitably 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 Kelvin.

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 measurement 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. For 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 very 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:

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

$$= \frac{W(g)/M(g)}{[W(g)/M(g)] + [W(1)/M(1)]}$$

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

$$\text{wt\%} = 100\ W(g)/[W(g) + W(1)]$$

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

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

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

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

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 is assumed to be obeyed,

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

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

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

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,

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

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.

The Ostwald Coefficient, L

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

$$L = \frac{V(g)}{V(1)}$$

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, is related to the Ostwald coefficient by

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

where P is the partial pressure of gas. The mole fraction solubility will be at a partial pressure of P(g).

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

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

where P(1) is the partial pressure of the liquid in atmosphere.

The Henry's Law Contant

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

$$P(g) = K_H x$$

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

$$P(g) = K_2 C(1)$$

or

$$C(g) = K_C C(1)$$

where K_2 and K_C are constants, C the concentration, and (1) 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

$$N = n(g)/n(1)$$

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

For gas solubilities greater than about 0.01 mole fraction 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.

TABLE 1 Interconversion of parameters used for reporting solubility

---

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

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

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

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

---

where v_o is the molal volume of the gas in $\text{cm}^3 \text{mol}^{-1}$ 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 $v_{t,gas}$ the molal volume of the gas ($\text{cm}^3 \text{mol}^{-1}$) at the temperature of the measurement.

SALT EFFECTS

The effect of a dissolved salt in the solvent on the solubility of a gas is often studied. The activity coefficient of a dissolved gas is a function of the concentration of all solute species (see ref. 8). At a given temperature and pressure the logarithm of the dissolved gas activity coefficient can be represented by a power series in C_s, the electrolyte concentration, and C_i, the nonelectrolyte solute gas concentration

$$\log f_i = \sum_{m,n} k_{mn} C_s^{\,n} C_i^{\,m}$$

It is usually assumed that only the linear terms are important for low C_s and C_i values when there is negligible chemical interaction between solute species.

$$\log f_i = k_s C_s + k_i C_i$$

where k_s is the salt effect parameter and k_i is the solute-solute gas interaction parameter. The dissolved gas activity is the same in the pure solvent and a salt solution in that solvent for a given partial pressure and temperature

$$a_i = f_i S_i = f_i^{\,o} S_i^{\,o} \text{ and } f_i = f_i^{\,o} \frac{S_i^{\,o}}{S_i}$$

where S_i and $S_i^{\,o}$ are the gas solubility in the salt solution and in the pure solvent, respectively, and the f's are the corresponding activity coefficients. If follows that $\log f_i/f_o = \log S_i^{\,o}/S_i = k_s C_s + k_i (S_i - S_i^{\,o})$. When the quantity $(S_i - S_i^{\,o})$ is small the second term is negligible even though k_s and k_i may be of similar magnitude. This is generally the case for gas solubilities and the equation reduces to

$$\log \frac{f_i}{f_i^{\,o}} = \log \frac{S_i^{\,o}}{S_i} = k_s C_s$$

which is the form of the empirical Setschenow equation in use since the 1880's. A salt that increases the activity coefficient of the dissolved gas is said to salt-out and a salt that decreases the activity coefficient of the dissolved gas is said to salt-in.

Although salt effect studies have been carried out for many years, there appears to be no common agreement of the units for either the gas solubility or the salt concentration. Both molar (mol dm^{-3}) and molal (mol kg^{-1}) are used for the salt concentration. The gas solubility ratio $S_i^{\,o}/S_i$ is given as Bunsen coefficient ratio and Ostwald coefficient ratio, which would be the same as a molar ratio; Kueunen coefficient ratio, volume dissolved in 1 g or 1 kg of solvent which would be a molal ratio; and mole fraction ratio. Recent theoretical treatments use salt concentration in mol dm^{-3} and S_i^0/S_i ratio as mole fraction ratio with each salt ion acting as a mole. Evaluations which compare the results of several workers are made in the units most compatible with present theory.

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 $\Delta\bar{G}_1^0, \Delta\bar{H}_1^0, \Delta\bar{S}_1^0$ and $\Delta\bar{C}^0_{p1}$ 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:

$$\Delta\bar{G}_1^0 = -RAT - 100\ RB - RCT \ln (T/100)$$

$$\Delta\bar{S}_1^0 = RA + RC \ln (T/100) + RC$$

$$\Delta\bar{H}_1^0 = -100\ RB + RCT$$

$$\Delta\bar{C}^0_{p1} = RC$$

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

$$\Delta\bar{G}_1^0 = -RT \ln x = A + BT$$

in which case $A = \Delta\bar{H}_1^0$ and $-B = \Delta\bar{S}_1^0$.

REFERENCES

1. Battino, R.; Clever, H.L. *Chem. Rev.* 1966, *66*, 395.
2. Clever, H.L.; Battino, R. in *Solutions and Solubilities*, Ed. M.R.J. Dack, J. Wiley & Sons, New York, 1975, Chapter 7.
3. Hildebrand, J.H.; Prausnitz, J.M.; Scott, R.L. *Regular and Related Solutions*, Van Nostrand Reinhold, New York, 1970, Chapter 8.
4. Markham, A.E.; Kobe, K.A. *Chem. Rev.* 1941, *63*, 449.
5. Wilhelm, E.; Battino, R. *Chem. Rev.* 1973, *73*, 1.
6. Wilhelm, E.; Battino, R.; Wilcock, R.J. *Chem. Rev.* 1977, *77*, 219.
7. Kertes, A.S.; Levy, O.; Markovits, G.Y. in *Experimental Thermochemistry* Vol. II, Ed. B. Vodar and B. LeNaindre, Butterworth, London, 1974, Chapter 15.
8. Long, F.A.; McDevit, W.F. *Chem. Rev.* 1952, *51*, 119.

COMPONENTS:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5]	Rubin Battino and Emmerich Wilhelm Department of Chemistry Wright State University Dayton, OH 45435 USA July 1977, revised May 1980

CRITICAL EVALUATION:

The solubility of hydrogen in water has been studied by many workers. We found the experimental work of ten to be of sufficient reliability to use in 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 75 points used for the final smoothing were obtained as follows (reference number - number of data points taken from that reference): 1-11; 2-2; 3-1; 4-3; 5-5; 6-2; 7-3; 8-1; 9-41; 10-6. The fitting equation used was

$$\ln x_1 = A + B/(T/100K) + C \ln (T/100K) + D(T/100K) + E(T/100K)^2 \qquad (1)$$

Using T/100K as the variable rather than T/K gives coefficients of approximately equal magnitude. The best fit for the 75 data points was

$$\ln x_1 = -48.1611 + 55.2845/(T/100K) + 16.8893 \ln (T/100K) \qquad (2)$$

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 0.52% 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 $\Delta\bar{G}_1^\circ$, $\Delta\bar{H}_1^\circ$, $\Delta\bar{S}_1^\circ$, and $\Delta\bar{C}_{p_1}^\circ$ for the transfer of gas from the vapor phase at 101.325 Pa partial gas pressure to the (hypothetical) solution phase of unit mole fraction. These thermodynamic properties were calculated from the smoothing equation according to the following equations with R = 8.3144 J K^{-1} mol^{-1}:

$$\Delta\bar{G}_1^\circ/RT = -\ln x_1 \qquad (3)$$

$$\Delta\bar{H}_1^\circ/RT = -B(100K/T) + C + D(T/100K) + 2E\,(T/100K)^2 \qquad (4)$$

$$\Delta\bar{S}_1^\circ/R = A + C(\ln (T/100K) + 1) + 2D(T/100K) + 3E(T/100K)^2 \qquad (5)$$

$$\Delta\bar{C}_{p_1}^\circ/R = C + 2D(T/100K) + 6E(T/100K)^2 \qquad (6)$$

The experimental work of ten other workers was not compiled or used for the smoothing equation for a variety of reasons. Müller's two data points (11) were about 2% high. Symons (12) measured solubility by gas chromatography and his duplicate values at 25°C were 3% high. Braun's measurements (13) were 12% high at his lower temperatures and came down to reasonable values at 25°C. Bunsen's measurements (14) were erratically high and low indicating a poor precision. Christoff's single value (15) was 7% high; and Drucker's single value (16) was 2% high. Findlay's measurement at 25°C was 3% high (17). Just's two measurements (18) were 3-4% high. Knopp's (19) single value at 20°C was 4% high. Milligan's (20) single value at 25°C was about 3% low. Gereche and Bittrich's (21) value at 25°C is 1% high. A data sheet is included.

The curve obtained from the smoothing equation shows a distinct minimum at 327 K.

COMPONENTS: (1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5]	EVALUATOR: Rubin Battino and Emmerich Wilhelm Department of Chemistry Wright State University Dayton, OH 45435 USA July 1977, revised May 1980

CRITICAL EVALUATION:

Table 1. Recommended values of the solubility and thermodynamic functions[1,2] at 5K intervals for hydrogen in water at a hydrogen partial pressure of 101.325 kPa (1 atm). Calculations based on equations 2 to 6.

T/K	Mol Fraction $x_1 \times 10^5$	Ostwald Coefficient $L \times 10^2$	$\Delta\bar{G}_1^{\circ b}$/k J mol^{-1}	$\Delta\bar{H}_1^{\circ}$/k J mol^{-1}	$\Delta\bar{S}_1^{\circ}$/J K^{-1}mol^{-1}
273.15	1.755	2.184	24.87	-7.61	-118.9
278.15	1.657	2.010	25.46	-6.91	-116.4
283.15	1.576	2.032	26.03	-6.20	-113.8
288.15	1.510	1.980	26.60	-5.50	-111.4
293.15	1.455	1.940	27.15	-4.80	-109.0
298.15	1.411	1.911	27.69	-4.10	-106.6
303.15	1.377	1.893	28.21	-3.40	-104.3
308.15	1.350	1.883	28.73	-2.69	-102.0
313.15	1.330	1.883	29.23	-1.99	-99.7
318.15	1.317	1.890	29.73	-1.290	-97.5
323.15	1.310	1.905	30.21	-0.588	-95.3
328.15	1.308	1.927	30.68	+0.114	-93.1
333.15	1.312	1.957	31.14	0.816	-91.0
338.15	1.320	1.993	31.59	1.518	-88.9
343.15	1.333	2.037	32.03	2.22	-86.9
348.15	1.350	2.087	32.46	2.92	-84.8
353.15	1.371	2.144	32.88	3.62	-82.8

1. The heat capacity change, $\Delta C^{\circ}_{p_1}$, is independent of temperature and has a value of 140.4 J K^{-1} mol^{-1}.
2. cal_{th} = 4.184 Joules

COMPONENTS:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5]	Rubin Battino and Emmerich Wilhelm Department of Chemistry Wright State University Dayton, OH 45435 USA July 1977, revised May 1980

CRITICAL EVALUATION:

References

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1952, 3819.
2. Geffcken, G. *Z. Physik. Chem.* 1904, *49*, 257.
3. Hüfner, G. *Z. Physik. Chem.* 1907, *57*, 611.
4. Timofejew, W. *Z. Physik. Chem.* 1890, *6*, 141.
5. Winkler, L. W. *Ber.* 1891, *24*, 89.
6. deWet, W. J. *J. S. Afr. Chem. Inst.* 1964, *17*, 9.
7. Ruetschi, P.; Amlie, R. F. *J. Phys. Chem.* 1966, *70*, 718.
8. Shoor, S. K.; Walker, R. D.; Gubbins, K. E. *J. Phys. Chem.* 1969, *73*, 312.
9. Crozier, T. E.; Yamamoto, S. *J. Chem. Eng. Data* 1974, *19*, 242.
10. Gordon, L. I.; Cohen, Y.; Standley, D. R. *Deep-Sea Res.* 1977, *24*, 937.
11. Müller, C. *Z. Physik. Chem.* 1912, *81*, 483.
12. Symons, E. A. *Can. J. Chem.* 1971, *49*, 3940.
13. Braun, L. *Z. Physik. Chem.* 1900, *33*, 721.
14. Bunsen, R. *Ann.* 1855, *93*, 1.
15. Christoff, A. *Z. Physik. Chem.* 1906, *55*, 622.
16. Drucker, K.; Moles, E. *Z. Physik. Chem.* 1910, *75*, 405.
17. Findlay, A.; Shen, B. *J. Chem. Soc.* 1912, *101*, 1459.
18. Just, G. *Z. Physik. Chem.* 1901, *37*, 342.
19. Knopp, W. *Z. Physik. Chem.* 1904, *48*, 97.
20. Milligan, L. H. *J. Phys. Chem.* 1924, *28*, 494.
21. Gerecke, J.; Bittrich, H. J. *Wiss. Zeitschrift (Leuna-Merseburg)* 1971, *13*, 115.

COMPONENTS: (1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Timofejew, W. *Z. Physik. Chem.* 1890, *6*, 141-152.
VARIABLES: T/K: 274.55 - 298.85 H_2 P/kPa: 101.325 (1 atm)	PREPARED BY: R. Battino

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient $\alpha \times 10^2$
274.55	1.712[1]	2.1295
281.50	1.611[1]	2.0044
286.15	1.542[1]	1.9174
291.60	1.500	1.8629
298.85	1.434	1.7789

The Bunsen coefficients are average values of several measurements.

The mole fraction solubility values were calculated by the compiler.

[1] Mole fraction values which were used in the final smoothing equation for the recommended solubility equation given in the critical evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: An absorption vessel of 110 cm^3 or 300 cm^3 is used for the measurements. The volume of gas absorbed is measured on a gas buret. Also measured the solubility of hydrogen in alcohol (ethanol).	SOURCE AND PURITY OF MATERIALS: (1) Hydrogen. No comment by author. (2) Water. No comment by author.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Winkler, L. W.

Ber. 1891, *24*, 89-101.

VARIABLES:

T/K: 273.65 - 323.15
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient $\alpha \times 10^2$
273.65	2.141
273.73	2.134
273.77	2.132
283.22	1.956
283.00	1.961
283.15	1.948
293.15	1.828
293.18	1.815
293.15	1.815
303.16	1.692
303.15	1.696
303.12	1.671
303.15	1.712
303.15	1.714

T/K	Bunsen Coefficient $\alpha \times 10^2$
303.15	1.706
313.11	1.649
313.04	1.639
313.03	1.636
313.15	1.644
313.15	1.645
313.15	1.648
323.17	1.603
323.00	1.609
323.13	1.609
323.25	1.616
323.18	1.607
323.05	1.606

Average values calculated by the compiler.

T/K	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient $\alpha \times 10^2$
273.72	1.714	2.131
283.12	1.572[1]	1.955
293.16	1.465[1]	1.819
303.15	1.372[1]	1.699
313.11	1.332[1]	1.644
323.13	1.308[1]	1.608

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas is introduced over degassed water in an absorption vessel in a thermostat. The volume of gas absorbed is measured on a thermostated gas buret.

[1] Mole fraction solubility values which were used to obtain thefinal smoothing equation given in the critical evaluation.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Made from zinc and dilute sulfuric acid.

(2) Water. Distilled.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5]	Geffcken, G. *Z. Physik. Chem.* 1904, *49*, 257-302.
VARIABLES:	**PREPARED BY:**
T/K: 288.15 - 298.15 H_2 P/kPa: 101.325 (1 atm)	R. Battino

EXPERIMENTAL VALUES:

T/K	Ostwald Coefficient $L \times 10^2$
288.15	1.973
288.15	1.979
288.15	1.992
288.15	1.984
298.15	1.935
298.15	1.911
298.15	1.932
298.15	1.936
298.15	1.922
298.15	1.921
298.15	1.924

Average values calculated by the compiler.

T/K	Mol Fraction $x_1 \times 10^5$	Ostwald Coefficient $L \times 10^2$
288.15	1.511[1]	1.982
298.15	1.422[1]	1.926

[1] Mole fraction values which were used to obtain the recommended smoothing equation which was given in the critical evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Amount of gas dissolved is determined in a thermostated gas buret system. Details given in original paper. Solubilities also determined in aqueous solutions of acetic acid, monochloracetic acid, nitric acid, hydrochloric acid, sulfuric acid, sodium hydroxide, and potassium hydroxide.	(1) Hydrogen. No comment by author. (2) Water. No comment by author.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-624.

VARIABLES:

T/K: 293.15 - 293.34
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient $\alpha \times 10^2$	
293.34		1.812	
293.26		1.805	
293.15		1.812	
293.25	1.457[1]	1.810	Av.

The mole fraction value was calculated by the compiler.

[1] Mole fraction value which was used to obtain the recommended smoothing equation which was given in the critical evaluation.

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) Hydrogen. No comment by author.

(2) Water. Pure.

ESTIMATED ERROR:

REFERENCES:

1. Hüfner, G.
Archiv. F. Anatomie und Physiologie, Physiolog. Abtly. 1894, *5*, 191.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Morrison, T. J.; Billett, F.

J. Chem. Soc. 1952, 3819-3822.

VARIABLES:

T/K: 285.45 - 344.85
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^5$	Solubility $cm^3(STP)H_2$ 1.0000 kg^{-1} H_2O
285.45	1.546[1]	19.23
289.25	1.505[1]	18.71
290.45	1.492[1]	18.54
296.15	1.439[1]	17.86
298.15	1.427	17.70
306.35	1.372[1]	16.98
318.15	1.329[1]	16.37
320.45	1.324[1]	16.29
327.55	1.319[1]	16.18
333.45	1.314[1]	16.07
338.65	1.323[1]	16.14
344.85	1.328[1]	16.14

The authors smoothing equation is $\log_{10} S_o = -36.250 + 1847/(T/K) + 12.65 \log_{10} (T/K)$

The compiler calculated the mole fraction solubility values.

[1] Mole fraction values which were used to obtain the recommended smoothing equation which is given in the critical evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used the apparatus of Morrison and Billett (1) but with improvements described in the current paper in the degassing procedure and the absorption spirals. Degassed liquid is flowed slowly down a spiral containing the gas. The amount of gas absorbed is determined by using the liquid as its own gas buret. Volumes are determined in the burets and/or by weighing.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared from pure zinc and hydrochloric acid.

(2) Water. No comment by authors.

ESTIMATED ERROR:

REFERENCES:

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

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

de Wet, W. J.

J. S. Afr. Chem. Inst. 1964, *17*, 9-17.

VARIABLES:

T/K: 291.65 - 304.55
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient $\alpha \times 10^2$
291.65	1.497	1.86
298.85	1.411[1]	1.75
304.55	1.365[1]	1.69

The mole fraction solubility values were calculated by the compiler.

[1] Mole fraction values which were used to obtain the recommended smoothing equation which is given in the critical evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Degassed liquid is flowed in a thin film through a spiral containing the gas. Volumes are determined via calibrated burets.

Used modification of Morrison and Billett apparatus (1). Degassing as modified by Clever, et al. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. From commercial cylinders. Purified over activated charcoal at liquid nitrogen temperatures. Less than 0.3% impurities.

(2) Water. Distilled.

ESTIMATED ERROR:

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033; ibid., 1952, 3819.
2. Clever, H. L.; Battino, R.; Saylor, J. H.; Gross, P. M. *J. Phys. Chem.* 1957, *61*, 1078.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Ruetschi, P.; Amlie, R. F.

J. Phys. Chem. 1966, *70*, 718-723.

VARIABLES:

T/K: 303.15
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient $\alpha \times 10^2$
303.15	1.375[1]	1.703
303.15	1.365	1.690
303.15	1.381[1]	1.710
303.15	1.367[1]	1.693

The mole fraction solubility values were calculated by the compiler.

[1] Mole fraction values which were used to obtain the recommended smoothing equation which is given in the critical evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

They used the apparatus of Ben-Naim and Baer (1). A calibrated dissolution vessel contains degassed water. Gas is introduced wet from a calibrated gas buret system. Stirring the liquid forces it up sidearms attached to the top of the flask and the liquid returns via a central tube. The amount of gas dissolved is determined via the gas burets. The gas burets and dissolution vessel are thermostated in a water bath. The original paper contains a diagram and a description of operation. The solubility of H_2 was also determined in KOH and H_2SO_4 solutions at 303.15K.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Prepurified grade (99.5% min purity).

(2) Water. No comment by author.

ESTIMATED ERROR:

$\delta\alpha/\alpha = 0.005$

REFERENCES:

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

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Shoor, S. K.; Walker, R. D.; Gubbins, K. E.

J. Phys. Chem. 1969, *73*, 312-317.

VARIABLES:

T/K: 298.15 - 333.15
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x \times 10^5$	C_{H_2}/mol dm^{-3} $c \times 10^3$
298.15	1.431	0.792
313.15	1.295	0.713
333.15	1.305[1]	0.712

The mole fraction solubility values were calculated by the compiler.

[1] Mole fraction values which was used to obtain the recommended smoothing equation which is given in the critical evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions are saturated by bubbling. After equilibration, samples are removed and analyzed by gas chromatography. Details are given by Gubbins, et al. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Purity 99.9 per cent.

(2) Water. Distilled from an all-glass and teflon still.

ESTIMATED ERROR:

REFERENCES:

1. Gubbins, K. E.; Carden, S. N.; Walker, R. D. *J. Gas Chromatog.* 1965, *3*, 98.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.; Bittrich, H. J.

Wiss. Zeitschrift (Leuna-Merseburg) 1971, *13*, 115-122.

Chem. Abstr. 1972, *76*, 77239m.

VARIABLES:

T/K: 298.15
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient $\alpha \times 10^2$
298.15	1.427	1.77

The mole fraction solubility value was calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Absorbed gas is measured in a gas buret using mercury manometers. Only written description of apparatus given. Also measured solubilities in many aqueous salt solutions.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. No comment by authors.

(2) Water. No comment by authors.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Crozier, T. E.; Yamamoto, S.

J. Chem. Eng. Data 1974, *19*, 242-244.

VARIABLES:

T/K: 274.60 - 302.47
P/kPa: 101.325 (1 atm)

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	Mol Fraction[1] $x_1 \times 10^5$	Bunsen Coefficient $\alpha \times 10^2$	T/K	Mol Fraction[1] $x_1 \times 10^5$	Bunsen Coefficient $\alpha \times 10^2$
274.60	1.728	2.150	287.85	1.505	1.871
274.63	1.727	2.148	287.91	1.514	1.882
274.64	1.730	2.152	287.92	1.503	1.869
277.54	1.672	2.080	287.94	1.505	1.871
277.70	1.667	2.074	287.94	1.520	1.890
277.70	1.661	2.067	287.94	1.516	1.885
277.73	1.665	2.072	287.95	1.512	1.880
277.74	1.671	2.079	293.01	1.454	1.806
282.98	1.571	1.954	293.01	1.459	1.812
282.99	1.579	1.964	293.02	1.458	1.811
282.99	1.567	1.949	293.03	1.453	1.804
283.00	1.565	1.947	293.03	1.453	1.805
283.00	1.567	1.949	297.85	1.403	1.740
283.00	1.572	1.955	297.85	1.414	1.754
283.01	1.576	1.960	297.88	1.408	1.747
283.01	1.573	1.957	297.88	1.403	1.741
283.02	1.573	1.957	297.92	1.404	1.742
283.03	1.576	1.960	301.99	1.369	1.696
287.77	1.514	1.882	302.17	1.379	1.709
287.80	1.509	1.876	302.31	1.377	1.706
287.82	1.507	1.873	302.47	1.382	1.712

[1] All of the mole fraction values above except the one at 301.99 K were used in the computer fit to obtain the recommended smoothing equation which is given in the critical evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility measurements were made by the Scholander micro-gasometric technique (1) as modified by Douglas (2). Equilibration is with 6cm^3 of gas-free water. All volumes are read on a micrometer which adjusts the amount of mercury in the system.

The authors also report the solubility of hydrogen in seawater and NaCl solutions.

The authors smoothing equation for their data is

$$\ln \alpha = -39.9611 + 5393.81/(T/K) + 16.3135 \ln (T/100K)$$

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Linde Specialty Gas. 99.9995% purity.

(2) Water. Glass distilled water.

ESTIMATED ERROR:

$\delta T/K = 0.01$
$\delta\alpha/\alpha = 0.003$

REFERENCES:

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

2. Douglas, E. *J. Phys. Chem.* 1964, *68*, 169.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Gordon, L. I.; Cohen, Y.;
Standley, D. R.

Deep-Sea Res. 1977, *24*, 937 - 941.

VARIABLES:

T/K: 273.29 - 302.40
P/kPa: 101.325 (1 atm)

PREPARED BY:

EXPERIMENTAL VALUES:

Temperature		Mol Fraction	Bunsen Coefficient	Ostwald Coefficient
$t/^0C$	T/K	$x_1 \times 10^5$	$\alpha \times 10^3$	$L \times 10^3$
0.14	273.29	1.782[1]	22.17	22.18
5.04	278.19	1.658[1]	20.63	21.01
10.00	283.15	1.581[1]	19.66	20.38
16.67	289.82	1.501[1]	18.66	19.80
23.63	296.78	1.420[1]	17.62	19.14
29.25	302.40	1.387[1]	17.18	19.02

The mole fraction and Ostwald coefficient solubility values were calculated by the compiler.

[1] Mole fraction solubility values which were used to obtain the recommended smoothing equation which is given in the critical evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method of Ben-Naim and Baer (1) as modified by Murray, Riley, and Wilson (2) was used with slightly further modifications.

The Bunsen coefficients were corrected for the change in volume of the solution upon dissolution of the hydrogen using a partial molal volume of 26 cm^3 mol^{-1}. The correction increased the Bunsen coefficient about 0.12 per cent.

The results above average approximately 0.5 per cent higher than the results of Crozier and Yamamoto (3).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Ultra-pure electrolytically generated gas (Elhygen R generator).

(2) Water. Doubly distilled.

ESTIMATED ERROR:

Root mean square deviation from authors fitted equation is 0.7 per cent. Equation fitted to water and sea water data above and ref 3.

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735.
2. Murray, C. N.; Riley, J. P.; Wilson, T. R. S. *Deep-Sea Res.* 1969, *16*, 297.
3. Crozier, T. E.; Yamamoto, S. *J. Chem. Eng. Data* 1974, *19*, 242.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Longo, L. D.; Delivoria-Papadopoulos, M.; Power, G. G.; Hill, E. P.; Forster, R. E., *Am. J. Physiology*, 1970, *219*, 561-569.

VARIABLES:

PREPARED BY:

C. L. Young +

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	S.D.*
310.15	0.01629	0.0001

* standard deviation

\+ added by editor. Bunsen coefficient is about 1.5% lower than that derived from recommended smoothing equation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Liquid samples were equilibrated with gas and then the dissolved gas was stripped out under vacuum and measured in a manometric Van Slyke apparatus. Some details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$.

REFERENCES:

1. Power, G. G., *J. Appl. Physiology*, 1968, *24*, 468.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5]	Power, G.G.; Stegall, H. *J. Appl. Physiology*, 1970, *29*, 145-9
VARIABLES:	PREPARED BY: C.L. Young +

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	S.D.*	No. of measurements
310.15	0.01629	0.00011	3

* Standard deviation.

+ added by editor. Bunsen coefficient is about 1.5% lower than that derived from recommended smoothing equation

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:	EVALUATOR:
1. Hydrogen; H_2; 1333-74-0 2. Sea Water	Denis A. Wiesenburg Department of Oceanography Texas A&M University College Station, Texas 77843 USA June 1980

CRITICAL EVALUATION:

There are two reports of the solubility of hydrogen in sea water (1, 2). It is fortunate that these two reports cover both a wide range of temperatures and salinities, use different experimental techniques, and obtain results in good agreement. Crozier and Yamamoto (1) report 222 solubility measurements for distilled water and three salinities (27.665, 33.680, 39.927‰) for many different temperatures between 274.60 and 303.48°K. Their solubility measurements are estimated to have an accuracy of 0.5%. Gordon *et al.* (2) report 39 solubility values over the temperature range 272.80 *to* 302.41°K for distilled water and sea water to 39.096‰. The data of Gordon *et al.* (2) average about 0.5% higher than those of Crozier and Yamamoto (1), but differences are never greater than 1%. Both of these studies measured Bunsen solubility coefficients by equilibrating sea water with pure hydrogen at 1 atm total pressure. The volumes of sea water equilibrated in each study were quite different, however, 6 ml (1) vs. 1000 ml (2).

The solubility data of Crozier and Yamamoto (1) and Gordon *et al.* (2) are similar in precision and thus are combined to form the data base for this evaluation. Gordon *et al.* (2) also combined the two data sets and determined a smoothing equation, but they weighted each data set equally. Since the data of Crozier and Yamamoto (1) are not statistically different from those of Gordon *et al.* (2), the data used here are combined without weighting. The combined data sets have been fitted (3) by the method of least squares to an equation developed by Weiss (4) which expresses solubility as the natural logarithm of the Bunsen coefficient, α, and is consistent with both the integrated form of the van't Hoff equation and the Setchenow salt effect relation. The equation for hydrogen is valid from 273.15 to 303.15°K and a salinity range, S, of 0 to 40‰. The smooth equation reproduced the combined hydrogen data with a root-mean-square deviation of 7.8×10^{-5} units (∿0.46%). The equation is

$$\ln \alpha = -47.9848 + 65.0368\,(100/T) + 20.1709 \ln (T/100) + S[-0.082225 + 0.049564\,(T/100) - 0.0078689\,(T/100)^2]$$

where S is the salinity in parts per thousand. Wiesenburg and Guinasso (3) give an extensive table of hydrogen Bunsen coefficients calculated from the above equation.

Although the Bunsen solubility coefficients are well defined by the above equation, for practical purposes, oceanographers require the atmospheric equilibrium solubility values in their work. Weiss (4) has proposed an equation similar to the above which expresses the atmospheric equilibrium solubility from moist air at 1 atm total pressure, in units of volume (STP) dm^{-3}, as a function of salinity and temperature. In working with samples from the depths of the ocean, it is also advantageous to express atmospheric solubilities in terms of mol kg^{-1}, which are pressure and temperature independent (4, 5). Weiss' atmospheric solubility equation is based on the assumption of a constant atmospheric concentration of hydrogen. Since hydrogen is variable in the atmosphere, Weiss' (4) equation has been modified (3) to include the atmospheric concentration as a variable. The combined data sets for hydrogen (1, 2) have been fitted (3) to the equations

$$\ln c/\mathrm{nl\ dm^{-3}} = f_g - 314.3572 + 455.8526\,(100/T) + 297.5313 \ln (T/100) - 49.2778\,(T/100) + S[-0.070143 + 0.041069\,(T/100) - 0.0063763\,(T/100)^2]$$

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; 1333-74-0 2. Sea Water	Denis A. Wiesenburg Department of Oceanography Texas A&M University College Station, Texas 77843 USA June 1980

CRITICAL EVALUATION:

$$\begin{aligned}\ln m/\mathrm{nmol\ kg}^{-1} &= f_g - 320.3079 + 459.7398\ (100/T) \\ &+ 299.2600 \ln (T/100) - 49.3946\ (T/100) \\ &+ S\ [-0.074474 + 0.043363\ (T/100) - 0.0067420\ (T/100)^2]\end{aligned}$$

where f_g is the mole fraction of hydrogen in dry air. In these calculations hydrogen was assumed to be an ideal gas. Vapor pressure for pure water was calculated using the equation of Bridgeman and Aldrich (6) and corrected for salinity effects using the expression of Robinson (7). Knudsen's (8) formula was used to calculate densities. These two equations can be used to calculate the atmospheric equilibrium solubility of hydrogen under any given conditions of temperature, salinity, and atmospheric concentration. Using an atmospheric hydrogen mole fraction of 0.58×10^{-6} (9), the equations reproduce the individual calculated atmospheric solubilities with a root-mean-square deviation of 0.45%.

In making calculations of atmospheric equilibrium solubilities from Bunsen solubilities measured at 1 atm of pure hydrogen, there is a question of whether Henry's law can be extrapolated accurately through six orders of magnitude (10, 11). Schmidt (12) considered this problem by making atmospheric solubility measurements of hydrogen at partial pressures of hydrogen of about 10^{-5} atm. He measured solubilities for pure water and sea water (24 values) at 31.6‰ salinity over the temperature range 273.15 to 303.15°K by equilibrating sea water with air containing 21.5 ppmv hydrogen. The standard error of Schmidt's data (7%) is higher than that of the other data evaluated here (1, 2), but within the standard error of his data, Schmidt's data are consistent with the Bunsen coefficients measured at 1 atm.

References

1. Crozier, T. E.; Yamamoto, S. *J. Chem. Eng. Data* 1974, *19*, 242.
2. Gordon, L. I.; Cohen, Y.; Standley, D. R. *Deep-Sea Res.* 1977, *24*, 937.
3. Wiesenburg, D. A.; Guinasso, N. L., Jr. *J. Chem. Eng. Data* 1979, *24*, 356.
4. Weiss, R. F. *Deep-Sea Res.* 1970, *17*, 721.
5. Kester, D. in "Chemical Oceanography" v. 1 2nd Edition, J. P. Riley and G. Skirrow, eds. Academic Press, New York, 1975, pp. 497-556.
6. Bridgeman, O. C.; Aldrich, E. W. *J. Heat Transfer* 1964, *86*, 279.
7. Robinson, R. A. *J. Mar. Biol. Assoc. U.K.* 1954, *33*, 449.
8. Knudsen, M. Hydrographical Tables, G. E. Gad, Copenhagen, 1901.
9. Schmidt, U. *J. Geophys. Res.* 1978, *83*, 941.
10. Bieri, R. H. in "The Sea', v. 5, E. D. Goldberg, ed., Wiley Interscience, New York, 1974, pp. 199-218.
11. Meadows, R. W.; Spedding, D. J. *Tellus* 1974, *26*, 143.
12. Schmidt, U. *Tellus* 1979, *31*, 68.

COMPONENTS:

1. Hydrogen; H_2;1333-74-0
2. Sea Water

ORIGINAL MEASUREMENTS:

Crozier, T. E.; Yamamoto, S.

J. Chem. Eng Data 1974, *19*, 242 - 244.

VARIABLES:

T/K: 274.60 - 303.49
H_2 P/kPa: 101.325 (1 atm)
Salinity/‰: 0 - 39.927

PREPARED BY:

Denis A. Wiesenburg

EXPERIMENTAL VALUES:

Salinity ‰	Temp/K	Bunsen Coefficient α	Salinity ‰	Temp/K	Bunsen Coefficient α
0.0	274.60	0.02150	0.0	287.85	0.01871
	274.63	0.02148		287.91	0.01882
	274.64	0.02152		287.92	0.01869
	277.54	0.02081		287.94	0.01871
	277.70	0.02074		287.94	0.01890
	277.70	0.02067		287.94	0.01885
	277.73	0.02072		287.95	0.01880
	277.74	0.02079		290.01	0.01806
	282.98	0.01954		290.01	0.01812
	282.99	0.01964		290.02	0.01811
	282.99	0.01949		290.03	0.01804
	283.00	0.01947		290.03	0.01805
	283.00	0.01949		297.85	0.01740
	283.00	0.01955		297.85	0.01754
	283.01	0.01960		297.88	0.01747
	283.01	0.01957		297.88	0.01741
	283.02	0.01957		297.92	0.01742
	283.03	0.01960		301.99	0.01696
	287.77	0.01882		302.17	0.01709
	287.80	0.01876		302.31	0.01706
	287.82	0.01873		302.47	0.01712

Continued on next page.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility determinations were made using the Scholander microgasometric technique (1) as modified by Douglas (2). Pure hydrogen and degassed sea water were introduced into a reaction vessel in a constant temperature room. The vessel was shaken vigorously to allow equilibration between the hydrogen and sea water. The amount of gas absorbed and the volume of sea water were measured volumetrically with a microburet. Bunsen solubility coefficients were calculated from the observed volumes.

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen. Linde Specialty Gas, specified 99.9995% purity.
2. Sea Water. Passed through 0.45-μm millipore filter and poisoned with 1 mg/l of $MgCl_2$. Sea water was boiled or diluted with glass distilled water (used for 0 ‰) to obtain desired salinities.

ESTIMATED ERROR:

$\delta T/K = 0.01$

$\delta S/‰ = 0.003$

REFERENCES:

1. Braun, L.
Z. Phys. Chem. 1900, *33*, 721.
2. Douglas, E.
J. Phys. Chem. 1964, *68*, 169.
ibid. 1965, *69*, 2608.

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. Sea Water

ORIGINAL MEASUREMENTS:

Crozier, T. E.; Yamamoto, S.

J. Chem. Eng. Data 1974, *19*, 242 - 244.

VARIABLES:

T/K: 274.60 - 303.49
H_2 P/kPa: 101.325 (1 atm)
Salinity/‰: 0 - 39.927

PREPARED BY:

Denis A. Wiesenburg

EXPERIMENTAL VALUES:

Salinity ‰	Temp/K	Bunsen Coefficient α	Salinity ‰	Temp/K	Bunsen Coefficient α
27.665	274.78	0.01856	27.665	285.23	0.01680
	274.81	0.01859		285.23	0.01681
	274.83	0.01847		285.23	0.01681
	274.83	0.01850		285.24	0.01678
	274.83	0.01853		285.24	0.01684
	274.83	0.01851		285.25	0.01680
	274.84	0.01851		285.25	0.01684
	274.84	0.01845		292.23	0.01599
	274.84	0.01860		292.23	0.01598
	274.85	0.01861		292.23	0.01606
	280.17	0.01754		292.24	0.01595
	280.18	0.01751		292.24	0.01596
	280.18	0.01756		292.24	0.01597
	280.18	0.01754		292.24	0.01598
	280.19	0.01751		292.24	0.01599
	280.19	0.01755		292.24	0.01601
	280.19	0.01752		292.25	0.01602
	280.19	0.01747		298.35	0.01541
	280.19	0.01752		298.35	0.01549
	280.19	0.01754		298.35	0.01551
	285.21	0.01679		298.36	0.01546
	285.21	0.01680		298.36	0.01541
	285.22	0.01682		298.36	0.01547

Continued on next page.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

See previous page.

SOURCE AND PURITY OF MATERIALS:

See previous page.

ESTIMATED ERROR:

See previous page.

REFERENCES:

See previous page.

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. Sea Water

ORIGINAL MEASUREMENTS:

Crozier, T. E.; Yamamoto, S.

J. Chem. Eng. Data 1974, *19*, 242 - 244.

VARIABLES:

T/K: 274.60 - 303.49
H_2 P/kPa: 101.325 (1 atm)
Salinity/‰: 0 - 39.927

PREPARED BY:

Denis A. Wiesenburg

EXPERIMENTAL VALUES:

Salinity ‰	Temp/K	Bunsen Coefficient α
27.665	298.37	0.01548
	298.37	0.01550
	298.38	0.01540
	298.40	0.01549
	303.41	0.01511
	303.41	0.01508
	303.42	0.01503
	303.43	0.01507
	303.43	0.01511
	303.44	0.01501
	303.47	0.01510
	303.47	0.01512
	303.47	0.01513
	303.48	0.01516
33.680	275.10	0.01778
	275.12	0.01789
	275.12	0.01782
	275.13	0.01783
	275.13	0.01784
	275.14	0.01787
	275.14	0.01795
	275.14	0.01778
33.680	275.15	0.01783
	275.16	0.01783
	281.42	0.01679
	281.44	0.01682
	281.44	0.01684
	281.44	0.01678
	281.45	0.01686
	281.46	0.01684
	281.46	0.01690
	281.47	0.01682
	281.47	0.01682
	281.48	0.01679
	286.63	0.01618
	286.63	0.01616
	286.63	0.01609
	286.63	0.01606
	286.63	0.01608
	286.63	0.01619
	286.63	0.01621
	286.63	0.01618
	286.63	0.01617
	286.64	0.01619
	292.33	0.01559

Continued on next page.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

See previous page.

SOURCE AND PURITY OF MATERIALS:

See previous page.

ESTIMATED ERROR:

See previous page.

REFERENCES:

See previous page.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; 1333-74-0 2. Sea Water	Crozier, T. E.; Yamamoto, S. *J. Chem. Eng. Data* 1977, *19*, 242 - 244.
VARIABLES: T/K: 274.60 - 303.49 H_2 P/kPa: 101.325 (1 atm) Salinity/‰: 0 - 39.927	PREPARED BY: Denis A. Wiesenburg

EXPERIMENTAL VALUES:

Salinity ‰	Temp/K	Bunsen Coefficient α	Salinity ‰	Temp/K	Bunsen Coefficient α
33.680	292.36	0.01555	33.680	303.11	0.01472
	292.37	0.01554		303.11	0.01477
	292.38	0.01557		303.11	0.01482
	292.38	0.01545		303.12	0.01486
	292.40	0.01550		303.13	0.01473
	292.41	0.01555		303.14	0.01491
	292.43	0.01547			
	292.44	0.01554	39.927	274.65	0.01730
	292.46	0.01555		274.65	0.01730
	298.10	0.01519		274.65	0.01734
	298.13	0.01502		274.65	0.01729
	298.13	0.01502		274.65	0.01744
	298.14	0.01515		274.66	0.01728
	298.14	0.01507		274.66	0.01739
	298.15	0.01506		274.66	0.01723
	298.16	0.01513		274.66	0.01734
	298.16	0.01515		274.67	0.01723
	298.16	0.01504		279.63	0.01658
	298.17	0.01517		279.63	0.01655
	303.08	0.01480		279.65	0.01655
	303.11	0.01486		279.66	0.01658
	303.11	0.01477		279.67	0.01656
	303.11	0.01469		279.68	0.01652

Continued on next page.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
See previous page.	See previous page.
	ESTIMATED ERROR: See previous page.
	REFERENCES: See previous page.

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. Sea Water

ORIGINAL MEASUREMENTS:

Crozier, T. E.; Yamamoto, S.

J. Chem. Eng. Data 1974, *19*, 242 - 244.

VARIABLES:

T/K: 274.60 - 303.49
H_2 P/kPa: 101.325 (1 atm)
Salinity/‰: 0 - 39.927

PREPARED BY:

Denis A. Wiesenburg

EXPERIMENTAL VALUES:

Salinity ‰	Temp/K	Bunsen Coefficient α	Salinity ‰	Temp/K	Bunsen Coefficient α
39.927	279.68	0.01649	39.927	291.79	0.01519
	279.68	0.01654		291.83	0.01517
	279.68	0.01658		297.52	0.01469
	279.69	0.01653		297.52	0.01466
	285.63	0.01573		297.53	0.01465
	285.63	0.01573		297.53	0.01467
	285.63	0.01573		297.53	0.01471
	285.63	0.01575		297.54	0.01466
	285.63	0.01574		297.54	0.01461
	285.63	0.01569		297.54	0.01466
	285.65	0.01577		297.55	0.01465
	285.65	0.01574		297.55	0.01470
	285.66	0.01573		303.40	0.01446
	285.68	0.01571		303.41	0.01431
	291.73	0.01515		303.41	0.01441
	291.75	0.01516		303.41	0.01449
	291.75	0.01516		303.41	0.01439
	291.76	0.01514		303.42	0.01432
	291.76	0.01526		303.43	0.01444
	291.79	0.01519		303.44	0.01434
	291.79	0.01517		303.44	0.01440
	291.79	0.01525		303.44	0.01431

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

See previous page.

SOURCE AND PURITY OF MATERIALS:

See previous page.

ESTIMATED ERROR:

See previous page.

REFERENCES:

See previous page.

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. Sea Water

ORIGINAL MEASUREMENTS:

Gordon, L. I.; Cohen, Y.;
Standley, D. R.

Deep-Sea Res. 1977, *24*, 937 - 941.

VARIABLES:

T/K: 272.80 - 302.41
H_2 P/kPa: 101.325 (1 atm)
Salinity/‰: 0 - 39.096

PREPARED BY:

Denis A. Wiesenburg

EXPERIMENTAL VALUES:

Temp/K	Salinity ‰	Bunsen Coefficient $\alpha \times 10^3$
272.80	29.931	18.75
273.29	0.000	22.17
273.18	10.626	21.00
273.21	20.396	19.90
273.17	35.109	18.44
278.19	0.000	20.63
278.20	9.470	19.55
278.20	19.757	18.94
278.19	30.060	17.68
278.21	37.810	17.03
283.15	0.000	19.66
283.17	0.000	19.67
283.11	10.063	18.80
283.17	19.694	17.68
283.19	19.736	17.75
283.12	38.079	16.26
289.82	0.000	18.66
289.92	10.524	17.72
289.83	20.156	16.94
289.83	32.284	15.93
289.79	37.317	15.50
296.78	0.000	17.62
296.78	4.919	17.50
296.77	10.385	17.02
296.77	17.115	16.53
296.78	19.675	16.20
296.77	34.728	15.13
296.77	39.096	14.88
297.91	32.901	15.39
302.40	0.000	17.18
302.40	7.946	16.68
302.41	12.260	16.28
302.40	17.154	16.02
302.40	21.898	15.68
302.41	25.171	15.31
302.40	25.325	15.23
302.41	32.022	14.97
302.40	32.570	14.82
302.41	38.981	14.39

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

Solubility determinations were made using the method of Ben-Naim and Baer (1) as modified by Murray et al. (2), with slight further modifications. Pure hydrogen which had been saturated with sea water was placed in contact with a known volume of sea water in a thermostated dissolution flask. The sea water was mechanically stirred and the total gas pressure was maintained at 1 atm, using a gas manometer and a mercury leveling bulb. Solubility was calculated from the difference in buret readings, before and after solubility equilibrium had been maintained (about 7 hours duration), and the known volume of sea water.

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen. Ultra-pure electrolytically generated hydrogen was used.
2. Sea Water. Aged surface sea water filtered and adjusted to pH < 3.2 with 4N HCl. Sea waters of various salinities were made by addition of distilled water or by evaporation.

ESTIMATED ERROR:

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735.
2. Murray, C.N.; Riley, J.P.; Wilson, T.R.S. *Deep-Sea Res.* 1969, *16*, 297.

COMPONENTS:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5] (3) Electrolyte	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, October

CRITICAL EVALUATION:

An Evaluation of the Solubility of Hydrogen in Aqueous Electrolyte Solutions at a Hydrogen Partial Pressure of 101.325 kPa.

Not enough workers have measured the solubility of hydrogen 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, the solubility data have been converted to Sechenow salt effect parameters in the form

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

where c 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.

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

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

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

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

where m 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 proportional to a gas molality ratio m°/m. The density data required to convert the salt effect parameter from one form to another were taken from the *International Critical Tables*, McGraw-Hill, 1928, v. III.

The salt effect parameter is often assumed to be independent of electrolyte concentration. This is definitely not true of aqueous sulfuric acid solutions. It is probably true only as an approximation for many other solutions. There are indications through out the literature that the salt effect parameter values are larger in dilute solutions than at higher concentrations but there are no definitive studies on the point.

The effect of the electrolyte concentration on the salt effect parameter was checked by one of two ways. A graph was prepared either of log(α°/α) *vs.* c or of $k_{sc\alpha}$ *vs.* c. A linear log(α°/α) *vs.* c plot shows no concentration dependence to the salt effect parameter and the slope is $k_{sc\alpha}$. A linear $k_{sc\alpha}$ *vs.* c plot of zero slope shows no concentration dependence to the salt effect parameter. The second type of graph is more sensitive to small changes in $k_{sc\alpha}$ with concentration than the first type.

The solubility of hydrogen in water has usually been taken from the paper under evaluation for the calculation of the salt effect parameter. The reason for using the water solubility of the author, instead of the recommended solubility of hydrogen in water, is that systematic errors in a given authors work may cancel in the $\alpha°/\alpha$ ratio.

The use of a salt effect parameter of the Sechenow type should not be taken to mean that it is necessarily the best way to represent salt effect results. It is used here as a convenient parameter for the comparison of data from several sources.

Studies of the solubility of hydrogen in aqueous electrolyte solutions appear in about fifteen papers. Some specific comments on several of the papers follow.

Geffcken (1) measured the solubility of hydrogen in five aqueous systems over an extended electrolyte range of concentration. His average value of the Ostwald coefficient of hydrogen in water of 0.01926 at 298.15 K is 0.78 per cent higher than the recommended value. His salt effect parameters usually show a small decrease in value as the electrolyte concentration increases.

Morrison and Billett (4) measured the solubility of hydrogen at four temperatures in four aqueous systems. Their values of the solubility of hydrogen in water agree well with the recommended values. A weakness of their work is that they report only the salt effect parameter, which is based on a solubility measurement at just one electrolyte concentration. They have reported what is equivalent to a molal gas solubility ratio.

Bruhn, Gerlach, and Pawlek (7) measured the solubility of hydrogen in eight aqueous systems at temperatures up to 523 K in a high pressure apparatus. Their solubilities are given as Bunsen coefficients which are treated here as if they apply at a hydrogen partial pressure of 101.325 kPa. They did not measure the solubility of hydrogen in water, but they did their own evaluation of the solubility of hydrogen in water from literature data. Their data table includes both the solubility, α, and the corresponding ratio $\alpha/\alpha°$. From the $\alpha/\alpha°$ values one can deduce the solubility values of hydrogen in water used by them are

T/K	298.15	323.15	348.15	373.15
$\alpha°/\mathrm{cm^3\ cm^{-3}\ atm^{-1}}$	0.01744	0.01629	0.01637	0.01835
T/K	398.15	423.15	473.15	523.15
$\alpha°/\mathrm{cm^3\ cm^{-3}\ atm^{-1}}$	0.02031	0.02328	0.03149	0.04456

The salt effect parameters, $k_{sc\alpha}$, at the electrolyte concentrations of 0.5, 1.0, and 1.5 mol $\mathrm{dm^{-3}}$ were calculated directly from the inverse of the $\alpha/\alpha°$ ratio tabulated in the paper. The values, which scatter widely, do not appear to show a correlation with either electrolyte concentration or temperature. The tabulated values of $k_{sc\alpha}$ are average values of the three values measured at the three electrolyte concentrations. Although the data are classed as tentative they do not appear to be quite as reliable as the data from most of the other papers. In general the salt effect parameters calculated from the data in their paper are greater than the values obtained by other workers. This is probably due in part to the difficulties in making measurements at high pressure.

Deckwer (14) measured the solubility of hydrogen in aqueous manganese (II) sulfate solution at several temperatures between 293.15 and 353.15 K. He did not measure the solubility of hydrogen in water, but he took literature values from the Seidell Linke Handbook. A more consistent set of salt effect parameters was obtained when the recommended water solubility values from this volume were used. They are the salt effect parameters presented.

Shoor, Walker, and Gubbins (9) measured the solubility of hydrogen in aqueous KOH solutions. They calculated their salt effect parameters from the hydrogen mole fraction solubility ratio, x^0/x. Their salt effect parameters were not converted from the k_{scx} to the $k_{sc\alpha}$ form because (1) reliable density data for aqueous KOH was not readily available, and (2) the authors did not define whether their mole fraction values were based on the KOH ion pairs or on the K^+ and OH^- ions.

Hydrogen solubility measurements have been reported in over 20 aqueous electrolyte systems. Each system is discussed briefly on the following pages. Unless otherwise stated, the salt effect parameters are for a one mole dm^{-3} solution at a hydrogen partial pressure of 101.325 kPa. Tentative values of the salt effect parameters are given as calculated from the various papers. The systems are given in the order of the standard arrangement for electrolytes used in U.S. National Bureau of Standards publications.

1. Hydrogen + water + Hydrochloric acid [7647-01-0]

Geffcken (1) measured the solubility of hydrogen in aqueous hydrochloric acid at nine concentrations up to 2.836 mol dm^{-3} at 298.15 K. The salt effect parameter decreases with increasing HCl concentration

$$k_{sc\alpha}/\text{cm}^3\ \text{mol}^{-1} = 0.0297 - 2.20 \times 10^{-4}(c_3/\text{mol dm}^{-3})$$

At 298.15 K and one mole dm^{-3} HCl the tentative value of $k_{sc\alpha}$ is 0.0295.

2. Hydrogen + water + Sulfuric acid [7664-93-9]

Although the solubility of hydrogen in aqueous sulfuric acid has been measured in four laboratories, no two laboratories report data at a common temperature. Christoff (2) measured the solubility at 293.15 K and three concentrations between 35.8 and 95.6 weight per cent sulfuric acid. There is not enough data to identify the acid concentration of minimum hydrogen solubility, but it is probably near 80 weight percent. Salt effect parameters of 0.0729 and 0.0490 were calculated from the Christoff data at 4.63 and 9.53 mol dm^{-3} H_2SO_4. Assuming a linear change of $k_{sc\alpha}$ with concentration gives

$$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1} = 0.0955 - 4.88 \times 10^{-3}\ c_3/\text{mol dm}^{-3}$$

Geffcken (1) measured the solubility at 298.15 K at eleven sulfuric acid concentrations up to 2 mol dm^{-3}. The salt effect parameter decreases with increasing acid concentration

$$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1} = 0.0718 - 7.16 \times 10^{-4} c_3/\text{mol dm}^{-3}$$

Ruetschi and Amlie (8) measured the solubility of hydrogen at ten concentrations up to 7.6 mol dm^{-3} sulfuric acid. The salt effect parameter decreases with increasing acid concentration

$$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1} = 0.0932 - 6.68 \times 10^{-3}\ c_3/\text{mol dm}^{-3}$$

The data of Christoff and of Ruetschi and Amlie roughly parallel each other as a function of concentration, but the data of Christoff is too limited for the agreement to be meaningful.

Bruhn, Gerlach and Pawlek (7) measured the solubility of hydrogen at sulfuric acid concentrations of 0.5, 1.0, and 1.5 mol dm^{-3} at five temperatures between 323.15 and 523.15 K. As discussed earlier in the section their salt effect parameter values show considerable scatter and poor correlation with both acid concentration and temperature. The average of their $k_{sc\alpha}$ values at each temperature show little change with temperature.

Tentative values of the salt effect parameters at a sulfuric acid concentration of one mole dm^{-3} from the four papers are:

T/K	293.15	298.15	303.15	323.15
$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1}$	0.0906	0.0711	0.0865	0.075
σ[1]	--	--	--	0.014

T/K	373.15	423.15	473.15	523.15
$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1}$	0.074	0.080	0.074	0.074
σ[1]	0.023	0.001	0.003	0.026

3. Hydrogen + water + Nitric acid [7697-37-2]

Geffcken (2) made ten measurements of the hydrogen solubility at 298.15 K up to a concentration of 4.23 mol dm^{-3} nitric acid. The salt effect parameters show some scatter but there is a tendency to a decrease in the parameters as the acid concentration increases.

$$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1} = 0.0220 - 5.3 \times 10^{-4}\ c_3/\text{mol dm}^{-3}$$

The tentative value of the salt effect parameter at 298.15 K and one mol dm^{-3} nitric acid is 0.0215 dm^3 mol^{-1}.

4. Hydrogen + water + Ammonium hydroxide [1336-21-6]

Bruhn, Gerlach, and Pawlek (7) measured the solubility of hydrogen in aqueous solutions of ammonium hydroxide at concentrations of 2.87, 3.63, and 8.28 mol dm^{-3} at temperatures up to 423 K. Ammonium hydroxide shows only a small salt effect. There is no discernable trend with either concentration or temperature. The tentative values are the average of the three salt effect parameters at each temperature.

T/K	298.15	323.15	348.15	373.15	423.15
$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1}$	0.0043	0.0064	0.0025	0.0040	0.0042
σ[1]	0.0016	0.0012	0.0015	0.0012	0.0014

5. Hydrogen + water + Ammonium chloride [12125-02-9]

Gerecke and Bittrich (12) measured the solubility of hydrogen in several ammonium chloride solutions at temperatures of 288.15 and 323.15 K. They cite a salt effect parameter value at 298.15 K from the thesis of Gerecke (10). The hydrogen solubility is reported as a Kuenen coefficient and the salt concentration is reported as molality (mol kg^{-1}). Their salt effect parameter, k_{sms}, was converted to a $k_{sc\alpha}$ value. The tentative values for a one mol dm^{-3} solution are

T/K	288.15	298.15	323.15
$k_{sms}/\text{kg mol}^{-1}$	0.055	0.057	0.044
$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1}$	0.057	0.059	0.046

6. Hydrogen + water + Ammonium sulfate [7783-20-2]

Bruhn, Gerlach, and Pawlek (7) measured the solubility of hydrogen in aqueous ammonium sulfate at 0.25, 0.75, 1.5 and 3.0 mol dm^{-3} at temperatures up to 523 K. The individual $k_{sc\alpha}$ values show considerable scatter, The four values at each temperature were averaged for the tentative salt effect parameter values. They are

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[1] Standard deviation

T/K	298.15	323.15	373.15	423.15	473.15	523.15
$k_{sc\alpha}/dm^3\ mol^{-1}$	0.148	0.145	0.152	0.140	0.156	0.151
σ	0.022	0.046	0.025	0.024	--	--

7. Hydrogen + water + Ammonium nitrate [6684-52-2]

Knopp (15) made measurements on this system for six different concentrations at 293.15K. The results show some scatter. The tentative value of $k_{sc\alpha}$ is 0.033 $dm^3\ mol^{-1}$

8. Hydrogen + water + Zinc sulfate [7732-02-0]

Steiner (16) made measurements on this system for four different concentrations at temperatures near 288K and "adjusted" values to 288.2K. The tentative value of $k_{sc\alpha}$ is 0.237 $dm^3\ mol^{-1}$ at a salt concentration of 1 mol dm^3. There appears to be a slight decrease of $k_{sc\alpha}$ with increasing concentration.

9. Hydrogen + water + Copper (II) sulfate [7758-98-7]

Bruhn, Gerlach, and Pawlek (7) measured the solubility of hydrogen in aqueous copper sulfate of 0.5, 1.0, and 1.5 mol dm^{-3} and temperatures up to 398.15 K. There is no definite trend in the salt effect parameter with either copper sulfate concentration or temperature. The three values of $k_{sc\alpha}$ at each temperature were averaged to give the tentative salt effect parameters below.

T/K	298.15	323.15	348.15	373.15	398.15
$k_{sc\alpha}/dm^3\ mol^{-1}$	0.169	0.170	0.156	0.158	0.176
σ	0.021	0.037	0.015	0.023	0.018

10. Hydrogen + water + Nickel sulfate [7786-81-4]

Bruhn, Gerlach, and Pawlek (7) measured the solubility of hydrogen in aqueous nickel sulfate at 0.5, 1.0, and 1.5 mol dm^{-3} and temperatures up to 398.15 K. There is no definite trend in the salt effect parameter with either nickel sulfate concentration or temperature. The three values of $k_{sc\alpha}$ at each temperature were averaged to obtain the tentative salt effect parameters below.

T/K	298.15	323.15	348.15	373.15	398.15
$k_{sc\alpha}/dm^3\ mol^{-1}$	0.174	0.184	0.164	0.177	0.173
σ	0.021	0.036	0.018	0.033	0.015

11. Hydrogen + water + Cobalt (II) sulfate [10124-43-3]

Bruhn, Gerlach, and Pawlek (7) measured the solubility of hydrogen in aqueous cobalt sulfate at 0.5, 1.0, and 1.5 mol dm^{-3} and temperatures up to 398.15 K. There is no definite trend in the salt effect parameter with either cobalt sulfate concentration or temperature. The three values of $k_{sc\alpha}$ at each temperature were averaged to obtain the tentative salt effect parameters below.

T/K	298.15	323.15	348.15	373.15	398.15
$k_{sc\alpha}/dm^3\ mol^{-1}$	0.157	0.156	0.157	0.159	0.155
σ	0.019	0.036	0.006	0.012	0.027

12. Hydrogen + water + Hydrate iron (III) oxide [12259-21-1]

The data of Shkol'nikova (6) are classed as tentative. She made no solubility measurements in pure water. No salt effect parameters were calculated for the colloidal solutions.

13. Hydrogen + water + Manganese (II) sulfate [7785-87-7]

Deckwer (14) measured the solubility of hydrogen in aqueous manganese (II) sulfate up to a concentration of 3.5 mol dm^{-3} at six temperatures between 293.15 and 353.15 K. He did not measure the solubility of hydrogen in water. The salt effect parameters were calculated using the recommended hydrogen in water values of this volume, rather than the literature values picked by Deckwer.

The salt effect parameters appear to be a function of the electrolyte concentration at each temperature. An equation for the salt effect parameter as a linear function of the Manganese (II) sulfate concentration and the $k_{sc\alpha}$ values at concentrations of one and three mol dm^{-3} are given below.

T/K	$k_{sc\alpha} = a + b\ C_3$	$k_{sc\alpha}$ 1 mol dm^{-3}	 3 mol dm^{-3}
293.15	$0.111 + 0.037\ C_3$	0.148	0.222
303.15	$0.133 + 0.025\ C_3$	0.158	0.208
313.15	$0.155 + 0.013\ C_3$	0.168	0.194
323.15	$0.154 + 0.010\ C_3$	0.164	0.184
333.15	$0.175 + 0.003\ C_3$	0.178	0.184
353.15	$0.160 + 0.007\ C_3$	0.167	0.181

14. Hydrogen + water + Hydrated aluminum oxide [1333-84-6]

The data of Shkol'nikova (6) are classed as tentative. She made no pure water hydrogen solubility measurements. No salt effect parameters were calculated for the colloidal solutions.

15. Hydrogen + water + Aluminium Chloride [7446-70-0]

This system has been studied by Steiner (16) at four different salt concentrations at temperatures near 288K. Values "adjusted" to 288.2K were reported and give a tentative value of $k_{sc\alpha}$ of 0.197 $dm^3\ mol^{-1}$ at a salt concentration of 1 mol dm^{-3}. There appears to be a slight decrease of $k_{sc\alpha}$ with increasing concentration.

16. Hydrogen + water + Lanthanum chloride [10099-58-8]

Morrison and Billett (4) measured the solubility of hydrogen in 0.333 mol kg^{-1} $LaCl_3$ at four temperatures. Their salt effect parameter, k_{sms}, was recalculated as a $k_{sc\alpha}$ value at 1 mol dm^{-3}. The values are classed as tentative.

T/K	285.75	303.15	322.55	344.85
k_{sms}/kg mol^{-1}	0.237	0.234	0.228	0.225
$k_{sc\alpha}$/$dm^3\ mol^{-1}$	0.240	0.247	0.252	0.265

17. Hydrogen + water + Uranyl sulfate [1314-64-3]

Stephan, Hatfield, Peoples and Pray (5) measured the solubility of hydrogen in aqueous uranyl sulfate of 40, 100, and 243 g dm^{-3} uranium at temperatures of 373.15, 408.15, and 435.93 K. Salt effect parameters were not calculated. The data are classed as tentative.

18. Hydrogen + water + Magnesium sulfate [7487-88-9]

This system has also been studied by Steiner (16) at four different salt concentrations at temperatures near 288K. Values "adjusted" to 288.2K were reported and give a tentative value of $k_{sc\alpha}$ of 0.233 $dm^3\ mol^{-1}$ at a salt concentration of 1 mol dm^{-3}. There appears to be a slight increase of $k_{sc\alpha}$ with increasing concentration.

19. Hydrogen + water + Calcium chloride [10043-52-4]

This system has been studied by Steiner (16) at six different salt concentrations at temperatures near 288K. Values "adjusted" to 288.2K were reported and give a tentative value of $k_{sc\alpha}$ of 0.194 $dm^3\ mol^{-1}$ at a salt concentration of 1 mol dm^{-3}. The salt effect parameters show some scatter but there is a tendency to a decrease in $k_{sc\alpha}$ as the salt concentration increases:

$$k_{sc\alpha}/dm^3\ mol^{-1} = 0.1976 - 3.2 \times 10^{-3}\ c_3/mol\ dm^{-3}$$

where c_3 is the salt concentration.

20. Hydrogen + water + Barium chloride [10361-37-2]

This system has been investigated by Braun (17). The salt effect parameters are as below at a concentration of 70g/kg (solution). The values calculated from Braun's data decrease with an increase in concentration. The Bunsen coefficients at the lowest temperature are thought to be considerably in error but the salting out parameters are probably more reliable, however the data are classified as doubtful.

T/K	278.2	283.2	288.2	293.2	298.2
$k_{sc\alpha}/dm^3\ mol^{-1}$	0.245	0.229	0.224	0.223	0.225

21. Hydrogen + water + Lithium chloride [7447-41-8]

Morrison and Billett (4) measured the solubility of hydrogen in one mol kg^{-1} lithium chloride at four temperatures. Gerecke and Bittrich (12) and Gerecke (10) reported salt effect parameters at 288.15 and 298.15 K respectively. All of the salt effect parameters were converted to $k_{sc\alpha}$ values which are classed as tentative. The values for one mol dm^{-3} solutions are:

T/K	285.75	288.15	298.15	303.15	322.55	344.85
$k_{sc\alpha}/dm^3\ mol^{-1}$	0.074	0.070	0.073	0.076	0.076	0.075

Steiners data (16) for this system give a value of $k_{sc\alpha}$ of 0.078 mol dm^{-3}.

22. Hydrogen + water + Sodium hydroxide [1310-73-2]

Geffcken (1) and Bruhn, Gerlach, and Pawlek (7) measured the solubility of hydrogen in aqueous sodium hydroxide. Geffcken made measurements at ten NaOH concentrations up to 4.687 mol dm^{-3} at 298.15 K. Bruhn *et al.* made measurements at 0.5, 1.0, and 1.5 mol dm^{-3} NaOH up to a temperature of 523 K. The salt effect parameter calculated from Geffcken's data is about 30 per cent lower than the values of Bruhn *et al.* at the higher temperatures.

The tentative salt effect parameters for a NaOH concentration of one mol dm^{-3} are

T/K	298.15	323.15	373.15	423.15	473.15	523.15
$k_{sc\alpha}/dm^3\ mol^{-1}$	0.137	0.181	0.190	0.179	0.173	0.189
σ	0.006	0.013	0.028	0.045	0.005	0.009

23. Hydrogen + water + Sodium chloride [7647-14-5]

The solubility of hydrogen in aqueous sodium chloride was measured by Morrison and Billett (4) at four temperatures, by Gerecke and Bittrich (12) at two temperatures, by Gerecke (10) at one temperature, and by Crozier and Yamamoto (13) at five temperatures.

All measurements were converted to salt effect parameters, $k_{sc\alpha}$. Morrison and Billett's measured the hydrogen solubility at one mol kg^{-1} NaCl, while Crozier and Yamamoto made measurements at 0.1895 and 0.4815 mol kg^{-1} NaCl. Gerecke and Bittrich made measurements over a range of 0.50 to 4.30 mol kg^{-1} NaCl. Both Morrison and Billett and Gerecke and Bittrich reported log (S°/S) values and not the original solubility data. In the Morrison and Billett paper the ratio, S°/S, was identified as the hydrogen solubility ratio per kg of water. Gerecke and Bittrich identified the S°/S ratio as a ratio of Kuenen coefficients, which was taken to mean the solubility of hydrogen per g of water in both pure water and solution. Conversions to $k_{sc\alpha}$ values were made consistent with the authors definitions.

The salt effect parameters scatter, but there is a general trend of a decrease of salt effect parameter magnitude as the temperature increases. A linear regression, over the 273-345 K temperature interval gave

$$k_{sc\alpha}/dm^3\ mol^{-1} = 0.2256 - 4.09 \times 10^{-4}\ T/K$$

The salt effect parameters calculated from the papers and the smoothed values are given below. The smoothed values have an uncertainty of about 10 per cent.

T/K	Braun	Morrison, Billett	Gerecke	Gerecke, Bittrich	Crozier, Yamamoto	Steiner	Value from Equation
274.04					0.127^{1}		0.113
278.2	0.103						0.111
283.2	0.095						0.109
283.97					0.101^{2}		0.109
285.75		0.107					0.109
288.15	0.093			0.107		0.106	0.108
289.55					0.115^{1}		0.107
293.2	0.090						0.105
295.34					0.106^{2}		0.105
298.15	0.096		0.106				0.103
301.50					0.088^{1}, 0.091^{2}		0.102
303.15		0.103					0.102
322.55		0.099					0.094
323.15				0.100			0.093
344.85		0.088					0.085

[1] measurements at ca. 0.2 mol dm^{-3}

[2] measurements at ca. 0.5 mol dm^{-3}

The Bunsen coefficient data of Braun at the lowest temperatures are thought to be considerably in error but the salting and parameters are probably more reliable. The values quoted in the table are for a concentration of 1 mol dm^{-3}. Braun's data gives larger values for more dilute solution and are classified as doubtful.

24. Hydrogen + water + Sodium sulfate [7757-82-6]

This system has been studied by Steiner (16) at three different concentrations. The average value of $k_{sc\alpha}$ is 0.279 $dm^3\ mol^{-1}$ at 288.2 K.

25. Hydrogen + water + Sulfuric acid [7664-93-9]
+ Sodium sulfate [7757-82-6]

Kobe and Kenton (3) made two measurements of the solubility of hydrogen in a mixture that was 1.76 mol kg^{-1} Na_2SO_4 and 0.90 mol kg^{-1} H_2SO_4. Using the sum of the component molalities gives the salt effect parameter, $k_{sm\alpha}$ = 0.157. The value indicates the Na_2SO_4 contributes more to the salting out effect than does the H_2SO_4. The value appears reasonable and is classed as tentative.

26. Hydrogen + water + Sodium nitrite [7632-00-0]

Longo, Delivoria-Papadopoulas, Power, Hill, and Forster (11) measured the solubility of hydrogen in water and in 0.14 mol dm^{-3} $NaNO_2$. The salt effect parameter calculated from their data is $k_{sc\alpha}$ 0.154 at 298.15 K. The value is greater than for other 1-1 electrolytes. It is classed as tentative.

27. Hydrogen + water + Sodium nitrate [7631-99-4]

Gerecke (10) measured the solubility of hydrogen in aqueous $NaNO_3$. He reported one value of the salt effect parameter, k_{sms}, of 0.081 at 298.15 K. This was converted to a salt effect parameter value, $k_{sc\alpha}$, of 0.098. The value is classed as tentative.

This system has also been studied by Steiner (16) at five concentrations at temperatures near 288 K. Values "adjusted" to 288.2 K were reported and give a tentative value of $k_{sc\alpha}$ of 0.0986 dm^3 mol^{-1} at a salt concentration of 1 mol dm^{-3}. The salt effect parameters show some scatter but there is a tendency to a decrease in $k_{sc\alpha}$ as the salt concentration increases

$$k_{sc\alpha}/\text{dm}^3\ \text{mol}^{-1} = 0.1007 - 2.1 \times 10^{-4}\ c_3/\text{mol dm}^{-3}$$

where c_3 is the salt concentration.

The data of Knopp (15) give salt effect parameters, $k_{sc\alpha}$ which scatter considerably with an average value of 0.094 dm^3 mol^{-1} at 293.15 K.

28. Hydrogen + water + Sodium carbonate [497-19-8]

Steiner (16) studied this system at four concentrations at temperatures near 288 K. Values "adjusted" to 288.2 K were reported and give a tentative value of $k_{sc\alpha}$ of 0.294 dm^3 mol^{-1}.

29. Hydrogen + water + Potassium hydroxide [1310-58-3]

The solubility of hydrogen in aqueous potassium hydroxide was measured by Geffcken (1), Knaster and Apel'baum (15), Bruhn, Gerlach, and Pawlek (7), Ruetschi and Amlie (8), and Shoor, Walker, and Gubbins (9).

The authors' results were converted to a Sechenow salt effect parameter of the form $k_{sc\alpha} = (1/c_3)\log(\alpha^\circ/\alpha)$, except for the results of Shoor, Walker, and Gubbins which were left in the original form of $k_{scx} = (1/c)\log(x^\circ/x)$. The value of $k_{sc\alpha}$ was taken as the slope of a linear regression of $\log(\alpha^\circ/\alpha)$ *vs.* c_3, except for the data of Bruhn *et al.* for which $k_{sc\alpha}$ values were averaged.

The results are given in the table below.

T/K	Geffcken	Kaster, Apel'baum	Bruhn, Gerlach, Pawlek	Reutschi, Amlie	Shoor, Walker, Gubbins
294.15		0.123			
298.15	0.137[1]				0.127[3]
303.15				0.133	
313.15					0.130[3]
318.15		0.132			
323.15			0.169[2]		
333.15					0.129[3]
348.15		0.137			
353.15					0.128[3]
373.15			0.156[2]		0.127[3]
423.15			0.164[2]		
473.15			0.151[2]		

---

[1] Average of four values at KOH concentrations between 0.715 and 1.480 mol dm^{-3}. Standard deviation 0.002.

[2] Average of three values at KOH concentrations 0.5, 1.0, and 1.5 mol dm^{-3}. The standard deviations are 0.025, 0.024, 0.024 and 0.015 from top to bottom.

[3] The salt effect parameters are given as k_{scx} values. Conversion to $k_{sc\alpha}$ values will make them smaller by about 0.01.

30. Hydrogen + water + Potassium chloride [7747-40-7]

Gerecke and Bittrich (12) measured the solubility of hydrogen at two concentrations of potassium chloride at 288.15 K. They quote a salt effect parameter of Gerecke (10) at 298.15. They worked with electrolyte molality and gas Kuenen coefficients. Their values are classed as tentative. Values of both k_{sms} and $k_{sc\alpha}$ are given.

T/K	288.15	298.15
k_{sms}/kg mol^{-1}	0.085	0.078
$k_{sc\alpha}$/dm^3 mol^{-1}	0.100	0.094

Steiner (16) also studied this system and the salt effect parameter $k_{sc\alpha}$ at 288.2K is given by

$$k_{sc\alpha}/dm^3 mol^{-1} = 0.1016 - 0.00295 \times c_3/mol\ dm^{-3}$$

where c_3 is the concentration of the salt.

Knopp's data (15) yield salt effect parameters which show no concentration dependence. The average value of $k_{sc\alpha}$ is 0.096 mol^{-1} dm^3.

31. Hydrogen + water + Potassium iodide [7681-11-0]

The solubility of hydrogen in aqueous potassium iodide was measured at four temperatures by Morrison and Billett (4) and at one temperature by Gerecke (10). Their values of k_{sms} were converted to $k_{sc\alpha}$ values. The salt effect parameters in both forms are given below.

T/K	285.75	298.15	303.15	322.55	344.85
k_{sms}/kg mol^{-1}	0.088	0.083	0.081	0.066	0.043
$k_{sc\alpha}$/dm^3 mol^{-1}	0.113	0.110	0.108	0.097	0.078

32. Hydrogen + water + Potassium nitrate [7757-79-1]

This system has been studied by Steiner (16), Gerecke (10) and Knopp (15). Values of the salt effect parameter derived from Knopp's data at 293.15K show considerable variation but no clear correlation with concentration the average value is 0.07 $mol^{-1}\ dm^3$. Steiner's data give values of $k_{sc\alpha}$ which decrease with increasing concentration but show considerable scatter. The value of $k_{sc\alpha}/mol^{-1}\ dm^3$ are given below

$k_{sc\alpha}/mol^{-1}\ dm^3$	0.1012	0.1121	0.0853	0.0864	0.0835
Conc. of salt /mol dm^{-3}	0.482	0.879	1.541	1.820	2.430

Gerecke (10) reports a salt effect parameter for aqueous potassium nitrate at 298.15 K. The value is classed as tentative. It is 0.061 as k_{sms} and 0.083 as $k_{sc\alpha}$.

33. Hydrogen + water + Potassium carbonate [584-08-7]

This system has been studied by Steiner (16) at seven different salt concentrations at temperatures near 288K. Values "adjusted" to 288.2K were reported and give a tentative value of $k_{sc\alpha}$ of 0.290 $mol^{-1}\ dm^3$ at a salt concentration of 1 mol dm^3. Their values decrease slightly with increasing concentration.

References:

1. Geffcken, G. Z. *Phys. Chem.* 1904, *49*; 257.
2. Christoff, A. *Z. Physik. Chem.* 1906, *55*, 622.
3. Kobe, K. A.; Kenton, F. H. *Ind. Eng. Chem., Anal. Ed.* 1938, *10*, 76.
4. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1952, 3819.
5. Stephan, E. L.; Hatfield, N. S.; Peoples, R. S.; Pray, H. A. H. *Battelle Memorial Institute Report BMI-1067*, 1956.
6. Shkol'nikova, R. I. *Uch. Zap. Leningr. Gos. Univ., Ser. Khim. Nauk.* 1959, Nr. 18, 64.
7. Bruhn, G.; Gerlach, J.; Pawlek, F. *Zeit. Anorg. Allg. Chem.* 1965, *337*, 68.
8. Ruetschi, P.; Amlie, R. F. *J. Phys. Chem.* 1966, *70*, 718.
9. Shoor, S. K.; Walker, R. D. Jr.; Gubbins, K. E. *J. Phys. Chem.* 1969, *73*, 312.
10. Gerecke, J. Dissertation (Dr. rer. nat.) 1969 THS "Carl Schorlemmer" Leuna-Merseburg, DDR
11. Longo, L. D.; Delivoria-Papadopoulas, M.; Power, G. G.; Hill, E. P.; Forster, R. E., *Am. J. Physiology*, 1970, *219*, 561.
12. Gerecke, J.; Bittrich, H. J. *Wiss. Z. Tech. Hocsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, 115 and 313.
13. Crozier, T. E.; Yamamoto, S. *J. Chem. Eng. Data* 1974, *19*, 242.
14. Deckwer, W.-D. *J. Chem. Eng. Data* 1980, *25*, 75.
15. Knopp, W. *Z. Phys. Chem.* 1904, *48*, 97.
16. Steiner, P. *Ann. der Phys. Chem.* 1894, *52*, 275
17. Braun, L. *A. Phys. Chem.* 1900, *33*, 721
18. Knaster, M.B.; Apel'baum, L.A. *Zh. Fiz. Khim.* 1964, *38*, 223.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Hydrochloric acid; HCl; [7647-01-0]

ORIGINAL MEASUREMENTS:

Geffcken, G. *Z. Phys. Chem.* 1904, *49*, 257-302

VARIABLES:

Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of acid/mol dm^{-3} (soln)	Ostwald coefficient, *L*
298.15	0.426	0.01875
	0.432	0.01868
	1.063	0.01789
	1.062	0.01732
	1.802	0.01699
	1.928	0.01688
	2.338	0.01652
	2.438	0.01627
	2.836	0.01606

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric method using simple adsorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by the action of dilute hydrochloric acid on aluminium in the presence of mercury chloride. Washed in potassium hydroxide solution and potassium permanganate solution. Dried.
2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta L = \pm 1\%$.
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sulfuric acid; H_2SO_4; [7664-93-9]

ORIGINAL MEASUREMENTS:

Geffcken, G. *Z. Phys. Chem.* 1904, *49*, 257-302

VARIABLES:

Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of acid/mol dm^{-3} (soln)	Ostwald coefficient, L
298.15	0.2635	0.01869
	0.2344	0.01838
	0.4925	0.01780
	0.5610	0.01768
	0.9330	0.01642
	0.9525	0.01632
	1.3025	0.01575
	1.5225	0.01496
	1.5870	0.01456
	1.9810	0.01422
	1.9945	0.01402

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric method using simple adsorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by the action of dilute hydrochloric acid on aluminium in the presence of mercury chloride. Washed in potassium hydroxide solution and potassium permanganate solution. Dried.
2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta L = \pm 1\%$
(estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Sulfuric acid; H_2SO_4; [7664-93-9]

ORIGINAL MEASUREMENTS:

Christoff, A.

Z. Physik. Chem. 1906, *55*, 622-634.

VARIABLES:

T/K: 293.15
P: 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	0.0	2.077
	35.82	5.690	0.9544
	61.62	16.37	0.7081
	95.6	222.	1.097

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 solvent 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 flask was filled with solvent, the gas was introduced, and the system shaken until equilibrium was reached.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared from the reaction of zinc and dilute sulfuric acid.

(2) Water. Distilled.

(3) Sulfuric acid. Merck (Darmstadt). Specific gravity 1.271, 1.523, and 1.839 for 35.82, 61.62, and 95.6 wt per cent, respectively.

ESTIMATED ERROR:

$\delta T/K = 0.02$ for acid
$= 0.5$ for gas

Barometric fluctuation stated to be negligible.

REFERENCES:

1. Ostwald, W. *Lehrbuch der allgem. Chemie (2 Aufl.)*, *1*, 615.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sulfuric acid; H_2SO_4; [7664-93-9]

ORIGINAL MEASUREMENTS:

Bruhn, G.; Gerlach, J.; Pawlek, F.

Zeit. Anorg. Allg. Chem.

1965, *337*, 68-79

VARIABLES:

Temperature, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of acid/mol l^{-1}	Bunsen coefficient, α
323.15	0.5	0.01521
	1.0	0.01348
	1.5	0.01220
373.15	0.5	0.01733
	1.0	0.01475
	1.5	0.01398
423.15	0.5	0.02125
	1.0	0.01935
	1.5	0.01770
473.15	0.5	0.02900
	1.0	0.02645
523.15	0.5	0.04180
	1.0	0.03600

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Similar to that described by Pray and Stephan (1). Composition of liquid determined by stripping solution of gas and estimating volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta\alpha = \pm 2\%$.

(estimated by compiler)

REFERENCES:

1. Pray, H.A.; Stephan, E.L. *Battelle Memorial Institute Report BMI-840*, 1953.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Sulfuric acid; H_2SO_4; [7664-93-9]

ORIGINAL MEASUREMENTS:

Ruetschi, P.; Amlie, R. F.

J. Phys. Chem. 1966, *70*, 718 - 723.

VARIABLES:

T/K: 303.15
H_2 P/kPa: 101.325 (1 atm)
H_2SO_4/eq dm^{-3}: 0 - 15.2

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	Temperature T/K	Normality $c_{½H_2SO_4}$/mol dm^{-3}	Molarity $c_{H_2SO_4}$/mol dm^{-3}	Solubility cm^3(STP) dm^{-3}	log S^o/S	(1/c)log S^o/S[1]
30	303.15	0.0	0.0	17.03		
				16.90		
				17.10		
				16.93		
				16.99 ± 0.08 Av.	-	-
		0.0011	0.00055	17.09	0	0
		0.100	0.050	16.66	0.0083	0.166
		0.502	0.251	16.15	0.0221	0.088
		1.02	0.51	15.17	0.0495	0.097
		3.04	1.52	12.76	0.1243	0.082
		5.05	2.525	10.83	0.195	0.077
		6.95	3.475	10.01	0.230	0.066
		9.67	4.835	8.87	0.283	0.059
		12.4	6.2	8.11	0.322	0.052
		15.2	7.6	7.68	0.345	0.045

[1] The c is the molar c, $c_{H_2SO_4}$/mol dm^{-3}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

They used the apparatus of Ben-Naim and Baer (1). A calibrated dissolution vessel contains degassed water. Gas is introduced wet from a calibrated gas buret system. Stirring the liquid forces it up sidearms attached to the top of the flask and the liquid returns via a central tube. The amount of gas dissolved is determined via the gas burets. The gas burets and dissolution vessel are thermostated in a water bath. The original paper contains a diagram and a description of operation.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Prepurified grade (99.5% min purity).

(2) Water. No comment by author.

(3) Sulfuric acid. Source not given. Reagent grade.

ESTIMATED ERROR:

REFERENCES:

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

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Nitric acid; HNO_3; [7697-37-2]	ORIGINAL MEASUREMENTS: Geffcken, G. *Z. Phys. Chem.* 1904, *49*, 257-302
VARIABLES: Concentration	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of acid/mol dm^{-3} (soln)	Ostwald Coefficient, *L*
298.15	0.741	0.01851
	0.753	0.01868
	1.22	0.01812
	1.45	0.01782
	2.09	0.01739
	2.96	0.01690
	3.18	0.01667
	3.22	0.01633
	4.13	0.01611
	4.23	0.01589

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric method using simple adsorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by the action of dilute hydrochloric acid on aluminium in the presence of mercury chloride. Washed in potassium hydroxide solution and potassium permanganate solution. Dried.
2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta L = \pm 1\%$.

(estimated by compiler.)

REFERENCES:

COMPONENTS:

1. Hydrogen, H_2; [1333-74-0]
2. Water, H_2O; [7732-18-5]
3. Ammonium hydroxide; NH_4OH; [1336-21-6]

ORIGINAL MEASUREMENTS:

Bruhn, G.; Gerlach, J.; Pawlek, F.

Zeit. Anorg. Allg. Chem.

1965, *337*, 68-79.

VARIABLES:

Temperature, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of salt/mol l^{-1}	Bunsen coefficient, α
298.15	2.87	0.01745
	5.63	0.01659
	8.28	0.01603
323.15	2.87	0.01571
	5.63	0.01473
	8.28	0.01460
348.15	2.87	0.01629
	5.63	0.01569
	8.28	0.01530
373.15	2.87	0.01791
	5.63	0.01762
	8.28	0.01656
423.15	2.87	0.02285
	5.63	0.02175
	8.28	0.02140

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static equilibrium cell. Similar to that described by Pray and Stephan (1) Composition of liquid determined by stripping solution of gas and estimating volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta\alpha = \pm 2\%$.
(estimated by compiler).

REFERENCES:

1. Pray, H.A.; Stephan, E.L. *Battelle Memorial Institute Report BMI-840*, 1953.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Ammonium chloride; NH_4Cl; [12125-02-9]

ORIGINAL MEASUREMENTS:

Gerecke, J.; Bittrich, H. J.

Wiss. Z. Tech. Hocsch. Chem. "Carl Schorlemmer" Leuna-Merseburg 1971, 115 - 122, 313 - 231.

Chem. Abstr. 1972, *76*, 77239, *77*, 66741.

VARIABLES:

T/K: 288, 323

P/kPa: 101.325 (1 atm)

m_{NH_4Cl}/mol kg^{-1}: 0.50 - 5.00

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	m_{NH_4Cl}/mol kg^{-1}	log (S°/S)
288	0.50	0.029
	1.00	0.058
	2.00	0.112
	5.00	0.262
323	0.50	0.021
	1.00	0.045
	2.00	0.093
	5.00	0.213

Values were taken from a graph in the paper by the compiler.

The solubility ratio, S°/S, is a ratio of Kuenen coefficients.

The authors value of the solubility of hydrogen in water at 298.15 K and one atm partial pressure is a Bunsen coefficient of 0.0177.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The hydrogen solubilities appear to have been determined by the method of Morrison and Billett (1).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen.

(2) Water.

(3) Ammonium chloride.

No information on the materials.

ESTIMATED ERROR:

δlog (S°/S) = $\pm$0.003 from graph.

REFERENCES:

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

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Electrolyte

ORIGINAL MEASUREMENTS:

Gerecke, J.
Dissertation (Dr. rer. nat.) 1969
THC "Carl Schorlemmer"
Leuna-Merseburg, DDR

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	$k_s = (1/m) \log (S^0/S)$
Ammonium chloride; NH_4Cl; [12125-02-9]	
298.15	0.055
Lithium chloride; LiCl; [7447-41-8]	
298.15	0.062
Sodium chloride; NaCl; [7647-14-5]	
298.15	0.095
Potassium chloride; KCl; [7447-40-7]	
298.15	0.078
Potassium iodide; KI; [7681-11-0]	
298.15	0.083
Sodium nitrate; $NaNO_3$; [7631-99-4]	
298.15	0.081
Potassium nitrate; KNO_3; [7757-79-1]	
298.15	0.061

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The values above were quoted in a paper by Gerecke and Bittrich (1).

The solubility ratio, S^0/S, is ratio of Kuenen coefficients. The salt concentration is m/mol kg^{-1}.

SOURCE AND PURITY OF MATERIALS:

No information on the source and purity of materials.

ESTIMATED ERROR:

REFERENCES:

1. Gerecke, J.; Bittrich, H.-J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*, 313 - 321.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

ORIGINAL MEASUREMENTS:

Bruhn, G.; Gerlach, J.; Pawlek, F.

Zeit. Anorg. Allg. Chem.

1965, *337*, 68-79.

VARIABLES:

Temperature, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of salt/mol l^{-1}	Bunsen coefficient, α
298.15	0.25	0.01638
	0.75	0.01358
	1.5	0.00953
	3.0	0.00766
323.15	0.25	0.01540
	0.75	0.01191
	1.5	0.00854
	3.0	0.00747
373.15	0.25	0.01657
	0.75	0.01449
	1.5	0.01029
	3.0	0.00759
423.15	0.25	0.02175
	0.75	0.01798
	1.5	0.01300
	3.0	0.01030
473.15	1.5	0.01703
	3.0	0.01250
523.15	1.5	0.02305
	3.0	0.02055

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static equilibrium cell. Similar to that described by Pray and Stephan (1). Composition of liquid determined by stripping solution of gas and estimating volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta\alpha = \pm 2\%$.

(estimated by compiler)

REFERENCES:

1. Pray, H.A.; Stephan, E.L. *Battelle Memorial Institute Report BMI-840*, 1953.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Ammonium nitrate; NH_4NO_3; [6484-52-2]

ORIGINAL MEASUREMENTS:

Knopp, W.

Z. Phys. Chem. 1904, *48*, 97-108.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt in 100 g soln.	Conc. of salt /mol dm^{-3} (soln.)	Density of soln. /g cm^{-3}	Bunsen absorption coefficient, α	10^4 mole fraction of hydrogen, $10^4 x_{H_2}$
293.15	0	0	0.99823	0.01883	0.1511
	1.037	0.1308	1.00267	0.01872	0.1508
	2.167	0.2765	1.00722	0.01845	0.1492
	3.378	0.4363	1.01216	0.01823	0.1481
	4.823	0.6333	1.01815	0.01773	0.1450
	6.773	0.9069	1.02620	0.01744	0.1436
	11.550	1.6308	1.04652	0.01647	0.1384

AUXILIARY INFORMATION

METHOD 'APPARATUS/PROCEDURE:

Manometric method with absorption pipet and gas buret being used. Densities were determined using a Sprengel pyknometer.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from pure zinc and dil. sulfuric acid in a Kipp's apparatus, passed through silver nitrate, potassium hydroxide and permanganate solutions.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Zinc sulfate; $ZnSO_4$; [7733-02-0]

ORIGINAL MEASUREMENTS:

Steiner, P.

Ann. der Phys. Chem.

1894, *52*, 275-299.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt / mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
290.94	0.397	1.0620	0.01495	0.01525
291.10	0.899	1.1394	0.01151	0.01175
291.37	1.277	1.1961	0.00940	0.00961
291.71	2.180	1.3265	0.00590	0.00605

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

3. Recrystallized.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Copper (2+) sulfate; $CuSO_4$; [7758-98-7]

ORIGINAL MEASUREMENTS:

Bruhn, G.; Gerlach, J.; Pawlek, F.

Zeit. Anorg. Allg. Chem.

1965, *337*, 68-79

VARIABLES:

Temperature, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of salt/mol l^{-1}	Bunsen coefficient,α
298.15	0.5	0.01422
	1.0	0.01222
	1.5	0.01050
323.15	0.5	0.01280
	1.0	0.01189
	1.5	0.00935
348.15	0.5	0.01372
	1.0	0.01102
	1.5	0.01001
373.15	0.5	0.01490
	1.0	0.01275
	1.5	0.01149
398.15	0.5	0.01619
	1.0	0.01384
	1.5	0.01153

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Similar to that described by Pray and Stephan (1). Composition of liquid determined by stripping solution of gas and estimating volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta\alpha = \pm 2\%$.

(estimated by compiler).

REFERENCES:

1. Pray, H.A.; Stephan, E.L. *Battelle Memorial Institute Report BMI-840*, 1953.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Nickel (2+) sulfate; $NiSO_4$; [7786-81-4]	Bruhn, G.; Gerlach, J.; Pawlek, F. *Zeit. Anorg. Allg. Chem.* 1965, *337*, 68-79.
VARIABLES:	**PREPARED BY:**
Temperature, concentration	C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of salt/mol l^{-1}	Bunsen coefficient, α
298.15	0.5	0.01412
	1.0	0.01205
	1.5	0.01031
323.15	0.5	0.01260
	1.0	0.01143
	1.5	0.00897
348.15	0.5	0.01356
	1.0	0.01076
	1.5	0.00985
373.15	0.5	0.01425
	1.0	0.01233
	1.5	0.01135
398.15	0.5	0.01630
	1.0	0.01390
	1.5	0.01155

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static equilibrium cell. Similar to that described by Pray and Stephan (1). Composition of liquid determined by stripping solution of gas and estimating volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta\alpha = \pm 2\%$.

(estimated by compiler).

REFERENCES:

1. Pray, H.A.; Stephan, E.L. *Batteile Memorial Institute Report BMI-840*, 1953.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Cobalt (2+) sulfate; $CoSO_4$; [10124-43-3]

ORIGINAL MEASUREMENTS:

Bruhn, G.; Gerlach, J.; Pawlek, F.

Zeit. Anorg. Allg. Chem.

1965, *337*, 68-79

VARIABLES:

Temperature, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of salt/mol l^{-1}	Bunsen coefficient,α
298.15	0.5	0.01446
	1.0	0.01250
	1.5	0.01085
323.15	0.5	0.01297
	1.0	0.01183
	1.5	0.01038
348.15	0.5	0.01364
	1.0	0.01125
	1.5	0.00971
373.15	0.5	0.01506
	1.0	0.01270
	1.5	0.01105
398.15	0.5	0.01641
	1.0	0.01455
	1.5	0.01275

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Similar to that described by Pray and Stephan (1). Composition of liquid determined by stripping solution of gas and estimating volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta\alpha = \pm 2\%$.

(estimated by compiler).

REFERENCES:

1. Pray, H.A.; Stephan, E.L. *Battelle Memorial Institute Report*, *BMI-840*, 1953.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5] (3) Hydrated iron oxide; $Fe_2O_3 \cdot xH_2O$; [12259-21-1]	Shkol'nikova, R. I. *Uch. Zap. Leningr. Gos. Univ., Ser. Khim. Nauk.* 1959, Nr. 18, 64 - 86. *Chem. Abstr.* 1961, *55*, 25443b.

VARIABLES:	PREPARED BY:
T/K: 293.15 - 313.15 P/kPa: 101.325 (1 atm) Fe_2O_3/Wt %: 0 - 0.8	A. L. Cramer H. L. Clever

EXPERIMENTAL VALUES:

T/K	Hydrated Fe_2O_3/Wt %	Bunsen Coefficient $\alpha \times 10^3$
293.15	0.1	17.4
	0.5	16.1
	0.8	15.3
303.15	0.1	15.7
	0.5	15.1
	0.8	13.4
313.15	0.1	14.1
	0.5	12.6
	0.8	10.9

The enthalpy of solution of hydrogen was calculated from the temperature coefficient of the Bunsen coefficient. It is 1590, 1980, 2240, and 3090 cal mol^{-1} in water, and 0.1, 0.5, and 0.8 wt % Fe_2O_3, respectively.

The values for the solubility of hydrogen in water were not given in the paper.

The hydrated iron oxide is described as a sol (colloidal).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung were modified (1).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Stated to be 99.99 per cent.

(2) Water. No information.

(3) Iron oxide. No information.

ESTIMATED ERROR:

REFERENCES:

1. Lannung, A.
   J. Am. Chem. Soc. 1930, *52*, 68.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Manganese (II) sulfate; $MnSO_4$; [7785-87-7]

ORIGINAL MEASUREMENTS:

Deckwer, W.-D.

J. Chem. Eng. Data 1980, *25*, 75 - 76.

VARIABLES:

T/K: 293.15 - 353.15 (20 - 80 °C)

P/kPa: 101.325 (1 atm)

c_{MnSO_4}/mol dm^{-3}: 0.5 - 3.5

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

c_{MnSO_4}/mol dm^{-3}	Bunsen coefficient, $\alpha \times 10^2$					
	293.15K	303.15K	313.15K	323.15K	333.15K	353.15K
0[1]	1.820	1.700	1.640	1.610	1.600	1.600
0.5	1.672	1.508	1.429	1.342	1.302	1.236
1.0	1.339	1.212	1.141	1.141	1.072	1.108
1.5	1.002	0.945	0.867	0.856	0.835	0.920
2.0	0.725	0.696	0.690	0.686	0.690	0.782
2.5	0.515	0.524	0.573	0.585	0.592	0.631
3.0	0.375	0.399	0.427	0.464	0.462	0.477
3.5	0.304	0.312	0.330	0.352	0.339	0.352

[1] Water values not measured by author, but taken from reference 1.

Bunsen coefficients are the average of five determinations. The reproducibility was usually better than 1 per cent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A gas chromatograph technique was used.

The gas was presaturated by passing through a $MnSO_4$ solution, then passed through the solution, equilibrium was established in one hour.

A known volume (about 10 cm^3) was transferred to an evacuated, heated column. Most of the H_2 desorbed from the saturated solution under these conditions, but any remaining was stripped by passage of argon gas.

The gas flow was dried on silica gel, and introduced to the gas chromatograph (Perkin-Elmer F116E). Peaks without tailing were obtained on a 2-cm column at 50 C filled with 5A molecular sieve and a heat conductivity detector.

The instrument was calibrated with H_2 and H_2/Ar mixtures.

The paper also reports solution densities, viscosities, & vapor pressure lowering.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Commercial sample of 99.9 per cent purity.

(2) Water. No information.

(3) Manganese (II) sulfate. No information

ESTIMATED ERROR: Mean relative error is about 2 per cent at $MnSO_4$ concentration of 1 mol dm^{-3}, increases to about 4 per cent at 3.5 mol dm^{-3} (author).

REFERENCES:

1. Seidell, A.; Linke, W. F. *Solubilities of Inorganic and Metalorganic Compounds*, Van Nostrand, Princeton, NJ, 1958, Vol. I.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Hydrated aluminium oxide; $Al_2O_3 \cdot xH_2O$; [1333-84-2]

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 (1 atm)
Al_2O_3/Wt %: 0 - 0.35

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Hydrated Al_2O_3/Wt %	Bunsen Coefficient $\alpha \times 10^3$
293.15	0.1	17.7
	0.35	15.0
303.15	0.1	16.7
	0.35	11.1
313.15	0.1	15.6
	0.35	9.2

The enthalpy of solution of hydrogen was calculated from the temperature coefficient of the Bunsen coefficient. It is 1590, 1150, and 3920 cal mol^{-1} in water, 0.1 and 0.35 wt % Al_2O_3, respectively.

The values for the solubility of hydrogen in water were not given in the paper.

The hydrated aluminium oxide is described as a sol (colloidal).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung (1) were modified.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Stated to be 99.99 per cent.

(2) Water. No information.

(3) Aluminium oxide. No information.

ESTIMATED ERROR:

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Aluminium chloride; $AlCl_3$ [7446-70-0]	Steiner, P. *Ann. der Phys. Chem.* 1894, *52*, 275-299.
VARIABLES:	PREPARED BY:
Concentration of salt	C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
290.61	0.541	1.0488	0.01460	0.01486
290.45	1.019	1.0914	0.01190	0.01210
290.43	1.802	1.1589	0.00860	0.00874
290.29	3.080	1.2647	0.00525	0.00533

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

3. Chlorine, hydrogen chloride and iron removed from sample by heating.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Lanthanum chloride; $LaCl_3$; [10099-58-8]

ORIGINAL MEASUREMENTS:

Morrison, T. J.; Billett, F.

J. Chem. Soc. 1952, 3819 - 3822.

VARIABLES:

T/K: 285.75 - 344.85

P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		$1/(T/K)$	Salt Effect Parameters		
$t/°C$	T/K		$(1/c)\log(S^0/S)$[1]	$(1/m)\log(S^0/S)$	$(1/m)\log(x^0/x)$
12.6	285.75	0.0035	0.079	0.237	0.267
30.0	303.15	0.0033	0.078	0.234	0.264
49.4	322.55	0.0031	0.076	0.228	0.258
71.7	344.85	0.0029	0.075	0.225	0.255

[1] In the authors notation c represented g eq $LaCl_3$ per 1.000 kg water.

The salt effect parameters were calculated from two solubility measurements. The solubility in 1.000 kg water, S^0, and the solubility in a 1 equivalent of salt per 1.000 kg of water, S. Values of the solubility of hydrogen in water are given in the paper, but not the solubility in the salt solution.

The compiler calculated the salt effect parameter on a salt molal basis,and on a salt molal and gas mole fraction basis.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The degassed solvent flows in a thin film down an absorption helix containing the hydrogen 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) Hydrogen. Prepared from pure zinc and dilute hydrochloric acid.

(2) Water. No information given.

(3) Lanthanum chloride. "AnalaR" material.

ESTIMATED ERROR:

$\delta k = 0.010$

REFERENCES:

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

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Uranyl sulfate; UO_6S; [1314-64-3]

ORIGINAL MEASUREMENTS:

Stephan, E. L.; Hatfield, N. S.; Peoples, R. S.; Pray, H. A. H.

Battelle Memorial Institute Report BMI-1067, 1956.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	g Uranium per liter	$P^\dagger$/bar	Solubility*	T/K	g Uranium per liter	$P^\dagger$/bar	Solubility*
373.15	40	26.4	0.375	373.15	100	30.5	0.35
		27.6	0.395			34.1	0.396
		29.1	0.392			54.8	0.63
		30.2	0.41			55.8	0.645
		46.4	0.62			57.3	0.662
		47.6	0.64			58.4	0.648
		48.7	0.675			70.3	0.83
		50.1	0.69			72.2	0.867
		68.2	0.97			73.4	0.84
		69.3	0.98			76.5	0.84
		70.7	0.91			97.8	1.20
		71.6	1.08			99.8	1.24
		72.1	1.01			100.3	1.25
		98.7	1.44			101.7	1.27
		101.1	1.48			104.8	1.27
		102.4	1.50			104.9	1.27
		106.2	1.49		243	23.6	0.20
	100	26.3	0.305			24.8	0.207
		27.4	0.31			26.8	0.23
		27.6	0.325			43.5	0.372
		29.3	0.34			44.6	0.40

(cont.)

* ml of hydrogen at S.T.P./g of solution

† partial pressure of hydrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas and liquid equilibrated for 18 hours. Pressure measured with Bourdon gauge and temperature measured with thermocouple. Composition of liquid estimated by volumetric method. Details in source. Partial pressure estimated by subtracting vapor pressure from total pressure.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta P/\text{bar} = \pm 0.3$;

δ(Solubility) = ±3% (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Uranyl sulfate; UO_6S;[1314-64-3]	Stephan, E. L.; Hatfield, N. S.; Peoples, R. S.; Pray, H. A. H. *Battelle Memorial Institute Report BMI-1067*, 1956.

EXPERIMENTAL VALUES:

T/K	g Uranium per liter	$P^{\dagger}$/bar	Solubility*
373.15	243	46.2	0.392
		73.6	0.62
		77.3	0.668
		78.5	0.65
		101.8	0.92
		103.1	0.93
		105.8	0.91
		106.8	0.95
		108.6	0.96
408.15	40	27.4	0.40
		29.0	0.40
		30.1	0.44
		46.0	0.676
		47.4	0.71
		47.6	0.702
		48.4	0.718
		49.5	0.77
		67.6	0.99
		68.5	1.04
		70.1	1.07
		71.4	1.05
		98.9	1.47
		102.1	1.59
		104.8	1.56
	100	18.8	0.270
		19.8	0.251
		21.4	0.272
		44.3	0.55
		45.9	0.613
		47.3	0.63
		69.2	0.855
		70.1	0.887
		71.4	0.95
		99.2	1.27
		100.3	1.265
		101.3	1.325
		102.9	1.30
	243	22.4	0.219
		23.9	0.236
		56.4	0.561
		57.6	0.558
		58.7	0.588
		60.7	0.625
		92.3	0.875
408.15	243	93.5	0.895
		95.0	0.95
435.93	40	14.2	0.324
		15.4	0.330
		16.5	0.294
		37.9	0.705
		40.0	0.753
		41.4	0.782
		43.1	0.805
		56.9	1.20
		61.4	1.112
		66.0	1.22
		93.4	1.71
		94.1	1.715
		96.5	1.77
	100	18.1	0.321
		18.6	0.316
		18.8	0.333
		19.2	0.358
		35.9	0.585
		35.9	0.617
		39.3	0.595
		40.0	0.663
		41.0	0.683
		43.4	0.745
		43.5	0.73
		46.5	0.77
		58.6	0.97
		60.7	1.03
		64.2	1.05
		66.0	1.09
		71.7	1.14
		84.0	1.41
		88.0	1.43
	243	32.3	0.391
		33.4	0.384
		34.1	0.395
		34.5	0.42
		71.0	0.82
		74.2	0.83
		78.3	0.91
		102.4	1.24
		105.1	1.27

* ml of hydrogen at S.T.P./g of solution † partial pressure of hydrogen

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Magnesium sulfate; $MgSO_4$; [7487-88-9]

ORIGINAL MEASUREMENTS:

Steiner, P.
Ann. der Phys. Chem.
1894, *52*, 275-299.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
290.25	0.433	1.0503	0.01479	0.01501
290.45	0.936	1.1064	0.01140	0.01159
290.70	1.631	1.1805	0.00783	0.00797
291.41	2.501	1.2679	0.00487	0.00499

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Calcium chloride; $CaCl_2$; [10043-52-4]

ORIGINAL MEASUREMENTS:

Steiner, P.
Ann. der Phys. Chem.
1894, *52*, 275-299.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
291.67	0.321	1.0285	0.01579	0.01619
291.19	0.578	1.0513	0.01419	0.01450
291.55	1.122	1.0981	0.01112	0.01138
291.24	1.827	1.1568	0.00821	0.00839
290.99	2.556	1.2150	0.00606	0.00619
290.83	2.962	1.2470	0.00510	0.00519

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwalt type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Barium chloride; $BaCl_2$; [10361-37-2]	Braun, L. *Z. phys. Chem.* 1900, *33*, 721-741.
VARIABLES:	PREPARED BY:
Temperature, concentration of salt	C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt per 100 g soln. /g	Bunsen coefficient, α	T/K	Wt. of salt per 100 g soln. /g	Bunsen coefficient, α
278.2	0	0.02366	288.2	6.453	0.01734
	3.291	0.02110		7.002	0.01715
	3.600	0.02089	293.2	0	0.01905
	6.453	0.01957		3.291	0.01719
	7.002	0.01937		3.600	0.01700
283.2	0	0.02213		6.453	0.01605
	3.291	0.01983		7.002	0.01591
	3.600	0.01971	298.2	0	0.01750
	6.453	0.01857		3.291	0.01570
	7.002	0.01833		3.600	0.01562
288.2	0	0.02059		6.453	0.01474
	3.291	0.01847		7.002	0.01455
	3.600	0.01839			

N.B. The Bunsen coefficients at the lowest temperature are thought to be considerably in error but the salting out parameters at the lowest temperatures are probably more reliable (see water evaluation).

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 by 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:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Lithium chloride; LiCl; [7447-41-8]	Steiner, P. *Ann. der Phys. Chem.* 1894, *52*, 275-299.
VARIABLES:	**PREPARED BY:**
Concentration of salt	C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
283.62	0.835	1.0192	0.01676	0.01619
285.55	1.800	1.0416	0.01396	0.01370
285.92	3.734	1.0843	0.01006	0.00990

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Lithium Chloride; LiCl; [7447-41-8]

ORIGINAL MEASUREMENTS:

Morrison, T. J.; Billett, F.

J. Chem. Soc. 1952, 3819 - 3822.

VARIABLES:

T/K: 285.75 - 344.85
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature			Salt Effect Parameters	
t/ C	T/K	1/(T/K)	(1/m)log(S^o/S)[1]	(1/m)log(x^o/x)
12.6	285.75	0.0035	0.064	0.079
30.0	303.15	0.0033	0.065	0.080
49.4	322.55	0.0031	0.061	0.076
71.7	344.85	0.0029	0.054	0.069

[1] The authors used (1/c)log(S^o/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 hydrogen solubility S is cm^3(STP) kg^{-1}.

The salt effect parameters were calculated from two measurements. The solubility of hydrogen in water, S^o, and in the one molal salt solution, S. Only the solubility of the hydrogen 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 hydrogen 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) Hydrogen. Prepared from pure zinc and dilute hydrochloric acid.

(2) Water. No information given.

(3) Lithium Chloride. "AnalaR" material.

ESTIMATED ERROR:

$\delta k = 0.010$

REFERENCES:

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

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Lithium chloride; LiCl; [7447-41-8]

ORIGINAL MEASUREMENTS:

Gerecke, J.; Bittrich, H. J.

Wiss. Z. Tech. Hoesch. Chem. "Carl Schorlemmer" Leuna-Merseburg 1971, 115 - 122, 313 - 321.

Chem. Abstr. 1972, *76*, 77239, *77*, 66741.

VARIABLES:

T/K: 288

P/kPa: 101.325 (1 atm)

m_{LiCl}/mol kg^{-1}: 0.43 - 3.75

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	m_{LiCl}/mol kg^{-1}	log (S°/S)
288	0.43	0.026
	0.75	0.046
	1.43	0.089
	3.75	0.225

Values were taken from a graph in the paper by the compiler.

The solubility ratio, S°/S, is a ratio of Kuenen coefficients.

The authors value of the solubility of hydrogen in water at 298.15 K and one atm partial pressure is a Bunsen coefficient of 0.0177.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The hydrogen solubilities appear to have been determined by the method of Morrison and Billett (1).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen.

(2) Water.

(3) Lithium chloride.

No information on the materials.

ESTIMATED ERROR:

δlog (S°/S) = $\pm$0.003 from graph.

REFERENCES:

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

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Sodium hydroxide; NaOH; [1310-73-2]	ORIGINAL MEASUREMENTS: Geffcken, G. *Z. Phys. Chem.* 1904, *49*, 257-302
VARIABLES: Concentration	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of hydroxide/mol dm^{-3} (soln)	Ostwald coefficient, L
298.15	0.543	0.01632
	0.571	0.01608
	0.962	0.01442
	0.974	0.01409
	1.059	0.01372
	1.137	0.01348
	1.850	0.01018
	3.400	0.00648
	3.430	0.00639
	4.687	0.00483

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric method using simple adsorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by the action of dilute hydrochloric acid on aluminium in the presence of mercury chloride. Washed in potassium hydroxide solution and potassium permanganate.
2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta L = \pm 1\%$.

(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sodium hydroxide; NaOH; [1310-73-2]

ORIGINAL MEASUREMENTS:

Bruhn, G.; Gerlach, J.; Pawlek, F.

Zeit. Anorg. Allg. Chem.

1965 *337*, 68-79

VARIABLES:

Temperature, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of salt/mol l^{-1}	Bunsen coefficient, α
323.15	0.5	0.01306
	1.0	0.01108
	1.5	0.00868
373.15	0.5	0.01433
	1.0	0.01270
	1.5	0.00933
423.15	0.5	0.01790
	1.0	0.01682
	1.5	0.01308
473.15	0.5	0.02597
	1.0	0.02115
	1.5	0.01710
523.15	0.5	0.03535
	1.0	0.02930
	1.5	0.02350

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Similar to that described by Pray and Stephan (1). Composition of liquid determined by stripping solution of gas and estimating volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta\alpha = \pm 2\%$.

(estimated by compiler).

REFERENCES:

1. Pray, H.A.; Stephan, E.L. *Battelle Memorial Institute Report BMI-840*, 1953.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

Steiner, P.
Ann. der Phys. Chem.
1894, *52*, 275-299.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. YOung

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
286.71	0.825	1.0315	0.01565	0.01548
286.95	2.049	1.0807	0.01140	0.01130
286.32	2.801	1.1088	0.00938	0.00925
286.63	4.815	1.1817	0.00602	0.00595

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sodium chloride; NaCl;
   [7647-14-5]

ORIGINAL MEASUREMENTS:

Braun, L.
Z. phys. Chem.
1900, *33*, 721-741

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt per 100 g soln. /g	Bunsen coefficient, α	T/K	Wt. of salt per 100 g soln. /g	Bunsen coefficient, α
278.2	0	0.02366	288.2	4.496	0.01714
	1.250	0.02180		5.506	0.01665
	1.523	0.02155		5.999	0.01640
	3.798	0.01977	293.2	0	0.01905
	4.496	0.01920		1.250	0.01771
	5.506	0.01861		1.523	0.01754
	5.999	0.01839		3.798	0.01623
283.2	0	0.02213		4.496	0.01587
	1.250	0.02052		5.506	0.01532
	1.523	0.02030		5.999	0.01528
	3.798	0.01876	298.2	0	0.01750
	4.496	0.01817		1.250	0.01621
	5.506	0.01769		1.523	0.01603
	5.999	0.01749		3.798	0.01476
288.2	0	0.02059		4.496	0.01429
	1.250	0.01914		5.506	0.01395
	1.523	0.01896		5.999	0.01383
	3.798	0.01760			

N.B. The Bunsen coefficients at the lowest temperatures are thought to be considerably in error but the salting out parameters are probably more reliable (see water evaluation).

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 by 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:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5] (3) Sodium Chloride; NaCl; [7647-14-5]	Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1952, 3819 - 3822.
VARIABLES:	**PREPARED BY:**
T/K: 285.75 - 344.85 P/kPa: 101.325 (1 atm)	H. L. Clever

EXPERIMENTAL VALUES:

Temperature			Salt Effect Parameters	
$t/^\circ C$	T/K	$1/(T/K)$	$(1/m)\log(S^o/S)^1$	$(1/m)\log(x^o/x)$
12.6	285.75	0.0035	0.097	0.112
30.0	303.15	0.0033	0.092	0.107
49.4	322.55	0.0031	0.082	0.097
71.7	344.85	0.0029	0.066	0.081

[1] The authors used $(1/c)\log(S^o/S)$ 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 $m_{NaCl}/\text{mol kg}^{-1}$. The hydrogen solubility S is $cm^3(STP)\ kg^{-1}$.

The salt effect parameters were calculated from two measurements. The solubility of hydrogen in water, S^o, and in the one molal salt solution, S. Only the solubility of the hydrogen 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:	SOURCE AND PURITY OF MATERIALS:
The degassed solvent flows in a thin film down an absorption helix containing the hydrogen gas plus solvent vapor at a total pressure of one atmosphere. The volume of gas absorbed is measured in an attached buret system (1).	(1) Hydrogen. Prepared from pure zinc and dilute hydrochloric acid. (2) Water. No information given. (3) Sodium Chloride. "AnalaR" material.
	ESTIMATED ERROR: $\delta k = 0.010$
	REFERENCES: 1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

Gerecke, J.; Bittrich, H. J.

Wiss. Z. Tech. Hocsch. Chem. "Carl Schorlemmer" Leuna-Merseburg 1971, 115 - 122, 313 - 321.

Chem. Abstr. 1972, *76*, 77239, *77*, 66741.

VARIABLES:

T/K: 288, 323

P/kPa: 101.325 (1 atm)

m_{NaCl}/mol kg^{-1}: 0.50 - 4.30

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	m_{NaCl}/mol kg^{-1}	log (S°/S)
288	0.50	0.051
	1.00	0.097
	2.00	0.164
	4.30	0.388
323	0.50	0.042
	1.00	0.083
	2.00	0.190
	4.30	0.325

Values were taken from a graph in the paper by the compiler.

The solubility ratio, S°/S, is a ratio of Kuenen coefficients.

The authors value of the solubility of hydrogen in water at 298.15 K and one atm partial pressure is a Bunsen coefficient of 0.0177.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The hydrogen solubilities appear to have been determined by the method of Morrison and Billett (1).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen.

(2) Water.

(3) Sodium chloride.

No information on the materials.

ESTIMATED ERROR:

δlog (S°/S) = ±0.003 from graph.

REFERENCES:

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

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

Crozier, T. E.; Yamamoto, S.

J. Chem. Eng. Data 1974, *19*, 242-244.

VARIABLES:

T/K: 274.03 - 301.51
P/kPa: 101.325 (1 atm)
$w_{NaCl}/^0/_{00}$: 10.950, 27.376

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
10.950 parts NaCl per 1000		
283.97	0.01852	0.01925
289.55	0.01770	0.01876
	0.01770	0.01876
301.48	0.01650	0.01821
301.51	0.01651	0.01822
27.376 parts NaCl per 1000		
274.03	0.01877	0.01883
274.04	0.01881	0.01887
295.34	0.01586	0.01715
295.37	0.01585	0.01714
301.47	0.01552	0.01713

The authors report 42 values of the solubility of hydrogen in pure water at temperatures between 274.60 and 302.47 K. See page 18.

The sodium chloride concentrations of 10.950 and 27.376 parts per 1000 are equivalent to molalities , $m_{NaCl}/\text{mol kg}^{-1}$, of 0.1895 and 0.4815, respectively.

The compiler calculated the Ostwald coefficients from the authors Bunsen coeffcients.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility measurements were made by the Scholander (1) microgasometric technique as modified by Douglas (2). Equilibration is with 6 cm^3 of gas-free water. All volumes are read on a micrometer which adjusts the amount of mercury in the system.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Linde Specialty Gas. Research grade, 99.9995 per cent pure.

(2) Water. Distilled from glass apparatus.

(3) Sodium chloride. No information.

ESTIMATED ERROR:

$\delta T/K = 0.01$
δ(Parts per 1000/ $^0/_{00}$) = 0.003

REFERENCES:

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

2. Douglas, E.
J. Phys. Chem. 1964, *68*, 169.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sodium sulfate; Na_2SO_4; [7757-82-6]

ORIGINAL MEASUREMENTS:

Steiner, P.
Ann. der Phys. Chem.
1894, *52*, 275-299.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
291.66	0.335	1.0412	0.01482	0.01519
291.72	0.638	1.0768	0.01223	0.01254
291.56	1.364	1.1608*	0.00757	0.00775

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

* at 291.15 K.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Sodium sulfate; Na_2SO_4; [7757-82-6]

(4) Sulfuric acid; H_2SO_4; [7664-93-9]

ORIGINAL MEASUREMENTS:

Kobe, K. A.; Kenton, F. H.

Ind. Eng. Chem., Anal. Ed. 1938, *10*, 76 - 77.

VARIABLES:

T/K: 298.15
H_2 P/kPa: 101.325 (760 mmHg)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Solvent Volume cm^3	Hydrogen Volume Absorbed cm^3	Bunsen Coefficient α	Ostwald Coefficient L
25	298.15	49.54	0.37		
		99.54	0.72	0.0067	0.0073

The solvent was a mixture of 800 g H_2O,
200 g Na_2SO_4 (anhydrous),
40 ml H_2SO_4 (conc., 36 N).

Thus the molality of the solution was

$$m_{Na_2SO_4}/\text{mol kg}^{-1} = 1.76$$

$$m_{H_2SO_4}/\text{mol kg}^{-1} = 0.90$$

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, 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 adsorption bulb. The bulb was shaken until equilibrium was reached. The remaining gas was returned to the buret. The difference in final and initial volumes was taken as the gas absorbed.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Purity stated to be 99$^+$ percent.

(2) Water. Distilled.

(3, 4) Sodium sulfate and sulfuric acid. Sources not given. Analytical grades.

ESTIMATED ERROR:

$\delta\alpha/\text{cm}^3 = 0.001$ (authors)

REFERENCES:

1. Kobe, K. A.; Williams, J. S. *Ind. Eng. Chem., Anal. Ed.* 1935, *7*, 37.

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Sodium nitrite; $NaNO_2$; [7632-00-0]	ORIGINAL MEASUREMENTS: Longo, L. D.; Delivoria-Papadopoulas, M.; Power, G. G.; Hill, E. P.; Forster, R. E., *Am. J. Physiology*, 1970, *219*, 561-569.
VARIABLES:	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Bunsen coefficient, α	S.D.*
310.15	0.14	0.0155	0.0003

* standard deviation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Liquid samples were equilibrated with gas and then the dissolved gas was stripped out under vacuum and measured in a manometric Van Slyke apparatus. Some details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$.

REFERENCES:

1. Power, G. G., *J. Appl. Physiology*, 1968, *24*, 468.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sodium nitrate; $NaNO_3$; [7631-99-4]

ORIGINAL MEASUREMENTS:

Steiner, P.

Ann. der Phys. Chem.

1894, *52*, 275-299.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
290.95	0.679	1.0367	0.01572	0.01603
290.80	1.413	1.0765	0.01345	0.01370
290.55	2.656	1.1417	0.01034	0.01052
290.51	3.980	1.2099	0.00797	0.00810
290.42	5.711	1.2963	0.00568	0.00578

\# given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sodium nitrate; $NaNO_3$; [7631-99-4]

ORIGINAL MEASUREMENTS:

Knopp, W.
Z. Phys. Chem.
1904, *48*, 97-108.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt in 100 g soln.	Conc. of salt /mol dm^{-3} (soln.)	Density of soln. /g cm^{-3}	Bunsen absorption coefficient, α	10^4 mole fraction of hydrogen, $10^4 x_{H_2}$
293.15	0	0	0.99823	0.01883	0.1511
	1.041	0.1236	1.00524	0.01839	0.1476
	2.192	0.2634	1.01303	0.01774	0.1428
	4.405	0.5416	1.02820	0.01694	0.1367
	6.702	0.8442	1.04411	0.01518	0.1229
	12.637	1.7394	1.08667	0.01300	0.1064

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method with absorption pipet and gas buret were used. Densities were determined using a Sprengel pyknometer.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from pure zinc and dil. sulfuric acid in a Kipp's apparatus, passed through silver nitrate, potassium hydroxide and permanganate solutions.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Sodium carbonate; Na_2CO_3; [497-19-8]

ORIGINAL MEASUREMENTS:

Steiner, P.
Ann. der Phys. Chem.
1894, *52*, 275-299.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
285.09	0.207	1.0217	0.01677	0.01639
284.76	0.438	1.0457	0.01420	0.01385
285.23	0.819	1.0835	0.01106	0.01082
286.22	1.218	1.1213	0.00851	0.00839

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Potassium hydroxide; KOH; [1310-58-3]

ORIGINAL MEASUREMENTS:

Geffcken, G. *Z. Phys. Chem.* 1904, *49*, 257-302

VARIABLES:

Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of hydroxide/mol dm^{-3} (soln)	Ostwald coefficient, *L*
298.15	0.536	0.01658
	0.715	0.01539
	1.059	0.01378
	1.056	0.01389
	1.480	0.01195

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric method using simple adsorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by the action of dilute hydrochloric acid on aluminium in the presence of mercury chloride. Washed in potassium hydroxide solution and potassium permanganate solution. Dried.
2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1; \delta L = \pm 1\%$.

(estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Potassium hydroxide; KOH
[1310-58-3]

ORIGINAL MEASUREMENTS:

Knaster, M. B.; Apel'baum, L. A.

Zh. Fiz. Khim. 1964, *38*, 223 - 225.

Russ. J. Phys. Chem. 1964, *38*, 120 - 122.

VARIABLES:

T/K: 294.15, 318.15, 348.15
P/kPa: 101.325 (760 mmHg)
c_3/mol dm^{-3}: 0 - 10

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	 T/K	Potassium Hydroxide c_3/mol dm^{-3}	Bunsen Coefficient $10^3\alpha$	Salt Effect Parameter[1] $k_{sc}/dm^3\ mol^{-1}$
21	294.15	0	18.10	-
		1	14.15	0.107
		4	6.11	0.118
		7	2.51	0.123
		10	1.11	0.121
45	318.15	0	16.30	-
		1	12.75	0.107
		4	5.35	0.121
		7	2.13	0.126
		10	0.809	0.130
75	348.15	0	16.10	-
		1	12.14	0.123
		4	5.21	0.122
		7	1.98	0.130
		10	0.736	0.134

[1] Salt effect parameter, $k_{sc\alpha}/dm^3\ mol^{-1}$ = $(1/(c_3/mol\ dm^3))\ \log\ (\alpha^0/\alpha)$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The KOH solution was introduced into the saturating vessel. The solution was saturated with gas, which was bubbled through the solution at a rate of 15 $dm^3\ h^{-1}$ for 5 h. The gas stream was turned off and the solution was allowed to stand for one h to allow suspended gas bubbles to escape. A known amount of the gas-saturated solution was transferred to an evacuated flask. The gas evolved from the solution was withdrawn, together with water vapor, into an evacuated and calibrated portion of the apparatus. The water vapor was frozen out in a liquid oxygen trap. The pressure (*ca.* 1 mmHg) of the residual gas at a known temperature and volume was measured on a McLeod gage.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. The gas was produced by electrolysis and subjected to a standard purification process.

(2) Water. No information.

(3) Potassium hydroxide. No information.

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta\alpha/\alpha = 0.007$ (authors)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Potassium hydroxide, KOH; [1310-58-3]

ORIGINAL MEASUREMENTS:

Bruhn, G.; Gerlach, J.; Pawlek, F.

Zeit. Anorg. Allg. Chem.

1965, *337*, 68-79

VARIABLES:

Temperature, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of salt/mol l^{-1}	Bunsen coefficient, α
323.15	0.5	0.01299
	1.0	0.01146
	1.5	0.00947
373.15	0.5	0.01528
	1.0	0.01360
	1.5	0.00992
423.15	0.5	0.01880
	1.0	0.01620
	1.5	0.01404
473.15	0.5	0.02650
	1.0	0.02298
	1.5	0.01313

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Similar to that described by Pray and Stephan (1). Composition of liquid determined by stripping solution of gas and estimating volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta\alpha = \pm 2\%$.

(estimated by compiler).

REFERENCES:

1. Pray, H.A.; Stephan, E.L. *Battelle Memorial Institute Report, BMI-840,* 1953.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Potassium hydroxide; KOH; [1310-58-3]

ORIGINAL MEASUREMENTS:

Ruetschi, P.; Amlie, R. F.

J. Phys. Chem. 1966, *70*, 718 - 723.

VARIABLES:

T/K: 303.15
H_2 P/kPa: 101.325 (1 atm)
C_{KOH}/mol dm^{-3}: 0 - 10.23

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/°C$	T/K	Molarity[1] C_{KOH}/mol dm^{-3}	Solubility cm^3(STP)dm^{-3}	$\log(S^o/S)$	$(1/c)\log(S^o/S)$
30	303.15	0.0	17.03		
			16.90		
			17.10		
			16.93		
			16.99 ± 0.08 Av.	-	-
		0.0091	16.68	0.003	0.33
		0.102	16.29	0.018	0.18
		0.510	14.13	0.080	0.16
		1.03	12.13	0.146	0.141
		1.98	9.27	0.264	0.133
		3.04	6.71	0.404	0.133
		5.00	3.65	0.666	0.133
		7.61	1.59	1.029	0.135
		10.23	0.77	1.344	0.131

[1] The authors labeled the concentration as equivalents per liter.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

They used the apparatus of Ben-Naim and Baer (1). A calibrated dissolution vessel contains degassed water. Gas is introduced wet from a calibrated gas buret system. Stirring the liquid forces it up sidearms attached to the top of the flask and the liquid returns via a central tube. The amount of gas dissolved is determined via the gas burets. The gas burets and dissolution vessel are thermostated in a water bath. The original paper contains a diagram and a description of operation.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Prepurified grade (99.5% min purity).

(2) Water. No comment by author.

(3) Potassium hydroxide. Source not given. Reagent grade.

ESTIMATED ERROR:

REFERENCES:

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

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Potassium hydroxide; KOH; [1310-58-3]

ORIGINAL MEASUREMENTS:

Shoor, S. K.; Walker, R. D. Jr.; Gubbins, K. E.

J. Phys. Chem. 1969, *73*, 312 - 317.

EXPERIMENTAL VALUES:

T/K	Potassium Hydroxide		Mol Fraction	Solubility Ratio	Salt Effect Parameter
	KOH/wt %	c_{KOH}/mol dm^{-3}	$H_2/x_1 \times 10^5$	$\gamma = x^0/x$	$k_s = \log(x^0/x)/c$
298.15	0.0	0.0	1.43	1.00	-
	5.00	0.92		1.36	0.145
	9.00	1.70		1.71	0.137
	19.50	4.12		3.50	0.132
	41.40	10.37		20.1	0.127
	52.40	14.35		72.0	0.129
					0.129 (authors)
313.15	0.0	0.0	1.29	1.00	-
	5.00	0.92		1.28	0.117
	9.00	1.70		1.64	0.126
	19.50	4.12		3.29	0.125
	32.40	7.60		8.70	0.124
	41.40	10.37		20.4	0.126
	52.40	14.35		73.7	0.130
					0.129 (authors)
333.15	0.0	0.0	1.30	1.00	-
	5.00	0.92		1.32	0.131
	9.00	1.70		1.74	0.141
	19.50	4.12		3.58	0.134
	32.40	7.60		9.16	0.127
	41.40	10.37		21.4	0.128
	52.40	14.35		76.7	0.131
					0.129 (authors)
353.15	0.0	0.0	1.322	1.00	-
	5.00	0.92		1.33	0.135
	9.00	1.70		1.81	0.152
	19.50	4.12		3.65	0.136
	32.40	7.60		9.04	0.126
	41.40	10.37		21.8	0.129
	52.40	14.35		75.4	0.131
					0.129 (authors)
373.15	0.0	0.0	1.342	1.00	-
	38.00	9.27		15.3	0.128
	41.40	10.37		21.9	0.129
	52.40	14.35		82.6	0.134
	56.50	16.20		108.	0.126

The compiler calculated the salt effect parameters, $k_s = (1/c)\log(x^0/x)$, at the individual KOH concentrations. The authors values are noted.

Continued on next page..

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Potassium hydroxide; KOH; [1310-58-3]

ORIGINAL MEASUREMENTS:

Shoor, S. K.; Walker, R. D., Jr.; Gubbins, K. E.

J. Phys. Chem. 1969, *73*, 312 - 317.

VARIABLES:

T/K: 298.15 - 373.15
P/kPa: 101.325 (1 atm)
KOH/wt %: 0 - 56.50

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

See preceding page.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: A gas chromatographic method was used (1). The hydrogen saturated solutions were prepared by bubbling the gas through presaturators and then through the KOH solution. Samples were drawn from the solution over a 48 hour period to determine whether or not equilibrium was established. Samples were transferred from the saturator to the gas chromatograph in gas tight Hamilton syringes. All analyses were made with a thermal conductivity detector, and with nitrogen as the carrier gas.

The results are reported as activity coefficients, which are the mole fraction solubility ratio, x^0/x, where x^0 is the gas mol fraction solubility in water, and x is the gas mol fraction solubility in the aqueous KOH solution, both at a gas partial pressure of one atm. Solubility values were corrected to one atm assuming Henry's law is obeyed. The activity coefficients are the average of at least four measurements.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Minimum purity stated to be 99.9 per cent.

(2) Water. Specially distilled and degassed from an all glass-Teflon still.

(3) Potassium hydroxide. Baker Analyzed Reagent Grade. Contained a maximum of 1 per cent K_2CO_3.The KOH solutions were protected from atmospheric CO_2 with Ascarite.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta \gamma/\gamma = 0.01$

REFERENCES:

1. Gubbins, K. E.; Carden, S. N.; Walker, R. D. Jr. *J. Gas Chromatog.* 1965, *3*, 98.

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Potassium chloride; KCl; [7747-40-7]	ORIGINAL MEASUREMENTS: Steiner, P. *Ann. der Phys. Chem.* 1894, *52*, 275-299.
VARIABLES: Concentration of salt	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
292.38	0.526	1.0240	0.01618	0.01667
292.15	1.051	1.0480	0.01447	0.01489
291.86	1.755	1.0794	0.01246	0.01279
291.97	2.909	1.1294	0.00985	0.01012
291.77	3.554	1.1565	0.00869	0.00892

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.	SOURCE AND PURITY OF MATERIALS: No details given.
	ESTIMATED ERROR: $\delta\alpha/\alpha = \pm 0.02$.
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Knopp, W.
Z. Phys. Chem.
1904, *48*, 97-108.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt in 100 g soln.	Conc. of salt /mol dm^{-3} (soln.)	Density of soln. /g cm^{-3}	Bunsen absorption coefficient, α	10^4 mole fraction of hydrogen, $10^4 x_{H_2}$
293.15	0	0	0.99823	0.01883	0.1511
	1.089	0.1475	1.00520	0.01823	0.1464
	2.123	0.2907	1.01182	0.01757	0.1413
	4.070	0.5687	1.02431	0.01661	0.1339
	6.375	0.9127	1.03936	0.01531	0.1239
	7.380	1.0682	1.04600	0.01472	0.1194
	13.612	2.1222	1.08754	0.01255	0.1030

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method with absorption pipet and gas buret were used. Densities were determined using a Sprengel pyknometer.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from pure zinc and dil. sulfuric acid in a Kipp's apparatus, passed through silver nitrate, potassium hydroxide and permanganate solutions.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Potassium chloride; KCl; [7747-40-7]

ORIGINAL MEASUREMENTS:

Gerecke, J.; Bittrich, H.-J.

Wiss. Z. Tech. Hocsch. Chem. "Carl Schorlemmer" Leuna-Merseburg 1971, 115 - 122, 313 - 321.

Chem. Abstr. 1972, *76*,77239 ,*77*,66741

VARIABLES:

T/K: 288
P/kPa: 101.325 (1 atm)
m_{KCl}/mol kg^{-1}: 0.50, 1.0

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	m_{KCl}/mol kg^{-1}	log (S^0/S)
288	0.50	0.043
	1.00	0.084

Values were taken from a graph in the paper by the compiler.

The solubility ratio, S^0/S, is a ratio of Kuenen coefficients.

The authors value of the solubility of hydrogen in water at 298.15 K and one atm partial pressure is a Bunsen coefficient of 0.0177.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The hydrogen solubilities appear to have been determined by the method of Morrison and Billett (1).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen.

(2) Water.

(3) Potassium chloride.

No information on the materials.

ESTIMATED ERROR:

δlog (S^0/S) = ±0.003 from graph.

REFERENCES:

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

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

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

ORIGINAL MEASUREMENTS:

Morrison, T. J.; Billett, F.

J. Chem. Soc. 1952, 3819 - 3822.

VARIABLES:

T/K: 285.75 - 344.85
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature			Salt Effect Parameters	
$t/^\circ C$	T/K	1/(T/K)	$(1/m)\log(S^o/S)$[1]	$(1/m)\log(x^o/x)$
12.6	285.75	0.0035	0.088	0.103
30.0	303.15	0.0033	0.081	0.096
49.4	322.55	0.0031	0.066	0.081
71.7	344.85	0.0029	0.043	0.058

[1] The authors used $(1/c)\log(S^o/S)$ 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 hydrogen solubility S is cm^3(STP) kg^{-1}.

The salt effect parameters were calculated from two measurements. The solubility of hydrogen in water, S^o, and in the one molal salt solution, S. Only the solubility of the hydrogen 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 hydrogen 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) Hydrogen. Prepared from pure zinc and dilute hydrochloric acid.

(2) Water. No information given.

(3) Potassium Iodide. "AnalaR" material.

ESTIMATED ERROR:

$\delta k = 0.010$

REFERENCES:

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

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. Potassium nitrate; KNO_3; [7757-79-1]	Steiner, P. *Ann. der Phys. Chem.* 1894, *52*, 275-299.
VARIABLES:	PREPARED BY:
Concentration of salt	C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
290.97	0.482	1.0295	0.01650	0.01683
290.73	0.879	1.0539	0.01530	0.01501
289.96	1.541	1.0936	0.01373	0.01391
290.42	1.820	1.1101	0.01290	0.01311
290.96	2.430	1.1460	0.01157	0.01180

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.	No details given.
	ESTIMATED ERROR:
	$\delta\alpha/\alpha = \pm 0.02$.
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Potassium nitrate; KNO_3; [7757-79-1]

ORIGINAL MEASUREMENTS:

Knopp, W.

Z. Phys. Chem.

1904, *48*, 97-108.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt in 100 g soln.	Conc. of salt /mol dm^{-3} (soln.)	Density of soln. /g cm^{-3}	Bunsen absorption coefficient, α	10^4 mole fraction of hydrogen, $10^4 x_{H_2}$
293.15	0	0	0.99823	0.01883	0.1511
	1.244	0.1245	1.00593	0.01835	0.1475
	2.094	0.2114	1.01133	0.01818	0.1464
	4.010	0.4127	1.02362	0.01785	0.1443
	5.925	0.6225	1.03592	0.01743	0.1415
	7.742	0.8293	1.04768	0.01667	0.1358
	13.510	1.5436	1.08646	0.01436	0.1198

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method with absorption pipet and gas buret being used. Densities were determined using a Sprengel pyknometer.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from pure zinc and dil. sulfuric acid in a Kipp's apparatus, passed through silver nitrate, potassium hydroxide and permanganate solutions.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Potassium carbonate; K_2CO_3; [584-08-7]

ORIGINAL MEASUREMENTS:

Steiner, P.
Ann. der Phys. Chem.
1894, *52*, 275-299.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
284.38	0.209	1.0248	0.01675	0.01628
285.44	0.341	1.0405	0.01532	0.01501
284.47	0.690	1.0807	0.01216	0.01183
285.66	1.376	1.1555	0.00775	0.00761
285.77	2.156	1.2353	0.00470	0.00462
285.92	2.939	1.3112	0.00290	0.00285
286.32	4.352	1.4395	0.00162	0.00160

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$.

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Urea; CH_4N_2O or $(NH_2)_2CO$; [57-13-6]

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-624.

VARIABLES:

T/K: 293.29, 293.36
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	C_{urea}/ mol cm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.11	293.26	0.0	---	--	1.810[2]
20.21	293.36	1.0	668.4	6.13	1.700
20.14	293.29	1.0	699.3	6.39	1.706

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at stated pressure.

[2] Average of three runs, see Hüfner's H_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 662.5 and 694.3 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 Harnstoff in paper.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Formed by the reaction of dilute sulfuric acid on zinc. The gas was washed with permanganate and caustic solutions and stored over mercury.

(2) Water. Pure.

(3) Urea. Source not given.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G.
Archiv. F. Anatomie und Physiologie, Physiolog. Abtly. 1894, *5*, 191.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Chloroacetic acid; $C_2H_3ClO_2$ [79-11-8]

ORIGINAL MEASUREMENTS:

Geffcken, G. *Z. Phys. Chem.*

1904, *49*, 257-302

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of acid/mol dm^{-3} (soln)	Ostwald coefficient, *L*
288.15	0.527	0.01905
	0.990	0.01852
	1.773	0.01783

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric method using simple adsorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by the action of dilute hydrochloric acid on aluminium in the presence of mercury chloride. Washed in potassium hydroxide solution and potassium permanganate solution. Dried.
2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta L = \pm 1\%$.
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. 2,2,2-Trichloro-1,1 -Ethanediol (Chloralhydrate); $C_2H_3Cl_3O_2$; [302-17-0]

ORIGINAL MEASUREMENTS:

Knopp, W.

Z. Phys. Chem.

1904, *48*, 97-108.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt in 100 g soln. /g	Conc. of salt /mol dm^{-3} (soln.)	Density of soln. /g cm^{-3}	Bunsen absorption coefficient α	10^4 × Mole fraction of hydrogen $10^4 x_{H_2}$
293.15	0	0	0.99823	0.01883	0.1511
	4.911	0.310	1.02017	0.01839	0.1509
	7.69	0.504	1.03199	0.01802	0.1501
	14.56	1.030	1.06687	0.01712	0.1476
	18.77	1.397	1.08844	0.01653	0.1460
	29.50	2.530	1.14659	0.01542	0.1461
	32.00	2.845	1.16175	0.01518	0.1463
	38.42	3.770	1.19817	0.01440	0.1463
	49.79	6.000	1.27242	0.01353	0.1530
	60.12	9.120	1.34522	0.01324	0.1697
	63.90	10.700	1.37426	0.01307	0.1768

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method with absorption pipet and gas buret were used. Densities were determined using a Sprengel pyknometer.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from pure zinc and dil. sulfuric acid in a Kipp's apparatus, passed through silver nitrate, potassium hydroxide and permanganate solutions.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. 2,2,2-Trichloro-1,1,-Ethanediol (Chloralhydrate); $C_2H_3Cl_3O_2$; [302-17-0]

ORIGINAL MEASUREMENTS:

Muller, C.

Z. Phys. Chem. 1912-13, *81*, 483-503.

VARIABLES:

Concentration of component 3

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of comp. (3) (wt-%)	Bunsen coefficient	Bunsen# coefficient at 288.2 K	Density of soln. at t/°C	t/°C
		First set of experimental data			
288.15	10	0.01740	0.01740	1.045	4
289.55	16.1	0.01719	0.01737	1.0772	16
288.95	33.35	0.01475	0.01484	1.1734	15
288.15	39.4	0.01470	0.01470	1.2144	15
288.75	51	0.01300	0.01306	1.2848	16
289.35	60.8	0.01281	0.01230	1.3585	16
288.65	70.7	0.01282	0.01287	1.44	16
288.15	79	0.01320	0.01320	1.5105	15
		Second set of experimental data			
292.55	15.5	0.01732	0.01724	1.0728	19
290.55	28.3	0.01569	0.01540	1.1444	17.4
291.85	46.56	0.01388	0.01375	1.2527	18.7
289.65	52	0.01314	0.01280	1.2899	17
290.15	63	0.01270	0.01243	1.3735	17
290.35	66	0.01285	0.01260	1.398	17.5
291.05	68	0.01286	0.01270	1.4121	18
291.45	78.4	0.01398	0.01380	1.4997	18

\# given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which pressure was determined using a mercury manometer. Solution was degassed by boiling under reduced pressure. A considerable amount of water was removed by this process. Gas was saturated with water vapor before being admitted to absorption buret.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by reaction of acid on zinc, washed with caustic potash solution.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/P = \pm 0.001$;

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Acetic acid; $C_2H_4O_2$; [64-19-7]

ORIGINAL MEASUREMENTS:

Geffcken, G. *Z. Phys. Chem.* 1904, *49*, 257-302

VARIABLES:

Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Conc of acid/mol dm^{-3} (soln)	Ostwald coefficient, *L*
298.15	0.517	0.01925
	0.528	0.01923
	1.160	0.01903
	1.20	0.01895
	1.963	0.01885
	1.980	0.01882
	3.178	0.01862
	3.220	0.01858
	4.157	0.01849

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric method using simple adsorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by the action of dilute hydrochloric acid on aluminium in the presence of mercury chloride. Washed in potassium hydroxide solution and potassium permanganate solution. Dried.

2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta L = \pm 1\%$.
(estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5] (3) Acetamide; C_2H_5NO or CH_3CONH_2; [60-35-5]	Hüfner, G. *Z. Physik. Chem.* 1907, *57*, 611-624
VARIABLES: T/K: 293.10, 293.43 H_2 P/kPa: 101.325 (1 atm)	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]	Bunsen Coefficient $\alpha \times 10^2$
20.11	293.26	0.0	---	--	1.810[2]
20.28	293.43	1.0	662.5	6.42	1.796
19.95	293.10	1.0	682.0	6.60	1.794

[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 three runs, see Hüfner's H_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 662.5 and 694.3 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) Hydrogen. Formed by the reaction of dilute sulfuric acid on zinc. The gas was washed with permanganate and caustic solutions and stored over mercury.

(2) Water. Pure.

(3) Acetamide. Source not given.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Glycine; $C_2H_5NO_2$ or $CH_2(NH_2)COOH$; [56-40-6]

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-624.

VARIABLES:

T/K: 293.26, 293.31
H_2 P/kPa: 101.325 (1 atm)

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 $\alpha \times 10^2$
20.11	293.26	0.0	---	--	1.810[2]
20.16	293.31	1.0	666.7	5.67	1.577

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution of the stated pressure.

[2] Average of three runs, see Hüfner's H_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 662.5 and 688.1 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.

Glycine name glykoholl (aminoessigsaure) in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Formed by the reaction of dilute sulfuric acid on zinc. The gas was washed with permanganate and caustic solutions and stored over mercury.

(2) Water. Pure.

(3) Glycine. Merck.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. Ethanol or Ethyl Alcohol; C_2H_5OH; 64-17-5
3. Water; H_2O; 7732-18-5

ORIGINAL MEASUREMENTS:

Cargill, R.W.

J Chem. Soc., Faraday Trans. I
1978, *74*, 1444-1456

VARIABLES:

T/K : 277.4 - 335.2
P/kPa : 101.325 (1 atm)
C_2H_5OH/X_2: 0.0 - 1.0

PREPARED BY:

R.W. Cargill

EXPERIMENTAL VALUES:

Mol Fraction Ethanol/X_2	T/K	10^4 T^{-1}	$\log(S_o/cm^3kg^{-1})$	S_o/cm^3kg^{-1}
0.98	278.9	35.87	1.962	91.6
0.98	289.2	34.59	1.984	96.4
0.98	299.2	33.43	2.000	100
0.98	309.2	32.35	2.025	106
0.98	320.2	31.24	2.045	111
0.98	333.2	30.02	2.061	115

[a] Values from reference 3.

The Solubility, S_o, calculated as cm^3 gas at 273.15 K and Ar partial pressure of 101.325 kPa (1 atm) per kg of solvent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

METHOD: Absorption of gas by a thin film of liquid. The Morrison and Billett (1) method was modified by replacing valve A with a constant flow pump and by measuring the mass of the solvent leaving the absorption tube (instead of the volume) on a top-pan balance.

APPARATUS/PROCEDURE: The solvent is degassed using the vapor pump principle (1). Each determination absorbs about 20 cm^3 of gas in up to 500 cm^3 of solvent, which was recycled. The density of the solvent was checked after each run, so that the exact composition of the solution could be determined (2).

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen. British Oxygen Co. Gas 99.9 percent pure, stored over saturated brine.
2. Ethanol. Absolute alcohol.
3. Water. Distilled then deionized.

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta P/mmHg = 0.5$
Solubilities reproducible within 0.5 percent.

REFERENCES:

1. Morrison, T. J.,; Billett, F. *J. Chem. Soc.* 1948, 2033; 1952, 3819
2. International Critical Tables, Volume III, pp 112-118.
3. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1952, 3819.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; 1333-74-0 2. Ethanol or Ethyl Alcohol; C_2H_5OH; 64-17-5 3. Water; H_2O; 7732-18-5	Cargill, R.W. *J. Chem. Soc., Faraday Trans I* 1978, *74*, 1444-1456.

EXPERIMENTAL VALUES:

Mol Fraction Ethanol/X_2	T/K	$10^4\ T^{-1}$	$\log(S_o/\mathrm{cm^3\,kg^{-1}})$	$S_o/\mathrm{cm^3\,kg^{-1}}$
0.18	279.1	35.84	1.296	19.8
0.18	289.3	34.58	1.325	21.1
0.18	298.9	33.47	1.330	21.4
0.18	309.8	32.29	1.354	22.6
0.18	321.2	31.24	1.403	25.3
0.18	332.9	30.05	1.433	27.1
0.22	278.4	35.93	1.327	21.2
0.22	286.6	34.91	1.348	22.3
0.22	295.9	33.81	1.365	23.2
0.22	304.7	32.83	1.400	25.1
0.22	315.4	31.72	1.422	26.4
0.22	324.7	30.80	1.457	28.6
0.22	333.5	29.99	1.487	30.7
0.22	335.1	29.85	1.506	32.1
0.31	279.1	35.84	1.433	27.1
0.31	289.5	34.55	1.475	29.9
0.31	298.8	33.48	1.496	31.3
0.31	309.8	32.29	1.536	34.4
0.31	321.9	31.07	1.573	37.4
0.31	333.4	30.00	1.600	39.8
0.41	278.4	35.95	1.542	34.8
0.41	286.7	34.90	1.561	36.3
0.41	305.2	32.78	1.649	44.6
0.41	315.0	31.76	1.679	47.8
0.41	324.7	30.80	1.709	51.2
0.41	335.2	29.84	1.735	54.3
0.59	278.6	35.90	1.699	50.0
0.59	288.8	34.64	1.729	53.6
0.59	297.7	33.60	1.753	56.6
0.59	310.9	32.18	1.795	62.4
0.59	321.3	31.13	1.827	67.1
0.59	332.9	30.05	1.865	73.3
0.68	279.7	35.76	1.786	61.1
0.68	288.8	34.80	1.802	63.4
0.68	309.7	32.30	1.865	73.3
0.68	320.6	31.20	1.889	77.5
0.68	332.7	30.07	1.919	83.0
0.89	278.6	35.90	1.904	80.2
0.89	294.9	33.92	1.944	87.9
0.89	314.3	31.83	1.996	99.1
0.89	328.8	30.42	2.046	111
0.89	332.2	30.11	2.036	108

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. Ethanol or Ethyl Alcohol; C_2H_5OH; 64-17-5
3. Water; H_2O; 7732-18-5

ORIGINAL MEASUREMENTS:

Cargill, R.W.
J. Chem. Soc., Faraday Trans.I
1978, *74*, 1444-1456

EXPERIMENTAL VALUES:

Mol Fraction Ethanol/X_2	T/K	10^4 T^{-1}	$\log(S_o/\text{cm}^3\text{kg}^{-1})$	$S_o/\text{cm}^3\text{kg}^{-1}$
0.00	277.8	36.01	1.319	20.8
0.00	278.4	35.93	1.320	20.9
0.00	284.1	35.21	1.289	19.5
0.00	285.5	35.04	1.284	19.2[a]
0.00	289.3	34.58	1.272	18.7[a]
0.00	290.5	34.42	1.268	18.5[a]
0.00	294.5	33.97	1.257	18.1
0.00	296.2	33.77	1.252	17.9[a]
0.00	297.0	33.68	1.251	17.8
0.00	298.2	33.55	1.248	17.7[a]
0.00	305.3	32.77	1.233	17.1
0.00	306.4	32.63	1.230	17.0[a]
0.00	318.2	31.44	1.214	16.4[a]
0.00	320.5	31.20	1.212	16.3[a]
0.00	327.6	30.53	1.206	16.2[a]
0.00	332.4	30.09	1.212	16.3
0.00	333.5	29.99	1.206	16.1[a]
0.00	338.7	29.54	1.208	16.1[a]
0.00	344.9	29.00	1.208	16.1[a]
0.008	277.4	36.06	1.330	21.4
0.008	278.8	35.88	1.326	21.2
0.008	285.5	35.04	1.295	19.7
0.008	294.2	34.00	1.267	18.5
0.008	304.0	32.90	1.244	17.5
0.008	314.3	31.83	1.222	16.7
0.008	324.6	30.81	1.222	16.7
0.008	332.8	30.06	1.218	16.5
0.021	277.9	36.00	1.327	21.2
0.021	285.3	35.07	1.312	20.5
0.021	294.3	33.99	1.269	18.6
0.021	303.5	32.96	1.253	17.9
0.021	313.2	31.94	1.232	17.1
0.021	323.0	30.95	1.231	17.0
0.021	332.7	30.07	1.228	16.9
0.048	277.4	36.06	1.338	21.8
0.048	285.8	35.01	1.307	20.3
0.048	295.4	33.87	1.272	18.7
0.048	303.8	32.93	1.257	18.0
0.048	314.3	31.83	1.245	17.6
0.048	323.9	30.88	1.238	17.3
0.048	334.5	29.90	1.251	17.8
0.075	281.6	35.53	1.296	19.8
0.075	285.5	35.04	1.286	19.3
0.075	298.8	33.48	1.262	18.3
0.075	313.7	31.89	1.264	18.4
0.10	277.9	36.00	1.290	19.5
0.10	285.4	35.05	1.278	19.0
0.10	293.2	34.00	1.278	19.0
0.10	304.1	32.89	1.259	18.2
0.10	312.6	32.00	1.264	18.4
0.10	323.6	30.94	1.296	19.8
0.10	333.5	29.99	1.325	21.1

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Sulfinylbismethane or dimethyl sulfoxide; C_2H_6OS; [67-68-5]

(4) N,N,N-Trimethylmethanaminium hydroxide; $C_4H_{12}N.HO$; [75-59-2]

ORIGINAL MEASUREMENTS:

Symons, E. A.

Can. J. Chem. 1971, *49*, 3940 - 3947.

VARIABLES:

T/K: 298.15 - 353.15
P/kPa: 101.325 (1 atm)
C_2H_6SO/mol %: 0 - 100
C_{salt}/mol dm^{-3}: 0.0 - 0.42

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

See preceding page.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co., Inc. Lecture bottle, extra dry, used as received.

(2) Water. Deionized distilled water.

(3) Dimethylsulfoxide. Fisher Co. Certified Reagent grade. Dried at least 48 h over Linde type 4A molecular sieves, then vacuum distilled with nitrogen bled through a 16 in Vegreux column. The central fraction, 38-40°C (ca. 1 mmHg), was retained for use under a nitrogen atmosphere at ambient temperature.

(4) N,N,N-Trimethylmethanaminium hydroxide or tetramethyl ammonium hydroxide. Matheson, Coleman and Bell Co., Inc., A 25 per cent aqueous solution in a polyethylene bottle, titrated against standard sulfuric acid solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas chromatographic method (1).

The gas-liquid equilibrium cell was a modified 100 cm^3 round bottom flask equipped with magnetic stirrer, syringe sampling portal, and vacuum/gas line. The solvent was added, the flask evacuated several minutes to remove dissolved gases. Then the gas was introduced to a partial pressure of one atm. The solution was stirred for five minutes, then sampled. Three to four successive samples were taken.

The 5.0 cm^3 samples were taken by gas tight syringe. The sample was introduced to a stripping cell, stripped out over a period of 1-2 minutes by the nitrogen carrier gas and then passed into a Varian Aerograph (No. 1420) equipped with an injection portal, column (10' ¼" stainless steel, packed with 40-60 mesh 13X molecular sieve) at ambient temperature, and a thermal conductivity cell at 65°C.

SOURCE AND PURITY OF MATERIALS:

See above.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta c/c = 0.02$ (author's estimate)

REFERENCES:

1. Gubbins, K. E.; Carden, S. N.; Walker, R. D. Jr. *J. Gas Chromatogr.* 1965, 98.

2. Symons, E. A.; Buncel, E. *Can. J. Chem.* 1973, *51*, 1673.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Sulfinylbismethane or dimethyl sulfoxide; C_2H_6OS; [67-68-5]

(4) N,N,N-Trimethylmethanaminium hydroxide; $C_4H_{12}N.HO$; [75-59-2]

ORIGINAL MEASUREMENTS:

Symons, E. A.

Can. J. Chem. 1971, *49*, 3940 - 3947.

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Dimethylsulfoxide mol %	c_{base}[1]	Solubility c_{H_2}/mol dm^{-3} $c \times 10^3$
25.0	298.15	100	0	1.05,1.08
35.0	308.15			1.18
50.0	323.15			1.37
65.0	338.15			1.54
80.0	353.15			1.73
35.0	308.15	96.9	0.022	1.13,1.15
50.0	323.15			1.33
65.0	338.15			1.50,1.52,1.53
80.0	353.15			1.71
35.0	308.15	87.5	0.096	1.07
50.0	323.15			1.27
65.0	338.15			1.44,1.45,1.48
80.0	353.15			1.64
25.0	298.15	77.9	0.13	0.93
35.0	308.15			1.03
50.0	323.15			1.20
65.0	338.15			1.35,1.39,1.40
80.0	353.15			1.49
25.0	298.15	59.0	0.42	0.78
35.0	308.15			0.87
50.0	323.15			0.98
65.0	338.15			1.16,1.18
80.0	353.15			1.31
25.0	298.15	40.1	0.36	0.61
35.0	308.15			0.66
50.0	323.15			0.77
65.0	338.15			0.92,0.95
80.0	353.15			1.10
25.0	298.15	20.2	0	0.58
35.0	308.15			0.60
50.0	323.15			0.69
65.0	338.15			0.80
25.0	298.15	0	0	0.80,0.80[2]

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[1] $c_{base} \equiv c_{C_4H_{12}N.OH}$/mol dm^{-3}.

[2] See reference 2. Equivalent to a mole fraction of 1.45 x 10^{-5}.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Propanoic acid; $C_3H_6O_2$; [79-09-4]

ORIGINAL MEASUREMENTS:

Braun, L.
Z. phys. Chem.
1900, *33*, 721-741

VARIABLES:

Temperature, concentration of acid

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of acid per 100 g soln. /g	Bunsen coefficient, α	T/K	Wt. of acid per 100 g soln. /g	Bunsen coefficient, α
278.2	0	0.02366	288.2	6.500	0.01925
	2.634	0.02245		9.763	0.01929
	3.373	0.02221		9.910	0.01908
	5.267	0.02239	293.2	0	0.01905
	6.500	0.02181		2.634	0.01876
	9.763	0.02120		3.373	0.01866
	9.910	0.02129		5.267	0.01842
283.2	0	0.02213		6.500	0.01829
	2.634	0.02142		9.763	0.01788
	3.373	0.02120		9.910	0.01782
	5.267	0.02117	298.2	0	0.01750
	6.500	0.02093		2.634	0.01722
	9.763	0.02042		3.373	0.01706
	9.910	0.02029		5.267	0.01705
288.2	0	0.02059		6.500	0.01690
	2.634	0.02003		9.763	0.01638
	3.373	0.01987		9.910	0.01602
	5.267	0.01983			

N.B. The Bunsen coefficients at the lowest temperatures are thought to be considerably in error but the salting out parameters at the lower temperatures are probably more reliable (see water evaluation).

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 by assuming Raoult's law. Solution was degassed. Concentration of acid was estimated by titration with base.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.03$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) D-Alanine; $C_3H_7NO_2$ or $CH_3CH(NH_2)COOH$; [338-69-2]

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-624.

VARIABLES:

T/K: 293.23

H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	$C_{C_3H_7NO_2}$/mol dm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.11	293.26	0.0	---	--	1.810[2]
20.08	293.23	1.0	664.2	5.57	1.555

[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 three runs, see Hüfner's H_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 662.5 and 688.1 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) Hydrogen. Formed by the reaction of dilute sulfuric acid on zinc. The gas was washed with permanganate and caustic solutions and stored over mercury.

(2) Water. Pure.

(3) D-Alanine. Merck.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G.
Archiv. F. Anatomie und Physiologie, Physiolog. Abtly. 1894, *5*, 191.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. 1,2,3-Propanetriol (Glycerol, Glycerine); $C_3H_8O_3$; [56-81-5]

ORIGINAL MEASUREMENTS:

Muller, C.

Z. Phys. Chem. 1912-13, *81*, 483-503.

VARIABLES:

Concentration of component 3

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of comp. (3) (wt-%)	Bunsen coefficient	Bunsen # coefficient at 288.2 K	Density of soln. at t/°C	t/°C
287.65	14.9	0.01654	0.01647	1.0366	14
286.15	22.8	0.01532	0.01510	1.0536	12.5
286.95	38	0.01226	0.01216	1.0966	14
287.65	43.5	0.01117	0.01110	1.1115	15
286.85	49.15	0.01019	0.01010	1.1268	14.5
288.05	51.5	0.01026	0.01025	1.1333	14.5
285.45	68	0.00822	0.00806	1.181	12.5
291.15	90.7	0.00853	0.00870	1.2386	18

\# given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which pressure was determined using a mercury manometer. Solution was degassed by boiling under reduced pressure. A considerable amount of water was removed by this process. Gas was saturated with water vapor before being admitted to absorption buret.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by reaction of acid on zinc, washed with caustic potash solution.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/P = \pm 0.001$;

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. 1,2,3-Propanetriol (Glycerol, Glycerin); $C_3H_8O_3$; [56-81-5]

ORIGINAL MEASUREMENTS:

Druker, K; Moles, E.
Z. Physik. Chem.
1910, *75*, 405-436.

VARIABLES:

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 density H_2O/ density soln.
298.2	0.0	760	101	0.01962	1.0
	0.040	716.3	95.50	0.0186	1.0101
	0.105	736.1	98.14	0.0178	1.0260
	0.220	684.3	91.23	0.0154	1.0542
	0.498	709.9	94.65	0.0099	1.1290
	0.505	730.1	97.34	0.0097	1.1300
	0.526	672.2	89.62	0.0090	1.1365
	0.670	741.1	98.81	0.0067	1.1752
	0.800	708.0	94.39	0.0051	1.2113
	0.820	665.5	88.73	0.0051	1.2159
	0.880	662.3	88.30	0.0044	1.2307
	0.950	741.8	98.90	0.0034	1.2502

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. Electrolytically prepared from aqueous potassium hydroxide soln. Passed over hot platinum-asbestos to remove oxygen.
2. Distilled.
3. "Pure" sample, purity about 98 mole per cent.

ESTIMATED ERROR:

$\delta L/L = \pm 1-3\%$ for dil. soln.;
$\pm 5-7\%$ in concentrated soln.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. 2-Methyl-2-propanol or t-Butanol; C_4H_9OH; 75-65-0
3. Water; H_2O; 7732-18-5

ORIGINAL MEASUREMENTS:

Cargill, R.W.

J. Chem. Soc., Faraday Trans. I 1978, *74*, 1444-1456

VARIABLES:

T/K : 277.5-334.6
P/kPa : 101.325 (1 atm)
C_4H_9OH/X_2 : 0.0-0.85

PREPARED BY:

R.W. Cargill

EXPERIMENTAL VALUES:

Mol Fraction Alcohol/X_2	T/K	$10^4\ T^{-1}$	$\log(S_o/\text{cm}^3\text{kg}^{-1})$	$S_o/\text{cm}^3\text{kg}^{-1}$
0.85	281.4	35.55	1.910	81.3
0.85	289.2	34.59	1.932	85.5
0.85	298.7	33.49	1.968	92.9
0.85	309.2	32.35	1.997	99.3
0.85	320.3	31.23	2.026	106
0.85	332.8	30.06	2.054	113

[a]Values from reference 3.

The Solubility, S_o, calculated as cm^3 gas at 273.15 K and Ar partial pressure of 101.325 kPa (1 atm) per kg of solvent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

METHOD: Absorption of gas by a thin film of liquid. The Morrison and Billett (1) method was modified by replacing valve A with a constant flow pump, and by measuring the mass of the solvent leaving the absorption tube (instead of the volume) on a top-pan balance.

APPARATUS/PROCEDURE: The solvent is degassed using the vapor pump principle (1). Each determination absorbs about 20 cm^3 of gas in up to 500 cm^3 of solvent, which was recycled. The density of the solvent was checked after each run, so that the exact composition of the solution could be determined (2).

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen. British Oxygen Co Gas 99.9 per cent pure, stored over saturated brine.
2. 2-Methyl-2-propanol. Reagent grade, (98 percent boils 82-83°C).
3. Water. Distilled then deionized.

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta P/mmHg = 0.5$

Solubility values reproducible within 0.5 percent (authors).

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033; 1952, 3819.
2. International Critical Tables, Volume III, pp 112-118.
3. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1952, 3819

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. 2-Methyl-2-propanol or t-Butanol; C_4H_9OH; 75-65-0
3. Water; H_2O; 7732-18-5

ORIGINAL MEASUREMENTS:

Cargill, R.W.

J. Chem. Soc., Faraday Trans. I 1978, *74*, 1444-1456

EXPERIMENTAL VALUES:

Mol Fraction Alcohol/X_2	T/K	$10^4\ T^{-1}$	$\log(S_0/\text{cm}^3\text{kg}^{-1})$	$S_0/\text{cm}^3\text{kg}^{-1}$
0.072	278.2	35.96	1.271	18.7
0.072	286.7	34.90	1.265	18.4
0.072	296.8	33.70	1.282	19.1
0.072	306.1	32.68	1.301	20.0
0.072	320.7	31.19	1.333	21.5
0.072	331.7	30.16	1.374	23.7
0.10	280.7	35.64	1.300	20.0
0.10	285.7	35.02	1.316	20.7
0.10	298.3	33.54	1.342	22.0
0.10	299.6	33.38	1.336	21.7
0.10	308.2	32.46	1.359	22.9
0.10	318.4	31.42	1.387	24.4
0.10	319.7	31.29	1.391	24.6
0.10	332.8	30.06	1.459	28.8
0.14	278.0	35.98	1.373	23.6
0.14	286.9	34.87	1.408	25.6
0.14	299.5	33.40	1.444	27.8
0.14	307.5	32.53	1.475	29.9
0.14	322.1	31.06	1.520	33.1
0.14	333.9	29.96	1.559	36.2
0.31	278.1	35.97	1.625	42.2
0.31	287.3	34.82	1.657	45.4
0.31	296.6	33.72	1.677	47.5
0.31	308.4	32.44	1.715	51.9
0.31	321.8	31.08	1.755	56.9
0.31	333.9	29.96	1.803	63.5
0.53	277.5	36.05	1.786	61.1
0.53	287.3	34.82	1.808	64.3
0.53	297.2	33.66	1.836	68.6
0.53	308.7	32.41	1.867	73.6
0.53	320.7	31.19	1.903	80.0
0.53	334.6	29.90	1.954	90.0
0.71	279.2	35.83	1.849	70.6
0.71	289.8	34.52	1.870	74.1
0.71	303.2	33.01	1.930	85.1
0.71	319.5	31.30	1.977	94.8
0.71	332.8	30.06	2.023	105

COMPONENTS:

1. Hydrogen; H_2; 1333-74-0
2. 2-Methyl-2-propanol or t-Butanol; C_4H_9OH; 75-65-0
3. Water; H_2O; 7732-18-5

ORIGINAL MEASUREMENTS:

Cargill, R.W.

J. Chem. Soc., Faraday Trans. I 1978, *74*, 1444-1456

EXPERIMENTAL VALUES:

Mol Fraction Alcohol/x_2	T/K	$10^4\ T^{-1}$	$\log(S_0/\mathrm{cm^3\,kg^{-1}})$	$S_0/\mathrm{cm^3\,kg^{-1}}$
0.00	277.8	36.01	1.319	20.8
0.00	278.4	35.93	1.320	20.9
0.00	284.1	35.21	1.289	19.5
0.00	285.5	35.04	1.284	19.2[a]
0.00	289.3	34.58	1.272	18.7[a]
0.00	290.5	34.42	1.268	18.5[a]
0.00	294.5	33.97	1.257	18.1
0.00	296.2	33.77	1.252	17.9[a]
0.00	297.0	33.68	1.251	17.8
0.00	298.2	33.55	1.248	17.7[a]
0.00	305.3	32.77	1.233	17.1
0.00	306.4	32.63	1.230	17.0[a]
0.00	318.2	31.44	1.214	16.4[a]
0.00	320.5	31.20	1.212	16.3[a]
0.00	327.6	30.53	1.206	16.2[a]
0.00	332.4	30.09	1.212	16.3
0.00	333.5	29.99	1.206	16.1[a]
0.00	338.7	29.54	1.208	16.1[a]
0.00	344.9	29.00	1.208	16.1[a]
0.006	277.8	36.01	1.331	21.4
0.006	286.1	34.97	1.288	19.4
0.006	293.8	34.05	1.265	18.4
0.006	304.8	32.82	1.243	17.5
0.006	314.4	31.82	1.227	16.9
0.006	323.6	30.91	1.212	16.3
0.006	333.5	29.99	1.208	16.1
0.011	277.9	36.00	1.323	21.0
0.011	285.2	35.08	1.291	19.5
0.011	294.8	33.93	1.259	18.2
0.011	304.7	32.83	1.236	17.2
0.011	313.2	31.94	1.226	16.8
0.011	324.1	30.86	1.218	16.5
0.011	333.9	29.97	1.223	16.7
0.029	278.3	35.94	1.291	19.5
0.029	285.8	35.01	1.275	18.8
0.029	294.9	33.92	1.246	17.6
0.029	303.2	32.99	1.236	17.2
0.029	319.0	31.36	1.229	16.9
0.029	333.4	30.00	1.240	17.4
0.046	279.2	35.83	1.250	17.8
0.046	285.2	35.08	1.244	17.5
0.046	294.9	33.92	1.236	17.2
0.046	303.7	32.96	1.231	17.0
0.046	313.9	31.87	1.256	18.0
0.046	324.1	30.86	1.273	18.8
0.046	333.4	30.00	1.290	19.5

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. D-glucose (Grape sugar); $C_6H_{12}O_6$; [50-99-7]	Muller, C. *Z. Phys. Chem.* 1912-13, *81*, 483-503.
VARIABLES:	PREPARED BY:
Concentration of component 3	C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of comp. (3) (wt-%)	Bunsen coefficient	Bunsen # coefficient at 293.2 K	Density of soln. at t/°C	t/°C
293.7	12.2	0.01595	0.01600	1.048	20.5
293.7	20.7	0.01445	0.01450	1.083	20.5
294.3	32.56	0.01243	0.01250	1.129	21
295.0	45.8	0.01000	0.01015	1.198	21.8
294.7	59.0	0.00775	0.00775	1.265	21

\# given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which pressure was determined using a mercury manometer. Solution was degassed by boiling under reduced pressure. A considerable amount of water was removed by this process. Gas was saturated with water vapor before being admitted to absorption buret.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by reaction of acid on zinc, washed with caustic potash solution.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/P = \pm 0.001$;

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) D-Glucose; $C_6H_{12}O_6$; [50-99-7]

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-624.

VARIABLES:

T/K: 293.15 - 293.50
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		D-Glucose		Gas	Absorbed	Bunsen
t/°C	T/K	g dm^{-3}	mol dm^{-3}	Pressure mmHg	Gas Volume[1]	Coefficient $\alpha \times 10^2$
20.11	293.26	0	0	---	--	1.810[2]
20.0	293.15	41.45	0.230	670.4	6.36	1.759
20.16	293.31	80.8	0.448	688.1	6.12	1.649
20.25	293.40	87.3	0.485	682.2	6.02	1.664[3]
20.35	293.50	166.2	0.923	670.6	5.60	1.514[4]
20.28	293.43	174.0	0.966	670.2	5.48	1.516

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution.

[2] Average of three, see Hufner's H_2 + H_2O data sheet.

[3] Compiler calculated a value of 1.636×10^{-2} from data in the paper.

[4] Compiler calculated a value of 1.54×10^{-2} from data in the paper.

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 662.5 and 688.1 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 Traubenzucker (grape sugar) in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Formed by the reaction of dilute sulfuric acid on zinc. The gas was washed with permanganate and caustic solutions and stored over mercury.

(2) Water. Pure.

(3) D-Glucose. Source not given.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G.
Archiv. F. Anatomie und Physiologie, Physiolog. Abtly. 1894, *5*, 191.

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. β-D-Fructofuranosyl-α-D-gluco-pyranoside (Sucrose); $C_{12}H_{22}O_{11}$; [57-50-1]	ORIGINAL MEASUREMENTS: Steiner, P. *Ann. der Phys. Chem.* 1894, *52*, 275-299.
VARIABLES: Concentration of salt	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of salt /mol dm^{-3}	Density of soln. at 288.2 K /g cm^{-3}	Bunsen coefficient, α	Bunsen coefficient# at 288.2 K
288.2	0	0.999	0.01883	0.01883
287.31	0.520	1.0672	0.01571	0.01561
287.34	0.993	1.1286	0.01292	0.01284
286.95	1.699	1.2184	0.00900	0.00892

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Volumetric method using an Ostwald type gas buret and pipet. Solvent was degassed before being admitted to the pipet. Details in source.	SOURCE AND PURITY OF MATERIALS: No details given.
	ESTIMATED ERROR: $\delta\alpha/\alpha = \pm 0.02$.
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. β-D-Fructofuranosyl α-D-Glucopyranoside (Sucrose); $C_{12}H_{22}O_3$; [57-50-1]

ORIGINAL MEASUREMENTS:

Muller, C.

Z. Phys. Chem. 1912-13, *81*, 483-503.

VARIABLES:

Concentration of component 3

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc. of comp. (3) (wt-%)	Bunsen coefficient	Bunsen # coefficient at 288.2 K	Density of soln. at t/°C	t/°C
288.4	5.04	0.01723	0.01726	1.019	15
284.8	14.70	0.01547	0.01510	1.060	11.6
285.2	20.26	0.01500	0.01462	1.084	11.8
285.9	29.86	0.01290	0.01257	1.128	13
285.0	31.74	0.01220	0.01185	1.138	12
286.5	39.65	0.01047	0.01033	1.175	13.5
285.8	42.94	0.00956	0.00939	1.195	12.5

given in original, method of calculation from Bunsen coefficient at experimental temperature not clear.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which pressure was determined using a mercury manometer. Solution was degassed by boiling under reduced pressure. A considerable amount of water was removed by this process. Gas was saturated with water vapor before being admitted to absorption buret.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by reaction of acid on zinc, washed with caustic potash solution.

2 and 3. No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/P = \pm 0.001$;

$\delta\alpha/\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Serum albumin

ORIGINAL MEASUREMENTS:

Shkol'nikova, R. I.

Uch. Zp. 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 (1 atm)
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 $\alpha \times 10^3$	Ostwald Coefficient $L \times 10^3$	Bunsen Coefficient $\alpha \times 10^3$	Ostwald Coefficient $L \times 10^3$
283.15	18.9	19.6	16.1	16.7
288.15	18.3	19.3	15.4	16.2
293.15	17.1	18.3	14.4	15.4
298.15	16.7	18.2	13.9	15.2
303.15	15.3	17.0	11.9	13.2
308.15	14.5	16.4	11.6	13.1
313.15	14.1	16.1	11.3	12.9

T/K	serum albumin/Wt %			
	1.68		1.99	
	Bunsen Coefficient $\alpha \times 10^3$	Ostwald Coefficient $L \times 10^3$	Bunsen Coefficient $\alpha \times 10^3$	Ostwald Coefficient $L \times 10^3$
283.15	15.9	16.5	14.6	15.1
288.15	15.2	16.0	13.9	14.6
293.15	13.1	14.0	12.1	13.0
298.15	12.8	14.0	11.6	12.7
303.15	10.7	11.9	9.9	11.0
308.15	10.5	11.8	9.6	10.8
313.15	10.1	11.6	9.4	10.8

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung were modified (1).

The author calculated the enthalpy of solution from the temperature coefficient of the Bunsen coefficient. It is 1590, 1760, 2210, 2370, and 2360 cal mol^{-1} in water, and in 0.575, 1.15, 1.68, and 1.99 wt % serum albumin respectively.

The values of the solubility of hydrogen in water were not given in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Stated to be 99.99 per cent.

(2) Water. No information.

(3) serum albumin. No information.

ESTIMATED ERROR:

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Dextrin (colloidal)

ORIGINAL MEASUREMENTS:

Findlay, A.; Shen, B.

J. Chem. Soc. 1912, *101*, 1459-68.

VARIABLES:

Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K = 298.15

Solubility, *S*, given as $\frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase.}}$

Conc of dextrin $/10^{-2}$g cm^{-3}	Density of solution	S^+
3.98	1.012	0.0194
5.59	1.019	0.0191
8.12	1.028	0.0188
19.20	1.066	0.0174

S^+ solubility independent of pressure over range 1-2 atm.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas buret and absorption pipet. Manometer tube was of such a length as to allow measurements up to 2×10^5 Pa (2 atm).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 1.5\%$.
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Gelatin (colloidal)

ORIGINAL MEASUREMENTS:

Findlay, A.; Shen, B.

J. Chem. Soc. 1912, *101*, 1459-68.

VARIABLES:

Pressure, concentration

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K = 298.15

Solubility, S, given as $\dfrac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$

Conc. of gelatin $/10^{-2}$g cm^{-3}	Density of solution	$p^{+}_{H_2}$ $/10^5$Pa	S	$p^{+}_{H_2}$ $/10^5$Pa	S
1.53	1.002	1.004	0.0194	1.149	0.0188
		1.336	0.0193	1.471	0.0195
		1.664	0.0195	1.845	0.0194
2.69	1.005	0.995	0.0189	1.157	0.0185
		1.316	0.0189	1.468	0.0190
		1.660	0.0189	1.840	0.0191
4.72	1.011	1.004	0.0185	1.152	0.0181
		1.332	0.0186	1.483	0.0186
		1.673	0.0186	1.860	0.0185
5.71	1.015	1.000	0.0182	1.155	0.0173
		1.300	0.0183	1.464	0.0184
		1.659	0.0181	1.844	0.0183

+ partial pressure of hydrogen.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas buret and absorption pipet. Manometer tube was of such a length as to allow measurements up to 2 x 10^5Pa (2 atm)

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 1.5\%$
(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

(3) Gelatin

ORIGINAL MEASUREMENTS:

Shkol'nikova, R. I.

Uch. Zp. 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 (1 atm)
Gelatin/Wt %: 1, 5, 10

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Gelatin/Wt % 1		Gelatin/Wt % 5	
	Bunsen Coefficient $\alpha \times 10^3$	Ostwald Coefficient $L \times 10^3$	Bunsen Coefficient $\alpha \times 10^3$	Ostwald Coefficient $L \times 10^3$
283.15	17.9	18.5	15.2	15.8
288.15	16.1	16.9	14.3	14.8
293.15	14.4	15.5	13.0	14.0
298.15	13.1	14.3	11.0	12.9
303.15	11.6	12.9	10.5	11.6
308.15	10.6	12.3	9.8	11.6
313.15	10.2	11.7	9.3	10.7

T/K	Gelatin/Wt % 10	
	Bunsen Coefficient $\alpha \times 10^3$	Ostwald Coefficient $L \times 10^3$
283.15	14.2	14.8
288.15	13.2	13.8
293.15	12.1	13.0
298.15	11.0	12.1
303.15	10.0	11.1
308.15	9.1	10.3
313.15	8.2	9.1

The author calculated the enthalpy of solution of hydrogen from the temperature coefficient of the Bunsen coefficients. It is 1590, 3260, 3060, and 3240 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).

The values of the solubility of hydrogen in water were not given in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Stated to be 99.99 per cent.

(2) Water. No information.

(3) Gelatin. No information.

ESTIMATED ERROR:

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Starch (colloidal)

ORIGINAL MEASUREMENTS:

Findlay, A.; Shen, B.

J. Chem. Soc. 1912, *101*, 1459-68.

VARIABLES:

Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K = 298.15

Solubility, *S*, given as $\frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$

Conc. of starch $/10^{-2}$g cm^{-3}	Density of solution	S^+
2.01	1.005	0.0194
3.56	1.011	0.0189
7.13	1.024	0.0181
9.29	1.032	0.0182

S^+ Solubility independent of pressure over range 1-2 atm.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas buret and absorption pipet. Manometer tube was of such a length as to allow measurements up to 2×10^5Pa (2 atm).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1; \delta S = \pm 1.5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Phosphate buffer and human red cell ghosts in phosphate buffer.	Power, G.G.; Stegall, H. *J. Appl. Physiology*, 1970, *29*, 145-9
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient α	S.D.*	No. of measurements
	Phosphate Buffer		
310.15	0.01588	0.00007	4
	Ghosts suspension in phosphate buffer		
310.15	0.01602	0.00006	5

* Standard deviation.

$\alpha°$ ghost = (α ghosts suspension $-\alpha$ buffer)/g ghosts cm^{-3}
= 0.024 ± 0.008

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:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Alkanes	H. L. Clever Chemistry Department Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

The solubility of hydrogen at a partial pressure of 101.325 kPa (1 atm) in alkanes.

The data on the solubility of hydrogen in alkanes at hydrogen partial pressures less than 200 kPa are evaluated in this section. The hydrogen solubility data at hydrogen partial pressures greater than 200 kPa are compiled and evaluated in another part of the volume, which should be consulted along with this section. In general, a simple Henry's law treatment, uncorrected for non-idealality in either gas or liquid phase, of the solubility data measured at hydrogen partial pressures greater than 200 kPa, usually results in a mole fraction solubility at a hydrogen partial pressure of 101.325 kPa (1 atm) that is 50 to 100 per cent higher than the value actually measured at atmospheric pressure.

Most of the hydrogen solubility values at pressures less than 200 kPa were measured at a hydrogen partial pressure near 101.325 kPa (1 atm). The mole fraction solubility is calculated for a hydrogen partial pressure of 101.325 kPa (1 atm) from the experimental measurement, assuming that the gas is ideal, Henry's law is obeyed, and in some cases, that the Ostwald coefficient is independent of pressure. For most systems these assumptions are justified for the less than 200 kPa solubility experiments.

Hydrogen + Pentane [109-66-0]

Makranczy, Megyery-Balog, Rusz, and Patyi (1) report an Ostwald coefficient at 298.15 K which is equivalent to a mole fraction solubility of 6.7×10^{-4}. Frolich, Tauch, Hogan, and Peer (2) measured the hydrogen solubility in pentane at 298.15 K and pressures of 10 MPa and greater. A simple Henry's law treatment of the Frolich *et al.* data gives a mole fraction solubility that is 50 - 70 per cent greater than the Makranczy *et al.* value. The Makranczy *et al.* values at 298.15 K have proven to be reliable for other systems. Thus their value is accepted as a tentative value.

Hydrogen + Hexane [110-54-3]

Four laboratories have reported values of the solubility of hydrogen in hexane at or near 101.325 kPa partial pressure of hydrogen. Guerry (3) reported values at 293.15 and 298.15 K, Waters, Mortimer, and Clements (4) reported solubility values at four temperatures between 263.15 and 293.15 K, Makranczy *et al.* (1) reported a value at 298.15 K, and Katayama and Nitta (5) reported values at five temperatures between 213.15 and 298.15 K.

The Waters *et al.* data was extrapolated to obtain a solubility value at 298.15 K. That value, along with the 298.15 K values from the other three papers, has an arithmetic mean of 6.61×10^{-4} and has a standard deviation of 0.13. The values range from 6.43 to 6.99×10^{-4}.

It is the judgement of the evaluator that Katayama and Nitta used the most reliable method. The data from all four papers was treated by a linear regression with the Katayama and Nitta data given a weight of two. The 263.15 K value of Waters *et al.* deviated over two standard deivations from the regression line. Both the 263.15 and 273.15 K values of Waters *et al.* were discarded, and the following equation obtained on a linear regression of the remaining data with a weight of two to the Katayama and Nitta data and a weight of one to the data of the others.

The tentative equation for the temperature interval of 213.15 to 298.15 K is

$$\ln x_1 = -5.8952 - 4.2455/(T/100K)$$

with a standard error about the regression line of 2.34×10^{-5}.

From the equation, the temperature independent thermodynamic quantities are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ \ 3.53 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\ \text{mol}^{-1}\ \ -49.0.$$

Table 1. Solubility of hydrogen in hexane at a hydrogen partial pressure of 101.325 kPa (1 atm). Tentative mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
213.15	3.76	13.977
223.15	4.11	14.467
233.15	4.46	14.957
243.15	4.80	15.447
253.15	5.15	15.937
263.15	5.48	16.428
273.15	5.82	16.918
283.15	6.15	17.408
288.15	6.31	17.653
293.15	6.47	17.898
298.15	6.63	18.144

Hydrogen + Heptane [142-82-5]

Four laboratories have reported solubility measurements near a partial pressure of 101.325 kPa of hydrogen in heptane. The work of Cook, Hanson and Alder (7) is one of the first successful attempts to measure high accuracy, high precision gas solubility values. They report eleven measurements between temperatures of 243.15 and 328.15 K, which the evaluator believes to be of good accuracy.

The early value of Ijams (6) at 298.15 K is 14 per cent lower than the value of Cook *et al.* The solubility values reported at 298.15 K by Makranczy *et al.* (1) and by Guerry (3) agree well, but they are 4 per cent lower than the Cook *et al.* value.

The temperature of one solubility measurement made by Cook, Hanson and Alder is in question. In their paper (7) they give a temperature of 238.15 K (-35°C), but in Cook's thesis (8) the temperature is given as 243.15 K (-30°C). The latter value smooths the data better and appears to be the correct temperature.

The tentative equation for the temperature interval of 243.15 to 328.15 K is based entirely on the data of Cook *et al.* (7). The equation is

$$\ln x_1 = -5.6689 - 4.8099/(T/100\text{K})$$

with a standard error about the regression line of 4.60×10^{-6}.

From the equation the temperature independent thermodynamic quantities are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ \ 4.00 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\ \text{mol}^{-1}\ -\ 47.1.$$

Smoothed values of the mole fraction solubility and partial molar Gibbs energy of solution are in the following table.

Table 2. Solubility of hydrogen in heptane at a hydrogen partial pressure of 101.325 kPa (1 atm). Tentative mole fraction solubility and partial molal Gibbs energy of solution are a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta \bar{G}_1^\circ$/kJ mol^{-1}
243.15	4.77	15.460
253.15	5.16	15.931
263.15	5.55	16.402
273.15	5.93	16.873
283.15	6.31	17.345
288.15	6.50	17.580
293.15	6.69	17.816
298.15	6.88	18.051
303.15	7.06	18.287
313.15	7.43	18.759
323.15	7.79	19.230

Hydrogen + Octane [111-65-9]

Cook, Hanson and Alder (7) report four solubility measurements between temperatures of 248.15 and 308.15 K. Makranczy, Megyery-Balog, Rusz, and Patyi (1) report one measurement of 298.15 K which is 6.3 per cent lower than the Cook *et al.* value, and Ijams (6) reports one value of 298.15 K which is 1.4 per cent greater than the Cook *et al.* value.

As discussed in connection with the hydrogen + heptane system, the Cook *et al.* data are considered the most reliable for this system. The tentative equation and smooth values are based entirely on their data.

Although a three constant equation will fit the Cook *et al.* data almost exactly, we are justified in using only a two constant equation. The linear regression of the data gives the tentative equation for the mole fraction solubility over the temperature interval of 248.15 to 308.15 K as

$$\ln x_1 = -5.6624 - 4.8438/(T/100K)$$

with a standard error about the regression line of 3.08×10^{-6}.

From the equation the temperature independent thermodynamic quantities are

$$\Delta \bar{H}_1^\circ/\text{kJ mol}^{-1} \ 4.03 \ \text{and} \ \Delta \bar{S}_1^\circ/\text{J K}^{-1}\ \text{mol}^{-1} \ -47.1.$$

Smoothed values of the mole fraction solubility and partial molal Gibbs energy of solution are in Table 3.

Table 3. Solubility of hydrogen in octane at a hydrogen partial pressure of 101.325 kPa (1 atm). Tentative mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta \bar{G}_1^\circ$/kJ mol^{-1}
253.15	5.13	15.945
263.15	5.51	16.416
273.15	5.90	16.887
283.15	6.28	17.358
288.15	6.47	17.593
293.15	6.66	17.828
298.15	6.84	18.064
303.15	7.03	18.299
308.15	7.21	18.535

Hydrogen + 2,2,4-Trimethylpentane [540-84-1]

Cook, Hanson, and Alder (7) have reported data at a hydrogen partial pressure of 101.325 kPa (1 atm) on the system. Their data were carefully obtained, and are classed as tentative. Ijams (6) reports one solubility value of 298.15 K which is 4.3 per cent smaller than the Cook *et al.* value.

A linear regression of the data of Cook *et al.* gives the equation for the mole fraction solubility over the temperature interval of 248.15 to 308.15 K

$$\ln x_1 = -5.6469 - 4.4889/(T/100K)$$

with a standard error about the regression line of 4.34×10^{-6}.

The enthalpy and entropy changes for transfer of one mole of gas from the gas phase at 101.325 kPa (1 atm) to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \quad 3.73 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \quad -46.9_5$$

The smoothed values of mole fraction solubility and partial molal Gibbs energy of solution are given in Table 4.

Table 4. Solubility of hydrogen in 2,2,4-trimethylpentane at a hydrogen partial pressure of 101.325 kPa (1 atm). Tentative mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
253.15	5.99	15.618
263.15	6.41	16.087
273.15	6.82	16.557
283.15	7.23	17.026
293.15	7.63	17.496
298.15	7.83	17.730
303.15	8.03	17.965
308.15	8.22	18.200

Hydrogen + Nonane [111-84-2]

Thomsen and Gjaldbaek (9) report three solubility measurements at temperatures between 298.05 and 308.05 K. Makranczy *et al.*(1) report one value at 298.15 K. Both data sets are classed as tentative, but the Thomsen and Gjaldbaek data at three temperatures were measured with higher precision. Thus the Thomsen and Gjaldbaek data are preferred. An equation and smoothed data table appears on their data sheet. The equation corresponds to temperature independent enthalpy and entropy changes for the transfer of hydrogen from the gas at 101.325 kPa (1 atm) to the infinitely dilute solution of

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \quad 3.74 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \quad -47.9.$$

Hydrogen + Decane [124-18-5]

Both Ijams (6) and Makranczy *et al.* (1) report a single value at 298.15 K. The values differ by nearly 20 per cent. The Makranczy value is classed as tentative and the Ijams value as doubtful.

Hydrogen + Undecane [1120-21-4]
+ Dodecane [112-40-3]
+ Tridecane [629-50-5]
+ Tetradecane [629-59-4]
+ Pentadecane [629-62-9]

Makranczy, Megyery-Balog, Rusz, and Patyi (1) report one solubility value at 298.15 K for each of the above five systems. The data are classed as tentative.

Hydrogen + Hexadecane [544-76-3]

Makranczy *et al.* (1) report one solubility value at 298.15 K. Cukor and Prausnitz (10) report eight values between the temperatures of 300 and 475 K. The Cukor and Prausnitz value at 300 K is 20 per cent greater than the Makranczy *et al.* value at 298.15 K. Although both results are classed as tentative, the Cukor and Prausnitz value is preferred.

The Cukor and Prausnitz data were fitted to a three constant equation by a linear regression. The equation for the mole fraction solubility at a hydrogen partial pressure of 101.325 kPa (1 atm) over the 300 to 475 K temperature interval is

$$\ln x_1 = -11.01165 + 3.8183/(T/100K) + 2.4811 \ln (T/100K)$$

with a standard error around the regression line of 2.36×10^{-6}. The equation reproduces the Cukor and Prausnitz mole fraction values to within almost one part per thousand.

The equation results in the following values of the enthalpy, entropy, and heat capacity change for the transfer of one mole of hydrogen from the gas phase at 101.325 kPa hydrogen pressure to the infinitely dilute solution.

Table 5. Hydrogen + Hexadecane thermodynamics of transfer of one mole of hydrogen from gas at 101.325 kPa to infinitely dilute solution.

T/K	$\Delta\bar{H}_1^\circ$/kJ mol^{-1}	$\Delta\bar{S}_1^\circ$/J K^{-1} mol^{-1}	$\Delta\bar{C}_{p_1}^\circ$ /J K^{-1} mol^{-1}
325	3.53	-46.6	20.6
400	5.08	-42.3	20.6
475	6.62	-38.8	20.6

Hydrogen + 2,6,10,15,19,23-Hexamethyltetracosane or Squalane [111-01-3]

Chappelow and Prausnitz (11) report eight values of the solubility of hydrogen in squalane over the temperature interval of 300 to 475 K which are classed as tentative. The mole fraction values at 101.325 kPa hydrogen partial pressure were fitted to a three constant equation by a linear regression. The equation is

$$\ln x_1 = -8.1089 + 0.07805/(T/100K) + 1.3623 \ln (T/100K)$$

with a standard error about the regression line of 3.15×10^{-6}. The equation reproduces the mole fraction values (see data sheet) to within two parts per thousand.

The equation results in the following values of the thermodynamic changes.

Table 6. Hydrogen + Squalane. Thermodynamic changes on transfer of one mole of hydrogen from the gas phase at 101.325 kPa (1 atm) to the infinitely dilute solution.

T/K	$\Delta\bar{H}_1^\circ$/kJ mol^{-1}	$\Delta\bar{S}_1^\circ$/J K^{-1} mol^{-1}	$\Delta\bar{C}_{p_1}^\circ$ /J K^{-1} mol^{-1}
325	3.33	-43.6	11.3
400	4.47	-40.4	11.3
475	5.32	-38.4	11.3

References:

1. Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269.
2. Frolich, P. K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.
3. Guerry, D. Jr. Ph.D. Thesis, Vanderbilt University, Nashville, TN 1944.
4. Waters, J. A.; Mortimer, G. A.; Clements, H. E. *J. Chem. Eng. Data* 1970, *15*, 174, 462.
5. Katayama, T.; Nitta, T. *J. Chem. Eng. Data* 1976, *21*, 194.
6. Ijams, C. C. Ph.D. Thesis, Vanderbilt University, Nashville, TN 1941.
7. Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748.
8. Cook, M. W. University of California Radiation Lab, Report UCRL-2459, 1954.
9. Thomsen, E. S.; Gjaldbaek, J. C. *Acta Chem. Scand.* 1963, *17*, 127.
10. Cukor, P. M.; Prausnitz, J. M. *J. Phys. Chem.* 1972, *76*, 598.
11. Chappelow, C. C.; Prausnitz, J. M. *Am. Inst. Chem. Eng. J.* 1974, *20*, 1097.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Pentane; C_5H_{12}; [109-66-0]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*, 269-280.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	6.7	0.130	0.142

*original datum

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Alkanes; C_6H_{14} and C_7H_{16}

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

Thesis Director, L. J. Bircher

VARIABLES:

T/K: 293.15, 298.15
P/kPa: 101.325 (1 atm)

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	6.41	0.110	0.118
298.15	6.51	0.111	0.121
Heptane; C_7H_{16}; [142-82-5]			
293.15	6.37	0.0975	0.105
298.15	6.63	0.101	0.110

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) Hydrogen. Air Reduction Co. Purity 99.5 per cent.

(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) Hydrogen; H_2; [1333-74-0]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Waters, J. A.; Mortimer, G. A.; Clements, H. E.

J. Chem. Eng. Data 1970, *15*, 174-176 and 462 (correction).

VARIABLES:

T/K: 263.15 - 293.15

H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		c_{H_2}/mol dm^{-3}	Mol Fraction	Bunsen Coefficient	Ostwald Coefficient
t/°C	T/K	x 10^3	x_1 x 10^4	α	L
-10	263.15	3.801	4.77	0.0852	0.0821
0	273.15	4.131	5.26	0.0926	0.0926
10	283.15	4.471	5.70	0.0991	0.1027
20	293.15	4.640	6.09	0.104	0.112

The mole fraction and Ostwald coefficient values were calculated from the authors data by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The authors reported two methods of solubility measurement. The hydrogen solubilities were measured by their method A.

The apparatus consisted of two glass bulbs connected by ¼" stainless steel tubing fitted with Hoke valves and a strain gage. The strain gage signal was measured by a potentiometer. The bulbs were immersed in an oil bath. The temperature was measured with a Pt resistance thermometer and Mueller bridge.

The solvent was degassed three times at liquid N_2 temperature. The solvent vapor pressure was measured in the apparatus. Gas in the second bulb at a known P and T was allowed into the bulb containing the solvent. The change in P was followed until equilibrium was reached. The gas uptake was calculated using Charles law. A correction was made for H_2 adsorption on the walls.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Air Reduction Co. Minimum purity 99.50 per cent.

(2) Hexane. Phillips Petroleum Co. Maximum impurities 0.5% benzene and 0.5% methyleyclopentane.

ESTIMATED ERROR:

δP/mmHg = 0.1
δT/K = 0.01

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem. Engng. Data. 1976, *21*,194-6

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction* of hydrogen in liquid, x_{H_2}
298.15	0.130	1430	0.000699
273.15	0.105	1670	0.000599
253.15	0.0873	1920	0.000521
233.15	0.0710	2230	0.000448
213.15	0.0550	2690	0.000372

* 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. Takachiho Chemical Industry Co. sample, purity 99.99 mole per cent.

2. Merck Uvasol spectral grade sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at $T = 213.15K$, ± 0.05 at other temperatures; $\delta x_{H_2} = \pm 1.5\%$

REFERENCES:

1. Nitta, T.; Tatsuishi. A.; Katayama, T. *J. Chem. Eng. Jpn.* 1973, *6*, 475.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*, 269-280.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	6.5	0.110	0.120

*original datum

Mol fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Begyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(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

Thesis Director: L. J. Bircher

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
Heptane; C_7H_{16}; [142-82-5]			
298.15	5.90	0.0897	0.0979
Octane; C_8H_{18}; [111-65-9]			
298.15	6.93	0.0950	0.1037
2,2,4-Trimethylpentane or isooctane; C_8H_{18}; [540-84-1]			
298.15	7.48	0.1010	0.1102
Decane; $C_{10}H_{22}$; [124-18-5]			
298.15	5.37	0.0615	0.0671

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) Hydrogen. 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) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.;
Alder, B. J.

J. Chem. Phys. 1957, *26*, 748 - 751.

EXPERIMENTAL VALUES:

T/K	Solubility[1] mol g^{-1} x 10^6			Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
238.15[4]	4.797	4.7[1]		4.804	7.80	6.94
248.15	4.978	4.976[1]		4.985	8.04	7.31
263.15	5.514	5.513[1]		5.522	8.76	8.43
273.15	5.895	5.894[1]		5.903	9.25	9.25
283.15	6.282	6.281[1]		6.290	9.74	10.09
285.25	6.354			6.363[3]	9.82	10.26
288.15	6.466	6.465[1]		6.475[3]	9.96	10.51
298.15	6.865	6.866[1]				
	6.871					
	6.875	6.874[1]				
	6.872	6.871[1]				
	6.871	av.		6.879	10.43	11.39
308.15	7.281					
	7.278					
	7.280	7.281[1]	7.281[2]			
	7.273	7.274[1]	7.274[2]			
	7.276					
	7.283	7.282[1]	7.283[2]			
	7.282	7.281[1]	7.282[2]			
	7.279	av.		7.288	10.94	12.34
318.15	7.70			7.71[3]	11.43	13.31
328.15	7.91			7.92[3]	11.59	13.92

[1] Data from (1).

[2] Data from (2).

[3] Values calculated by the compiler.

[4] The paper gives the temperature as -35 °C (238.15 K), but reference (1) gives the temperature as -30 °C (243.15 K). The higher temperature smooths the data better.

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.6689 - 4.8099/(T/100\text{K})$

Standard error about the regression line = 4.60 x 10^{-6}

See the hydrogen + heptane evaluation for the recommended equation.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Heptane; C_7H_{16}; [142-82-5]	Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748 - 751.
VARIABLES: T/K: 243.15 - 328.15 P/kPa: 101.325 (1 atm)	PREPARED BY: P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

See preceeding page.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, after temperature equilibrium is reached, the gas is contacted with the degassed solvent. The system is shaken until solubility equilibrium is attained. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co. Mass spectrographic analysis showed gas 99.75 per cent pure. Impurity mostly N_2.

(2) Heptane. Phillips Petroleum Co. Pure grade, 99+ mol per cent. Distilled, center portion used, b.p. 371.45K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1$ = 0.001 (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS: (1) Hydrogen; H_2; [1333-74-0] (2) Heptane; C_7H_{16}; [142-82-5]	ORIGINAL MEASUREMENTS: Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269-280.
VARIABLES: T/K: 298.15 P/kPa: 101.325 (1 atm)	PREPARED BY: S. A. Johnson H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	6.6	0.100	0.109

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

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) Hydrogen; H_2; [1333-74-0] (2) Octane; C_8H_{18}; [111-65-9]	Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748 - 751.
VARIABLES:	**PREPARED BY:**
T/K: 248.15 - 308.15 P/kPa: 101.325 (1 atm)	P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility[1] mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
248.15	4.331	4.947	7.17	6.52
273.15	5.139	5.869	8.28	8.28
298.15	5.984	6.832	9.37	10.22
308.15	6.343	7.241	9.81	11.07

[1] Data from (1).

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -8.5728 - 0.8677/(T/100K) + 1.4425 \ln (T/100K)$

Standard error about the regression line = 5.97×10^{-7}

For the recommended equation see the hydrogen + octane evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, after temperature equilibrium is reached, the gas is contacted with the degassed solvent. The system is shaken until solubility equilibrium is at attained. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co. Mass spectrographic analysis showed gas 99.75 per cent pure. Impurity mostly N_2.

(2) Octane. Eastman Kodak Co. Distilled, center portion used, b.p. 398.65K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*, 269-280.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	6.4	0.088	0.096

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 2,2,4-Trimethylpentane or isooctane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.;
Alder, B. J.

J. Chem. Phys. 1957, *26*, 748-751.

VARIABLES:

T/K: 283.15 - 318.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility[1] mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
248.15	5.080	5.801	8.29	7.53
273.15	5.937	6.779	9.42	9.42
298.15	6.845	7.815	10.54	11.51
308.15	7.234	8.258	11.01	12.42

[1] Data from (1).

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -9.2505 + 0.4341/(T/100K) + 1.7861 \ln (T/100K)$

Standard error around the regression line = 5.79×10^{-7}

T/K	Mol Fraction x_1 x 10^4
253.15	5.991
263.15	6.379
273.15	6.777
283.15	7.186
293.15	7.605
298.15	7.820
303.15	8.036
308.15	8.255

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, after temperature equilibrium is reached, the gas is contacted with the degassed solvent. The system is shaken until solubility equilibrium is attained. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co. Mass spectrographic analysis showed gas 99.75 per cent pure. Impurity mostly N_2.

(2) 2,2,4-Trimethylpentane. Phillips Petroleum Co. Pure Grade, 99+ mol per cent. Distilled, center portion used, b.p. 372.35 K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Nonane; C_9H_{20}; [111-84-2]

ORIGINAL MEASUREMENTS:

Thomsen, E. S.; Gjaldbaek, J. C.

Acta Chem. Scand. 1963, *17*, 127-133.

VARIABLES:

T/K: 298.05 - 308.05
Total P/kPa: 101.325 (1 atm)

PREPARED BY:

E. S. Thomsen

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
298.05	6.87	8.58	9.36
298.15	6.98	8.71	9.51
308.05	7.27	8.98	10.1

The mole fraction and Ostwald solubility values were calculated by the compiler. Solubility values are for 101.325 (1 atm) partial pressure hydrogen assuming Henry's law is obeyed.

Smoothed Data: $\ln x_1 = -5.7654 - 4.5010/(T/100K)$

Standard error about the regression line = 7.53×10^{-6}

T/K	Mol Fraction $x \times 10^4$
298.15	6.93
308.15	7.10
308.15	7.27

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) Hydrogen. Source not given. Contained 0.02 per cent O_2 and 0.03 per cent N_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) Hydrogen; H_2; [1333-74-0] (2) Nonane; C_9H_{20}; [111-84-2]	ORIGINAL MEASUREMENTS: Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269-280.
VARIABLES: T/K: 298.15 P/kPa: 101.325 (1 atm)	PREPARED BY: S. A. Johnson H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	6.5	0.081	0.088

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

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) Hydrogen; H_2: [1333-74-0] (2) Decane; $C_{10}H_{22}$; [124-18-5]	Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269-280.
VARIABLES: T/K: 298.15 P/kPa: 101.325 (1 atm)	PREPARED BY: S. A. Johnson H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	6.5	0.074	0.081

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

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) Hydrogen; H_2; [1333-74-0] (2) Undecane; $C_{11}H_{24}$; [1120-21-4]	Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269-280.
VARIABLES:	**PREPARED BY:**
T/K: 298.15 P/kPa: 101.325 (1 atm)	S. A. Johnson H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	6.8	0.072	0.079

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Dodecane; $C_{12}H_{26}$; [112-40-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*, 269-280.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	7.3	0.071	0.078

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS: (1) Hydrogen; H_2; [1333-74-0] (2) Tridecane; $C_{13}H_{28}$; [629-50-5]	ORIGINAL MEASUREMENTS: Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269-280.
VARIABLES: T/K: 298.15 P/kPa: 101.325 (1 atm)	PREPARED BY: S. A. Johnson H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	7.4	0.068	0.074

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Hydrogen; H_2: [1333-74-0]

(2) Tetradecane; $C_{14}H_{30}$; [629-59-4]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*, 269-280.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	6.8	0.059	0.064

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Pentadecane; $C_{15}H_{32}$; [629-62-9]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*, 269-280.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	7.0	0.057	0.062

*original datum

Mol fractions and busnen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Cukor, P.M.; Prausnitz, J.M.

J. Phys. Chem. 1972, *76*, 598-601.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant [a] /atm	Mole fraction of [b] hydrogen in liquid, x_{H_2}
300	1111	0.000900
325	1004	0.000996
350	909	0.00110
375	825	0.00121
400	749	0.00134
425	681	0.00147
450	621	0.00161
475	567	0.00176

a. Quoted in supplementary material for original paper.

b. Calculated by compiler for a partial pressure of 1 atmosphere.

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:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 2\%$.

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:

(1) Hydrogen; H_2; [1333-74-0]

(2) Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*, 269-280.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient* L
298.15	7.2	0.055	0.060

*original datum

Mol fractions and bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

Both components were analytical grade reagents of either Hungarian or foreign origin.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03$ (authors)

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 2, 6, 10, 15, 19, 23 - hexamethyltetracosane, (Squalane) $C_{30}H_{62}$; [111-01-3]

ORIGINAL MEASUREMENTS:

Chappelow, C.C.; Prausnitz, J.M.

Am.Inst.Chem.Engnrs.J. 1974, *20*, 1097-1104.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant[a] /atm	Mole fraction[b] of hydrogen at 1 atm partial pressure, x_{H_2}
300	726	0.001377
325	650	0.001538
350	589	0.001698
375	538	0.001859
400	494	0.002024
425	455	0.002198
450	421	0.002375
475	391	0.002558

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:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 1\%$. (estimated by compiler).

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) Hydrogen; H_2; [1333-74-0] (2) Cyclohexane; C_6H_{12}; [110-82-7]	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

Four laboratories have reported values of the solubility of hydrogen in cyclohexane at atmospheric pressure. Guerry (1) reported measurements at 293.15 and 298.15 K, Kruyer and Nobel (2) reported a value at 298.15 K, Dymond (3) reported four values over the 293.95 to 309.53 K temperature range, and Kraus and Gestrich (4) reported four values over the 283.15 to 313.15 K temperature range, which were presented on a graph.

It is the judgement of the evaluator that Dymond's measurements were carried out with more care and on better designed apparatus than the measurements of the others. Kruyer and Nobel's single value is 1.2 per cent less than Dymond's value, and the other data ranges 6 to 8 per cent below the values of Dymond.

A linear regression was applied to the data of Dymond to obtain the tentative equation

$$\ln x_1 = -5.6962 - 6.2403/(T/100K)$$

with a standard error about the regression line of 4.73×10^{-7}.

The temperature independent values of the thermodynamic changes in enthalpy and entropy for transfer of one mole of hydrogen from the gas at 101.325 kPa (1 atm) to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ 5.19, \text{ and } \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ -47.4.$$

Smoothed values of the mole fraction solubility and Gibbs energy of solution are in the table.

Table 1. Solubility of hydrogen in cyclohexane at a hydrogen partial pressure of 101.325 kPa (1 atm). Tentative mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta\bar{G}_1^\circ/\text{kJ mol}^{-1}$
293.15	4.00	19.07
298.15	4.14	19.31
303.15	4.29	19.54
308.15	4.43	19.78

References:

1. Guerry, D. J Ph.D. thesis, Vanderbilt University, Nashville, TN 1944.
2. Kruyer, S.; Nobel, A. P. P. *Rec. Trav. Chim.* 1961, *80*, 1145.
3. Dymond, J. H. *J. Phys. Chem.* 1967, *71*, 1829.
4. Krauss, W.; Gestrich, W. *Chem. Tech. (Heidelberg)* 1977, *6*, 35.

ADDED NOTE:

Puri and Ruether (5) measured the solubility of hydrogen in mixtures of acetone and cyclohexane at 298.15 K and a total pressure of about 10^5 Pa. Their Ostwald coefficient value, measured for hydrogen + cyclohexane, converts to a mole fraction solubility of 4.24×10^{-4} at a hydrogen partial pressure of 101.325 kPa. The value is classed as tentative. The values of Dymond are still preferred.

5. Puri, P. S.; Ruether, J. A. *Can. J. Chem. Eng.* 1974, *52*, 636.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Cyclic hydrocarbons; C_6H_{10} and C_6H_{12}

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

Thesis Director: L. J. Bircher

VARIABLES:

T/K: 293.15, 298.15
P/kPa: 101.325 (1 atm)

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	3.35	0.0742	0.0796
298.15	3.42	0.0753	0.0822
Cyclohexane; C_6H_{12}; [110-82-7]			
293.15	3.79	0.0787	0.0845
298.15	3.80	0.0785	0.0857

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) Hydrogen. Air Reduction Co. Purity 99.5 per cent.

(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. Hydrogen; H_2; [1333-74-0]
2. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Kruyer, S.; Nobel, A.P.P.

Rec. Trav. Chim. 1961, *80*, 1145-56

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Mole fraction of hydrogen, x_{H_2} [a]
298.15	0.092	0.000409

[a] Calculated by compiler for a partial pressure of 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Technique consisted of saturating liquid with hydrogen in a spiral adsorption tube and then stripping out the hydrogen with argon. The resulting argon-hydrogen mixture was analysed with a katharometer.

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen and argon passed through molecular sieve 4A in liquid oxygen and nitrogen trap respectively.

2. Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta L = \pm 3\%$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Dymond, J. H.

J. Phys. Chem. 1967, *71*, 1829-1831.

VARIABLES:

T/K: 293.95 - 309.53
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.95	4.02	8.33	8.96
298.16	4.14	8.54	9.32
304.77	4.34	8.88	9.91
309.53	4.47	9.09	10.3

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.6962 - 6.2403/(T/100K)$

Standard error about the regression line = 4.73×10^{-7}

T/K	Mol Fraction $x_1 \times 10^4$
293.15	4.00
298.15	4.14
303.15	4.29
308.15	4.43

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) Hydrogen. Stuart Oxygen Co. Dried.

(2) Cyclohexane. Matheson, Coleman and Bell chromatoquality reagent. Dried and fractionally frozen. m.p. 6.45°C.

ESTIMATED ERROR:

REFERENCES:

1. Dymond, J.; Hildebrand, J. H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Krauss, W.; Gestrich, W.

Chem. Tech (Heidelberg), 1977, *6*, 35-37.

VARIABLES:

Temperature,

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Solubility*/ mol dm^{-3} bar^{-1}	Mole fraction§ of hydrogen in liquid, x_{H_2}
283.15	0.0032	0.00035
293.15	0.0034	0.00037
303.15	0.0036	0.00040
313.15	0.0038	0.00042

* read off graph, the equations given in the original paper appear to be in error.

§ calculated by compiler for a partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell. Volumetric apparatus in which a known volume of gas was added to a known volume of liquid and the equilibrium pressure measured. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 10^{-5}$

(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Propanone, (Acetone); C_3H_6O; [67-64-1]
3. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Puri, P.S.; Ruether, J.A.

Can. J. Chem. Eng. 1974 *52*, 636-640.

VARIABLES:

Liquid phase composition

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	Mole fraction of acetone in liquid,	Ostwald coefficient, *L* *
298.15	1.000	0.0943
	0.8285	0.0929
	0.7769	0.0900
	0.5406	0.1028
	0.3914	0.1058
	0.2466	0.1030
	0.0000	0.0953

* total pressure approximately 10^5Pa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus similar to that described in ref. (1).

Degassed solution placed in calibrated dissolution vessel, gas saturated with solvent vapor introduced from a calibrated gas buret. Amount of gas dissolved determined from pressure and volume changes.

SOURCE AND PURITY OF MATERIALS:

1. Liquid Carbonic Canadian Corp., sample purity 99.97 mole per cent.

2 & 3 Baker Reagent grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta L = \pm 0.5\%$

(estimated by compiler)

REFERENCES:

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

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Benzene; C_6H_6; [71-43-2]
3. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Kruyer, S.; Nobel, A.P.P.

Rec. Trav. Chim. 1961, *80*, 1145-56

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Mole fraction of hydrogen, x_{H_2}
299.05	0.088	0.00036
312.75	0.095	0.00037
323.15	0.104	0.00040
333.15	0.110	0.00042

Liquid was an equimolar mixture of benzene and cyclohexane

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Technique consisted of saturating liquid with hydrogen in a spiral adsorption tube and then stripping out the hydrogen with argon. The resulting argon-hydrogen mixture was analysed with a katharometer.

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen and argon psssed through molecular sieve 4A in liquid nitrogen and oxygen trap respectively.

2. and 3. Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta L = \pm 3\%$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Decahydronaphthalene [a] [Decalin]; $C_{10}H_{18}$; [91-17-8]	Kruyer, S.; Nobel , A.P.P. *Rec. Trav. Chim.* 1961, *80*, 1145-56
VARIABLES:	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Mole fraction of hydrogen, x_{H_2} [b]
298.15	0.065	0.000422

[a] Probably contained about 15% *cis*-isomer

[b] Calculated by compiler assuming a density of decalin (*cis,trans* mixture) of 0.87 g cm^{-3} . Partial pressure of 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Technique consisted of saturating liquid with hydrogen in a spiral adsorption tube and then stripping out the hydrogen with argon. The resulting argon-hydrogen mixture was analysed with a katharometer.

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen and argon passed through molecular sieve 4A in liquid oxygen and nitrogen trap respectively.

2. "Chemically pure".

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta L = \pm 3\%$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. *Cis*-decahydronaphthalene (Decalin); $C_{10}H_{18}$; [493-01-6]	Krauss, W.; Gestrich, W. *Chem.-Tech. (Heidelberg)* 1977, *6*, 35-37.
VARIABLES:	PREPARED BY:
Temperature	C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility* S/mol dm^{-3} bar^{-1}	Mole fraction§ of hydrogen in liquid, x_{H_2}
283.15	0.0021	0.000325
293.15	0.00225	0.000352
303.15	0.00235	0.000370
313.15	0.00250	0.000397

* Read off graph, the equations given in the original paper appear to be in error.

§ Calculated by compiler for a partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell. Volumetric apparatus in which a known volume of gas was added to a known volume of liquid and the equilibrium pressure measured. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 10^{-5}$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. *Trans*-decahydronaphthalene
   (Decalin); $C_{10}H_{18}$; [493-02-7]

ORIGINAL MEASUREMENTS:

Krauss, W.; Gestrich, W.;
Chem.-Tech. (Heidelberg) 1977, *6*,
35-37.

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility* S/mol dm^{-3} bar^{-1}	Mole fraction§ of hydrogen in liquid, x_{H_2}
283.15	0.0022	0.00035
293.15	0.0023	0.00037
303.15	0.0025	0.00041
313.15	0.0026	0.00043

* Read off graph, the equations given in the original paper appear to be in error.

§ Calculated by compiler for a partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell. Volumetric apparatus in which a known volume of gas was added to a known volume of liquid and the equilibrium pressure measured. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 10^{-5}$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,1- Bicyclohexyl; $C_{12}H_{22}$; [92-51-3]

ORIGINAL MEASUREMENTS:

Cukor, P.M.; Prausnitz, J.M.

J. Phys. Chem. 1972, *76*, 598-601.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant [a] /atm	Mole fraction of [b] hydrogen in liquid, x_{H_2}
300	2252	0.000444
325	2060	0.000485
350	1864	0.000536
375	1669	0.000599
400	1479	0.000676
425	1296	0.000772
450	1124	0.000890
475	964	0.001037

a. Quoted in supplementary material for original paper.

b. Calculated by compiler for a partial pressure of 1 atmosphere.

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:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 2\%$.

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) Hydrogen; H_2; [1333-74-0] (2) Benzene; C_6H_6; [71-43-2]	H. L. Clever Chemistry Department Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

The solubility of hydrogen in benzene at a hydrogen partial pressure of 101.325 kPa (1 atm) over the temperature interval of 283.15 to 338.15 K.

Eight laboratories have reported solubility values on the hydrogen + benzene system at hydrogen partial pressures near 101.325 kPa (1 atm). Another six laboratories have reported solubility values of hydrogen partial pressures greater than 200 kPa which are compiled and evaluated in another part of the volume.

The atmospheric pressure measurements were:

Just (1) values of 293.15 and 298.15 K, Horiuti (2) four values between 280.15 and 335.95 K, Maxted and Moon (3) five values between 273.65 [sic] and 313.15 K, Cook *et al.* (4) five values between 283.15 and 318.15 K, Kruyer and Nobel (5) a value of 298.15 K, deWet (6) three values between 291.65 and 304.55 K, and Krauss and Gestrich (7) four values between 283.15 and 313.15 K, and Puri and Ruether (8) one value at 298.15 K.

It is generally accepted by workers in gas solubility that the measurements of Horiuti (2), and of Cook, Hanson, and Alder (4) were carried out with exceptional care and accuracy.

Linear regressions were made of two arrangements of the mole fraction solubility data from the papers above. Both data sets were fitted to two and to three constant equations.

The first data arrangement was to use all of the data except the mole fraction solubility at 273.65 K of Maxted and Moon (3). Benzene freezes near 278.7 K, thus that temperature appears to be in error. The second data arrangement was to use just the nine data points of Horiuti (2) and Cook *et al.* (4).

The three constant equations could not be justified for either of the two data arrangements. There was no significant change in the standard error about the regression line between the two and three constant equations.

When all of the data were used, only the 298.15 K value of Just (1) fell more than two standard deviations from the regression line. It was omitted and all of the remaining data were fitted by a linear regression to a two constant equation.

The two constant equations obtained from the two data arrangements were essentially identical except that the equation from all of the data had a standard error about the regression line of 8.10×10^{-6} and the Horiuti and the Cook *et al.* data had a standard deviation of 2.89×10^{-6}. The two equations gave the same values of smoothed mole fraction solubilities at 5 degree intervals from 283.15 to 338.15 K to three digits.

The recommended equation for the mole fraction solubility over the temperature interval of 283.15 to 338.15 K is

$$\ln x_1 = -5.5284 - 8.1390/(T/100\mathrm{K})$$

with a standard error about the regression line of 2.89×10^{-6}.

The temperature independent thermodynamic changes from the equation for the transfer of one mole of hydrogen gas from the gas phase at 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\mathrm{kJ\ mol^{-1}}\ 6.767, \text{ and } \Delta\bar{S}_1^\circ/\mathrm{J\ K^{-1}\ mol^{-1}}\ -45.96.$$

Values of the mole fraction solubility and partial molal Gibbs energy of solution are in Table 1.

Table 1. Solubility of hydrogen in benzene at a hydrogen partial pressure of 101.325 kPa (1 atm). Recommended mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta \bar{G}_1^\circ$/kJ mol^{-1}
283.15	2.242	19.782
288.15	2.357	20.012
293.15	2.473	20.242
298.15	2.591	20.471
303.15	2.710	20.701
308.15	2.831	20.931
313.15	2.953	21.161
318.15	3.076	21.391
323.15	3.200	21.621
328.15	3.326	21.850
333.15	3.452	22.080
338.15	3.579	22.310

References:

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.
2. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. (Jpn)* 1931/32, *17*, 125.
3. Maxted, E. B.; Moon, C. H. *Trans. Faraday Soc.* 1936, *32*, 769.
4. Cook, M. W.; Hanson, D. M.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748.
5. Kruyer, S.; Nobel, A. P. P. *Rec. Trav. Chim.* 1961, *80*, 1145.
6. deWet, W. J. *J. S. Afr. Chem. Inst.* 1964, *17*, 9.
7. Krauss, W.; Gestrich, W. *Chem. Tech. (Heidelberg)* 1977, *6*, 35.
8. Puri, P. S.; Ruether, J. A. *Can. J. Chem. Eng.* 1974 , *52*, 636.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	2.61	6.589	7.071
298.15	2.76	6.926	7.560

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(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) Hydrogen; H_2; [1333-74-0]

(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: 280.15 - 335.95
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
280.15	2.170	5.56	5.85
296.05	2.570	6.46	7.00
314.45	2.982	7.33	8.44
335.95	3.570	8.545	10.51

The mole fraction and Bunsen coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.4671 - 8.3096/(T/100K)$

Standard error about the regression line = 2.32×10^{-6}

See hydrogen + benzene evaluation for the recommended equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet is determined at various meniscus heights by weighing a quantity of water. The meniscus height is read with a cathetometer.

The dry gas is introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care is taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas is determined from the gas buret readings, the volume of solvent is determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared by electrolysis.

(2) Benzene. Merck. Extra pure, free from sulfur sample refluxed with sodium amalgam. Boiling point 80.18°C (760 mmHg).

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta x_1/x_1 = 0.005$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Benzene, C_6H_6; [71-43-2]	Maxted, E.B., Moon, C.H., *Trans. Faraday Soc.* 1936, *32*, 769-75.
VARIABLES:	PREPARED BY:
Temperature	C.L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	Mole fraction of hydrogen, x_{H_2}.
273.65	0.0526	0.000204
281.45	0.0572	0.000224
294.35	0.0625	0.000248
303.75	0.0672	0.000270
313.15	0.0727	0.000296

Partial pressure of hydrogen = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Volumetric apparatus with rocking absorption cell. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade.
2. Degassed, high purity sample, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta x_H = \pm 1\%$.

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.;
Alder, B. J.

J. Chem. Phys. 1957, *26*, 748 - 751.

VARIABLES:

T/K: 283.15 - 318.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility[1] mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
283.15	2.884	2.253	5.75	5.96
288.25	3.030			
	3.024			
	3.027 av.	2.364[2]	6.00	6.33
298.15	3.306			
	3.301			
	3.303			
	3.303 av.	2.578	6.46	7.05
308.15	3.595			
	3.582			
	3.596			
	3.591	2.805	6.95	7.84
318.15	3.89			
	3.88			
	3.88_5av.	3.034[2]	7.42	8.64

[1] Data from (1).

[2] Values calculated by compiler from data in (1).

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.6949 - 7.6547/(T/100K)$

Standard error about the regression line = 1.86 x 10^{-7}

See the hydrogen + benzene evaluation for the recommended equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, after temperature equilibrium is reached, the gas is contacted with the degassed solvent. The system is shaken until solubility equilibrium is attained. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co. Mass spectrographic analysis showed gas 99.75 per cent pure. Impurity mostly N_2.

(2) Benzene. Baker and Adamson Reagent Grade. Distilled, used center cut, boiling point 353.15 K. Other solvent properties given in reference 1.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Benzene; C_6H_6; [71-43-2]	Kruyer, S.; Nobel, A.P.P. *Rec. Trav. Chim.* 1961, *80*, 1145-56
VARIABLES:	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Mole fraction of hydrogen, x_{H_2} [a]
298.15	0.071	0.000258

[a] Calculated by compiler for a partial pressure of 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Technique consisted of saturating liquid with hydrogen in a spiral adsorption tube and then stripping out the hydrogen with argon. The resulting argon-hydrogen mixture was analysed with a katharometer.

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen and argon passed through molecular sieve 4A in liquid oxygen and nitrogen trap respectively.

2. Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta L = \pm 3\%$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

de Wet, W. J.

J. S. Afr. Chem. Inst. 1964, *17*, 9 - 13.

VARIABLES:

T/K: 291.65 - 304.55
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
291.65	2.52	6.36	6.79
298.15	2.65	6.65	7.26
304.55	2.86	7.11	7.93

The mole fraction and Ostwald coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.3098 - 8.6944/(T/100K)$

Standard error about the regression line = 3.24×10^{-6}

See the evaluation of the hydrogen + benzene system for the recommended equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modification of that used by Morrison and Billett (1) and others (2). The degassed solvent is saturated with gas as it flows down a glass helix containing the gas. The amount of solvent passed down the helix was such that 10 to 25 cm^3 of gas was absorbed.

Degassing. The solvent is placed in a large continuously evacuated bulb until the solvent boils freely without further release of dissolved gases.

Saturation. The solvent is flowed in a thin film down the glass helix containing the gas. The volume of gas absorbed is measured on an attached buret system.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Gas from commercial cylinders purified over activated charcoal at liquid air temperature. Impurities estimated to be less than 0.3 per cent.

(2) Benzene. Source not given. Distilled immediately before use.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

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

2. Clever, H. L.; Battino, R.; Saylor, J. H.; Gross, P. M. *J. Phys. Chem.* 1957, *61*, 1078.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Benzene; C_6H_6; [71-43-2]	Krauss, W.; Gestrich, W. *Chem.-Tech. (Heidelberg)*, 1977, *6*, 35-37.
VARIABLES:	PREPARED BY:
Temperature	C.L. Young

EXPERIMENTAL VALUES:

T/K	Solubility* S/ mol dm^{-3} bar^{-1}	Mole fraction§ of hydrogen in liquid, x_{H_2}
283.15	0.00235	0.000209
293.15	0.00265	0.000235
303.15	0.00285	0.000260
313.15	0.00310	0.000286

* read off graph, the equations given in the original paper appear to be in error.

§ calculated by compiler for a partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Stirred equilibrium cell. Volumetric apparatus in which a known volume of gas was added to a known volume of liquid and the equilibrium pressure measured. Details in source.	No details given.
	ESTIMATED ERROR:
	$\delta T/K = \pm 0.05$; $\delta x_{H_2} = 5 \times 10^{-6}$ (estimated by compiler)
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Propanone, (Acetone); C_3H_6O; [67-64-1]
3. Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Puri, P.S.; Ruether, J.A.

Can. J. Chem. Eng. 1974, *52*, 636-640.

VARIABLES:

Liquid phase composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Mole fraction of acetone in liquid	Ostwald coefficient, L *
298.15	1.000	0.0943
	0.8536	0.0919
	0.6381	0.0952
	0.4255	0.0890
	0.2233	0.0847
	0.0000	0.0756

* total pressure approximately 10^5Pa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus similar to that described in ref. (1).

Degassed solution placed in calibrated dissolution vessel, gas saturated with solvent vapor introduced from calibrated gas buret. Amount of gas dissolved determined from pressure and volume changes.

SOURCE AND PURITY OF MATERIALS:

1. Liquid Carbonic Canadian Corp. sample purity 99.97 mole per cent.

2.& 3. Baker reagent grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta L = \pm 0.5\%$.

(estimated by compiler)

REFERENCES:

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

COMPONENTS:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Methylbenzene or toluene; C_7H_8; [108-88-3]	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

Six laboratories have reported on the solubility of hydrogen in methylbenzene at a hydrogen partial pressure near 101.325 kPa. Just (1) reported two values at 293.15 and 298.15 K, Cook, Hanson, and Alder (2) reported four values between temperatures of 258.15 and 308.15 K, Saylor and Battino (3) reported one value at 298.15 K, deWet (4) reported three values between temperatures of 291.25 and 305.25 K, Waters, Mortimer and Clements (5) reported four values between temperatures of 263.15 and 293.15 K, and Krauss and Gestrich (6) reported four values between temperatures of 283.15 and 313.15 K.

Comparison of the mole fraction solubility values at 101.325 kPa shows that the data falls into three ranges. The data of Just and of deWet agree and are greater than the other workers. The results of Cook *et al.* and of Saylor and Battino agree within 0.4 per cent and are of intermediate value. The data of Waters *et al.* and of Krauss and Gestrich agree within 3 to 5 per cent and are the low set of values.

All of the data are classed as tentative, but the data of Cook *et al.* are preferred by the evaluator because of their well designed apparatus, and self-consistent results. The values below are based on a linear regression of the Cook *et al.* mole fraction solubility data.

The equation for use between 258.15 and 308.15 K is

$$\ln x_1 = -6.0373 - 6.0307/(T/100\text{K})$$

which has a standard error about the regression line of 7.17×10^{-7}.

The changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas at 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \ 5.01 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \ -50.2.$$

Smoothed values of the mole fraction solubility and Gibbs energy of solution are in Table 1.

Table 1. The solubility of hydrogen in methylbenzene at a hydrogen partial pressure of 101.325 kPa. Mole fraction solubility and the partial molar Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction 10^4x_1	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
258.15	2.31	17.972
268.15	2.52	18.474
278.15	2.73	18.976
288.15	2.94	19.478
298.15	3.15	19.980
308.15	3.37	20.482

References:

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.
2. Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748.
3. Saylor, J. H.; Battino, R. *J. Phys. Chem.* 1958, *62*, 1334.
4. deWet, W. J. *J. S. Afr. Chem. Inst.* 1964, *17*, 9.
5. Water, J. A.; Mortimer, G. A.; Clements, H. E. *J. Chem. Eng. Data* 1970, *15*, 174.
6. Krauss, W.; Gestrich, W. *Chem.-Tech.(Heidelberg)* 1977, *6*, 35.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Methylbenzene or toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	3.70	7.812	8.384
298.15	3.82	8.010	8.742

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(2) Methylbenzene. 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) Hydrogen; H_2; [1333-74-0]

(2) Methylbenzene or toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.; Alder, B. J.

J. Chem. Phys. 1957, *26*, 748-751.

VARIABLES:

T/K: 258.15 - 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility[1] mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
258.15	2.507	2.311	5.06	4.78
273.15	2.844	2.621	5.65	5.65
298.15	3.438 3.436 3.437 av.	3.167	6.64	7.25
308.15	3.685 3.685 3.685 av.	3.369	6.99	7.89

[1] Data from (1).

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -6.0373 - 6.0307/(T/100K)$

Standard error about the regression line = 7.17×10^{-7}

See the hydrogen + methylbenzene evaluation for the recommended equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, after temperature equilibrium is reached, the gas is contacted with the degassed solvent. The system is shaken until solubility equilibrium is attained. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co. Mass spectrographic analysis showed gas 99.75 per cent pure. Impurity mostly N_2.

(2) Methylbenzene. Baker and Adamson Reagent Grade. Distilled, center portion used, b.p. 383.65K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Methylbenzene or toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Saylor, J. H.; Battino, R.

J. Phys. Chem. 1958, *62*, 1334 - 1337.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
298.15	3.18	6.67	7.28

The mole fraction and Bunsen coefficient values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solvent was degassed (2) by evacuating the space above it, shaking, and then passing it as a fine mist into another evacuated container. The degassed solvent was saturated with gas as it passed down a glass helix in a thin film. The glass helix contained the gas and solvent vapor at a total pressure of one atm (1). The volume of the liquid and the volume of the gas absorbed were determined in a system of burets.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. No information given.

(2) Methylbenzene. Malinckrodt reagent grade. Shaken with conc. H_2SO_4, water washed, dried over Drierite, distilled. Boiling point 110.40 - 110.60 °C.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 3$
$\delta x_1/x_1 = 0.04$ (authors)

REFERENCES:

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

2. Baldwin, R. R.; Daniel, S. G. *J. Appl. Chem.* 1952, *2*, 161

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Methylbenzene or toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

de Wet, W. J.

J. S. Afr. Chem. Inst. 1964, *17*, 9 - 13.

VARIABLES:

T/K: 291.25 - 305.25
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
291.25	3.60	7.62	8.12
298.45	3.79	7.95	8.69
305.25	3.98	8.29	9.26

The mole fraction and Ostwald coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.7429 - 6.3694/(T/100K)$

Standard error about regression line = 4.19×10^{-7}

See the evaluation of hydrogen + methylbenzene for the recommended equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modification of that used by Morrison and Billett (1) and others (2). The degassed solvent is saturated with gas as it flows down a glass helix containing the gas. The amount of solvent passed down the helix was such that 10 to 25 cm^3 of gas was absorbed.

Degassing. The solvent is placed in a large continously evacuated bulb until the solvent boils freely without further release of dissolved gases.

Saturation. The solvent is flowed in a thin film down the glass helix containing the gas. The volume of gas absorbed is measured on an attached buret system.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Gas from commercial cylinders purified over activated charcoal at liquid air temperature. Impurities estimated to be less than 0.3 per cent.

(2) Methylbenzene. Source not given. Distilled immediately before use.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

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

2. Clever, H. L.; Battino, R.; Saylor, J. H.; Gross, P. M. *J. Phys. Chem.* 1957, *61*, 1078.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Methylbenzene or toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Waters, J. A.; Mortimer, G. A.; Clements, H. E.

J. Chem. Eng. Data 1970, *15*, 174-176 and 462 (correction).

VARIABLES:

T/K: 263.15 - 293.15

H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	c_{H_2}/mol dm^{-3} $\times 10^3$	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
-10	263.15	2.164	2.23	0.0485	0.0467
0	273.15	2.396	2.49	0.0537	0.0537
10	283.15	2.538	2.67	0.0569	0.0590
20	293.15	2.708	2.88	0.0607	0.0651

The mole fraction and Ostwald coefficient values were calculated from the authors data by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The authors reported two methods of solubility measurement. The hydrogen solubilities were measured by their method A.

The apparatus consisted of two glass bulbs connected by ¼" stainless steel tubing fitted with Hoke valves and a strain gage. The strain gage signal was measured by a potentiometer. The bulbs were immersed in an oil bath. The temperature was measured with a Pt resistance thermometer and Mueller bridge.

The solvent was degassed three times at liquid N_2 temperature. The solvent vapor pressure was measured in the apparatus. Gas in the second bulb at a known P and T was allowed into the bulb containing the solvent. The change in P was followed until equilibrium was reached. The gas uptake was calculated using Charles law. A correction was made for H_2 adsorption on the walls.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Air Reduction Co. Minimum purity 99.50 per cent.

(2) Methylbenzene. Fisher Co. Spectrophotometric grade.

ESTIMATED ERROR:

δP/mmHg = 0.1

δT/K = 0.01

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methylbenzene (Toluene); C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Krauss, W.; Gestrich, W.

Chem.-Tech. (Heidelberg), 1977, *6*, 35-37.

VARIABLES:

Temperature,

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Solubility*/ mol dm^{-3} bar^{-1}	Mole fraction§ of hydrogen in liquid, x_{H_2}
283.15	0.0026	0.00028
293.15	0.00275	0.000295
303.15	0.0029	0.000315
313.15	0.00305	0.000335

* read off graph, the equations given in the original paper appear to be in error.

§ calculated by compiler for a partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell. Volumetric apparatus in which a known volume of gas was added to a known volume of liquid and the equilibrium pressure measured. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 10^{-5}$

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 1,3-Dimethylbenzene (m-Xylene); C_8H_{10}; [108-38-3]

ORIGINAL MEASUREMENTS:

de Wet, W. J.

J. S. Afr. Chem. Inst. 1964, *17*, 9 - 13.

VARIABLES:

T/K: 291.15 - 305.25
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
291.15	3.96	7.25	7.73
298.45	4.14	7.52	8.22
305.25	4.36	7.87	8.79

The mole fraction and Ostwald coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.7584 - 6.0492/(T/100K)$

Standard error about the regression line = 2.21×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
288.15	3.87
293.15	4.01
298.15	4.15
303.15	4.29
308.15	4.43

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modification of that used by Morrison and Billett (1) and others (2). The degassed solvent is saturated with gas as it flows down a glass helix containing the gas. The amount of solvent passed down the helix was such that 10 to 25 cm^3 of gas was absorbed.

Degassing. The solvent is placed in a large continuously evacuated bulb until the solvent boils freely without further release of dissolved gases.

Saturation. The solvent is flowed in a thin film down the glass helix containing the gas. The volume of gas absorbed is measured on an attached buret system.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Gas from commercial cylinders purified over activated charcoal at liquid air temperature. Impurities estimated to be less than 0.3 per cent.

(2) 1,3-Dimethylbenzene (m-Xylene). Source not given. Distilled immediately before use.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

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

2. Clever, H. L.; Battino, R.; Saylor, J. H.; Gross, P. M. *J. Phys. Chem.* 1957, *61*, 1078.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Dimethylbenzene or xylene; C_8H_{10}; [1330-20-7]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	3.99	7.300	7.834
298.15	4.12	7.499	8.185

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.

The author measured the Ostwald coefficients 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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(2) Dimethylbenzene. 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:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) (1-Methylethenyl)benzene or α-methylstyrene; C_9H_{10}; [98-83-9]	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

The system has often been used as a model system in hydrogenation studies. In spite of the importance of the system, the solubility of hydrogen in α-methylstyrene is not known with good accuracy. The solubility measurements from three laboratories do not show good agreement.

Polejes (1,2) reports eighteen solubility measurements at atmospheric pressure over the 286.15 to 315.85 K temperature interval in his thesis, and he has published a graph showing the hydrogen solubility obeys Henry's law at 299.8 K (80°F) and hydrogen partial pressures up to 4.83 MPa (700 psia). Ma (3,4) reports eight measurements at atmospheric pressure over the 303.15 to 333.15 K temperature interval in his thesis and he has published the data in a graph showing the solubility of hydrogen in α-methylstyrene and its hydrogenation product cumene and in a 60 per cent α-methylstyrene 40 per cent cumene mixture. Herskowitz, Morita, and Smith (5) report thirty five solubility measurements at atmospheric pressure over the 287.95 to 346.65 K temperature range. Polejes' values are the lowest, and Ma's values are the highest. The range between low and high values as a per cent of the median value of Herskowitz *et al.* is 30 per cent at 303 K and is 40 per cent at 333 K.

In addition to the measurements above there are two other sets of solubility measurements referenced in the literature which were not available to the *solubility series*. Ma (3) and Sherwood and Farkas (6) reference solubility data of Farkas which apparently were never published. It is probably safe to assume the data of Farkas have been superseded by those of Ma, since both sets of measurements were made in the same laboratory. Herskowitz *et al.* reference unpublished data in the Ph.D. thesis of Ali (7), which they state shows a solubility maximum at 328 K (58°C). An attempt to obtain a copy of the Ali data for the *solubility series* was not successful.

In the opinion of the evaluator there is not enough evidence to justify rejection of any of the three available data sets. The three sets of data are classed as doubtful, but the data of Herskowitz *et al.* are preferred for use. Herskowitz *et al.* give a smoothing equation for their data as a function of temperature with the solubility in mole cm^{-3}. The equation is on their data sheet. If the data of Ali (7) are published they may settle the uncertainty about the system.

References:

1. Polejes, J. D. Ph.D. Thesis, University of Wisconsin, Madison, WI, 1959.

2. Johnson, D. L.; Saito, H.; Polejes, J. D.; Hougen, O. A. *A. I. Chem. Eng. J.* 1957, *3*, 411.

3. Ma, Y. H. Sc.D. Thesis, Massachusetts Institute of Technology, Cambridge, MA, 1967.

4. Satterfield, C. N.; Ma, Y. H.; Sherwood, T. K. *I. Chem. Eng. Symp. Ser.* 1968, No. 28, 22.

5. Herskowitz, M.; Morita, S.; Smith, J. M. *J. Chem. Eng. Data* 1978, *23*, 227.

6. Sherwood, T. K.; Farkas, E. J. *Chem. Eng. Sci.* 1966, *21*, 573.

7. Ali, J. K. Ph.D. Thesis, University of Birmingham, Birmingham, UK, 1974.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) (1-Methylethenyl)benzene or α-methylstyrene; C_9H_{10}; [98-83-9]

ORIGINAL MEASUREMENTS:

Polejes, J. D.
Ph. D. thesis, 1959
University of Wisconsin

Distr. Abstr. 1959, *19*, 3261.

Thesis Director O. A. Hougen

VARIABLES:

T/K: 286.15 - 315.85
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Mol Fraction $x_1 \times 10^4$	c_{H_2}/ mol $cm^{-3} \times 10^6$
13.0	286.15	2.72	2.11
13.9	287.05	2.73	2.12
18.1	291.25	2.80	2.16
19.0	292.15	2.78	2.14
20.4	293.55	2.78	2.14
25.0	298.15	2.89	2.22
28.0	301.15	2.90	2.22
30.5	303.65	2.95	2.25
31.8	304.95	3.03	2.31
34.0	307.15	2.97	2.26
34.2	307.35	3.01	2.29
35.0	308.15	2.94	2.23
37.5	310.65	2.93	2.22
38.0	311.15	3.06	2.32
40.4	313.55	3.14	2.37
42.0	315.15	3.12	2.35
42.5	315.65	3.11	2.34
42.7	315.85	3.03	2.28

Data read from a large scale figure in the thesis.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consisted of a water jacketed flask with magnetic stirrer, a vacuum system, and a gas supply and gas buret.

The solvent was degassed by pumping for twice the time for gas bubble evolution to cease. A measured volume of gas was brought into contact with the solvent, the solvent was stirred until there was no more gas uptake.

There was no mention as to whether or not the gas was presaturated with sovent vapor. The amount of solvent was determined by weight.

The mole fraction solubility was fitted to an equation linear in temperature.

Reference 1 shows a figure of hydrogen solubility in α-methylstyrene at 80 °F (299.82 K). The solubility of hydrogen (dm^3 H_2 (273.15 K, 1 atm)dm^{-3}) obeys Henry's law up to a hydrogen partial pressure of 700 psia. Data for the figure is not in the thesis.

SOURCE AND PURITY OF MATERIALS:

1) Hydrogen.

2) α-Methylstyrene.

The compiler had a copy of the gas solubility part of the thesis, pp 132 - 139. The materials were not described in that part of the thesis.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.05$

REFERENCES:

1. Johnson, D. L.; Saito, H.; Polejes, J. D.; Hougen, O. A. *A. I. Chem. Eng. J.* 1957, *3*, 411.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) (1-Methylethenyl)benzene or α-methylstyrene; C_9H_{10}; [98-83-9]

ORIGINAL MEASUREMENTS:

Ma, Y. H.
Sc. D. thesis, <u>1967</u>
Massachusetts Institute of Technolog

Satterfield, C. N.; Ma, Y. H.;
Sherwood, T. K.
I. Chem. E. Symp. Ser. <u>1968</u>, No. 28,
22 - 29.

VARIABLES:

T/K: 303.15 - 333.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Henry's Constant	C_{H_2}/mol cm^{-3} x 10^6	Mol Fraction
t/°C	T/K	cm^3 atm mol^{-1} H_2		x_1 x 10^4
30	303.15	3.37 x 10^5	2.97	3.89
		3.42 x 10^5	2.92	3.83
40	313.15	2.97 x 10^5	3.37	4.46
		3.03 x 10^5	3.30	4.37
50	323.15	2.82 x 10^5	3.55	4.74
		2.83 x 10^5	3.53	4.72
		2.87 x 10^5	3.48	4.65
60	333.15	2.75 x 10^5	3.64	4.91

The compiler read the Henry's constant values from a large scale graph in the thesis. The same graph appears in the cited paper as figure 2.

Henry's law was of the form p/atm = K c_{H_2} /mol H_2 cm^{-3} solvent.

The values of the concentration of hydrogen and mole fraction hydrogen at one atm partial pressure were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a water-jacketted flask with a magnetic stirrer, a vacuum system, a gas supply, and a monometer system to maintain constant pressure.

Between 150 and 200 cm^3 of solvent is degassed in the flask by stirring and vacuum pumping for three to four times the time for gas bubble evolution to cease.

Gas is admitted to 1 atm total pressure and maintained at 1 atm while the gas dissolves.

The saturated liquid is sampled four times at 15 m intervals with a gas tight syringe. Twenty microliter samples of liquid are analyzed for hydrogen in a gas chromatograph with a seven foot 5 A molecular sieve packed column. The column is kept at 100 °C, the carrier gas is nitrogen, and a thermal conductivity detector is used. The apparatus is calibrated with samples of known H_2 concentration.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen.

(2) α -Methylstyrene.

The compiler had a copy of the gas solubility part of the thesis, pp. 72 - 77, and 99. The materials were not described on those pages.

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta x_1/x_1 = 0.05$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) (1-Methylethenyl)benzene or α-methylstyrene; C_9H_{10}; [98-83-9]

ORIGINAL MEASUREMENTS:

Herskowitz, M.; Morita, S.; Smith, J. M.

J. Chem. Eng. Data 1978, *23*, 227-228.

VARIABLES:

T/K: 287.95 - 346.65
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Hydrogen Solubility, c_{H_2}/mol cm^{-3} x 10^6						Av.	Std.Dev.
14.8	287.95	2.39	2.43	2.45	2.43			2.42$_5$	0.02$_5$
33.8	306.95	2.74	2.74	2.78	2.78	2.70		2.74$_8$	0.03$_3$
41.0	314.15	2.79	2.86	2.82	2.83	2.88		2.83$_6$	0.03$_5$
48.5	321.65	3.08	3.10	3.06	3.06	3.08	3.04	3.07$_0$	0.02$_1$
58.5	331.65	3.09	3.12	3.09	3.16	3.11	3.09	3.11$_0$	0.02$_8$
65.5	338.65	3.18	3.17	3.16	3.16	3.16		3.16$_6$	0.00$_9$
73.5	346.65	3.29	3.26	3.24	3.27			3.26$_5$	0.02$_1$

The authors applied a linear regression to their data to obtain the equation

$$c_{H_2}/\text{mol cm}^{-3} = (2.26 + 0.0145\ t/^{\circ}\text{C}) \times 10^{-6}$$

for the solubility of hydrogen in α-methyl styrene at a hydrogen partial pressure of 101.325 kPa (1 atm) between the temperatures of 15 and 74 °C with a stanard deviation of 0.064 x 10^{-6}. The compiler calculated the average solubilities in the table below.

T/K	Mol Fraction x_1 x 10^4	Bunsen Coefficient α	Ostwald Coefficient L
287.95	3.13	0.0544	0.0573
306.95	3.61	0.0616	0.0692
314.15	3.76	0.0636	0.0731
321.65	4.10	0.0688	0.0810
331.65	4.19	0.0697	0.0846
338.65	4.30	0.0710	0.0880
346.65	4.47	0.0732	0.0929

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solvent was saturated with H_2 at atmospheric pressure by bubbling the gas through the solvent for at least 10 hours. Saturation was approached from both under- and over-saturation.

The saturated solution samples were analyzed on a gas chromatograph. Thirty microliter samples of H_2 saturated solvent were analyzed for H_2 in a gas chromatograph using a 6 m long, 0.63 cm OD diameter column packed with 20-40 mesh 5A molecular sieve particles, with nitrogen as the carrier gas. The apparatus was calibrated with a hydrogen + nitrogen mixture of known composition.

Other solvent names:
Isopropenylbenzene
2-Phenyl-1-propene

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Liquid Carbonic Corp. Stated purity 99.99 per cent.

(2) (1-Methylethenyl)benzene. Dow Chemical Co. Stated purity was 99.2 per cent.

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta c/c = 0.03$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) (1-Methylethyl)-benzene or cumene; C_9H_{12}; [98-82-8]	Ma, Y. H. Sc. D. thesis, 1967 Massachusetts Institute of Technology Satterfield, C. N.; Ma, Y. H.; Sherwood, T. K. *I. Chem. E. Symp. Ser.* 1968, No. 28, 22 - 29.
VARIABLES:	PREPARED BY:
T/K: 303.15 - 333.15 P/kPa: 101.325 (1 atm)	H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Henry's Constant cm^3 atm mol^{-1} H_2	c_{H_2}/mol cm^{-3} x 10^6	Mol Fraction x_1 x 10^4
25	298.15	3.12×10^5	3.21	4.50
		3.10×10^5	3.16	4.43
30	303.15	2.90×10^5	3.45	4.86
40	313.15	2.65×10^5	3.77	5.36
		2.68×10^5	3.73	5.31
50	323.15	2.53×10^5	3.95	5.68
		2.58×10^5	3.88	5.58
60	333.15	2.44×10^5	4.10	5.95

The compiler read the Henry's constant values from a large scale graph in the thesis. The same graph appears in the cited paper as figure 2.

Henry's law was of the form p/atm = K c_{H_2}/mol H_2 cm^{-3} solvent.

The values of the concentration of hydrogen and mole fraction hydrogen at one atm partial pressure were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a water-jacketted flask with a magnetic stirrer, a vacuum system, a gas supply, and a monometer system to maintain constant pressure.

Between 150 and 200 cm^3 of solvent is degassed in the flask by stirring and vacuum pumping for three to four times the time for gas bubble evolution to cease.

Gas is admitted to 1 atm total pressure and maintained at 1 atm while the gas dissolves.

The saturated liquid is sampled four times at 15 m intervals with a gas tight syringe. Twenty microliter samples of liquid are analyzed for hydrogen in a gas chromatograph with a seven foot 5 A molecular sieve packed column. The column is kept at 100°C, the carrier gas is nitrogen, and a thermal conductivity detector is used. The apparatus is calibrated with samples of known H_2 concentration.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen.

(2) Cumene.

The compiler had a copy of the gas solubility part of the thesis, pp. 72 - 77, and 99. The materials were not described on those pages.

ESTIMATED ERROR:

$\delta T/K = 0.1$

$\delta x_1/x_1 = 0.05$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) (1-Methylethenyl)benzene or α-methylstyrene; C_9H_{10}; [98-83-9]; 60 vol %.

(3) (1-Methylethyl)-benzene or cumene; C_9H_{12}; [98-82-8]; 40 vol %.

ORIGINAL MEASUREMENTS:

Ma, Y. H.
Sc. D. thesis, 1967
Massachusetts Institute of Technology

Satterfield, C. N.; Ma, Y. H.; Sherwood, T. K.
I. Chem. E. Symp. Ser. 1968, No. 28, 22 - 29.

VARIABLES:

T/K: 303.15 - 333.15
P/kPa: 101.325 (1 atm)
Cumene/vol %: 40

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Henry's Constant cm^3 atm mol^{-1} H_2	C_{H_2}/mol cm^{-3} x 10^6	Mol Fraction x_1 x 10^4
30	303.15	3.04 x 10^5	3.29	4.43
		3.07 x 10^5	3.26	4.39
40	313.15	2.79 x 10^5	3.58	4.87
		2.84 x 10^5	3.52	4.79
50	323.15	2.63 x 10^5	3.80	5.23
60	333.15	2.59 x 10^5	3.86	5.36

The compiler read the Henry's constant values from a large scale graph in the thesis. The same graph appears in the cited paper as figure 2.

Henry's law was of the form p/atm = K c_{H_2}/mol H_2 cm^{-3} solvent.

The values of the concentration of hydrogen and mole fraction hydrogen at one atm partial pressure were calculated by the compiler.

The solvent is 60 vol % α-methylystyrene, 40 vol % cumene. Assuming no volume change on mixing the solution is 0.617 mole fraction α-methylstyrene.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a water-jacketted flask with a magnetic stirrer, a vacuum system, a gas supply, and a monometer system to maintain constant pressure.

Between 150 and 200 cm^3 of solvent is degassed in the flask by stirring and vacuum pumping for three to four times the time for gas bubble evolution to cease.

Gas is admitted to 1 atm total pressure and maintained at 1 atm while the gas dissolves.

The saturated liquid is sampled four times at 15 m intervals with a gas tight syringe. Twenty microliter samples of liquid are analyzed for hydrogen in a gas chromatograph with a seven foot 5 A molecular sieve packed column. The column is kept at 100°C, the carrier gas is nitrogen, and a thermal conductivity detector is used. The apparatus is calibrated with samples of known H_2 concentration.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen.

(2) α-Methylstyrene.

(3) Cumene.

The compiler had a copy of the gas solubility part of the thesis, pp. 72 - 77, and 99. The materials were not described on those pages.

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta x_1/x_1 = 0.05$

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Benzene, 1,1'-methylenebis-, (Diphenylmethane); $C_{13}H_{12}$; [101-81-5]

ORIGINAL MEASUREMENTS:

Cukor, P.M.; Prausnitz, J.M.

J. Phys. Chem. 1972, *76*, 598-601.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant [a] /atm	Mole fraction of [b] hydrogen in liquid x_{H_2}
300	3464	0.0002886
325	3020	0.0003311
350	2644	0.0003782
375	2322	0.0004306
400	2048	0.0004882
425	1813	0.0005515
450	1610	0.0006211
475	1436	0.0006963

a. Quoted in supplementary material for original paper.

b. Calculated by compiler for a partial pressure of 1 atmosphere.

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:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 2\%$.

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: 1. Hydrogen; H_2; [1333-74-0] 2. 1,2,3,4- Tetrahydronaphthalene, (Tetralin); $C_{10}H_{12}$; [119-62-2]	ORIGINAL MEASUREMENTS: Krauss, W.; Gestrich, W. *Chem. Tech. (Heidelberg)*, 1977, *6*, 35-37.
VARIABLES: Temperature	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Solubility*/ mol dm^{-3} bar^{-1}	Mole fraction§ of hydrogen in liquid, x_{H_2}
283.15	0.0014	0.00019
293.15	0.00165	0.000225
303.15	0.00185	0.000254
313.15	0.00200	0.000277

* read off graph, the equations given in the original paper appear to be in error.

§ calculated by compiler for a partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell. Volumetric apparatus in which a known volume of gas was added to a known volume of liquid and the equilibrium pressure measured. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 10^{-5}$
(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Alcohols

EVALUATOR:

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

1980, September

CRITICAL EVALUATION:

An Evaluation of the Mole Fraction Solubility of Hydrogen in Alcohols at a Hydrogen Partial Pressure of 101.325 kPa (1 atm).

The solubility of hydrogen in alcohols from papers that report the solubility at 200 kPa pressure or less is evaluated in this section. For the compilation and evaluation of the solubility of hydrogen in alcohols from paper that report the solubility at pressures greater than 200 kPa see a later section of the volume.

Most of the solubility measurements evaluated in this section were made at a total pressure near 101.325 kPa (1 atm). Mole fraction solubility values were calculated at a hydrogen partial pressure of 101.325 kPa assuming the gas to be ideal, Henry's law to be obeyed, and the Ostwald coefficient to be independent of pressure. The assumptions probably introduce errors that are less than the experimental error of the solubility measurement.

Hydrogen + Methanol [67-56-1]

Just (1) reported solubility measurements at 293.15 and 298.15 K and Katayama and Nitta (2) reported five measurements between the temperatures of 213.15 and 298.15 K. At 298.15 K Just's mole fraction solubility is 3 per cent greater than Katayama and Nitta's. Although both sets of data are classed as tentative the thermodynamic changes and smoothed solubility values below are based on a linear regression of the Katayama and Nitta data.

The equation for use over the 213.15 to 298.15 K range is

$$\ln x_1 = -7.3644 - 4.0838/(T/100\mathrm{K})$$

with a standard error about the regression line of 8.45×10^{-7}.

The temperature independent thermodynamic changes for the transfer of one mole of hydrogen from the gas at a hydrogen partial pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\mathrm{kJ\ mol^{-1}}\ \ 3.395 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\mathrm{J\ K^{-1}\ mol^{-1}}\ \ -61.2.$$

The smoothed solubility values and the Gibbs energy of solution are given in Table 1.

Table 1. Solubility of hydrogen in methanol at a hydrogen partial pressure of 101.325 kPa. Tentative values of mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction 10^4x_1	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
213.15	0.932	16.447
223.15	1.016	17.059
233.15	1.10	17.671
243.15	1.18	18.283
253.15	1.26	18.896
263.15	1.34	19.508
273.15	1.42	20.120
283.15	1.50	20.733
288.15	1.5	21.039
293.15	1.57	21.345
298.15	1.61	21.651

The single datum of Makranczy *et al.* (7) is several per cent lower than the smoothed solubility values and is classified as doubtful.

Hydrogen + Ethanol [64-17-5]

There are five papers on the solubility of hydrogen in ethanol. The early work of Carius (3) is mostly of historical interest. Only his solubility value at 274.15 K agrees with the results of modern day work. His values at the other temperatures up to 296.85 K are low and show an incorrect sign of the temperature coefficient of solubility. The data should be rejected. Just's (1) two values of 293.15 and 298.15 K are about five per cent greater than modern values and are classed as doubtful.

The measurements of Maxted and Moon (4), Katayama and Nitta (2), and Cargill (5) are in good agreement. The total of nineteen solubility values over the 213.15 to 333.15 K temperature interval from the three papers were combined in a linear regression to obtain the equation

$$\ln x_1 = -7.0155 - 4.3918/(T/100\text{K})$$

with a standard error about the regression line is 2.04×10^{-6}. A three constant equation shows no improvement in the standard error.

The temperature independent thermodynamic changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas at a partial pressure of 101.325 to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \quad 3.65, \text{ and } \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \quad -58.3.$$

The smoothed values of mole fraction solubility and Gibbs energy of solution are in Table 2.

Table 2. The solubility of hydrogen in ethanol at a hydrogen partial pressure of 101.325 kPa. The recommended mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature.

T/K	Mole Fraction* $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
213.15	1.14_5	16.084
223.15	1.25	16.668
233.15	1.36_5	17.251
243.15	1.47_5	17.834
253.15	1.58_5	18.417
263.15	1.69	19.001
273.15	1.80	19.584
283.15	1.90_5	20.167
288.15	1.95_5	20.459
293.15	2.00_5	20.751
298.15	2.06	21.042
303.15	2.11	21.334
313.15	2.21	21.917
323.15	2.30_5	22.501
333.15	2.40	23.084

* Mole fraction values rounded to 0.005×10^{-4}

The single datum of Makranczy *et al.* (7) is several per cent lower than the smoothed solubility values and is classified as doubtful.

Hydrogen + 1-Propanol [71-23-8]

Katayama and Nitta (2) have reported solubility measurements on the hydrogen + 1-propanol system. A linear regression of their five measurements over the 213.15 to 298.15 K temperature interval gives the equation

$$\ln x_1 = -6.9745 - 4.1646/(T/100\text{K})$$

with a standard deviation about the regression line of 2.17×10^{-6}.

The single datum of Makranczy *et al.* (7) is in reasonable agreement with the data in table 3.

The temperature independent thermodynamic changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas at a hydrogen partial pressure of 101.325 to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ \ 3.46, \text{ and } \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ \ -58.0.$$

The smoothed values of mole fraction solubility and Gibbs energy of solution are in Table 3.

Table 3. The solubility of hydrogen in 1-propanol at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction 10^4x_1	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
213.15	1.33	15.823
223.15	1.45	16.403
233.15	1.57	16.983
243.15	1.69	17.562
253.15	1.81	18.142
263.15	1.92	18.722
273.15	2.04	19.302
283.15	2.15	19.882
288.15	2.20	20.172
293.15	2.26	20.462
298.15	2.31	20.752

Hydrogen + 2-Propanol [67-63-0]

Puri and Ruether (6) measured the solubility of hydrogen in mixtures of acetone and 2-propanol at 298.15 K and a total pressure of approximately 10^5Pa. Their Ostwald coefficient measured for hydrogen and pure 2-propanol converts to a mole fraction solubility at 101.325 kPa of 2.66×10^{-4}. The value is classed as tentative.

Hydrogen + 1-Butanol [71-36-3]

Katayama and Nitta (2) report five solubility measurements over the 213.15 to 298.15 K temperature interval, and Makranczy, Rusz, and Balog-Megyery (7) report one measurement at 298.15 K. The two values at 298.15 K agree within 1.5 per cent. The data are classed as tentative.

The six measurements from the two papers were combined in a linear regression to obtain the equation for the 213.15 to 298.15 K temperature interval of

$$\ln x_1 = -6.9350 - 3.8994/(T/100\text{K})$$

with a standard error about the regression line of 2.65×10^{-6}.

The temperature independent thermodynamic changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas phase at a hydrogen partial pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ \ 3.24, \text{ and } \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ \ -57.7.$$

The smoothed values of the mole fraction solubility and the partial molar Gibbs energy of solution are in Table 4.

Table 4. Solubility of hydrogen in 1-butanol at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
213.15	1.57	15.528
223.15	1.70	16.104
233.15	1.83	16.681
243.15	1.96	17.258
253.15	2.09	17.834
263.15	2.22	18.411
273.15	2.34	18.987
283.15	2.46	19.564
288.15	2.52	19.852
293.15	2.58	20.141
298.15	2.64	20.429

Hydrogen + 1-Pentanol [71-41-0]

Just (1) has reported solubility measurements on the hydrogen + 1-pentanol system. On comparison of Just's two values of 293.15 and 298.15 K with the solubility of hydrogen in alcohols of similar molecular weight, Just's values appear to be smaller than expected. The values are classed as doubtful.

The datum of Makranczy *et al.* (7) appears to be more in line with data on both lower and higher alcohols and is classified as tentative.

Hydrogen + 1-Hexanol [111-27-3]

The value of Makranczy *et al.* (7) for this system appears to be in line with data on both lower and higher alcohols and is classified as tentative.

Hydrogen + 1-Heptanol [111-70-6]
Hydrogen + 1-Octanol [111-87-5]

The mole fraction solubility data at 298.15 K of Makranczy *et al.* (7) are considerably lower than those of Ijams (8). The former are classified as tentative and the latter as doubtful.

Hydrogen + 1-Nonanol [143-08-8]
Hydrogen + 1-Decanol [112-30-1]
Hydrogen + 1-Undecanol [112-42-5]
Hydrogen + 1-Dodecanol [112-53-8]

Makranczy *et al.* (7) measured the solubility of hydrogen at 298.15 K in each of the above systems. The results are classified as tentative.

Hydrogen + Cyclohexanol [108-93-0]

Cauquil (9) and Kruyer and Nobel (10) each report one value of the solubility of hydrogen in this system. There is a twofold difference in the two values with the Cauquil value being the higher value. Both values are classed as doubtful. However, comparison of the trends in the solubility of helium and neon in cyclohexanol and aliphatic alcohols of similar molecular weight definitely indicate the lower value of Kruyer and Nobel should be preferred.

References:

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.
2. Katayama, T.; Nitta, T. *J. Chem. Engng. Data.* 1976, *21*, 194.
3. Carius, L. *Justus Liebigs Ann. Chem.* 1855, *94*, 129.
4. Maxted, E. B.; Moon, C. H. *Trans. Faraday Soc.* 1936, *32*, 769.
5. Cargill, R. W. *J. Chem. Soc., Faraday Trans. I* 1978, *74*, 1444.
6. Puri, P. S.; Ruether, J. A. *Can. J. Chem. Eng.* 1974, *52*, 636.
7. Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41.
8. Ijams, C. C. Ph.D. Thesis, Vanderbilt University, Nashville, TN, 1941.
9. Cauquil, G. *J. Chim. Phys.* 1927, *24*, 53.
10. Kruyer, S.; Nobel, A. P. P. *Rec. Trav. Chim.* 1961, *80*, 1145.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Methanol; CH_3OH; [67-56-1]	Just, G. *Z. Phys. Chem.* 1901, *37*, 342 - 367.
VARIABLES: T/K: 293.15 - 298.15 P/kPa: 101.325 (1 atm)	PREPARED BY: M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	1.52	8.401	9.016
298.15	1.57	8.657	9.449

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(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. Hydrogen; H_2; [1333-74-0]
2. Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem.Engng.Data. 1976, *21*, 194-6

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,L	Henry's Constant /atm	Mole fraction* of hydrogen in liquid, x_{H_2}
298.15	0.0975	6160	0.000162
273.15	0.0797	7110	0.000141
253.15	0.0675	7960	0.000126
233.15	0.0557	9090	0.000110
213.15	0.0442	10710	0.0000934

* 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. Takachiho Chemical Industry Co. sample, purity 99.99 mole per cent.
2. Nakarai Chemicals sample, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at 213.15K, ± 0.05 at other temperatures, $\delta x_{H_2} = \pm 1.5\%$

REFERENCES:

1. Nitta, T.; Tatsuishi. A.; Katayama, T. *J.Chem.Eng.Jpn.* 1973, *6*, 475.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 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: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of hydrogen*, x_{H_2}
298.15	101.3	0.0917	0.000153

* calculated by compiler

\+ partial pressure of hydrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.	No details given.
	ESTIMATED ERROR: δx_{H_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) Hydrogen; H_2; [1333-74-0]

(2) Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Carius, L.

Justus Liebigs Ann. Chem. 1855, *94*, 129 - 166.

Also known as *Ann. Chem. Pharm.*

VARIABLES:

T/K: 274.15- 296.85
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
274.15	1.764	6.916	6.941
278.15	1.754	6.847	6.972
284.55	1.752	6.765	7.05
287.55	1.741	6.726	7.08
293.05	1.736	6.668	7.15
296.85	1.734	6.633	7.21

The mole fraction and Ostwald coefficient values were calculated by the compiler.

The values above are not recommended. The value at 274.15 K agrees well with the recent work of Katayama and Nitta (See data sheet). The other values appear to be low and of the wrong temperature coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and method of Bunsen (1) were used.

The apparatus consists of an absorption tube sealed at the low end with a rubber plate, and a water jacket.

The gas is placed in the absorption tube, and its pressure, temperature, and volume determined. The solvent is added, and the system shaken until the volume no longer changes. Final temperature, pressure and volume measurements are made.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared from the reaction of zinc and dilute sulfuric acid.

(2) Ethanol. Absolute alcohol. Specific gravity 0.792 at 20 °C.

ESTIMATED ERROR:

REFERENCES:

1. Bunsen, R. W. *Justus Liebigs Ann. Chem.* 1855, *93*, 1.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(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 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	2.09	8.032	8.620
298.15	2.14	8.186	8.935

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(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: 1. Hydrogen; H_2; [1333-74-0] 2. Ethanol; C_2H_6O; [64-17-5]	ORIGINAL MEASUREMENTS: Maxted, E.B.; Moon, C.H.; *Trans. Faraday Soc.* 1936, *32*, 769-75.
VARIABLES: Temperature	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	Mole fraction of hydrogen, x_{H_2}
273.75	0.0718	0.000183
283.15	0.0737	0.000190
293.45	0.0769	0.000200
298.15	0.0784	0.000205
303.15	0.0802	0.000211
313.15	0.0840	0.000223
313.95	0.0839	0.000223
323.15	0.0864	0.000233

Partial pressure of hydrogen = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD: /APPARATUS PROCEDURE:

Volumetric apparatus with rocking absorption cell. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade.
2. Degassed, high purity sample, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta x_{H_2} = \pm 1\%$.

(estimated by compiler.)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-75-0]
2. Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem. Engng.Data. 1976, *21*, 194-6.

VARIABLES:

Temperature.

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction* of hydrogen in liquid, x_{H_2}
293.15	0.0852	4900	0.000204
273.15	0.0696	5640	0.000177
253.15	0.0580	6400	0.000156
233.15	0.0480	7270	0.000138
213.15	0.0372	8750	0.000114

* 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. Takachiho Chemical Industry Co. sample, purity 99.99 mole per cent.
2. Nakarai Chemicals sample, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at 213.15K, ± 0.05 at other temperatures; $\delta x_{H_2} = \pm 1.5\%$

REFERENCES:

1. Nitta, T.; Tatsuishi, A.; Katayama, T. ; *J. Chem.Eng.Jpn.* 1973, *6*, 475.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Cargill, R. W.

J. Chem. Soc., Faraday Trans. I 1978, *74*, 1444 - 1456.

VARIABLES:

T/K: 278.9 - 333.2
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	10^4 T^{-1}	S_O/cm^3kg^{-1}	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
278.9	35.87	91.6	1.88	7.34	7.49
289.2	34.59	96.4	1.98	7.64	8.09
299.2	33.43	100	2.05_5	7.84	8.59
309.2	32.35	106	2.18	8.2	9.3
320.2	31.24	111	2.28	8.5	10.0
333.2	30.02	115	2.36	8.7	10.6

The mole fraction, Bunsen coefficient, and Ostwald coefficient values were calculated by the compiler.

The solubility, S_O, calculated as cm^3(273.15 K, 101.325 kPa (1 atm)) hydrogen per kg of solvent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Absorption of gas by a thin film of liquid. The Morrison and Billett (1) method was modified by replacing valve A with a constant flow pump and by measuring the mass of the solvent leaving the absorption tube (instead of the volume) on a top-pan balance.

The solvent is degassed using the vapor pump principle (1). Each determination absorbs about 20 cm^3 of gas in up to 500 cm^3 of solvent.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. British Oxygen Co. Gas 99.9 per cent pure, stored over saturated brine.

(2) Ethanol. Absolute alcohol. Sample was 0.98 mole fraction alcohol, 0.02 mole fraction water. (*ca.* 0.8 wt per cent water).

ESTIMATED ERROR:

T/K = 0.1
P/mmHg = 0.5
Solubilities reproducible within 0.5 per cent.

REFERENCES:

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

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0 2. Ethanol; C_2H_6O; [64-17-5]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of hydrogen*, x_{H_2}
298.15	101.3	0.0768	0.000184

* calculated by compiler

\+ partial pressure of hydrogen.

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:

$\delta x_{H_2} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*,3175h.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1-Propanol; C_3H_8O; [71-23-8]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem.Engng. Data. 1976,*21*,194-6

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction* of hydrogen in liquid, x_{H_2}
298.15	0.0763	4270	0.000234
273.15	0.0615	4970	0.000201
253.15	0.0520	5550	0.000180
233.15	0.0426	6360	0.000157
213.15	0.0336	7510	0.000133

* 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. Takachiho Chemical Industry Co. sample, purity 99.99 mole per cent.

2. Nakarai Chemicals sample, distilled, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at 213.15K; ±0.05 at other temperatures; $\delta x_{H_2} = \pm 1.5\%$

REFERENCES:

1. Nitta, T.; Tatsuishi. A.; Katayama, T. *J.Chem.Eng.Jpn.* 1973, *6*,475.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Propanol; C_3H_8O; [71-23-8]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Rusz, L.; Balog-Megyery, K.

Hung. J. Ind. Chem. 1979, *7*, 41-6.

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of hydrogen*, x_{H_2}
298.15	101.3	0.0742	0.000228

* calculated by compiler

\+ partial pressure of hydrogen

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:

$\delta x_{H_2} = \pm 3\%$

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. Hydrogen, H_2; [1333-74-0]] 2. 1-Butanol; $C_4H_{10}O$; [71-36-3]	Katayama, T.; Nitta, T. *J. Chem.Engng.Data.* 1976, *21*,194-6
VARIABLES:	PREPARED BY:
Temperature	C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,L	Henry's Constant /atm	Mole fraction* of hydrogen in liquid, x_{H_2}
298.15	0.0709	3750	0.000267
273.15	0.0577	4320	0.000231
253.15	0.0493	4770	0.000210
233.15	0.0398	5530	0.000181
213.15	0.0324	6340	0.000158

* 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. Takachiho Chemical Industry Co. sample, purity 99.99 mole per cent.
2. Nakarai Chemicals sample, distilled, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at 213.15K; ± 0.05 at other temperature; $\delta x_{H_2} = \pm 1.5\%$

REFERENCES:

1. Nitta, T.; Tatsuishi. A.; Katayama, T. *J. Chem.Eng. Jpn.* 1973,*6*, 475.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1-Butanol; $C_4H_{10}O$; [71-36-3]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES:	PREPARED BY: C.L. Young.

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of hydrogen*, x_{H_2}
298.15	101.3	0.0699	0.000263

* calculated by compiler

\+ partial pressure of hydrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.	No details given.
	ESTIMATED ERROR: $\delta x_{H_2} = \pm 3\%$
	REFERENCES: 1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 1-Pentanol; $C_5H_{12}O$; [71-41-0]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	1.59	3.292	3.533
298.15	1.65	3.397	3.708

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(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:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1-Pentanol; $C_5H_{12}O$; [71-41-0] or 1-Hexanol; $C_6H_{14}O$; [111-27-3]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of hydrogen*, x_{H_2}
		1-Pentanol	
298.15	101.3	0.0604	0.000268
		1-Hexanol	
298.15	101.3	0.0589	0.000301

* calculated by compiler

\+ partial pressure of hydrogen

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:

$\delta x_{H_2} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(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

Thesis Director: L. J. Bircher

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H.L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
1-Heptanol; $C_7H_{16}O$; [111-70-6]			
298.15	3.85	0.0607	0.0663
1-Octanol; $C_8H_{18}O$; [111-87-5]			
298.15	3.92	0.0555	0.0606

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) Hydrogen. 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. Hydrogen; H_2; [1333-74-0] 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:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of hydrogen*, x_{H_2}
		1-Heptanol	
298.15	101.3	0.0546	0.000316
		1-Octanol	
298.15	101.3	0.0513	0.000332

* calculated by compiler

\+ partial pressure of hydrogen.

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:

$\delta x_{H_2} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. 1-Nonanol; $C_9H_{20}O$; [143-08-8] or 1-Decanol; $C_{10}H_{22}O$; [112-30-1]	ORIGINAL MEASUREMENTS: Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of hydrogen*, x_{H_2}
		1-Nonanol	
298.15	101.3	0.0480	0.000343
		1-Decanol	
298.15	101.3	0.0458	0.000358

* calculated by compiler

\+ partial pressure of hydrogen

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:

$\delta x_{H_2} = \pm 3\%$

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. Hydrogen; H_2; [1333-74-0] 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: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of hydrogen*, x_{H_2}
		1-Undecanol	
298.15	101.3	0.0426	0.000362
		1-Dodecanol	
298.15	101.3	0.0404	0.000370

* calculated by compiler

\+ partial pressure of hydrogen

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:

$\delta x_{H_2} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Cyclohexanol; $C_6H_{12}O$; [108-93-0]

ORIGINAL MEASUREMENTS:

Cauquil, G.

J. Chim. Phys. 1927, *24*, 53 - 55.

VARIABLES:

T/K: 299.15
P/kPa: 101 - 102 (760-6
(760 - 766 mmHg)

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
299.15	3.5	0.075	0.082
	3.6	0.076	0.083

The author reported what the compiler believes is an Ostwald coefficient. The compiler calculated the mole fraction and Bunsen coefficient values.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consisted of a flask and a mercury leveling bulb to control the pressure.

The solvent volume was measured, the gas introduced over the solvent, The gas absorbed was found by differnce between the initial and final gas volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. No information.

(2) Cyclohexanol. Source not given. Distilled.

ESTIMATED ERROR:

$\delta L/L = 0.10$ (compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Cyclohexanol; $C_6H_{12}O$; [108-93-0]	Kruyer, S.; Nobel, A.P.P. *Rec. Trav. Chim.* 1961, *80*, 1145-56
VARIABLES:	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Mole fraction of hydrogen, x_{H_2} [a]
298.15	0.039	0.000168

[a] Calculated by compiler for a partial pressure of 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Technique consisted of saturating liquid with hydrogen in a spiral adsorption tube and then stripping out the hydrogen with argon. The resulting argon-hydrogen mixture was analysed with a katharometer.

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen and argon passed through molecular sieve 4A in liquid oxygen and nitrogen trap respectively.

2. Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta L = \pm 3\%$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 2-Propanone, (Acetone); C_3H_6O; [67-64-1] 3. 2-Propanol; C_3H_8O; [67-63-0]	Puri, P.S.; Ruether, J.A. *Can. J. Chem. Eng.* 1974, *52*, 636-640
VARIABLES:	**PREPARED BY:**
Liquid phase composition	C.L. Young

EXPERIMENTAL VALUES:

T/K	Mole fraction of acetone in liquid,	Ostwald coefficient, * L
298.15	1.000	0.0943
	0.736	0.1016
	0.655	0.1038
	0.486	0.1038
	0.351	0.1023
	0.122	0.0920
	0.000	0.0845

* total pressure approximately 10^5Pa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Volumetric apparatus similar to that described in ref. (1). Degassed solution placed in calibrated dissolution vessel, gas saturated with solvent vapor introduced from calibrated gas buret. Amount of gas dissolved determined from pressure and volume changes.	1. Liquid Carbonic Canadian Corp. sample purity 99.97 mole per cent. 2. and 3. Baker Reagent grade.
	ESTIMATED ERROR:
	$\delta T/K = \pm 0.01$; $\delta L = \pm 0.5\%$. (estimated by compiler).
	REFERENCES:
	1. Ben-Naim, A.; Baer, S. *Trans. Faraday. Soc.* 1963, *59*, 2735.

COMPONENTS:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Ethers	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

An Evaluation of the Mole Fraction Solubility of Hydrogen in Ethers at a Hydrogen Partial Pressure of 101.325 kPa (1 atm).

Most of the solubility measurements evaluated in this section were carried out at a total pressure near 101.325 kPa. The mole fraction solubility values at a hydrogen partial pressure of 101.325 kPa were calculated on the assumption that the following statements are true. The gas is ideal, Henry's law is obeyed, and the Ostwald coefficient is independent of pressure. The assumptions introduce errors that are probably smaller than the experimental errors of the solubility measurements.

Hydrogen + 1,1'-Oxybisethane or diethyl ether [60-29-7]

Christoff (1) made one measurement at 273.15 K, and Horiuti (2) made six measurements between the temperatures of 192.55 and 294.25 K of the solubility of hydrogen in diethyl ether. Horiuti's value of the mole fraction solubility at 273.15 K is 6.1 per cent greater than Christoff's value.

Both authors work is classed as tentative. However, the work of Horiuti is preferred. Horiuti's mole fraction solubility values show a definite curvature on a log x_1 *vs.* 1/T plot.

Although the observed curvature may be due to a systematic error in the measurement related to the relatively large vapor pressure of the solvent, the evaluator choses to believe the effect is real and has treated Horiuti's data by a linear regression to obtain the three constant tentative equation for use between 193.15 and 298.15 K.

$$\ln x_1 = -10.3539 + 1.2545/(T/100K) + 2.3384 \ln (T/100K)$$

with a standard error about the regression line of 4.32×10^{-6}.

The three constant equation gives temperature dependent values of the thermodynamic changes of enthalpy and entropy for the transfer of one mole of hydrogen from the gas phase at a partial pressure of 101.325 kPa to the infinitely dilute solution. Values of the thermodynamic changes at several temperatures are given in Table 1. Smoothed values of the mole fraction solubility and the partial molar Gibbs energy of solution as a function of temperature are given in Table 2.

Table 1. Hydrogen + diethyl ether. Changes in enthalpy, entropy and heat capacity for the transfer of one mole of hydrogen from the gas at a partial pressure of 101.325 kPa to the infinitely dilute solution at several temperatures.

T/K	$\Delta\bar{H}_1^\circ$/kJ mol^{-1}	$\Delta\bar{S}_1^\circ$/J K^{-1} mol^{-1}	$\Delta\bar{C}_{p_1}^\circ$ /J K^{-1} mol^{-1}
223.15	3.30	-51.0	19.4
248.15	3.78	-49.0	19.4
273.15	4.27	-47.1	19.4
298.15	4.75	-45.4	19.4

Table 2. The solubility of hydrogen in diethyl ether at a hydrogen partial pressure of 101.325. Tentative values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4\ x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
193.15	2.84	13.112
203.15	3.10	13.646
213.15	3.37	14.170
223.15	3.65	14.685
233.15	3.95	15.191
243.15	4.26	15.688
253.15	4.59	16.178
263.15	4.93	16.660
273.15	5.29	17.135
278.15	5.47	17.370
283.15	5.66	17.602
288.15	5.85	17.834
293.15	6.05	18.063
298.15	6.24	18.291

Hydrogen + 1,1'-Oxybispropane or dipropyl ether [111-43-3]

Guerry (3) measured the solubility at temperatures of 293.15 and 298.15 K. The results are classed as tentative.

Hydrogen + 1,4-Dioxane [123-91-1]

Guerry (3) measured the solubility at temperatures of 293.15 and 298.15 K. Krauss and Gestrich (4) measured the solubility at four temperatures between 283.15 and 313.15 K. The mole fraction value of Guerry is 6.5 per cent larger than the Krauss and Gestrich value at 293.15 K. Both sets of data are classed as tentative. However, the tentative equation and smoothed data below are based on a linear regression of only the data of Krauss and Gestrich. The equation for use from 283.15 to 313.15 K is

$$\ln x_1 = -5.7347 - 8.6743/(T/100\text{K})$$

with a standard error about the regression line of 2.96×10^{-6}.

The temperature independent values for the thermodynamic changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas at a partial pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ 7.21 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ -47.7.$$

Smoothed values of the solubility and partial molar Gibbs energy of solution are in Table 3.

Table 3. Solubility of hydrogen in 1,4-dioxane at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4\ x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
283.15	1.51	20.713
293.15	1.68	21.190
298.15	1.76	21.428
303.15	1.85	21.666
313.15	2.03	22.143

Hydrogen + Tetrahydrofuran [109-99-9]
+ 2,3-Dihydropyran [22512-65-6]
+ Tetrahydro-2*H*-pyran [142-68-7]

Guerry (3) measured the solubility at temperatures of 293.15 and 298.15 K in each of these systems. The results are classed as tentative.

References:

1. Christoff, A. *Z. Phys. Chem.* 1912, *79*, 456.
2. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. (Jpn)* 1931/32, *17*, 125.
3. Guerry, D. Jr. Ph.D. thesis, Vanderbilt University, Nashville, TN 1944.
4. Krauss, W.; Gestrich, W. *Chem.-Tech. (Heidelberg)* 1977, *6*, 35.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 1,1'-Oxybisethane or diethyl ether; $C_4H_{10}O$; [60-29-7]

ORIGINAL MEASUREMENTS:

Christoff, A.

Z. Phys. Chem. 1912, *79*, 456 - 460.

VARIABLES:

T/K: 273.15
P/kPa: Atmospheric

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mole Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
273.15	5.01	11.15	11.15

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.

The value is 6.2 per cent lower that the value reported by Horiuti at 273.15 K. The Horiuti value is preferred.

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) Hydrogen. Prepared by the reaction of zinc and dilute sulfuric acid.

(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) Hydrogen; H_2; [1333-74-0]

(2) 1,1'-Oxybisethane or diethyl ether; $C_4H_{10}O$; [60-29-7]

ORIGINAL MEASUREMENTS:

Horiuti, J.

Sci. pap. Inst. Phys. Chem. Res. (Jpn) 1931/32, *17*, 125 - 256.

VARIABLES:

T/K: 192.55 - 294.25
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
192.55	2.84	7.06	4.98
213.25	3.34	8.10	6.32
233.15	3.98	9.37	8.00
252.05	4.53	10.4	9.64
273.15	5.335	11.88	11.88
294.25	6.060	13.08	14.09

The mole fraction and Bunsen coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -10.3539 + 1.2545/(T/100K) + 2.3384 \ln (T/100K)$

Standard error about the regression line = 4.32×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
193.15	2.84
203.15	3.10
213.15	3.37
223.15	3.65
233.15	3.95
243.15	4.26

T/K	Mol Fraction $x_1 \times 10^4$
253.15	4.59
263.15	4.93
273.15	5.29
283.15	5.66
293.15	6.05
298.15	6.24

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret a solvent reservoir, and an absorption pipet. The volume of the pipet is determined at various meniscus heights by weighing a quantity of water. The meniscus height is read with a cathetometer.

The dry gas is introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care is taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas is determined from the gas buret readings, the volume of solvent is determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared by electrolysis.

(2) 1,1'-Oxybisethane. Merck's "for analysis". Stored over sodium amalgam and distilled before use. Constant boiling within 0.01 degree.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta x_1/x_1 = 0.01$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 1,1'-Oxybispropane or dipropyl ether; $C_6H_{14}O$; [111-43-3]

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

Thesis Director: L. J. Bircher

VARIABLES:

T/K: 293.15, 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	6.15	0.101	0.108
298.15	6.43	0.105	0.115

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) Hydrogen. Air Reduction Co. Purity 99.5 per cent.

(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) Hydrogen; H_2; [1333-74-0]

(2) Cyclic ethers: C_4H_8O, $C_4H_8O_2$; C_5H_8O, and $C_5H_{10}O$

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph. D. thesis, 1944
Vanderbilt University
Nashville, TN

Thesis Director: L. J. Bircher

VARIABLES:

T/K: 293.15, 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

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	2.60	0.0719	0.0771
298.15	2.74	0.0752	0.0821
1,4-Dioxane; $C_4H_8O_2$; [123-91-1]			
293.15	1.79	0.0471	0.0505
298.15	1.93	0.0502	0.0548
2,3-Dihydropyran; C_5H_8O; [25512-65-6]			
293.15	2.68	0.0662	0.0710
298.15	2.64	0.0648	0.0707
Tetrahydro-2H-pyran; $C_5H_{10}O$; [142-68-7]			
293.15	3.12	0.0718	0.0770
298.15	3.24	0.0742	0.0810

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:

(1) Hydrogen. Air Reduction Co. Purity 99.5 per cent.

(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.

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.

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. Hydrogen; H_2; [1333-74-0] 2. 1,4-Dioxane; $C_4H_8O_2$; [123-91-1]	ORIGINAL MEASUREMENTS: Krauss, W.; Gestrich, W. *Chem. - Tech. (Heidelberg)*, 1977 *6*, 35-37.
VARIABLES: Temperature	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Solubility*/ mol dm^{-3} bar^{-1}	Mole fraction§ of hydrogen in liquid, x_{H_2}
283.15	0.00175	0.000150
293.15	0.00195	0.000168
303.15	0.00215	0.000188
313.15	0.0023	0.00020

* read off graph, the equations given in the original paper appear to be in error.

§ calculated by compiler for a partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Stirred equilibrium cell. Volumetric apparatus in which a known volume of gas was added to a known volume of liquid and the equilibrium pressure measured. Details in source.	SOURCE AND PURITY OF MATERIALS: No details given. ESTIMATED ERROR: $\delta T/K = \pm 0.05$; $\delta x_{H_2} = \pm 10^{-5}$ (estimated by compiler) REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) 2-Propanone or acetone; C_3H_6O; [67-64-1]	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

Three laboratories have reported measurements of the solubility of hydrogen in acetone at pressures near 101.325 kPa. Just (1) measured the solubility at 293.15 and 298.15 K, Horiuti (2) made seven measurements over the temperature interval of 191.25 to 313.15 K, and Puri and Ruether (3) measured the Ostwald coefficient of solubility at 298.15 K and a total pressure of approximately 10^5 Pa.

The Just mole fraction solubility values are about 25 per cent less than Horiuti's values, and the Puri and Ruether value is 5.3 per cent less than Horiuti's smoothed value at 298.15 K. The Just values are rejected, and the Horiuti, and Puri and Ruether values are classed as tentative. However, the values of Horiuti are preferred.

A linear regression was made of Horiuti's mole fraction solubility values. A three constant equation appears to be justified, although as with the hydrogen + diethyl ether system, this may be due to an error in the measurement connected with the relatively large solvent vapor pressure. The tentative equation for use over the 193.15 to 313.15 K temperature interval is

$$\ln x_1 = -9.5956 - 1.1902/(T/100\text{K}) + 1.7267 \ln (T/100\text{K})$$

with a standard error about the regression line of 2.40×10^{-6}.

Several values of the temperature dependent enthalpy and entropy changes for the transfer of one mole of hydrogen gas at a partial pressure of 101.325 kPa to the infinitely dilute solution are given in Table 1.

Smoothed values of the mole fraction solubility and partial molar Gibbs energy of solution are given in Table 2.

Table 1. Hydrogen + Acetone. Changes in enthalpy and entropy on transfer of mole of hydrogen from the gas at 101.325 kPa to the infinitely dilute solution.

T/K	$\Delta\bar{H}_1^\circ$/kJ mol^{-1}	$\Delta\bar{S}_1^\circ$/J K^{-1} mol^{-1}	$\Delta\bar{C}_{p_1}^\circ$ /J K^{-1} mol^{-1}
198.15	3.76	-55.6	14.4
223.15	4.19	-53.9	14.4
248.15	4.55	-52.4	14.4
273.15	4.91	-51.0	14.4
298.15	5.27	-49.7	14.4

Table 2. The solubility of hydrogen in acetone at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4\ x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
193.15	1.14	14.574
203.15	1.29	15.130
213.15	1.44	15.679
223.15	1.60	16.221
233.15	1.76	16.757
243.15	1.93	17.287
253.15	2.11	17.811
263.15	2.30	18.329
273.15	2.49	18.841
283.15	2.70	19.349
288.15	2.80	19.600
293.15	2.90	19.851
298.15	3.01	20.100
303.15	3.12	20.348
313.15	3.34	20.841

References:

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.

2. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)* 1931/32, *17*, 125.

3. Puri, P. S.; Ruether, J. A. *Can. J. Chem. Eng.* 1974, *52*, 636.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 2-Propanone or acetone; C_3H_6O; [67-64-1]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	2.14	6.548	7.027
298.15	2.31	7.000	7.641

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(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) Hydrogen; H_2; [1333-74-0]

(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: 191.25 - 313.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
191.25	1.12	3.90	2.73
212.45	1.42	4.83	3.76
232.55	1.77	5.85	4.98
252.25	2.07	6.69	6.18
273.15	2.50	7.83	7.83
294.05	2.95	8.99	9.68
313.15	3.320	9.865	11.31

The mole fraction and Bunsen coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -9.5956 - 1.1902/(T/100K) + 1.7267 \ln (T/100K)$

Standard error about the regression line = 2.40×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
193.15	1.14
203.15	1.29
213.15	1.44
223.15	1.60
233.15	1.76
243.15	1.93
253.15	2.11

T/K	Mol Fraction $x_1 \times 10^4$
263.15	2.30
273.15	2.49
283.15	2.70
293.15	2.90
298.15	3.01
303.15	3.12
313.15	3.34

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet is determined at various meniscus heights by weighing a quantity of water. The meniscus height is read with a cathetometer.

The dry gas is introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care is taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas is determined from the gas buret readings, the volume of solvent is determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared by electrolysis.

(2) 2-Propanone. Nippon Pure Chem. Co. or Merck. Extra pure grade, recrystallized with sodium sulfite. Stored over calcium chloride then fractionated.

Boiling point 56.09°C (760 mmHg).

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta x_1/x_1 = 0.01$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Cyclohexanone; $C_6H_{10}O$; [108-94-1]

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

Thesis Director: L. J. Bircher

VARIABLES:

T/K: 293.15, 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	2.16	0.0467	0.0501
298.15	2.23	0.0480	0.0524

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) Hydrogen. Air Reduction Co. Purity 99.5 per cent.

(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. Hydrogen; H_2; [1333-74-0] 2. Phenol; C_6H_6O; [108-95-2]	Kruyer, S.; Nobel , A.P.P. *Rec. Trav. Chim.* 1961, *80*, 1145-56
VARIABLES:	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Mole fraction of hydrogen, x_{H_2} [a]
298.15	0.033	0.000122

[a] Calculated by compiler for a partial pressure of 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Technique consisted of saturating liquid with hydrogen in a spiral adsorption tube and then stripping out the hydrogen with argon. The resulting argon-hydrogen mixture was analysed with a katharometer.

SOURCE AND PURITY OF MATERIALS:

1. Hydrogen and argon passed through molecular sieve 4A in liquid oxygen and nitrogen trap respectively.

2. "Chemically pure".

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta L = \pm 3\%$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Acetic acid; $C_2H_4O_2$;
[64-19-7]

EVALUATOR:

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

1980, September

CRITICAL EVALUATION:

The solubility of hydrogen in acetic acid was measured at 293.15 and 298.15 K by Just (1) and between 291.75 and 347.95 K by Maxted and Moon (2). The mole fraction solubility values from the two laboratories show some scatter, but in general agree within one to two per cent.

A linear regression was applied to the total of 14 solubility measurements to obtain the tentative equation for use between 289.75 (the melting point of acetic acid) and 348.15 K.

$$\ln x_1 = -6.7248 - 6.2238/(T/100K)$$

with a standard error about the regression line of 1.88 x 10^{-6}.

The temperature independent thermodynamic changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas at a pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \quad 5.17 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \quad -55.9.$$

The smoothed values of the mole fraction solubility and partial molal Gibbs energy of solution are in Table 1.

Table 1. The solubility of hydrogen in acetic acid at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4\ x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
289.75 (m.p.)	1.40	21.375
293.15	1.44	21.565
298.15	1.49	21.845
303.15	1.54	22.124
308.15	1.59	22.404
313.15	1.65	22.684
318.15	1.70	22.963
323.15	1.75	23.242
328.15	1.80	23.522
333.15	1.85	23.801
338.15	1.91	24.081
343.15	1.96	24.361
348.15	2.01	24.640

References:

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.

2. Maxted, E. B.; Moon, C. H. *Trans. Faraday Soc.* 1936, *32*, 769.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Acetic Acid; $C_2H_4O_2$; [64-19-7]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	1.47	5.751	6.172
298.15	1.49	5.799	6.330

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(2) Acetic acid. 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. Hydrogen; H_2; [1333-74-0]

2. Acetic acid; $C_2H_4O_2$; [64-19-7]

ORIGINAL MEASUREMENTS:

Maxted, E.B.; Moon, C.H.;

Trans. Faraday, Soc. 1936, *32*, 769-75.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	Mole fraction of hydrogen, x_{H_2}
291.75	0.0558	0.000142
300.55	0.0596	0.000154
310.65	0.0620	0.000161
318.15	0.0649	0.000170
328.05	0.0676	0.000179
337.95	0.0714	0.000191
347.95	0.0742	0.000201
293.15*	0.0566	0.000145
303.15*	0.0594	0.000153
323.15*	0.0669	0.000176
293.15**	0.0547	0.000140
303.15**	0.0590	0.000152

*and** minor modification of apparatus used, details in source.

Partial pressure of hydrogen = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Volumetric apparatus with rocking absorption cell. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade.
2. Degassed, high purity sample, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta x_{H_2} = \pm 1\%$.

(estimated by compiler.)

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Esters	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

An Evaluation of the Mole Fraction Solubility of Hydrogen in Esters at a Hydrogen Partial Pressure of 101.325 kPa (1 atm).

Most of the solubility measurements evaluated in this section were carried out at a total pressure near 101.325 kPa. The mole fraction solubility values at a hydrogen partial pressure of 101.325 kPa were calculated on the assumption that the following statements are true. The gas is ideal, Henry's law is obeyed, and the Ostwald coefficient is independent of pressure. The assumptions introduce errors that are probably smaller than the experimental errors of the solubility measurement.

Hydrogen + Acetic acid, methyl ester or methyl acetate [79-20-9]

Horiuti (2) measured seven values of the solubility over the 194.65 to 313.15 K temperature interval. There are no other measurements. The work of Horiuti generally has proved to be reliable. The tentative equation for the 193.15 to 313.15 K temperature range was obtained by a linear regression of his data.

$$\ln x_1 = -6.1832 - 5.7501/(T/100K)$$

with a standard error about the regression line of 3.00×10^{-6}.

The temperature independent values of changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas phase at a pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \quad 4.78 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \quad -51.4.$$

Smoothed values of the mole fraction solubility at a hydrogen partial pressure of 101.325 kPa are given on the data sheet.

Hydrogen + Acetic acid,ethyl ester or ethyl acetate [141-78-6]

Just (1) reported solubility values at 293.15 and 298.15 K. Maxted and Moon (3) reported five values over the 273.65 to 312.95 K temperature interval.

Several of the solubility values appear to be inaccurate. The most likely inaccurate values are the 293.15 K value of Just, and either the 273.65 or the 312.95 K value of Maxted and Moon. Linear regressions were made of several combinations of the data. Thermodynamic values of changes in enthalpy and entropy were consistent with other hydrogen + solvent systems when the 293.15 K value of Just and the 273.65 K value of Maxted and Moon were omitted.

The tentative equation for use between 273.15 and 313.15 K is

$$\ln x_1 = -5.8144 - 6.4228/(T/100K)$$

with a standard error about the regression line of 3.77×10^{-6}.

The temperature independent changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas at a pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \quad 5.34 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \quad -48.3.$$

The smoothed solubility data and partial molal Gibbs energy of solution are in Table 1 .

Table 1 . The solubility of hydrogen in ethyl acetate at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
273.15	2.84	18.545
278.15	2.96	18.787
283.15	3.09	19.028
288.15	3.21	19.270
293.15	3.34	19.512
298.15	3.46	19.754
303.15	3.59	19.995
308.15	3.71	20.237
313.15	3.84	20.479

Hydrogen + Acetic acid, 2-methyl propyl ester or
isobutyl acetate [110-19-0]
Hydrogen + Acetic acid, pentyl ester or amyl
acetate [628-63-7]

Only Just (1) has reported solubility measurements on the above systems. His solubility values at 293.15 and 298.15 K are classed as tentative.

References:

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.

2. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)* 1931/32, *17*, 125.

3. Maxted, E. B.; Moon, C. H. *Trans. Faraday Soc.* 1936, *32*, 769.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(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: 194.65 - 313.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
194.65	1.09	3.49	2.49
212.85	1.39	4.34	3.38
233.05	1.72	5.24	4.47
253.05	2.09	6.24	5.78
273.15	2.52	7.30	7.30
294.05	2.93	8.28	8.91
313.15	3.333	9.168	10.51

The mole fraction and Bunsen coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -6.1832 - 5.7501/(T/100K)$

Standard error about the regression line = 3.00×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
193.15	1.05
203.15	1.22
213.15	1.39
223.15	1.57
233.15	1.75
243.15	1.94
253.15	2.13

T/K	Mol Fraction $x_1 \times 10^4$
263.15	2.32
273.15	2.51
283.15	2.71
293.15	2.90
298.15	3.00
303.15	3.10
313.15	3.29

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet is determined at various meniscus heights by weighing a quantity of water. The meniscus height is read with a cathetometer.

The dry gas is introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care is taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas is determined from the gas buret readings, the volume of solvent is determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared by electrolysis.

(2) Acetic acid, methyl ester. Merck. Extra pure grade treated with phosphorous pentoxide several times and distilled several times. Boiling point, 57.12°C (760 mmHg).

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta x_1/x_1 = 0.015$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(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 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	3.20	7.340	7.877
298.15	3.43	7.802	8.516

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(2) Acetic Acid ethyl 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. Hydrogen; H_2; [1333-74-0] 2. Acetic acid, ethyl ester (Ethyl Acetate); $C_4H_8O_2$; [141-78-6]	ORIGINAL MEASUREMENTS: Maxted, E.B.; Moon, C.H.; *Trans. Faraday Soc.* 1936, *32*, 769-75
VARIABLES: Temperature	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	Mole fraction of hydrogen, x_{H_2}
273.65	0.0708	0.000301
283.15	0.0724	0.000312
294.15	0.0761	0.000333
303.15	0.0808	0.000358
312.95	0.0863	0.000387

Partial pressure of hydrogen = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Volumetric apparatus with rocking absorption cell. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade.
2. Degassed, high purity sample, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta x_{H_2} = \pm 1\%$.

(estimated by compiler.)

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(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 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	5.13	8.653	9.287
298.15	5.33	8.940	9.758

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(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) Hydrogen; H_2; [1333-74-0]

(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 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	4.60	6.925	7.432
298.15	4.73	7.089	7.738

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(2) Acetic acid pentyl 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) Hydrogen; H_2; [1333-74-0]

(2) Halocarbons

EVALUATOR:

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

1980, September

CRITICAL EVALUATION:

An Evaluation of the Mole Fraction Solubility of Hydrogen in Halocarbons at a Hydrogen Partial Pressure of 101.325 kPa (1 atm).

Most of the solubility measurements evaluated in this section were made at a total pressure near 101.325 kPa. Mole fraction solubility values were calculated at a hydrogen partial pressure of 101.325 kPa with at least two of the following three assumptions. The gas is ideal, Henry's law is obeyed, and the Ostwald coefficient is independent of pressure. The assumptions introduce errors that are probably less than the experimental error of the solubility measurement.

Hydrogen + Hexadecafluoroheptane or Perfluoroheptane [335-57-9]

Gjaldbaek (1) reported four solubility measurements between the temperatures of 297.88 and 321.90 K. Cook, Hanson, and Alder (2) reported a total 14 measurements at six temperatures between 248.15 and 323.15 K.

Both sets of data are classed as tentative. The two data sets accord well except for Gjaldbaek's values near 321 K which are 8 per cent greater than the smoothed curve through the Cook *et al.* data.

The tentative equation for the 248.15 K to 323.15 K temperature interval was obtained by a linear regression of all of the data of Cook *et al.* and the two values near 298 K of Gjaldbaek.

$$\ln x_1 = -4.7741 - 5.3211/(T/100K)$$

with a standard error about the regression line of 1.98×10^{-5}.

The temperature independent values of the changes in enthalpy and entropy for the transfer of one mole of hydrogen in the gas at 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ 4.42 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ -39.7.$$

The smoothed values of solubility and the partial molal Gibbs energy are given in Table 1. A three constant equation would reproduce the experimental data more closely, but it does not appear justified because of the two solubility measurements between 321 and 322 K that were not used in the linear regression. The evaluator has preferred the data of Cook *et al.* because it has generally proven to be reliable.

Table 1. The solubility of hydrogen in perfluoroheptane at a hydrogen partial pressure of 101.325 kPa. The tentative mole fraction solubility and the partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4\ x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
248.15	9.89	14.274
258.15	10.75	14.671
268.15	11.61	15.068
278.15	12.47	15.465
288.15	13.32	15.862
293.15	13.75	16.060
298.15	14.18	16.259
303.15	14.60	16.457
313.15	15.44	16.854
323.15	16.27	17.251

Hydrogen + Tetrachloromethane [56-23-5]

The solubility of hydrogen in tetrachloromethane has been measured at two laboratories. Horiuti (3) made four measurements between 273.15 and 332.15 K. Cook, Hanson, and Alder (2) made three solubility measurements between the temperatures of 273.15 and 308.15 K. The work of both laboratories is generally reliable and both data sets are classed as tentative. The poorest agreement between the two data sets is at 273.15 K where the experimental values differ by 5.4 per cent with Horiuti's measurement the greater value.

When the two data sets are smoothed by a Gibbs energy equation linear in temperature the two laboratories have the same value of solubility at about 283 K. Above 283 K the Horiuti values are greater by about 2.7 per cent.

A linear regression of all of the data from both laboratories showed the 273.15 K solubility of Horiuti to deviate the most from the regression line. Although the deviation was less than 2 standard deviations an arbitrary decision was made to reject the value. A second linear regression of the remaining six values gave the tentative equation for use over the 273.15 to 333.15 K range.

$$\ln x_1 = -5.6661 - 7.0762/(T/100K)$$

with a standard error about the regression line of 3.95×10^{-6}.

The temperature independent values for the changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas at a pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ 5.88 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ -47.1.$$

Smoothed values of the solubility and partial molal Gibbs energy of solution are in Table 2.

Table 2. The solubility of hydrogen in tetrachloromethane at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction[1] $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
273.15	2.595	18.751
283.15	2.845	19.223
293.15	3.095	19.694
298.15	3.225	19.929
303.15	3.355	20.165
313.15	3.615	20.636
323.15	3.875	21.107
333.15	4.140	21.578

[1] Mole fractions rounded to nearest 0.005×10^{-4}.

Hydrogen + Trichloromethane [67-66-3]

Only Maxted and Moon (4) have measured the solubility of hydrogen in trichloromethane. Their values are classed as tentative. A linear regression of the four solubility values gives the tentative equation for use over the temperature range of 273.15 to 298.15 K of

$$\ln x_1 = -7.1710 - 3.7486/(T/100K)$$

with a standard error about the regression line of 3.57×10^{-6}.

The temperature independent values of the changes in enthalpy and entropy on transfer of one mole of hydrogen from the gas phase at 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \;\; 3.12 \;\; \text{and} \;\; \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \;\; -59.6.$$

Smoothed values of the solubility and the partial molal Gibbs energy of solution are in Table 3.

Table 3. The solubility of hydrogen in trichloromethane at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
273.15	1.97	19.374
278.15	1.99	19.708
283.15	2.02	20.025
288.15	2.07	20.324
293.15	2.13	20.606
298.15	2.20	20.872

Hydrogen + 1,2-Dichloroethane [107-06-2]

Only Waters, Mortimer, and Clements (5) have measured the solubility of hydrogen in 1,2-dichloroethane. Their four solubility values, classed as tentative, were put through a linear regression to obtain the equation for use over the 263.15 to 298.15 K temperature range.

$$\ln x_1 = -5.5837 - 9.1168/(T/100K)$$

with a standard error about the regression line of 1.89×10^{-6}.

The temperature independent values of the changes of enthalpy and entropy for the transfer of one mole hydrogen from the gas phase at a partial pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \;\; 7.58 \;\; \text{and} \;\; \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \;\; -46.4.$$

The smoothed values of solubility and the partial molal Gibbs energy of solution are in Table 4.

Table 4. The solubility of hydrogen in 1,2-dichloroethane at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
263.15	1.18	19.797
273.15	1.335	20.261
283.15	1.50	20.725
288.15	1.59	20.957
293.15	1.68	21.189
298.15	1.77	21.422

Hydrogen + 1,1,2,2-Tetrachloroethane [79-34-5]

Only deWet (6) has measured the solubility of hydrogen in 1,1,2,2-tetrachloroethane. A linear regression applied to his three tentative solubility values gives the equation for the 288.15 to 308.15 K temperature interval of

$$\ln x_1 = -6.5798 - 3.6640/(T/100K)$$

with a standard error about the regression line of 3.51×10^{-6}.

The values of the temperature independent changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas phase at a partial pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ 3.05 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ -54.7.$$

The smoothed solubility values and partial molal Gibbs energy of solution are in Table 5.

Table 5. The solubility of hydrogen in 1,1,2,2-tetrachloroethane at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4\ x_1$	$\Delta\bar{G}_1^\circ/\text{kJ mol}^{-1}$
288.15	3.89	18.810
293.15	3.98	19.084
298.15	4.06	19.357
303.15	4.14	19.631
308.15	4.23	19.904

Hydrogen + 1-Chlorohexane [544-10-5]

Guerry (7) has measured the solubility of hydrogen in 1-chlorohexane at the temperatures of 293.15 and 298.15 K. The values are classed as tentative.

Hydrogen + Chlorobenzene [108-90-7]

Horiuti (3) measured the solubility of hydrogen in chlorobenzene at seven temperatures between 232.25 and 353.95 K. His values of solubility are the only ones for the system and they are classed as tentative.

A graph of the data of Horiuti as $\ln x_1$ *vs.* $1/T$ shows a systematic deviation from linearity. Linear regressions for a two constant and a three constant equation show a four fold improvement in the standard error. Thus, the tentative equation for use over the 233.15 to 353.15 K temperature range is the three constant equation

$$\ln x_1 = -10.0240 - 0.7256/(T/100K) + 1.8288 \ln (T/100K)$$

with a standard error about the regression line of 1.44×10^{-6}.

The three constant equation gives temperature dependent values of the changes of enthalpy and entropy for the transfer of one mole of hydrogen from the gas phase at 101.325 kPa partial pressure to the infinitely dilute solution. Values of the thermodynamic changes at several temperatures are given in Table 6.

Table 6. Thermodynamic changes for the dissolution of hydrogen in chlorobenzene as a function of temperature.

T/K	$\Delta\bar{H}_1^\circ$/kJ mol^{-1}	$\Delta\bar{S}_1^\circ$/J K^{-1} mol^{-1}	$\Delta\bar{C}_{p_1}^\circ$/J K^{-1} mol^{-1}
233.15	4.15	-55.3	15.2
273.15	4.76	-52.9	15.2
298.15	5.14	-51.5	15.2
323.15	5.52	-50.3	15.2
353.15	5.97	-49.0	15.2

Smoothed values of the solubility and partial molal Gibbs energy of solution are in Table 7.

Table 7. The solubility of hydrogen in chlorobenzene at a partial pressure of hydrogen of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4\, x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
233.15	1.53	17.034
243.15	1.67	17.583
253.15	1.82	18.126
263.15	1.97	18.663
273.15	2.13	19.195
283.15	2.30	19.721
288.15	2.39	19.982
293.15	2.47	20.241
298.15	2.56	20.499
303.15	2.65	20.756
313.15	2.84	21.267
323.15	3.02	21.772
333.15	3.22	22.273
343.15	3.42	22.769
353.15	3.63	23.261

Hydrogen + 1,1,2-Trichloro-1,2,2-trifluoroethane
or Freon 113 [76-13-1]

Linford and Hildebrand (8) report values of the solubility at seven temperatures between 276.85 and 301.75 K. The data are classed as tentative. A linear regression of the data gives the equation for use over the temperature interval of 273.15 to 303.15 K of

$$\ln x_1 = -5.3371 - 5.9346/(T/100K)$$

with a standard error about the regression line of 2.88 x 10^{-6}.

The temperature independent values of the changes in enthalpy and entropy on transfer of one mole of hydrogen from the gas phase at a partial pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ 4.93 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ -44.4.$$

There is a table of smoothed mole fraction solubility values on the data sheet.

The authors also report the solubility of hydrogen in several mixtures of benzene + 1,1,2-trichloro-1,2,2-trifluoroethane.

Hydrogen + 1-Bromoheptane [629-04-9]

Ijams (9) measured one value of the solubility at a temperature of 298.15 K. The value is classed as tentative.

References:

1. Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623.
2. Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748.
3. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)* 1931/32, *17*, 125.
4. Maxted, E. B.; Moon, C. H. *Trans. Faraday Soc.* 1936, , 769.
5. Waters, J. A.; Mortimer, G. A.; Clements, H. E. *J. Chem. Eng. Data* 1970, *15*, 174.
6. deWet, W. J. *J. S. Afr. Chem. Inst.* 1964, *17*, 9.
7. Guerry, D. Jr. Ph.D. thesis, Vanderbilt University, Nashville, TN, 1944.
8. Linford, R. G.; Hildebrand, J. H. *Trans. Faraday Soc.* 1970, *66*, 577.
9. Ijams, C. C. Ph.D. thesis, Vanderbilt University, Nashville, TN, 1941.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Hexadecafluoroheptane or perfluoroheptane; C_7F_{16}; [335-57-9]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.; Alder, B. J.

J. Chem. Phys. 1957, *26*, 748-751.

VARIABLES:

T/K: 248.15 - 323.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility[1] mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
248.15	2.589	10.037	10.45	9.49
273.15	3.077	11.927	12.15	12.15
285.25	3.333			
	3.334			
	3.333_5 av.	12.922	13.03	13.60
298.15	3.613			
	3.616			
	3.615			
	3.614			
	3.614_5 av.	14.007	13.96	15.24
308.15	3.853			
	3.849			
	3.849			
	3.850			
	3.850_3 av.	14.920	14.74	16.63
323.15	4.29			
	4.30			
	4.29_5 av.	16.64[2]	16.21	19.18

[1] Data from (1).

[2] Mole fraction value calculated by the compiler.

The Bunsen and Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, after temperature equilibrium is reached, the gas is contacted with the degassed solvent. The system is shaken until solubility equilibrium is attained. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co. Mass spectrographic analysis showed gas 99.75 per cent pure. Impurity mostly N_2.

(2) Hexadecafluoroheptane. Source not given. Distilled, center portion used, b.p. 355.65K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.
2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

Smoothed Data: $\ln x_1 = -12.1850 + 4.9152/(T/100K) + 3.6328 \ln (T/100)$

Standard error about the regression line = 9.85×10^{-6}

See the hydrogen + hexadecafluoroheptane evaluation for the recommended equation.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Hexadecafluoroheptane or Perfluoroheptane; C_7F_{16}; [335-57-9]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.

Acta. Chem. Scand. 1952, *6*, 623-633.

VARIABLES:

T/K: 297.88 - 321.90
P/kPa: 101.325 (1 atm)

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^3x_1	Bunsen Coefficient $10^2\alpha$	Ostwald Coefficient 10^2L
297.88	14.2	14.1	15.4
297.95	14.1	14.0	15.3
321.45	17.4	16.6	19.5
321.90	17.4	16.6	19.6

The Ostwald and mole fraction solubility values were calculated by the compiler at 101.325 kPa (1 atm) hydrogen pressure assuming Henry's law is obeyed.

Smoothed Data: $\ln x_1 = -3.8039 - 8.2063/(T/100K)$

Standard error about the regression line is 5.85×10^{-6}.

See the hydrogen + hexadecafluoroheptane evaluation for the recommended equation.

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 reference 1.

The absorped volume of gas is calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent is determined by the weight of displaced mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Freed from oxygen and dried. 99.5 per cent H_2, 0.5 per cent N_2.

(2) Hexadecafluoroheptane. Sample described in earlier paper (2).

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.; Hildebrand, J.H.
J. Am. Chem. Soc. 1949, *71*, 3147.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Tetrachloromethane or carbon tetrachloride; CCl_4; [56-23-5]

ORIGINAL MEASUREMENTS:

Horiuti, J.

Sci. pap. Inst. Phys. Chem. Res. (Jpn) 1931/32, *17*, 125-256.

VARIABLES:

T/K: 273.15 - 332.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
273.15	2.73	6.50	6.50
294.05	3.18	7.38	7.94
311.95	3.58	8.13	9.28
332.15	4.128	9.243	11.24

The mole fraction and Bunsen coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.9012 - 6.3128/(T/100K)$

Standard error about the regression line = 4.10×10^{-6}

See the hydrogen + tetrachloromethane evaluation for the recommended equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet is determined at various meniscus heights by weighing a quantity of water. The meniscus height is read with a cathetometer.

The dry gas is introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care is taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas is determined from the gas buret readings, the volume of solvent is determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared by electrolysis.

(2) Tetrachloromethane. Kahlbaum. Dried, and distilled.

Boiling point 76.74°C (760 mmHg).

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta x_1/x_1 = 0.01$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Tetrachloromethane or carbon tetrachloride; CCl_4; [56-23-5]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.; Alder, B. J.

J. Chem. Phys. 1957, *26*, 748 - 751.

VARIABLES:

T/K: 273.15 - 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility[1] mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
273.15	1.688	2.589	6.16	6.16
298.15	2.078	3.193	7.37	8.05
308.15	2.245	3.447	7.86	8.87

[1] Data from (1).

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.7435 - 6.8721/(T/100K)$

Standard error about the regression line = 4.16×10^{-7}

See the hydrogen + tetrachloromethane evaluation for the recommended equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, after temperature equilibrium is reached, the gas is contacted with the degassed solvent. The system is shaken until solubility equilibrium is attained. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co. Mass spectrographic analysis showed gas 99.75 per cent pure. Impurity mostly N_2.

(2) Tetrachloromethane. Baker and Adamson Reagent Grade. Distilled, center portion used, b.p. 349.95K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Trichloromethane (Chloroform); $CHCl_3$; [67-66-3]	Maxted, E.B., Moon, C.H. *Trans. Faraday Soc.* 1936, *32*, 769-75.
VARIABLES:	PREPARED BY:
Temperature	C.L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	Mole fraction of hydrogen, x_{H_2}
274.15	0.0563	0.000197
283.15	0.0576	0.000204
291.85	0.0584	0.000209
298.45	0.0614	0.000222

Partial pressure of hydrogen = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Volumetric apparatus with rocking absorption cell. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade.
2. Degassed, high purity sample, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta x_{H_2} = \pm 1\%$.

(estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 1,2-Dichloroethane; $C_2H_4Cl_2$; [107-06-2]

ORIGINAL MEASUREMENTS:

Waters, J. A.; Mortimer, G. A.; Clements, H. E.

J. Chem. Eng. Data 1970, *15*, 174 - 176 and 462 (correction).

VARIABLES:

T/K; 263.15 - 298.15
H_2 P/KPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	c_{H_2}/mol dm^{-3} atm^{-1} x 10^3	Mol Fraction x_1 x 10^4	Bunsen Coefficient α	Ostwald Coefficient L
-10	263.15	1.557	1.18	0.0349	0.0336
0	273.15	1.739	1.34	0.0390	0.0390
10	283.15	1.890	1.48	0.0425	0.0441
25	298.15	2.239	1.78	0.0502	0.0548

The mole fraction and Ostwald coefficient values were calculated from the authors data by the compiler.

The authors also reported the vapor pressure of the solvent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The authors reported two methods of solubility measurement. The hydrogen solubilities were measured by their method A.

The apparatus consisted of two glass bulbs connected by ¼" stainless steel tubing fitted with Hoke valves and a strain gage. The strain gage signal was measured by a potentiometer. The bulbs were immersed in an oil bath. The temperature was measured with a Pt resistance thermometer and Mueller bridge.

The solvent was degassed three times at liquid N_2 temperature. The solvent vapor pressure was measured in the apparatus. Gas in the second bulb at a known P and T was allowed into the bulb containing the solvent. The change in P was followed until equilibrium was reached. The gas uptake was calculated using Charles law A correction was made for H_2 adsorption on the walls.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Air Reduction Co. Minimum purity 99.50 per cent.

(2) 1,2-Dichloroethane. Monsanto Co. Purity 99.95 per cent.

ESTIMATED ERROR:

δP/mmHg = 0.1
δT/K = 0.01

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 1,1,2,2-Tetrachloroethane; $C_2Cl_4H_2$; [79-34-5]

ORIGINAL MEASUREMENTS:

de Wet, W. J.

J. S. Afr. Chem. Inst. 1964, *17*, 9 - 13.

VARIABLES:

T/K: 291.45 - 304.85
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
291.45	3.96	8.42	8.98
299.15	4.05	8.58	9.40
304.85	4.19	8.84	9.87

The mole fraction and Ostwald coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -6.5798 - 3.6640/(T/100K)$

Standard error about the regression line = 3.51×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
288.15	3.89
293.15	3.98
298.15	4.06
303.15	4.15
308.15	4.23

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modification of that used by Morrison and Billett (1) and others (2). The degassed solvent is saturated with gas as it flows down a glass helix containing the gas. The amount of solvent passed down the helix was such that 10 to 25 cm^3 of gas was absorbed.

Degassing. The solvent is placed in a large continuously evacuated bulb until the solvent boils freely without further release of dissolved gases.

Saturation. The solvent is flowed in a thin film down the glass helix containing the gas. The volume of gas absorbed is measured on an attached buret system.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Gas from commercial cylinders purified over activated charcoal at liquid air temperature. Impurities estimated to be less than 0.3 per cent.

(2) 1,1,2,2-Tetrachloroethane. Source not given. Distilled immediately before use.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033; *Ibid.* 1952, 3819.
2. Clever, H. L.; Battino, R.; Saylor, J. H.; Gross, P. M. *J. Phys. Chem.* 1957, *61*, 1078.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 1-Chlorohexane; $C_6H_{13}Cl$; [544-10-5]

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

Thesis Director: L. J. Bircher

VARIABLES:

T/K: 293.15, 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	4.38	0.0715	0.0767
298.15	4.46	0.0724	0.0791

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) Hydrogen. Air Reduction Co. Purity 99.5 per cent.

(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) Hydrogen; H_2; [1333-40-7]

(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: 232.25 - 353.95

P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
232.25	1.52	3.56	3.03
252.65	1.80	4.13	3.82
273.15	2.13	4.79	4.79
294.35	2.51	5.52	5.95
313.15	2.83	6.12	7.02
333.45	3.24	6.86	8.37
353.95	3.63	7.53	9.76

The mole fraction and Bunsen coefficient values were calculated by the compiler.

Smoothed Data: $\ln x_1 = -10.0240 - 0.7256/(T/100K) + 1.8288 \ln (T/100K)$

Standard error about the regression line = 1.44×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
233.15	1.53
243.15	1.67
253.15	1.82
263.15	1.97
273.15	2.13
283.15	2.30
293.15	2.47

T/K	Mol Fraction $x_1 \times 10^4$
298.15	2.56
303.15	2.65
313.15	2.84
323.15	3.02
333.15	3.22
343.15	3.42
353.15	3.63

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet is determined at various meniscus heights by weighing a quantity of water. The meniscus height is read with a cathetometer.

The dry gas is introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care is taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas is determined from the gas buret readings, the volume of solvent is determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Prepared by electrolysis.

(2) Chlorobenzene. Kahlbaum. Dried, and distilled. Boiling point 131.96°C(760 mmHg).

ESTIMATED ERROR:

$\delta T/K = 0.05$

$\delta x_1/x_1 = 0.01$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 1,1,2-Trichloro-1,2,2-trifluoroethane or Freon 113; $C_2Cl_3F_3$; [76-13-1]

ORIGINAL MEASUREMENTS:

Linford, R. G.; Hildebrand, J. H.

Trans. Faraday Soc. 1970, *66*, 577 - 581.

VARIABLES:

T/K: 276.85 - 301.75
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
276.85	5.64	10.9	11.0
281.65	5.88	11.3	11.7
286.87	6.07	11.5	12.1
288.55	6.11	11.6	12.3
298.15	6.55	12.3	13.4
300.90	6.70	12.5	13.8
301.75	6.76	12.6	13.9

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.3371 - 5.9346/(T/100K)$

Standard error about the regression line = 2.88×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
273.15	5.48
278.15	5.70
283.15	5.91
288.15	6.13
293.15	6.35
298.15	6.57
303.15	6.79

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 sligs of degassed solvent into the gas. The amount of gas dissolved is calculated from the initial and final gas pressures.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Stuart Oxygen Co. Dried.

(2) 1,1,2-Trichloro-1,2,2-trifluoroethane. Matheson, Coleman and Bell. Spectroquality.

ESTIMATED ERROR:

REFERENCES:

1. Dymond, J.; Hildebrand, J. H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Benzene; C_6H_6; [71-43-2] (3) 1,1,2-Trichloro-1,2,2-trifluoroethane or Freon 113; $C_2Cl_3F_3$; [76-13-1]	Linford, R. G.; Hildebrand, J. H. *J. Phys. Chem.* 1969, *73*, 4410-4411.

VARIABLES:	PREPARED BY:
T/K: 298.15 P/kPa: 101.325 (1 atm) C_6H_6/x_2: 0.341, 0.695	D. G. T. Thornhill

EXPERIMENTAL VALUES:

T/K	Benzene Mol Fraction x_2	Hydrogen Mol Fraction $10^4 \times x_1$
298.15	0.000	6.55[a]
	0.341	3.35
	0.695	3.96
	1.000	2.58[b]

a. Linford, R. G.; Hildebrand, J. H. *Trans. Faraday Soc.* 1970, *66*, 577.

b. Cook, H. W.; Hansen, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748.

The hydrogen solubility is almost a linear function of the benzene mole fraction. The equation $x_1 = 6.63 \times 10^{-4} - 3.96 \times 10^{-4}\ x_2$ reproduces the hydrogen solubility with an average deviation of 2 per cent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturation of the liquid mixtures with dry gas. The gas solubilities were calculated from the initial and final volumes and pressures of gas. The mole fraction solubilities of gas were corrected to 101.325 kPa (1 atm) partial pressure by Henry's law.

The Dymond-Hildebrand (1) apparatus was used. Each liquid mixture (total volume 250 cm^3) was degassed by a freeze-thaw technique and loaded into the absorption vessel. Dry gas was then added to this vessel from a buret, and the liquid and gas were mixed together by means of a magnetically-operated all-glass pump. The pump allowed a thin film of liquid mixture to be repeatedly exposed to the gas, and thus speeded the attainment of equilibrium (c.a. 30 minutes).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Stated to be highest purity commercially obtainable. Dried before use.
(2) Benzene. Matheson, Coleman and Bell "Spectroquality". Used as received.
(3) 1,1,2-Trichloro-1,2,2-trifluoroethane. Matheson, Coleman and Bell "Spectroquality". Used as received.

ESTIMATED ERROR:

Temperature control was ± 0.05K (reference 1).
$\delta x_1/x_1 = \pm\ 0.01$ (evaluator).

REFERENCES:

1. Dymond, J. H.; Hildebrand, J. H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(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 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	3.99	0.0570	0.0622

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) Hydrogen. 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:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Carbon disulfide; CS_2; [75-15-0]	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

Three laboratories have reported values of the solubility of hydrogen in carbon disulfide. Just (1) reported solubility measurements at 293.15 and 298.15 K which are 40 to 45 per cent smaller than more recent values. The Just data are rejected. Gjaldbaek (2) reported two solubility values near 298 K and Cook, Hanson and Alder (3) reported values at temperatures of 248.15, 273.15, and 298.15 K. The Gjaldbaek and the Cook *et al.* value agree within 2.5 per cent. Both sets of values are classed as tentative, however, the difference is greater than the accuracy claimed for the results of Cook *et al.* The tentative smoothed values are based entirely on a linear regression of the Cook *et al.* data.

The tentative equation for the mole fraction solubility over the 248.15 to 298.15 K temperature range is

$$\ln x_1 = -6.2421 - 7.4625/(T/100K)$$

with a standard error about the regression line of 1.19×10^{-6}.

The values of the temperature independent changes in enthalpy and entropy for the transfer of one mole of hydrogen from the gas at 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1}\ 6.20 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1}\ -51.9.$$

The smoothed values of the mole fraction solubility and partial molal Gibbs energy of solution are in Table 1.

Table 1. The solubility of hydrogen in carbon disulfide at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4\ x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
248.15	0.962	19.083
258.15	1.081	19.602
268.15	1.204	20.121
278.15	1.330	20.640
288.15	1.460	21.159
298.15	1.593	21.678

References:

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.

2. Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623.

3. Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Carbon disulfide; CS_2; [75-15-0]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K: 293.15, 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	0.842	3.128	3.358
298.15	0.931	3.438	3.753

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(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) Hydrogen; H_2; [1333-74-0] (2) Carbon disulfide; CS_2; [75-15-0]	ORIGINAL MEASUREMENTS: Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623-633.
VARIABLES: T/K: 297.97, 298.01 P/kPa: 101.325 (1 atm)	PREPARED BY: J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
297.97	1.64	6.06	6.61
298.01	1.64	6.07	6.62

The Ostwald and mole fraction solubility values were calculated by the compiler. The solubilities are reported for an hydrogen partial pressure of 101.325 kPa (1 atm) assuming Henry's law is obeyed.

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 reference 1.

The absorbed volume of gas is calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent is determined by the weight of displaced mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Freed from oxygen and dried. 99.5 per cent H_2, 0.5 per cent N_2.

(2) Carbon disulfide. Merck. Analytical reagent grade. Distilled, boiling point 46.21 - 46.26°C.

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.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Carbon disulfide; CS_2; [75-15-0]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.;
Alder, B. J.

J. Chem. Phys. 1957, *26*, 748 - 751.

VARIABLES:

T/K: 248.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility[1] mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α	Ostwald Coefficient L
248.15	1.270	0.965	0.0378	0.0343
273.15	1.656	1.257	0.0478	0.0478
298.15	2.101	1.599[2]	0.0591	0.0645

[1] Data from (1).

[2] Recalculated by compiler from data in (1). Original paper gave 1.589.

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -6.2421 - 7.4625/(T/100K)$

Standard error about the regression line = 1.19×10^{-6}

See the evaluation of the hydrogen + carbon disulfide system for the recommended equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, after temperature equilibrium is reached, the gas is contacted with the degassed solvent. The system is shaken until solubility equilibrium is attained. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Co. Mass spectrographic analysis showed gas 99.75 per cent pure. Impurity mostly N_2.

(2) Carbon disulfide. Baker and Adamson Reagent Grade. Distilled, center portion used, b.p. 319.65K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:	EVALUATOR:
(1) Hydrogen; H_2; [1333-74-0] (2) Sulfinylbismethane or dimethylsulfoxide; C_2H_6OS; [67-68-5]	H. L. Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1980, September

CRITICAL EVALUATION:

Two workers have reported solubility measurements on the hydrogen + dimethylsulfoxide system. Dymond (1) reports one solubility measurement at 298.15 K and Symons (2) reports six measurements over the 298.15 to 353.15 K temperature interval.

Both sets of data are classed as tentative. Dymond's experimental method is capable of better precision than Symons' method. The two agree well at the common temperature of measurement of 298.15 K. The temperature coefficient of solubility is determined by Symons data. The enthalpy of solution appears to be greater than expected when compared with the enthalpy of solution of similar solvents. Thus, there is reason to use the data with some caution.

A linear regression was applied to the seven mole fraction solubility values from the two papers to obtain the tentative equation for use between 298.15 and 353.15 K.

$$\ln x_1 = -6.0383 - 10.2726/(T/100K)$$

with a standard error of about the regression line of 7.25×10^{-6}.

The values of the temperature independent changes in enthalpy and entropy on transfer of one mole of hydrogen from the gas at 101.325 kPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^\circ/\text{kJ mol}^{-1} \quad 8.54 \quad \text{and} \quad \Delta\bar{S}_1^\circ/\text{J K}^{-1}\text{ mol}^{-1} \quad -50.2.$$

The smoothed values of mole fraction solubility and the partial molal Gibbs energy are in Table 1.

Table 1. The solubility of hydrogen in dimethylsulfoxide at a hydrogen partial pressure of 101.325 kPa. Tentative values of the mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_1$	$\Delta\bar{G}_1^\circ$/kJ mol^{-1}
298.15	0.76	23.51
308.15	0.85	24.01
318.15	0.945	24.51
328.15	1.04	25.02
338.15	1.14	25.52
348.15	1.25	26.02

References:

1. Dymond, J. H. *J. Phys. Chem.* 1967, *71*, 1829.

2. Symons, E. A. *Can. J. Chem.* 1971, *49*, 3940.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Sulfinylbismethane or Dimethyl Sulfoxide; C_2H_6OS (CH_3SOCH_3); [67-68-5]

ORIGINAL MEASUREMENTS:

Dymond, J. H.

J. Phys. Chem. 1967, *71*, 1829-1831.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
298.15	0.761	2.39	2.61

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) Hydrogen. Stuart Oxygen Co. 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) Hydrogen; H_2; [1333-74-0]

(2) Sulfinylbismethane or dimethylsulfoxide; C_2H_6OS; [67-68-5]

ORIGINAL MEASUREMENTS:

Symons, E. A.

Can. J. Chem. 1971, *49*, 3940 - 3947.

VARIABLES:

T/K: 298.15 - 353.15

H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	Temperature T/K	C_{H_2}/mol dm^{-3} c x 10^3	Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
25.0	298.15	1.05[1]	0.75	2.35	2.57
		1.08[1]	0.77	2.42	2.64
35.0	308.15	1.18	0.85	2.64	2.99
50.0	323.15	1.37	1.00	3.07	3.64
65.0	338.15	1.54	1.14	3.45	4.28
80.0	353.15	1.74	1.30	3.90	5.03

[1] Values also quoted in Symons, E. A.; Buncel, E. *Can. J. Chem.* 1973, *51*, 1673. The mole fraction, Bunsen coefficient, Ostwald coefficient solubility values were calculated by the compiler.

SMOOTHED DATA: $\ln x_1 = -6.0375 - 10.2752/(T/100\ K)$

Standard error about the regression line = 8.10 x 10^{-7}

T/K	Mol Fraction x_1 x 10^4
298.15	0.76
308.15	0.85
318.15	0.945
328.15	1.04
338.15	1.145
348.15	1.25

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas chromatographic method (1).

The gas-liquid equilibrium cell was a modified 100 cm^3 round bottom flask equipped with magnetic stirrer, syringe sampling portal, and vacuum/gas line. The solvent was added, the flask evacuated several minutes to remove dissolved gases. The the gas was introduced to a partial pressure of one atm. The solution was stirred for five minutes, then sampled. Three to four successive samples were taken.

The 5.0 cm^3 samples were taken by gas tight syringe. The sample was introduced to a stripping cell, stripped out over a period of 1-2 minutes by the nitrogen carrier gas and then passed into a Varian Aerograph (No. 1420) equipped with an injection portal, column (10' ¼" stainless steel, packed with 40-60 mesh 13X molecular sieve) at ambient temperature, and a thermal conductivity cell at 65°C.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson Prepurified grade (99.5% min purity).

(2) Sulfinybismethane. Fisher. Certified Reagent Grade. Dried 48 h over 4A molecular sieves, vacuum distilled at *ca.* 1 mmHg. Fraction boiling 38-40°C was stored under nitrogen at ambient temperature for later use.

ESTIMATED ERROR:

δT/K = 0.05

δc/c = 0.02 (author's estimate)

REFERENCES:

1. Gubbins, K. E.; Carden, S. N.; Walker, R. D. Jr. *J. Gas Chromatogr.* 1965, 98.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Cyclopentanamine or cyclopentylamine; $C_5H_{11}N$ or $C_5H_9NH_2$; [1003-03-8]

ORIGINAL MEASUREMENTS:

Symons, E. A.

private communication

VARIABLES:

T/K: 203.15 - 298.15
P/MPa: 0.10 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mol Fraction[1]	Bunsen Coefficient	Ostwald Coefficient
t/°C	T/K	$x_1 \times 10^4$	$\alpha \times 10^2$	$L \times 10^2$
-70.0	203.15	1.04 ± 0.02 (2)	2.58	1.92
-50.0	223.15	1.21 ± 0.03 (4)	2.95	2.41
-35.0	238.15	1.48 ± 0.01 (3)	3.56	3.10
-20.1	253.05	1.68 ± 0.02 (5)	3.98	3.69
-20.0	253.15	1.73 ± 0.09 (4)	4.10	3.80
-16.7	256.45	1.76 ± 0.01 (4)	4.15	3.90
-15.3	257.85	1.77 ± 0.03 (5)	4.17	3.94
-10.0	263.15	1.86 ± 0.05 (4)	4.37	4.21
- 5.0	268.15	1.97 ± 0.02 (3)	4.59	4.51
+10.0	283.15	2.22 ± 0.03 (4)	5.10	5.29
20.2	293.35	2.50 ± 0.03 (7)	5.68	6.10
25.0	298.15	2.44 ± 0.04 (5)	5.52	6.03

[1] Mole fraction values are solubility ± range (number of samples). The data were provided by the author.

The Bunsen and Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The gas-liquid equilibrium cell is a modified 100 cm^3 r.b. flask equiped with a magnetic stirrer, and a sampling portal, and a vacuum/gas line. The solvent is added, and degassed by several evacuations. The gas is introduced to a one atm partial pressure. The solution is stirred for five minutes, then sampled. The stirring is continued while three to four successive samples are taken

The samples are taken in gas-tight syringes and weighed. The sample is introduced into a stripping cell, and stripped out over a 1-2 minute period. The sample then passes into a Varian Aerograph GLC by N_2 carrier gas. The column is 10' ½" stainless steel, packed with 40-60 mesh 13X molecular sieve.aThe column is at ambient temperature, and the thermal conductivity cell is at 65 °C.

SOURCE AND PURITY OF MATERIALS:

No information.

ESTIMATED ERROR:

See ranges given with the data.

REFERENCES:

1. Symons, E. A. *Can. J. Chem.* 1971, *49*, 3940.

2. Symons, E. A.; Powell, M. E.; Schnittker, J. B.; Clermont, M. J. *J. Am. Chem. Soc.* 1979, *101*, 6704.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Cyclohexanamine or cyclohexylamine; $C_6H_{13}N$ or $C_6H_{11}NH_2$; [108-91-8]

ORIGINAL MEASUREMENTS:

Symons, E. A.; Powell, M. E.; Schnittker, J. B.; Clermont, M. J.

J. Am. Chem. Soc. 1979, *101*, 6704 - 6709.

VARIABLES:

T/K: 258.15 - 288.15
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mol Fraction[1]	Bunsen Coefficient	Ostwald Coefficient
t/°C	T/K	$x_1 \times 10^4$	$\alpha \times 10^2$	$L \times 10^2$
-15.0	258.15	2.00 ± 0.09 (4)	4.06	3.84
-13.6	259.55	1.90 ± 0.09 (8)	3.85	3.66
- 5.0	268.15	2.26 + 0.09 (4) - 0.07	4.54	4.46
+ 5.1	278.25	2.47 + 0.04 (4) - 0.09	4.91	5.00
15.0	288.15	2.70 ± 0.10 (5)	5.32	5.61
15.2	288.35	2.57 ± 0.09 (10)	5.06	5.34
25.0	298.15	2.85[2]± 0.04 (4)	5.55	6.06
25.0	298.15	2.91 ± 0.04 (4)	5.67	6.19

[1] The mole fraction solubility values were provided by the author. Given is the mole fraction solubility ± range (number of samples).

[2] The solubility determined in the presence of cyclohexanamine, monocesium salt; $C_6H_{13}N.Cs$; 4820-05-7 , c/mol dm^{-3} 0.0024.

The Bunsen and Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The gas-liquid equilibrium cell is a modified 100 cm^3 round bottom flask equipped with a magnetic stirrer, syringe sampling portal, and vacuum/gas line. The solvent is added, the flask is evavuated several minutes to remove dissolved gases. The gas is introduced to a partial pressure of one atm. The solution is stirred for five minutes, then sampled. The stirring is continued while three to four successive samples are taken.

The samples are taken in a gas tight syringe and weighed. The sample is introduced into a stripping cell, stripped out over a period of 1-2 minutes, and then passed into a Varian Aerograph (No. 1420) by N_2 carrier gas. The chromatograph is equiped with an injection portal, column (10' ¼" stainless steel, packed with 40-60 mesh 13X molecular sieve) at ambient temperature, and a thermal conductivity cell at 65 °C.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Matheson of Canada, Ltd. Extra dry, 99.9 per cent.

(2) Cyclohexanamine. Eastman Chemical Co. Original 97 per cent. Fractional distillation onto 4 A molecular sieves, dry over molten potassium. Impurity less than 0.02 weight % (gas chromatography), melting point/°C = -17.8 ± 0.1, ρ/g cm^{-3} = 0.868_4^{20}.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta x_1/x_1 = 0.02$

REFERENCES:

1. Symons, E. A. *Can. J. Chem.* 1971, *49*, 3940.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Benzenamine or aniline; C_6H_7N; [62-53-3]	Just, G. *Z. Phys. Chem.* 1901, *37*, 342 - 367.

VARIABLES:	PREPARED BY:
T/K: 293.15 - 298.15 P/kPa: 101.325 (1 atm)	M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	1.15	2.826	3.033
298.15	1.07	2.610	2.849

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(2) Benzenamine. 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) Hydrogen; H_2; [1333-74-0]

(2) Cyclic amines; C_4H_9N, C_5H_5N, and $C_5H_{10}N$

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph. D. thesis, 1944
Vanderbilt University
Nashville, TN

Thesis Director: L. J. Bircher

VARIABLES:

T/K: 293.15, 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
Pyrrolidine; C_4H_9N; [123-75-1]			
293.15	2.17	0.0586	0.0629
298.15	2.39	0.0642	0.0701
Pyridine; C_5H_5N; [110-86-1]			
293.15	1.48	0.0412	0.0442
298.15	1.62	0.0449	0.0490
Piperidine; $C_5H_{11}N$; [110-89-1]			
293.15	2.49	0.0566	0.0607
298.15	2.58	0.0582	0.0635

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:

(1) Hydrogen. Air Reduction Co. Purity 99.5 per cent.

(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.

SOURCE AND PURITY OF MATERIALS:

Pyrrolidine. Pyrrole was prepared and catalytically reduced to pyrrolidine. B.p. (750 mmHg) t/°C 88.12 - 88.26 (corr.).

Pyridine. Mallincrodt Chemical Co. Purified and distilled. B.p. (743.9 mmHg) t/°C 114.96 - 115.06 (corr.).

Piperidine. Part was a commercial sample (Eastman Kodak Co.),part prepared by reduction of pyridine. B.p. (752.4 mmHg) t/°C 106.00-106.17.

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) Hydrogen; H_2; [1333-74-0]

(2) Nitrobenzene; $C_6H_5NO_2$; [98-95-3]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K: 293.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
293.15	1.51	3.292	3.533
298.15	1.56	3.397	3.708

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) Hydrogen. Prepared by the reaction of water with aluminum amalgam accelerated with mercury (II) chloride.

(2) Nitrobenzene. 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) Hydrogen; H_2; [1333-74-0]

(2) 1,1,2,2,3,3,4,4-Nonafluoro-N,N-bis(nonafluorobutyl)-1-butanamine or Perfluorotributylamine; $C_{12}F_{27}N$; [311-89-7]

ORIGINAL MEASUREMENTS:

Powell, R. J.

J. Chem. Eng. Data 1972, *17*, 302-304.

VARIABLES:

T/K: 288.15 - 318.15

H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$	$R\frac{\Delta \log X_1}{\Delta \log T} = N$
298.15	15.52	9.76	10.7	3.28

The author states that solubility measurements were made between 288.15 and 313.15 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:

$$\log X_1 = \log(15.52 \times 10^{-4}) + (3.28/R)\log(T/298.15)$$

with R = 1.9872 cal K^{-1} mol^{-1}.

T/K	Mol Fraction $X_1 \times 10^4$
288.15	14.67
293.15	15.10
298.15	15.52
303.15	15.95
308.15	16.39
313.15	16.83
318.15	17.28

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) Hydrogen. 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. Hydrogen; H_2; [1333-74-0]
2. Cyclotetrasiloxane,octamethyl-; $C_8H_{24}O_4Si_4$; [556-67-2]

ORIGINAL MEASUREMENTS:

Chappelow, C.C.; Prausnitz, J.M.

Am.Inst.Chem.Engnrs.J. 1974, *20*, 1098-1104

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant[a] /atm	Mole fraction[b] of hydrogen at 1 atm partial pressure, x_{H_2}
300	706	0.00142
325	622	0.00161
350	555	0.00180
375	490	0.00204
400	420	0.00238
425	338	0.00296

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:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 1\%$. (estimated by compiler).

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: (1) Hydrogen; H_2; [1333-74-0] (2) Petroleum	ORIGINAL MEASUREMENTS: Gniewosz, S.; Walfisz, A. *Z. Physik. Chem.* 1887, *1*, 70 - 72.
VARIABLES: T/K: 283.15, 293.15 Pressure: "atmospheric"	PREPARED BY: M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
283.15	0.0652	0.0676
293.15	0.0582	0.0625

The Ostwald coefficient was 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 gas absorbed in a volume of the degassed liquid was measured using the gas buret.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. No information.

(2) Petroleum. Russian petroleum. Cleaned by boiling in a large copper flask.

ESTIMATED ERROR:

$\delta\alpha/\alpha = 0.10$ (compiler)

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Oils

ORIGINAL MEASUREMENTS:

Baldwin, R. R.; Daniel, S. G.

J. Appl. Chem. 1952, *2*, 161 - 165.

J. Inst. Petrol., London, 1953, *39*, 105 - 124.

VARIABLES:

T/K: 273.15 - 373.15
H_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
Oil A.2, viscosity 268 centistokes at 100 °F, mean mol wt 610.		
273.15	0.0421	0.0421
293.15	0.0465	0.0499
333.15	0.0526	0.0642
373.15	0.0590	0.0806
Oil A.5, viscosity 34.9 centistokes at 100 °F, mean mol wt 400.		
273.15	0.0452	0.0452
293.15	0.0483	0.0518
333.15	0.0549	0.0669
373.15	0.0658	0.0899

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

1. Degassing. The liquid was deaerated by passage through a continuously evacuated vessel.The liquid was saturated with the 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 is intially evacuated. The gas released from the liquid was transferred to the calibrated buret by a Topler pump. Five operations and transfers recover all but a trace of the gas. The last trace (2 - 5 %) was removed by boiling.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Commercial cylinders, source not given. Gas analysis on a Bone and Wheeler apparatus shows gas to be at least 99.5 %.

(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 (±5 %).

ESTIMATED ERROR:

$\delta\alpha/\alpha = 0.01$
$\delta P/P = 0.01$

REFERENCES:

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Paraffin oil

ORIGINAL MEASUREMENTS:

Nasini, A. G.; Corinaldi, G.

Soc. Ital. Prog. Sci. Atti. Riun. 1932, *20*, 264 - 266.

VARIABLES:

T/K: 305.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen* Coefficient α	Ostwald Coefficient L
305.15	0.0464	0.0518

*Original datum.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure were based on those of Lannung (1).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Tank gas freed of oxygen by passage over red-hot metal.

(2) Paraffin oil. Density, ρ_{15}^{15} = 0.87

ESTIMATED ERROR:

$\delta T/K = 0.1$

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Vegetable oils

ORIGINAL MEASUREMENTS:

Vibrans, F. C.

Oil and Soap 1935, *12*, 14 - 15.

VARIABLES:

T/K: 296.15 - 318.15

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	cm^3 (273.15 K,1 atm) H_2 100 cm^{-3}				av.
Corn oil					
296.15-299.15	4.10	4.04	4.08	4.10	4.08
318.15	4.46	4.46	4.42	4.45	4.44
Cottonseed oil					
296.15-299.15	4.12	4.32			4.22
318.15	4.28	4.22	4.28	4.38	4.29
Hydrogenated cottonseed oil					
318.15	4.24	4.36			4.30

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Van Slyke manometric method used (1).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. From commercial cylinders, source or purity not stated.

(2) Corn oil. Commercial sample bought on the market. Represent - tive of its class.

Cottonseed oil. Commercial sample bought on the market, representative of its class.

ESTIMATED ERROR:

$\delta T/K$ = 3 at room T
= 2 at 318 K
$\delta c/c$ = 0.04

REFERENCES:

1. Van Slyke, D. D.; *et al.* *J. Biol. Chem.* 1924, *61*, 523 and 575.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Lard	Vibrans, F. C. *Oil and Soap* 1935, *12*, 14 - 15.
VARIABLES: T/K: 318.15 P/kPa: 101.325	PREPARED BY: P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

T/K	cm^3 (273.15 K, 1 atm) H_2 100 cm^{-3}
318.15	4.16
	4.24
	4.26
	4.43
	4.27 av.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The manometric method of Van Slyke (1) was used.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. From commercial cylinders, source and purity not given.

(2) Lard. Made from a mixture of killing and cutting fats, steam rendered.

ESTIMATED ERROR:

$\delta T/K = 2$

$\delta c/c = 0.04$

REFERENCES:

1. Van Slyke, D. D.; *et al.* *J. Biol. Chem.* 1924, *61*, 523 and 575.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Animal and vegetable oils	Schaffer, P. S.; Haller, H. S. *Oil and Soap* 1943, *20*, 161 - 162.
VARIABLES: T/K; 313.15, 333.15 P/kPa: 101.325 (1 atm)	PREPARED BY: P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

T/K	cm^3 (273.15, 1 atm) H_2 100 cm^{-3}
Cottonseed oil	
313.15	4.7
Butter oil	
313.15	5.4
333.15	6.8
Lard	
313.15	5.0

The authors 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 flask. Heat and vacuum are applied to remove dissolved gases. The sample is cooled to the temperature of the measurement. Hydrogen gas is admitted, a zero reading taken. Shaking is continued 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) Hydrogen. From commercial cylinders, source and purity not given, 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. Hydrogen; H_2; [1333-74-0]
2. Olive oil.

ORIGINAL MEASUREMENTS:

Power, G.G.; Stegall, H.

J. Appl. Physiology, 1970, *29*, 145-9.

VARIABLES:

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	S.D.*	No. of measurements
310.15	0.0436	0.0003	5

* Standard deviation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Liquid saturated with gas in a stirred cell. 5.0 cm 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. Hydrogen; H_2; [1333-74-0]
2. Sheep placental tissue

ORIGINAL MEASUREMENTS:

Longo, L. D.; Delivoria-Papadopoulas, M.; Power, G. G.; Hill, E. P.; Forster, R. E., *Am. J. Physiology*, 1970, *219*, 561-569.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	S.D.*
310.15	0.0165	0.0004

* standard deviation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Liquid samples were equilibrated with gas and then the dissolved gas was stripped out under vacuum and measured in a manometric Van Slyke apparatus. Some details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$.

REFERENCES:

1. Power, G. G., *J. Appl. Physiology*, 1968, *24*, 468.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) Rat abdominal muscle

ORIGINAL MEASUREMENTS:

Campos Carles, A.; Kawashiro, T.; Piiper, J.

Pflugers Arch. 1975, *359*, 209 - 218.

VARIABLES:

T/K: 310.15

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility Coefficient μmol dm^{-3} $torr^{-1}$	Corrected[2] Solubility Coefficient μmol dm^{-3} $torr^{-1}$	Bunsen Coefficient $\alpha \times 10^2$
310.15	1.00 ± 0.05[1]	1.13	1.92

[1] Mean value ± standard error of 11 measurements.

[2] Corrected for unextracted gas in the sample, and for gas lost during transfer of the sample.

Another report from this laboratory gives Krogh's diffusion constant, K =(1.67 ± 0.06) x 10^{-9} mmol $m^{-1}cm^{-1}$ $torr^{-1}$, and the diffusion coefficient, D = 24.7 x 10^{-6} cm^2 s^{-1} for hydrogen in rat abdominal muscle at 310.15 K.

The sample is a non-homogenised solid, not a liquid.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The hydrogen gas was presaturated with water vapor, then passed through an equilibration chamber containing the muscle sample resting on a screen to expose all sides. The gas was passed through the equilibration chamber for one hour at a rate of 8 cm^3 m^{-1}.

The muscle was transfered to an extraction chamber filled with air for the same length of time as equilibration. The gas in the extraction chamber was then forced into a gas chromatograph by mercury entering the chamber.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Source not given. Stated to be 99.9 per cent pure.

(2) Rat abdominal muscle. Flat abdominal wall muscle layer of about 1.6 g, 1.4 mm thick, and surface area of 10 cm^2 on one side. Sample taken from 250 - 430 g rat.

ESTIMATED ERROR:

REFERENCES:

1. Kawashiro, T.; Campos Carles, A.; Perry, S. F.; Piiper, J. *Pflugers Arch.* 1975, *359*, 219.

COMPONENTS:

(1) Deuterium; D_2; [7782-39-0]

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

ORIGINAL MEASUREMENTS:

Symons, E. A.; Buncel, E.

Can. J. Chem. 1973, *51*, 1673 - 1681.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	c_{D_2}/mol dm^{-3} $c \times 10^4$	Mol Fraction $x_1 \times 10^5$	Ostwald Coefficient $L \times 10^3$
298.15	8.3	1.50	20.5

The mole fraction and Ostwald coefficient values were calculated by the compiler.

The value is 2.7 per cent higher than the value reported at 298.15 K by Muccitelli, J. and Wen, W.-Y. *J. Solution Chem.* 1978, *7*, 257. The Muccitelli and Wen values are preferred.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas chromatographic method (1, 2).

The gas-liquid equilibrium cell was a modified 100 cm^3 round bottom flask equiped with magnetic stirrer, syringe sampling portal, and vacuum/gas line. The solvent was added, the flask evacuated several minutes to remove dissolved gases. Then the gas was introduced to a partial pressure of one atm. The solution was stirred for five minutes, then sampled. Three to four successive samples were taken.

The 5.0 cm^3 samples were taken by gas tight syringe. The sample was introduced to a stripping cell, stripped out over a period of 1-2 minutes by the nitrogen carrier gas and then passed into a Varian Aerograph (No. 1420) equiped with an injection portal, column (10' ¼" stainless steel, packed with 40-60 mesh 13X molecular sieve) at ambient temperature, and a thermal conductivity cell at 65 °C.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Matheson Co., Inc. Technical grade. Traces of oxygen removed by treatment with uranium turnings.

(2) Water. Deionized and distilled.

ESTIMATED ERROR:

$\delta c/c = 0.02$ (author's estimate)

REFERENCES:

1. Symons, E. A.
Can. J. Chem. 1971, *49*, 3940.

2. Gubbins, K. E.: Carden, S. N.; Walker, R. D. Jr.
J. Gas Chromatogr. 1965, 98.

COMPONENTS:

(1) Deuterium; D_2; [7782-39-0]

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

ORIGINAL MEASUREMENTS:

Muccitelli, J.; Wen, W.-Y.

J. Solution Chem. 1978, *7*, 257 - 267.

VARIABLES:

T/K: 278.15-303.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	mol Fraction $x_1 \times 10^5$	Ostwald Coefficient $L \times 10^3$
278.15	1.7829	22.795
	1.7904	22.891
	1.7891	22.875
	1.7851	22.824
283.15	1.6825	21.970
	1.6691	21.795
	1.6757	21.882
	1.6802	21.940
	1.6714	21.825
288.15	1.6028	21.388
	1.5936	21.265
	1.5948	21.281
	1.5892	21.207
293.15	1.5175	20.714
	1.5118	20.636
	1.5187	20.731
	1.5016	20.559
298.15	1.4637	20.469
	1.4555	20.354
	1.4663	20.505
	1.4569	20.374
303.15	1.3980	20.069
	1.3901	19.956
	1.3978	20.066
	1.3952	20.029

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure were similar to that described by Ben-Naim and Baer (1) as modified by Wen and Hung (2). It consisted of a mercury manometer, a gas-volume measuring buret, a dissolution cell of 450 cm^3 capacity, and a mercury reservoir. The apparatus is immersed in a water bath. The degassing apparatus was similar to the one described by Battino *et al.* (3). The cell containing the solvent is degassed, the system is filled with solvent-saturated gas to a total pressure of 1 atm. The solvent is stirred, as gas dissolves the pressure is maintained at one atm until equilibrium is reached.

The measured Ostwald coefficient was converted to mole fraction taking in to account the second virial coefficient of D_2. The authors fitted the data to the equation

$$R \ln (x/p) = -360.180 + 14525.6/(T/K)$$
$$52.0206 \ln (T/K) - 0.0234788 (T/K)$$

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Linde Speciality Gas. Minimum specified purity 99.5 per cent. Used as received.

(2) Water. Distilled, then purified with the Millipore Corp. Milli-Q system.

ESTIMATED ERROR:

$\delta T/K = 0.005$
$\delta P/torr = 3$
$\delta L/L = 0.004$ (precision, authors)

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735.
2. Wen, W.-Y.; Hung, J. H. *J. Phys. Chem.* 1970, *74*, 170.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Deuterium; D_2; [7782-39-0]

(2) Organic solvents

EVALUATOR:

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

1980, September

CRITICAL EVALUATION:

An Evaluation of the Deuterium Mole Fraction Solubility in Various Organic Solvents at a Deuterium Partial Pressure of 101.325 kPa (1 atm).

The solubility of deuterium in eleven organic solvents has been reported. There is only one set of measurements on each system, except for sulfinylbismethane for which two laboratories reported measurements at 298.15 K. Most of the solubility measurements were made by volumetric methods capable of better than average accuracy and precision (1, 2, 4). One laboratory (3, 5) used a gas chromatographic method, which may not be capable of as good an accuracy and precision. However, their work appears to have been carefully executed and all of the data are classed as tentative.

Tentative equations for the natural logarithm of the mole fraction solubility as a function of temperature, and a table of smoothed values of the mole fraction solubility appear on the individual data sheets, with the exception of the deuterium + cyclopentanamine system which did not have room on the sheet for the additional information. The smoothed data on the system is at the end of this section.

The changes in enthalpy, entropy and heat capacity for the transfer of one mole of deuterium from the gas phase at a deuterium partial pressure of 101.325 kPa to the infinitely dilute solution are summarized in Table 1 for the eleven systems.

The mole fraction solubilities of four of the systems studied by Cook, Hanson, and Alder (1) show a systematic curvature in ln x_1 as a function of 1/T. The measurements of Cook *et al.* were made with great care, and there is reason to believe the curvature is real. Thus the mole fraction solubilities of the four systems were fitted to a three constant equation, and values of the temperature dependent changes in enthalpy and entropy at 25 degree intervals are given in Table 1.

Both Dymond (2), and Symons and Buncel (3) measured the mole fraction solubility of deuterium in dimethylsulfoxide at 298.15 K. The two values agree within 0.6 per cent.

Table 1. Deuterium + organic solvent. Summary of the changes in enthalpy, $\Delta\bar{H}_1^\circ$, entropy, $\Delta\bar{S}_1^\circ$, and heat capacity, $\Delta\bar{C}_{p_1}^\circ$, on transfer of one mole of deuterium from the gas phase at a partial pressure of 101.325 kPa to the infinitely dilute solution.

T/K	$\Delta\bar{H}_1^\circ$/kJ mol^{-1}	$\Delta\bar{S}_1^\circ$/J K^{-1} mol^{-1}	$\Delta\bar{C}_{p_1}^\circ$/J K^{-1} mol^{-1}
Deuterium + Heptane [142-82-5] (1)[1]			
248.15	3.42	-49.1	14.8
273.15	3.79	-47.7	14.8
298.15	4.17	-46.4	14.8
323.15	4.54	-45.2	14.8
Deuterium + Octane [111-65-9] (1)			
248.15	3.35	-49.4	15.7
273.15	3.74	-47.9	15.7
298.15	4.14	-46.5	15.7
Deuterium + 2,2,4-Trimethylpentane [540-84-11] (1)			
248.15	3.14	-49.0	14.6
273.15	3.50	-47.6	14.6
298.15	3.87	-46.3	14.6
Deuterium + Benzene [71-43-2] (1)			
283.15-308.15	6.18	-47.7	0
Deuterium + Methylbenzene [108-88-3] (1)			
258.15-308.15	4.83	-50.5	0
Deuterium + Hexadecafluoroheptane [335-57-9] (1)			
248.15	3.39	-43.3	20.1
273.15	3.89	-41.4	20.1
298.15	4.39	-39.6	20.1
Deuterium + Tetrachloromethane [56-23-5] (1)			
273.15-308.15	5.38	-48.6	0
Deuterium + Carbon disulfide [75-15-0] (1)			
248.15-298.15	5.80	-53.1	0
Deuterium + Sulfinylbismethane[2] [67-68-5] (2,3)			
Only two solubility values at 298.15 K are reported. There is no temperature coefficient of solubility on which to base the calculations.			
Deuterium + Perfluorotributylamine [311-89-7] (4)			
288.15-318.15	3.85	-40.6	0
Deuterium + Cyclopentenamine [1003-03-8] (5)			
213.15-298.15	4.93	-51.8	0

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[1] Numbers in ( ) are the reference numbers.

[2] Dimethylsulfoxide.

Deuterium + Cyclopentanamine [1003-03-8]

The smoothed data are presented here, because there were not room for them on the data sheet of Symons (5). The tentative equation for use over the 213.15 to 298.15 K temperature range is

$$\ln x_1 = -6.2335 - 5.9271/(T/100K)$$

with a standard error about the regression line of 6.03 x 10^{-6}. The smoothed values of the mole fraction solubility are in Table 2.

Table 2. Solubility of deuterium in cyclopentanamine at a partial pressure of deuterium of 101.325 kPa. Tentative values of the mole fraction solubility.

T/K	Mol Fraction $10^4 x_1$	T/K	Mol Fraction $10^4 x_1$
213.15	1.22	273.15	2.24
223.15	1.38	278.15	2.33
233.15	1.54	283.15	2.42
243.15	1.71	288.15	2.51
253.15	1.89	293.15	2.60
263.15	2.06	298.15	2.69

References:

1. Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748.

2. Dymond, J. H. *J. Phys. Chem.* 1967, *71*, 1829.

3. Symons, E. A.; Buncel, E. *Can. J. Chem.* 1973, *51*, 1673.

4. Powell, R. J. *J. Chem. Eng. Data* 1972, *17*, 302.

5. Symons, E. A. In press.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Deuterium; D_2; [7782-39-0] (2) Heptane; C_7H_{16}; [142-82-5]	Cook, M. W.; Hanson, D. N. Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748 - 751.

EXPERIMENTAL VALUES:

T/K	Solubility mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α x 10^2	Ostwald Coefficient L x 10^2
238.15(sic)[1]	5.002	5.009	8.13	7.24
248.15	5.168	5.172	8.35	7.58
	6.160			
263.15	5.697	5.705	9.05	8.71
273.15	6.069	6.077	9.52	9.52
	6.069			
283.15	6.447	6.456	9.99	10.36
294.65	6.881	6.891[2]	10.52	11.34
298.15	7.014			
	7.025			
	7.023			
	7.033			
	7.024 av.	7.033	10.69	11.67
308.15	7.406			
	7.410			
	7.430			
	7.424			
	7.429			
	7.420 av.	7.437	11.16	12.59
323.15	8.051	8.061[2]	11.87	14.04
338.15	8.741	8.752[2]	12.64	15.65

[1] Context of paper indicates the temperature is 243.15 instead of 238.15.

[2] Calculated by the compiler.

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: Solubility values at 323.15 and 338.15 K were omitted from the fit.

$$\ln x_1 = -9.3132 + 0.3106/(T/100K) + 1.7845 \ln (T/100K)$$

Standard error about the regression line = 4.72 x 10^{-7}

T/K	Mol Fraction X_1 x 10^4
243.15	5.005
253.15	5.351
263.15	5.707
273.15	6.074
283.15	6.450
293.15	6.837
298.15	7.034
303.15	7.233
313.15	7.640
323.15	8.056
333.15	8.481

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Deuterium; D_2; [7782-39-0] (2) Heptane; C_7H_{16}; [142-82-5]	Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748 - 751.
VARIABLES: T/K: 243.15 - 338.15 P/kPa: 101.325 (1 atm)	PREPARED BY: P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

See preceding page.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, and after temperature equilibrium is reached it is contacted with the degassed solvent. The system is shaken until solubility equilibrium is reached. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quanties of gas, the pressure measurments, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Source not given. Mass spectrographic analysis showed gas 99.4 per cent pure. Impurity mostly N_2 with a small amount of HD.

(2) Heptane. Phillips Petroleum Co. 99 mole per cent grade distilled, used center cut, boiling point 371.45 K. Other solvent properties given in reference 1.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Deuterium; D_2; [7782-39-0] (2) Octane; C_8H_{18}; [111-65-9]	Cook, M. W.; Hanson, D. N.; Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748 - 751.

VARIABLES:	PREPARED BY:
T/K: 248.15 - 308.15 P/kPa: 101.325 (1 atm)	P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
248.15	5.167	7.49	6.80
273.15	6.047	8.53	8.53
298.15	6.990	9.58	10.46
308.15	7.389	10.02	11.30

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -9.5382 + 0.6414/(T/100K) + 1.8834 \ln (T/100)$

Standard error about the regression line = 1.98×10^{-7}

T/K	Mol Fraction $x_1 \times 10^4$
253.15	5.338
263.15	5.687
273.15	6.047
283.15	6.417
293.15	6.798
298.15	6.992
303.15	7.189
308.15	7.388

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, and after temperature equilibrium is reached it is contacted with the degassed solvent. The system is shaken until solubility equilibrium is reached. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Source not given. Mass spectrographic analysis showed gas 99.4 per cent pure. Impurity mostly N_2 with a small amount of HD.

(2) Octane. Eastman Kodak Co. Distilled, center portion used, b.p. 398.65 K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W. University of California Radiation Lab, Report UCRL-2459, 1954.
2. Cook, M. W.; Hanson, D. N. *Rev. Sci. Instr.* 1957, *28*, 370.

COMPONENTS:

(1) Deuterium; D_2; [7782-39-0]

(2) 2,2,4-Trimethylpentane or isooctane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.
Alder, B. J.

J. Chem. Phys. 1957, *26*, 748 - 751.

VARIABLES:

T/K: 248.15 - 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
248.15	6.004	8.58	7.80
273.15	6.960	9.67	9.67
298.15	7.960	10.74	11.72
308.15	8.396	11.19	12.63

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -9.2434 + 0.5759/(T/100K) + 1.7534 \ln (T/100K)$

Standard error about the regression line = 1.10×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
253.15	6.190
263.15	6.569
273.15	6.957
283.15	7.354
293.15	7.762
298.15	7.969
303.15	8.179
308.15	8.391

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, and after temperature equilibrium is reached it is contacted with the degassed solvent. The system is shaken until solubility equilibrium is reached. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Source not given. Mass spectrographic analysis showed gas 99.4 per cent pure. Impurity mostly N_2 with a small amount of HD.

(2) 2,2,4-Trimethylpentane. Phillips Petroleum Co. Pure grade, 99+ mol per cent. Distilled, center portion used, b.p. 372.35 K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Deuterium; D_2; [7782-39-0] (2) Benzene; C_6H_6; [71-43-2]	Cook, M. W.; Hanson, D. N. Alder, B. J. *J. Chem. Phys.* 1957, *26*, 748 - 751.
VARIABLES: T/K: 283.15 - 308.15 P/kPa: 101.325 (1 atm)	PREPARED BY: P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
283.15	2.328	5.94	6.16
298.15	2.655	6.66	7.26
308.15	2.881	7.13	8.05

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.7399 - 7.4344/(T/100K)$

Standard error about the regression line = 1.59×10^{-7}

T/K	Mol Fraction $x_1 \times 10^4$
283.15	2.328
288.15	2.436
293.15	2.546
298.15	2.656
303.15	2.768
308.15	2.880

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, and after temperature equilibrium is reached it is contacted with the degassed solvent. The system is shaken until solubility equilibrium is reached. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Source not given. Mass spectrographic analysis showed gas 99.4 per cent pure. Impurity mostly N_2 with a small amount of HD.

(2) Benzene. Baker and Adamson's Reagent Grade. Distilled, center portion used, b.p. 353.15K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W. University of California Radiation Lab, Report UCRL-2459, 1954.
2. Cook, M. W.; Hanson, D. N. *Rev. Sci. Instr.* 1957, *28*, 370.

COMPONENTS:

(1) Deuterium; D_2; [7782-39-0]

(2) Methylbenzene or toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.; Alder, B. J.

J. Chem. Phys. 1957, *26*, 748 - 751.

VARIABLES:

T/K: 258.15 - 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
258.15	2.424	5.30	5.01
273.15	2.730	5.88	5.88
298.15	3.266	6.85	7.48
308.15	3.492	7.25	8.18

The Bunsen and Ostwald coefficients were calculated by compiler.

Smoothed Data: $\ln x_1 = -6.0781 - 5.8052/(T/100\text{K})$

Standard error about the regression line = 8.87×10^{-7}

T/K	Mol Fraction $x_1 \times 10^4$
263.15	2.525
273.15	2.737
283.15	2.951
293.15	3.164
298.15	3.271
303.15	3.378
308.15	3.485

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, and after temperature equilibrium is reached it is contacted with the degassed solvent. The system is shaken until solubility equilibrium is reached. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Source not given. Mass spectrographic analysis showed gas 99.4 per cent pure. Impurity mostly N_2 with a small amount of HD.

(2) Methylbenzene. Baker and Adamson Reagent Grade. Distilled, center portion used, b.p. 383.65K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W. University of California Radiation Lab, Report UCRL-2459, 1954.
2. Cook, M. W.; Hanson, D. N. *Rev. Sci. Instr.* 1957, *28*, 370.

COMPONENTS:

(1) Deuterium; D_2; [7782-39-0]

(2) Hexadecafluoroheptane or perfluoroheptane; C_7F_{16}; [335-57-9]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.; Alder, B. J.

J. Chem. Phys. 1957, *26*, 748 - 751.

VARIABLES:

T/K: 248.15 - 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
248.15	10.556	10.99	9.98
273.15	12.403	12.64	12.64
285.25	13.371	13.48	14.08
298.15	14.427	14.38	15.69
308.15	15.329	15.14	17.08

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -9.8296 + 1.9302/(T/100K) + 2.4186 \ln (T/100K)$

Standard error about the regression line = 1.50×10^{-6}

T/K	Mol Fraction $x_1 \times 10^4$
253.15	10.91
263.15	11.64
273.15	12.40
283.15	13.19
293.15	14.02
298.15	14.44
303.15	14.88

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, and after temperature equilibrium is reached it is contacted with the degassed solvent. The system is shaken until solubility equilibrium is reached. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Source not given. Mass spectrographic analysis showed gas 99.4 per cent pure. Impurity mostly N_2 with a small amount of HD.

(2) Hexadecafluoroheptane. Source not given. Distilled, center portion used, b.p. 355.65K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:

(1) Deuterium; D_2; [7782-39-0]

(2) Tetrachloromethane or carbon tetrachloride; CCl_4; [56-23-5]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.; Alder, B. J.

J. Chem. Phys. 1957, *26*, 748 - 751.

VARIABLES:

T/K: 273.15 - 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
273.15	2.693	6.41	6.41
298.15	3.280	7.57	8.26
308.15	2.527(sic)	8.04[1]	9.07[1]

[1] The compiler suspects the mole fraction value is 3.527. The Bunsen and Ostwald coefficients and the smoothed data equation were calculated with the 3.527 value.

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -5.8498 - 6.4741/(T/100K)$

Standard error about the regression line = 5.23×10^{-7}

T/K	Mol Fraction $x_1 \times 10^4$
273.15	2.692
278.15	2.809
283.15	2.927
288.15	3.046
293.15	3.165
298.15	3.284
303.15	3.404
308.15	3.524

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, and after temperature equilibrium is reached it is contacted with the degassed solvent. The system is shaken until solubility equilibrium is reached. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Source not given. Mass spectrographic analysis showed gas 99.4 per cent pure. Impurity mostly N_2 with a small amount of HD.

(2) Tetrachloromethane. Baker and Adamson Reagent Grade. Distilled, center portion used, b.p. 349.95K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W.
University of California Radiation Lab, Report UCRL-2459, 1954.

2. Cook, M. W.; Hanson, D. N.
Rev. Sci. Instr. 1957, *28*, 370.

COMPONENTS:

(1) Deuterium, D_2; [7782-39-0]

(2) Carbon disulfide; CS_2; [75-15-0]

ORIGINAL MEASUREMENTS:

Cook, M. W.; Hanson, D. N.; Alder, B. J.

J. Chem. Phys. 1957, *26*, 748-751.

VARIABLES:

T/K: 248.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
248.15	1.011	3.96	3.60
273.15	1.300	4.95	4.95
298.15	1.621	5.99	6.54

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -6.3884 - 6.9802/(T/100K)$

Standard error about the regression line = 6.79×10^{-7}

T/K	Mol Fraction $x_1 \times 10^4$
253.15	1.067
263.15	1.185
273.15	1.305
283.15	1.429
293.15	1.554
298.15	1.617

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, designed especially for the determination of the solubility of hydrogen in liquids, consists of a gas bulb, a gas buret, a solvent bulb, and a manometer system. All are attached to a mounting plate, and the assembly is shaken in an air bath.

The solvent is degassed in the solvent bulb by heat and evacuation. The gas is placed in the gas bulb, and after temperature equilibrium is reached it is contacted with the degassed solvent. The system is shaken until solubility equilibrium is reached. Mercury is used as the displacement fluid.

The solubility is calculated from the initial and final quantities of gas, the pressure measurements, the vapor pressure of the solvent, and the solvent volume.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Source not given. Mass spectrographic analysis showed gas 99.4 per cent pure. Impurity mostly N_2 with a small amount of HD.

(2) Carbon disulfide. Baker and Adamson Reagent Grade. Distilled, center portion used, b.p. 319.65K. Other solvent properties given in reference (1).

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.001$ (authors)

REFERENCES:

1. Cook, M. W. University of California Radiation Lab, Report UCRL-2459, 1954.
2. Cook, M. W.; Hanson, D. N. *Rev. Sci. Instr.* 1957, *28*, 370.

COMPONENTS: (1) Deuterium; D_2; [7782-39-0] (2) Sulfinylbismethane or Dimethyl Sulfoxide; C_2H_6OS (CH_3SOCH_3); [67-68-5]	ORIGINAL MEASUREMENTS: Dymond, J. H. *J. Phys. Chem.* 1967, *71*, 1829-1831.
VARIABLES: T/K: 298.15 P/kPa: 101.325 (1 atm)	PREPARED BY: M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
298.15	0.799	2.51	2.74

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) Deuterium. Bio-Rad Labs. Dried.

(2) Dimethyl Sulfoxide. Matheson, Coleman, and Bell Co. Spectro-quality 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) Deuterium; D_2; [7782-39-0]

(2) Sulfinylbismethane or dimethylsulfoxide; C_2H_6OS; [67-68-5]

ORIGINAL MEASUREMENTS:

Symons, E. A.; Buncel, E.

Can. J. Chem. 1973, *51*, 1673 - 1681.

VARIABLES:

T/K: 298.15

D_2 P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	C_{D_2}/mol dm^{-3} $c \times 10^3$	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
298.15	1.13	0.80_5	2.53	2.76

The mole fraction, Bunsen coefficient, and Ostwald coefficient values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas chromatographic method (1, 2).

The gas-liquid equilibrium cell was a modified 100 cm^3 round bottom flask equipped with magnetic stirrer, syringe sampling portal, and vacuum/gas line. The solvent was added, the flask evacuated several minutes to remove dissolved gases. Then the gas was introduced to a partial pressure of one atm. The solution was stirred for five minutes, then sampled. Three to four successive samples were taken.

The 5.0 cm^3 samples were taken by gas tight syringe. The sample was introduced to a stripping cell, stripped out over a period of 1-2 minutes by the nitrogen carrier gas and then passed into a Varian Aerograph (No. 1420) equipped with an injection portal, column (10' ¼" stainless steel, packed with 40-60 mesh 13X molecular sieve) at ambient temperature, and a thermal conductivity cell at 65°C.

SOURCE AND PURITY OF MATERIALS:

(1) Deuterium. Matheson Co., Inc. Technical grade. Traces of oxygen removed by treatment with uranium turnings.

(2) Sulfinylbismethane. Fisher Certified Reagent. Dried 48 h over 4A molecular sieves, vacuum distilled at *ca.* 1 mmHg. Fraction boiling 38-40°C was stored under N_2 for use.

ESTIMATED ERROR:

$\delta T/K = 0.05$

$\delta c/c = 0.02$ (author's estimate)

REFERENCES:

1. Symons, E. A. *Can. J. Chem.* 1971, *49*, 3940.
2. Gubbins, K. E.; Carden, S. N.; Walker, R. D. Jr. *J. Gas Chromatogr.* 1965, 98.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Deuterium; D_2; [7782-39-0] (2) 1,1,2,2,3,3,4,4,4-Nonafluoro-N,N-bis(nonafluorobutyl)-1-butanamine or perfluorotributylamine; $C_{12}F_{27}N$; [311-89-7]	Powell, R. J. *J. Chem. Eng. Data* 1972, *17*, 302-304.
VARIABLES:	PREPARED BY:
T/K: 288.15 - 318.15 H_2 P/kPa: 101.325 (1 atm)	P. L. Long

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$	$R\frac{\Delta \log X_1}{\Delta \log T} = N$
298.15	16.03	10.1	11.0	3.04

The author states that solubility measurements were made between 288.15 and 313.15 K, but only the solubility at 298.15 was given in the paper. The slope R(Δlog X_1/Δlog T) was given. The smoothed data below were calculated by the compiler from the slope in the form:

$$\log X_1 = \log(16.03 \times 10^{-4}) - (3.04/R)\log(T/298.15)$$

with R = 1.9872 cal K^{-1} mol^{-1}.

T/K	Mol Fraction $x_1 \times 10^4$
288.15	15.22
293.15	15.62
298.15	16.03
303.15	16.44
308.15	16.86
313.15	17.28
318.15	17.71

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) Deuterium. 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. = 447.85-448.64K, & 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) Deuterium; D_2 [7782-39-0]

(2) Cyclopentanamine or cyclopentylamine; $C_5H_{11}N$ or $C_5H_9NH_2$; [1003-03-8]

ORIGINAL MEASUREMENTS:

Symons, E. A.

private communication

VARIABLES:

T/K: 213.15 - 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	Temperature T/K	Mol Fraction[1] $x_1 \times 10^4$	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
-60.0	213.15	1.26 ± 0.03 (5)	3.10	2.42
-50.3	222.85	1.39 ± 0.02 (4)	3.40	2.77
-40.0	233.15	1.47 ± 0.01 (3)	3.55	3.03
-30.0	243.15	1.70 ± 0.03 (4)	4.07	3.62
-21.0	252.15	1.89 ± 0.11 (8)	4.48	4.14
-20.0	253.15	1.89 ± 0.04 (4)	4.48	4.15
-15.0	258.15	1.87 ± 0.04 (12)	4.41	4.17
-10.0	263.15	2.07 ± 0.05 (4)	4.86	4.68
0.0	273.15	2.31 ± 0.03 (3)	5.36	5.36
+10.0	283.15	2.48 ± 0.01 (3)	5.70	5.91
20.1	293.25	2.53 ± 0.03 (7)	5.76	6.18
25.0	298.15	2.75 ± 0.03 (6)	6.23	6.80

[1] The mole fraction solubility values were provided by the author. Given is the mole fraction solubility ± range (number of samples).

The Bunsen and Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas chromatography method described by author (1).

The author studied the solubility of hydrogen in the same system. The results are:

T/K	Mol Fraction $x_1 \times 10^4$
223.15	1.45
263.15	2.19
298.15	2.97

The expected isotope effect of 5 - 10 per cent was not found. The system is being studied further.

SOURCE AND PURITY OF MATERIALS:

No information on the source and purity of materials.

ESTIMATED ERROR:

Results show a range of 5 - 8 %.

REFERENCES:

1. Symons, E. A.
Can. J. Chem. 1971, *49*, 3940.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Deuterium; D_2; [7782-39-0] (2) Ammonia; NH_3; [7664-41-7] (3) Potassium amide; KNH_2; [17242-52-3]	Bar-Eli, K.; Klein, F. S. *J. Chem. Phys.* 1961, *35*, 1915.
VARIABLES: T/K: 209.15, 231.55	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α/cm^3(STP) cm^{-3}atm^{-1}
209.15	0.0117 ± 0.0005
231.55	0.025 ± 0.0013

The concentration of potassium amide was not given, it was stated to be dilute. The authors appear to assume that the salt does not affect the solubility of deuterium in liquid ammonia.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A kinetic method in which the rate of reaction between a gas and its solvent is utilized to estimate the amount of gas dissolved. The principle of the method is to measure the apparent rate of reaction, while shaking the reaction mixture intermittently for varying time intervals.

The chemical reaction has to be slow enough to be easily measured, and the mixing need to be efficient, so that the partition equilibrium is established rapidly, compared to the time for the chemical reaction.

SOURCE AND PURITY OF MATERIALS:

No information.

ESTIMATED ERROR:

$\delta\alpha/\alpha = 0.10$

REFERENCES:

HYDROGEN AND DEUTERIUM SOLUBILITIES ABOVE 200 kPa

HYDROGEN SOLUBILITIES ABOVE 200 kPa

General Remarks for High Pressure Solubilities Studies on Mixtures Containing Hydrogen

C. L. Young

Up until the last two decades there was comparatively little data available on the solubility of hydrogen in liquids above 200 kPa. However, this position has now completely changed and there is currently much interest in the solubility of hydrogen in liquids, particularly at high pressures. The major reasons for this interest arise from design considerations for processes concerned with the liquefaction of coal and from the "unusual" phase behaviour of some hydrogen mixtures. Some hydrogen mixtures exhibit the barotropic or phase inversion phenomenon and some exhibit the phenomenon of gas-gas immiscibility (1,2).

Unfortunately it has not been possible to give many detailed critical evaluations for hydrogen solubilities at high pressures because there are surprisingly few systems which have been studied over the same pressure and temperature range by more than two workers. In no case has it been possible to classify data as *recommended* because even when several workers have studied the same system usually the overlap of temperature and pressure ranges are fairly small.

Work of Chao and collaborators

Chao and coworkers have made fairly extensive measurements on hydrogen and coal-related organic compounds. The results are thought to be reliable but since, in general, there are no other measurements with which to compare their data at the higher temperatures, any evaluation is necessarily rather speculative. In several cases at the highest temperatures, Chao and coworkers noticed some decomposition or reaction and it would be surprising if the effects of such were not significant and the dominant factor in determining the overall accuracy of some of the measurements under these conditions. The effect of decomposition or reaction cannot be simply allowed for as hydrogen appears to reduce the thermal decomposition of some hydrocarbons. For example, Sebastian *et al.* (3) found that hydrogen appeared to reduce the decomposition of thianaphthalene.

Work of Frolich, Trauch, Hogan and Peer

Frolich *et al.* (4) studied the solubility of hydrogen, nitrogen and methane in a range of organic substances. Unfortunately the data were presented in small graphical form. The data have been compiled but in view of the lack of any estimate of probable error the compiled data should be regarded with some caution and are generally classified as doubtful. They have been included principally because they are widely quoted in the literature. In some instances the data were not even presented in graphical form but the solubility data of hydrogen in one liquid quoted as being equivalent to that of hydrogen in another liquid.

Isotopic effects on solubility

Augood (5) made a study of the solubility of isotopic hydrogen, HD and H_2, in a number of solvents in order to obtain information for the production of heavy water. The table below gives values of $\beta_{2/1}$ *i.e.*, the ratio of Henry's law constant for the solubility of HD to H_2.

Solvent	T/K	*P*/MPa	$\beta_{2/1}$	Solvent	T/K	*P*/MPa	$\beta_{2/1}$
H_2O	293.2	18.72	1.029	H_2S	213.6	18.72	1.058
			1.024			10.44	1.025
NH_3	293.2	19.06	1.028			10.44	1.025
		19.06	1.018			10.30	1.042
		15.61	1.026	NO	119.5	17.61	1.154
		15.61	1.022			15.54	1.155
		8.86	1.015			11.41	1.152
	239.7	19.13	1.040			11.27	1.172
		18.23	1.038	CO_2	239.7	19.27	1.048
		15.61	1.030			18.85	1.036
		15.61	1.049			18.58	1.018
		14.51	1.036			10.44	1.043
SO_2	293.2	19.23	1.025			10.44	1.053
		19.13	1.021			10.44	1.040
		10.44	1.061	CO	81.4	18.16	1.090
		10.44	1.039			9.96	1.121
	263.2	19.20	1.038			9.61	1.199
		19.06	1.030	Ar	87.4	18.37	1.090
		12.92	1.040			18.37	1.084
		10.44	1.036			11.61	1.100
CH_4	111.7	18.03	1.055			11.61	1.130
		10.44	1.085	N_2	77.7	17.89	1.033
		6.58	1.065			16.85	1.038
		2.38	1.079			15.61	1.043
C_4H_{10}	273.2	18.99	1.013			15.44	1.056
		9.06	1.005			11.55	1.061
		9.06	1.018			9.75	1.075
	213.6	18.82	1.040			8.79	1.075
		18.82	1.034			5.27	1.130
		18.30	1.032			2.86	1.147
		17.47	1.040			2.72	1.166
		9.06	1.043			1.82	1.165
		9.06	1.060		67.0	8.86	1.200
H_2S	213.6	18.72	1.053			8.72	1.217

The ratio $\beta_{2/1}$ was determined by dissolving a HD + H_2 mixture containing 0.09 mole per cent of HD in the solvent and analysing the dissolved gas by mass spectrometry. Lachowicz *et al.* (6) carried out solubility experiments using H_2 and D_2 separately in n-heptane and octane to pressures of 30 MPa in the temperature range 298 to 323 K but found no differences in the solubility of the two isotopic gases.

Gas-gas immiscibility

Many hydrogen + organic substance mixtures probably exhibit the phenomenon referred to as gas-gas immiscibility although the occurrence of this phenomenon in hydrogen mixtures has not been extensively investigated or documented. The phenomenon was predicted by the author to occur in several hydrogen + alkane mixtures on theoretical grounds and has subsequently been observed experimentally. This phenomenon is relevant to the determination and interpretation of "solubilities" at high temperatures and pressures and is therefore briefly discussed here.

The phenomenon is conveniently considered in terms of the pressure-temperature projection of the pressure-temperature composition diagram of a binary mixture. Figure 1 shows the pressure, temperature projection of a simple system such as propane + hexane. In this case there is a continuous gas-liquid critical locus between the critical points of the two pure components. In many cases there is also a liquid-liquid gas line at lower temperatures which meets a liquid-liquid critical line at an upper critical end point as is illustrated in figure 2. There are several other possible types of phase behaviour. Two of these involve gas-gas immiscibility and are illustrated in figures 3 and 4.

In many cases some part of the p, T projection as illustrated in figures 1, 2, 3 and 4 are obscured by solidification of the mixture. In the case of most hydrogen + organic compound mixtures there is a solid phase present for temperatures considerably above the critical temperature of hydrogen (33 K). Therefore, for the present purpose it is only necessary to consider the right hand side of the pressure-temperature projection. The left hand side of projections modified for the existence of solid phases has not been studied for mixtures of hydrogen + organic compounds.

The phase behaviour exhibited in figure 3 is referred to as gas-gas immiscibility of the *second kind* whereas that exhibited in figure 4 is referred to as gas-gas immiscibility of the *first kind*. For gas-gas immiscibility of the first kind the critical locus starting at the critical point of the less volatile component moves to higher pressures and higher temperatures as the concentration of the more volatile component is increased from zero. It is possible to have two immiscible phases present at pressures and temperatures denoted by all points to the left of the critical locus. Since some of these temperatures are above the critical temperature of both components the phenomenon is referred to as gas-gas immiscibility. In gas-gas immiscibility of the second kind, which has a phase diagram as in figure 3, the critical locus starting at the critical point of the less volatile compound moves initially to lower temperatures and higher pressures but eventually moves back to higher temperatures and still higher pressures. Therefore it is possible at high pressures to have two phases present above the critical temperature of either component.

Probably hydrogen + most hydrocarbons with a carbon number of 8 or more will exhibit gas-gas immiscibility of the first kind. During the last two years several "gas" solubilities for hydrogen + hydrocarbons have been studied 30-50 °C below the critical temperature of the hydrocarbon. No detailed studies have been reported near the critical temperature of the hydrocarbon for systems which exhibit gas-gas immiscibility but it is to be expected that such studies may well soon be extended to such a region in view of the importance of hydrogen "solubilities" to coal liquefaction processes. It should also be pointed out that extrapolation of existing high temperature solubilities to temperatures near the critical region will lead to grossly inaccurate values.

References:

1. Rowlinson, J. S. *Liquids and Liquid Mixtures* 2nd edn. Butterworths, London, 1969.
2. Schneider, G. M. in *Spec. Period. Reports No. 22. Chemical Thermodynamics Vol. 2*, ed. McGlashan, M. L. Chem. Soc. London, 1978.
3. Sebastian, N. M.; Simnick, J. J.; Lin, H. M.; Chao, K.-C. *Can. J. Chem. Engng.* 1978, *56*, 743.
4. Frolich, P. K.; Trauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.
5. Augood, D. R. *Trans. Instn. Chem. Engnrs.* 1957, *35*, 394.
6. Lachowicz, S. K.; Newitt, D. M.; Weale, K. E. *Trans. Faraday Soc.* 1955, *51*, 1198.

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5]	Colin L. Young, Department of Physical Chemistry, University of Melbourne, Parkville , Victoria 3052, Australia. October 1980.

CRITICAL EVALUATION:

This system has been fairly extensively investigated but the evaluator is unable to recommend any particular set of data. Wiebe and coworkers' (1), (2) data cover the temperature range 273.15 to 373.15 K and pressures up to 100 MPa and are almost certainly the most reliable in this range. The data of Ipat'ev *et al.* (3), which are mostly at 298 K are significantly lower than those of Wiebe and because of their limited scope the former work is not considered further. The data of Ipat'ev and Theodorovich (4) covered the temperature range 373 to 498 K and are in general lower than the data of Wiebe and coworkers and the more recent data of Suciu (5). The data of Frolich *et al.* (6) were presented in a small graphical form and are rejected.

The data of Pray *et al.* (7), Stephan *et al.* (8), Wiebe and coworkers (1) and (2) and Suciu, Zoss and Sibbitt (9) are all classified as tentative although the latter work is considerably more doubtful. The data of Stephan *et al.* (8) cover the temperature range 373.15 to 435.93 K and the pressure range up to 10 MPa. However there is significant disagreement between the Stephan *et al.* (8) data and that of Wiebe (1), (2). The data of Pray *et al.* (7) are limited to pressures below 2.5 MPa but are included in the compilation since they cover the temperature range 297.0 to 616.5 K. The data of Suciu *et al.* (9) were presented in graphical form, the details given in the compiled tables being taken from theses by Suciu and Zoss. As can be seen from the compilation these data have very significant scatter for each isobar.

The table below gives smoothed values of Kuenen coefficient for the solubility taken from Wiebe and Gaddy.

Kuenen coefficients

T/K	25 atm	50 atm	75 atm	100 atm	150 atm	200 atm	300 atm
273.15	0.5363	1.068	1.601	2.130	3.168	4.187	6.139
283.15	0.4870	0.9690	1.453	1.932	2.872	3.796	5.579
293.15	0.4498	0.8945	1.341	1.785	2.649	3.499	5.158
303.15	0.4263	0.8475	1.271	1.689	2.508	3.311	4.897
313.15	0.4133	0.8215	1.232	1.638	2.432	3.210	4.747
323.15	0.4067	0.8090	1.212	1.612	2.395	3.165	4.695
333.15	0.4053	0.8095	1.211	1.610	2.393	3.168	4.692
343.15	0.4093	0.8171	1.224	1.628	2.422	3.208	4.746
353.15	0.4203	0.8385	1.254	1.667	2.485	3.286	4.866
363.15	0.4385	0.8720	1.298	1.727	2.576	3.402	5.042
373.15	0.4615	0.9120	1.355	1.805	2.681	3.544	5.220

T/K	400 atm	500 atm	600 atm	700 atm	800 atm	900 atm	1000 atm
273.15	8.009	9.838	11.626	13.370	15.013	16.548	18.001
283.15	7.300	8.980	10.610	12.214	13.746	15.215	16.623
293.15	6.766	8.328	9.856	11.362	12.808	14.217	15.592
303.15	6.430	7.922	9.390	10.818	12.218	13.583	14.928
313.15	6.245	7.705	9.135	10.524	11.889	13.230	14.569
323.15	6.166	7.613	9.017	10.389	11.735	13.072	14.404
333.15	6.173	7.625	9.016	10.405	11.746	13.084	14.407
343.15	6.249	7.717	9.131	10.527	11.893	13.233	14.557
353.15	6.392	7.885	9.324	10.757	12.169	13.533	14.867
363.15	6.600	8.129	9.665	11.093	12.555	13.946	15.303
373.15	6.841	8.429	9.994	11.512	12.980	14.394	15.775

These smoothed data are presented as tentative values and are expected to be accurate to ± 1 or 2%.

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5]	Colin L. Young, Department of Physical Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. October 1980.

CRITICAL EVALUATION:

References:

1. Wiebe, R.; Gaddy, V. L.; Heins, C. *Ind. Eng. Chem.* 1932, *24*, 823.

2. Wiebe, R.; Gaddy, V. L. *J. Am. Chem. Soc.* 1934, *56*, 76.

3. Ipat'ev, V. V.; Druzhina-Artemovich, S. I.; Tikhovirov, V. I. *Zh. Obshchei. Khim.* 1931, *1*, 594.

4. Ipat'ev, V. V.; Theodorovich, V. P. *Zh. Obshchei. Khim.* 1934, *4*, 395.

5. Suciu, S. *Ph.D. Thesis, Purdue University* 1951.

6. Frolich, K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.

7. Pray, H. A.; Schweichert, C. E.; Minnich, B. H. *Ind. Eng. Chem.* 1952, *44*, 1147.

8. Stephan, E. L.; Hatfield, N. S.; Peoples, R. S.; Pray, H. A. *Battelle Memorial Institute Rep. BMI-1067*, 1956.

9. Suciu, S.; Zoss, L. M.; Sibbitt, W. L. Paper no. 53-A64 *Am. Soc. Mech. Engnrs.* Nov/Dec 1953 New York.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V. L.; Heins, C.;
Ind. Eng. Chem. 1932, *24*, 823-825.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^3 Mole fraction of hydrogen in water, $10^3 x_{H_2}$
298.15	25.33	0.311
	50.66	0.619
	101.3	1.233
	202.6	2.417
	405.3	4.673
	607.9	6.799
	810.6	8.825
	1013.3	10.745

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Simple steel cylinder containing water through which hydrogen was passed. Pressure measured using dead weight gauge. Water saturated with hydrogen and liquid phase analysed using a volumetric technique. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.8 mole per cent, major impurity being nitrogen.

2. No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.2$;
$\delta x_{H_2} = \pm 0.5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V. L.

J. Am. Chem. Soc. 1934, *56*, 76-79.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
273.15	25.33	0.000383	323.15	405.30	0.004387
	50.66	0.000768		607.95	0.006402
	101.33	0.001520		810.60	0.008316
	202.65	0.002983		1013.25	0.010188
	405.30	0.005690	348.15	25.33	0.000295
	607.95	0.008239		50.66	0.000590
	810.60	0.010619		101.32	0.001173
	1013.25	0.012700		202.65	0.002310
298.15	25.33	0.000311		405.30	0.004487
	50.66	0.000619		607.95	0.006545
	101.33	0.001233		810.60	0.008504
	202.65	0.002417		1013.25	0.010385
	405.30	0.004673	373.15	25.33	0.000330
	607.95	0.006799		50.66	0.000651
	810.60	0.008825		101.32	0.001288
	1013.25	0.010745		202.65	0.002526
323.15	25.33	0.000290		405.30	0.004865
	50.66	0.000578		607.95	0.007091
	101.33	0.001151		810.60	0.009190
	202.65	0.002256		1013.25	0.011147

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Single 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 per cent; major impurity nitrogen.

2. No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{H_2} = \pm 1\%$.

REFERENCES:

1. Wiebe, R.; Gaddy, V. L.; Heins, C. *Ind. Eng. Chem.* 1931, *23*, 401.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

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

ORIGINAL MEASUREMENTS:

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

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

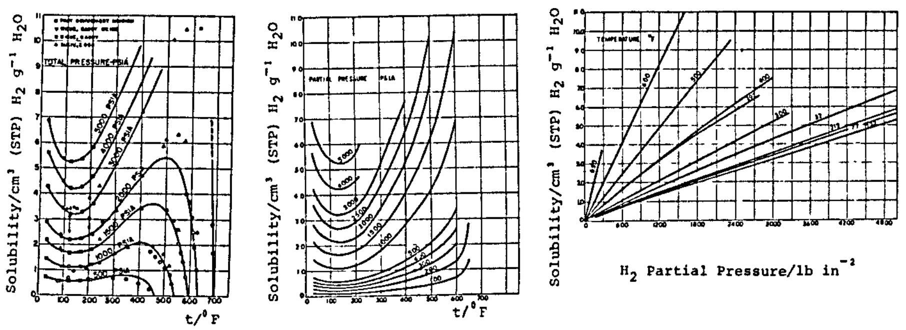
VARIABLES:

T/K: 273.15 - 609.3
(32- 637 °F)
Total P/kPa: 6895 - 20,680
(1000 - 3000 lb in^{-2})

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:



The figures above which show (a) hydrogen solubility *vs* temperature total pressure isobars (left), (b) hydrogen solubility *vs* temperature hydrogen partial pressure isobars (middle), and (c) hydrogen solubility *vs* hydrogen partial pressure isotherms were constructed by Suciu, Zoss, and Sibbitt (2).

In addition to the data from the Ph. D. theses of Suciu and of Zoss, they used data from:
Pray, H. A. H.;Schweichert, C. E.;Minnick, B. H. Battelle Memorial Inst. Report BMI-T-25; *Ind. Eng. Chem.* 1952, *44*, 1146 - 1151.
Wiebe, R.; Gaddy, V. L.; Heins, C. *Ind. Eng. Chem.* 1932, *24*, 823 - 825.
Wiebe, R.; Gaddy, V. L. *J. Am. Chem. Soc.* 1934, *56*, 76 - 79.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was described by Zoss, Suciu, and Sibbitt (1). The apparatus consisted of a high pressure vessel with integral vapor and liquid sample chambers, heaters, temperature controls, auxillary pumps, and analytical equipment.

The sequence of operations was: (a) The pressure vessel was evacuated, (b) charged with a known volume of water (about 175 cm^{-3}), (c) brought to a selected temperature level, (d) charged with gas (under conditions of constant total pressure, constant temperature, and continual agitation) until phase equilibrium was reached, (e) fastened in a vertical position until the vapor and liquid phases separated.

The gas and liquid phases were separatly analyzed.

The results were summarized in graphs (2).

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. Water-pumped. 99.9^+ per cent pure.

(2) Water. Distilled water, boiled three hours and cooled. Tested for pH and for oxygen content (polarography).

ESTIMATED ERROR:

$\delta t/°F = 0.5$
$\delta P/lb\ in^{-2} = 3$
$\delta S/S = 0.03$

REFERENCES:

1. Zoss, L. M.; Suciu, S.; Sibbitt, W. L. *Trans. ASME* 1954, *76*, 69 - 71.
2. Suciu,S.;Zoss,L.M.;Sibbitt,W.L. Paper No. 53-A64 American Society of Mechanical Engineers Meeting, Nov/Dec 1953,N

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5]	Suciu, S. Ph. D. thesis, 1951 Purdue University Zoss, L. M. Ph. D. thesis, 1952 Purdue University

EXPERIMENTAL VALUES:

Temperature		Pressure	Hydrogen	Vapor Composition	
$t/^{0}F$	T/K	lb in^{-2}	Solubility S/cm^3(STP) g^{-1}	c_{H_2O}/mol dm^{-3}	mol fraction x_{H_2O}
80	299.8	500	0.55^{1}		
124	324.3	(34.0 atm,	0.70^{1}		
200	366.5	3450 kPa)	0.57^{1}		
300	422.0		0.59^{1}		
350	449.8		0.58^{1}		
400	477.6		0.50^{1}		
445	502.6		0.27^{1}		
32	273.15	1000	0.847		
76	297.6	(68.0 atm,		0.050^{2}	
77	298.15	6895 kPa)	1.197	0.009^{2}	
78	298.7			0.018	0.0067
103	312.6		1.170		
112	317.6		1.095		
143	334.8			0.037^{2}	
145	335.9		0.951		0.0145^{2}
155	341.5			0.037	0.0134
192	362.0		1.11^{2}		0.022^{2}
245	391.5			0.087^{2}	
246	392.0				0.031^{2}
248	393.15		1.30^{2}		
297	420.4		1.64^{2}		
298	420.9				0.067^{2}
302	423.15			0.170^{2}	
355	452.6		1.90^{2}	0.309^{2}	
359	454.8				0.150^{2}
400	477.6		2.10^{2}		0.263^{2}
455	508.15		1.94^{2}	0.900^{2}	0.489^{2}
497	531.5		1.64^{2}		
500	533.15				0.661^{2}
517	542.6				0.750^{2}
520	544.3		1.20^{2}	1.787^{2}	
77	298.15	1500	1.82		
125	324.8	(102.1 atm,	1.70		
155	341.5	10,340 kPa)	1.70		
245	391.5		2.17		
410	483.15		3.41		
508	537.6		3.88		
555	563.7		2.58		
32	273.15	2000	0.981		
85	302.6	(136.1 atm,	2.34		
125	324.8	13,790 kPa)	3.15		
200	366.5			0.049^{2}	
201	367.0		3.07^{2}		
202	367.6				0.0065^{2}
252	395.4		2.94^{2}		
254	396.5				0.0189^{2}
300	422.0				0.040^{2}
302	423.15			0.170^{2}	
305	424.8		3.34^{2}		
400	477.6			0.510^{2}	
401	478.15				0.131^{2}
402	478.7				0.144^{2}
403	479.3		4.69^{2}		
483	523.7			1.049^{2}	
487	525.9				0.295^{2}
488	526.5		5.86^{2}		

Continued on next page.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Hydrogen; H_2; [1333-74-0] (2) Water; H_2O; [7732-18-5]	Suciu, S. Ph. D. thesis, 1951 Purdue University Zoss, L. M. Ph. D. thesis, 1952 Purdue University

EXPERIMENTAL VALUES:

Temperature		Pressure	Hydrogen Solubility	Vapor Composition	mol fraction
$t/^{0}F$	T/K	$p/\mathrm{lb\ in^{-2}}$	$S/\mathrm{cm^{-3}(STP)\ g^{-1}}$	$c_{H_2O}/\mathrm{mol\ dm^{-3}}$	x_{H_2O}
500	533.15	2000	6.11[2]	1.200[2]	0.345[2]
545	558.15		6.30[2]		
567	570.4			1.825[2]	0.535[2]
575	574.8		6.07[2]	2.612[2]	
577	575.9				0.695[2]
620	599.8				0.782[2]
622	600.9		2.50[2]	2.750[2]	
637	609.3			4.725[2]	
32	273.15	3000	1.215		
89	304.8	(204.1 atm,	3.40		
115	319.3	20,680 kPa)	3.39		
128	326.5		3.38		
142	334.3		3.45		
151	339.3		3.42		
201	367.0		3.86		
238	387.6		4.28		
305	424.8		5.18		
340	444.3			0.257	0.035
405	480.4		7.18	0.407	0.101
510	538.7			1.341	0.175
523	545.9		10.03		
575	574.8		10.45	1.655	0.218
632	606.5		10.50	2.400	0.266

All of the values in the table above appeared in the Ph. D. thesis of L. M. Zoss.

[1] Values calculated from the data of Pray, H. A.; Schweickert, C. E.; Minnick, B. H. Battelle Memorial Institute, BMI-T-25, May 1950.

[2] Values from the Ph. D. thesis of Suciu, S.

Both Ph. D. thesis were directed by W. L. Sibbitt of the Department of Mechanical Engineering.

The hydrogen solubility values were reported as Kuenen coefficients, $S/\mathrm{cm^3}$ H_2 at 1 atm and 273.15 K g^{-1} water.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Pray, H. A.; Schweichert, C. E.; Minnich, B. H.; *Ind. Eng. Chem.* 1952, *44*, 1147-1151.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^3 Mole fraction of hydrogen in water, $10^3 x_{H_2}$
297.0	13.79	0.24
	20.68	0.29
	24.13	0.32
533.1	6.89	0.28
	13.79	0.65
	20.68	0.89
588.7	6.89	0.46
	13.79	0.94
	20.68	1.43
616.5	6.89	1.00
	7.93	1.16
	8.27	1.20
	8.62	1.24

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:

$\delta T/K = \pm 1$; $\delta P/\text{bar} = \pm 1$;

$\delta x_{H_2} = 1\text{-}5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Stephan, E. L.; Hatfield, N. S.;
Peoples, R. S.; Pray, H. A. H.
Battelle Memorial Institute Report BMI-1067, 1956.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$P^\dagger$/bar	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	$P^\dagger$/bar	Mole fraction of hydrogen in liquid, x_{H_2}
373.15	15.5	0.000257	408.15	61.7	0.00111
	15.5	0.000265		63.1	0.00111
	16.2	0.000281		64.5	0.00114
	16.9	0.000281		94.8	0.00173
	16.9	0.000246		95.5	0.00174
	36.2	0.000539		96.9	0.00165
	37.6	0.000571		97.2	0.00169
	39.0	0.000595	435.93	15.5	0.000386
	39.0	0.000595		17.6	0.000400
	70.7	0.00111		17.6	0.000410
	71.4	0.00108		36.2	0.000836
	72.1	0.00108		39.2	0.000868
	72.7	0.00108		40.3	0.000868
	97.6	0.00145		40.7	0.000882
	98.9	0.00151		41.7	0.000940
	100.3	0.00155		45.2	0.001032
408.15	14.1	0.000291		54.9	0.00132
	14.8	0.000292		68.3	0.00152
	15.5	0.000289		69.3	0.00155
	16.2	0.000333		75.2	0.00170
	35.5	0.000643		77.6	0.00181
	36.2	0.000675		84.4	0.00197
	36.9	0.000699		88.9	0.00194
	61.0	0.00114		91.0	0.00202

† partial pressure of hydrogen

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static equilibrium cell. Gas and liquid equilibrated for 18 hours. Pressure measured with Bourdon gauge and temperature measured with thermocouple. Composition of liquid estimated by volumetric method. Details in source. Partial pressure estimated by subtracting vapor pressure from total pressure.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta P/\text{bar} = \pm 0.3$;
$\delta x_{H_2} = \pm 0.00002$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]
3. Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V. L.

J. Am. Chem. Soc.

1935, *57*, 1487-8.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

p/atm	p^*/MPa	Solubility#	Mole percentage of hydrogen in liquid	Mole percentage of hydrogen in gas	Mole* fraction of hydrogen x_{H_2}	Mole* fraction of nitrogen x_{N_2}
50	5.07	0.8344	80.27	76.57	0.000538	0.000132
		0.8359	80.08	76.41	0.000538	0.000134
100	10.13	1.638	80.73	76.40	0.00106	0.000254
		1.643	80.96	76.54	0.00107	0.000251
		1.645	80.88	76.60	0.00107	0.000253
200	20.27	3.215	82.22	-	0.00212	0.000459
		3.205	83.13	-	0.00214	0.000434
400	40.53	6.063	84.20	76.31	0.00409	0.000769
		6.072	84.46	76.32	0.00411	0.000758
600	60.80	8.805	85.05	76.36	0.00598	0.001057
		8.813	84.80	-	0.00597	0.001076
800	81.06	11.312	85.60	76.39	0.00772	0.00131
		11.342	85.04	76.41	0.00769	0.00136
1000	101.33	13.748	85.96	76.28	0.00941	0.00155
		13.701	85.66	-	0.00934	0.00158

* Calculated by compiler.

\# Volume of gas, measured at 273.15 K and 101.3 kPa, dissolved by 1 g of water at the specified temperature and pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

One pass flow method with two vessel absorption train. Second vessel used as source of sample for analysis. Pressure measured with dead weight gauges.

SOURCE AND PURITY OF MATERIALS:

1 and 2. Mixture prepared by burning hydrogen in air. Major impurity was argon.

3. No details.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta p/MPa = \pm 0.05$;

δx_{H_2}, δx_{N_2} = ±2%.

REFERENCES:

COMPONENTS:

1. Deuterium; D_2; [7782-39-0]

2. Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Stephan, E. L.; Hatfield, N. S.; Peoples, R. S.; Pray, H. A. H.
Battelle Memorial Institute Report BMI-1067, 1956.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P^*/bar	Mole fraction of deuterium in liquid, x_{D_2}
435.93	16.7	0.000375
	17.4	0.000433
	18.5	0.000464
	26.5	0.000660
	27.2	0.000625
	27.9	0.000696
533.15	20.6	0.001088
	21.4	0.001115
	22.3	0.001124
	25.0	0.001293
	26.4	0.001257
	28.5	0.001444
574.82	4.1	0.000312
	5.1	0.000419
	6.5	0.000553
	21.6	0.001729
	22.3	0.001907
	23.4	0.001845

P^* partial pressure of deuterium

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas and liquid equilibrated for 18 hours. Pressure measured with Bourdon gauge and temperature measured with thermocouple; composition of liquid estimated by volumetric method. Details in source. Partial pressure estimated by subtracting vapor pressure from total pressure.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta P/\text{bar} = \pm 0.3$;
$\delta x_{D_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. D-mannitol (cordycepic acid); $C_6H_{14}O_6$; [69-65-8]

ORIGINAL MEASUREMENTS:

Wisniak, J.; Hershkowitz, M.; Leibowitz, R.; Stein, S.

J. Chem. Engng. Data, 1974, *19*, 247-249.

VARIABLES:

Temperature, pressure, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Conc. /mol l^{-1} (soln)	10^4 Mole fraction of hydrogen in liquid, $10^4 x_{H_2}$
353.15	6.895	0.5	1.13
	13.79	0.5	2.12
	20.68	0.5	3.03
	27.58	0.5	3.99
	34.47	0.5	5.00
	41.37	0.5	5.96
	48.26	0.5	7.75
	55.16	0.5	7.87
373.15	6.895	0.5	1.29
	13.79	0.5	2.35
	20.68	0.5	3.45
	27.58	0.5	4.48
	34.47	0.5	5.66
	41.37	0.5	6.75
	48.26	0.5	7.84
	55.16	0.5	8.84
393.15	6.895	0.5	1.36
	13.79	0.5	2.55
	20.68	0.5	3.72
	27.58	0.5	4.92
	34.47	0.5	6.19
	41.37	0.5	7.33
	48.26	0.5	8.47
	55.16	0.5	9.69

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Large high pressure autoclave fitted with liquid sampling port. Analysis carried at by stripping solution in gas buret apparatus. Cell charged with components pressurized with hydrogen and equilibrated for at least 15 minutes. Liquid sample transferred to a two buret stripping apparatus.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Distilled.
3. Sigma sample purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.7$;

$\delta x_{H_2} = \pm 3\text{-}5\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Xylose; $C_5H_{10}O_5$; [25990-60-7]

ORIGINAL MEASUREMENTS:

Wisniak, J.; Hershkowitz, M.; Leibowitz, R.; Stein, S.

J. Chem. Engng. Data, 1974, *19*, 247-249

VARIABLES:

Temperature, pressure, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Conc. /mol l^{-1} (soln)	10^4 Mole fraction of hydrogen in liquid, $10^4\ x_{H_2}$
353.15	6.895	0.5	1.20
	13.79	0.5	2.16
	20.68	0.5	3.13
	27.58	0.5	4.06
	34.47	0.5	5.12
	41.37	0.5	6.10
	48.26	0.5	7.05
	55.16	0.5	8.15
373.15	6.895	0.5	1.18
	13.79	0.5	2.21
	20.68	0.5	3.36
	27.58	0.5	4.33
	34.47	0.5	5.47
	41.37	0.5	6.57
	48.26	0.5	7.53
	55.16	0.5	8.66
393.15	6.895	0.5	1.52
	13.79	0.5	2.76
	20.68	0.5	4.07
	27.58	0.5	5.21
	34.47	0.5	6.43
	41.37	0.5	7.77

cont.

AUXILIARY INFORMATION.

METHOD /APPARATUS/PROCEDURE:

Large high pressure autoclave fitted with liquid sampling port. Analysis carried at by stripping solution in gas buret apparatus. Cell charged with components pressurized with hydrogen and equilibrated for at least 15 minutes. Liquid sample transferred to a two buret stripping apparatus.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Distilled.
3. Sigma sample purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/bar = \pm 0.7$;

$\delta x_{H_2} = \pm 3\text{-}5\%$.

REFERENCES:

COMPONENTS :

1. Hydrogen; H_2; [1333-74-0]

2. Water; H_2O; [7732-18-5]

3. Xylose; $C_5H_{10}O_5$; [25990-60-7]

ORIGINAL MEASUREMENTS :

Wisniak, J.; Hershkowitz, M.; Leibowitz, R.; Stein, S.

J. Chem. Engng. Data, 1974, *19*, 247-249.

EXPERIMENTAL VALUES :

T/K	P/bar	Conc./mol l^{-1} (soln)	10^4 Mole fraction of hydrogen in liquid, $10^4 x_{H_2}$
393.15	48.26	0.5	8.97
	55.16	0.5	10.29
353.15	6.895	2.0	1.37
	13.79	2.0	2.73
	20.68	2.0	3.86
	27.58	2.0	4.97
	34.47	2.0	6.35
	41.37	2.0	7.56
	48.26	2.0	8.65
	55.16	2.0	9.88
373.15	6.895	2.0	1.20
	13.79	2.0	2.28
	20.68	2.0	3.25
	27.58	2.0	4.31
	34.47	2.0	5.58
	41.37	2.0	6.36
	48.26	2.0	7.41
	55.16	2.0	8.47
393.15	6.895	2.0	1.33
	13.79	2.0	2.56
	20.68	2.0	3.78
	27.58	2.0	4.99
	34.47	2.0	6.20
	41.37	2.0	7.37
	48.26	2.0	8.49
	55.16	2.0	9.76
373.15	6.895	3.0	1.41
	13.79	3.0	2.88
	20.68	3.0	3.99
	27.58	3.0	5.44
	34.47	3.0	6.65
	41.37	3.0	7.86
	42.26	3.0	8.51
	55.16	3.0	10.41
393.15	6.895	3.0	1.51
	13.79	3.0	2.66
	20.68	3.0	4.02
	27.58	3.0	5.38
	34.47	3.0	6.72
	41.37	3.0	7.69
	48.26	3.0	9.01
	55.16	3.0	10.33

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. Xylitol; $C_5H_{12}O_5$; [87-99-0]

ORIGINAL MEASUREMENTS:

Wisniak, J.; Hershkowitz, M.; Leibowitz, R.; Stein, S.

J. Chem. Engng. Data. 1974, *19*, 247-249.

VARIABLES:

Temperature, pressure, concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Conc. /mol l^{-1} (soln)	10^4 Mole fraction of hydrogen in liquid, $10^4x_{H_2}$
353.15	6.895	0.5	1.13
	13.79	0.5	2.03
	20.68	0.5	2.92
	27.58	0.5	3.98
	34.47	0.5	4.91
	41.37	0.5	5.74
	48.26	0.5	6.67
	55.16	0.5	7.75
373.15	6.895	0.5	1.23
	13.79	0.5	2.20
	20.68	0.5	3.22
	27.58	0.5	4.35
	34.47	0.5	5.37
	41.37	0.5	6.22
	48.26	0.5	7.37
	55.16	0.5	8.34
393.15	6.895	0.5	1.60
	13.79	0.5	2.89
	20.68	0.5	4.18
	27.58	0.5	5.47
	34.47	0.5	6.77
	41.37	0.5	7.95
	48.26	0.5	9.33

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Large high pressure autoclave fitted with liquid sampling port. Analysis carried at by stripping solution in gas buret apparatus. Cell charged with components pressurized with hydrogen and equilibrated for at least 15 minutes. Liquid sample transferred to a two buret stripping apparatus.

SOURCE AND PURITY OF MATERIALS;

1. No details given.
2. Distilled
3. Sigma sample purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/bar = \pm 0.7$;

$\delta x_{H_2} = \pm 3\text{-}5\%$.

REFERENCES:

COMPONENTS	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5 3. Xylitol; $C_5H_{12}O_5$; [87-99-0]	Wisniak, J.; Hershkowitz, M.; Leibowitz, R.; Stein, S. *J. Chem. Engng. Data.* 1974, *19*, 247-249.

EXPERIMENTAL VALUES :

T/K	P/bar	Conc. /mol l^{-1} (soln)	10^4 Mole fraction of hydrogen in liquid, $10^4x_{H_2}$
393.15	55.16	0.5	10.73
353.15	6.895	0.5	1.35
	13.79	2.0	2.61
	20.68	2.0	3.88
	27.58	2.0	5.03
	34.47	2.0	6.22
	41.37	2.0	7.45
	48.26	2.0	8.91
	55.16	2.0	9.87
373.15	6.895	2.0	1.50
	13.79	2.0	2.92
	20.68	2.0	4.11
	27.58	2.0	5.44
	34.47	2.0	6.84
	41.37	2.0	8.04
	48.26	2.0	9.43
	55.16	2.0	10.71
393.15	6.895	2.0	1.60
	13.79	2.0	2.96
	20.68	2.0	4.41
	27.58	2.0	5.94
	34.47	2.0	7.33
	41.37	2.0	8.73
	48.26	2.0	9.92
	55.16	2.0	11.39
353.15	6.895	3.0	1.41
	13.79	3.0	2.54
	20.68	3.0	3.58
	27.58	3.0	4.69
	34.47	3.0	5.83
	41.37	3.0	7.07
	48.26	3.0	8.17
	55.16	3.0	9.27
373.15	6.895	3.0	1.34
	13.79	3.0	2.42
	20.68	3.0	3.50
	27.58	3.0	4.56
	34.47	3.0	5.92
	41.37	3.0	6.92
	48.26	3.0	8.30
	55.16	3.0	9.44
393.15	6.895	3.0	1.40
	13.79	3.0	2.73
	20.68	3.0	3.84
	27.58	3.0	5.00
	34.47	3.0	6.34
	41.37	3.0	7.42
	48.26	3.0	8.71
	55.16	3.0	10.05

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Water; H_2O; [7732-18-5] 3. D-Glucitol, (Sorbitol); $C_6H_{14}O_6$; [50-70-4]	Wisniak, J.; Hershkowitz, M.; Leibowitz, R.; Stein S. *J. Chem. Engng. Data*, 1974, *19*, 247-9
VARIABLES:	PREPARED BY:
Temperature, pressure, concentration	C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Conc. /mol l^{-1} (soln)	10^4 Mole fraction of hydrogen in liquid, $10^4 x_{H_2}$
353.15	6.895	0.5	1.08
	13.79	0.5	2.08
	20.68	0.5	2.97
	27.58	0.5	3.94
	34.47	0.5	5.01
	41.37	0.5	5.86
	48.26	0.5	6.81
	55.16	0.5	7.75
373.15	6.895	0.5	1.29
	13.79	0.5	2.38
	20.68	0.5	3.58
	27.58	0.5	4.72
	34.47	0.5	5.86
	41.37	0.5	6.85
	48.26	0.5	8.02
	55.16	0.5	9.29
393.15	6.895	0.5	1.25
	13.79	0.5	2.54
	20.68	0.5	3.64
	27.58	0.5	4.68
	34.47	0.5	5.85
	41.37	0.5	7.21
	48.26	0.5	8.28

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Large high pressure autoclave fitted with liquid sampling port. Analysis carried at by stripping solution in gas buret apparatus. Cell charged with components pressurized with hydrogen and equilibrated for at least 15 minutes. Liquid sample transferred to a two buret stripping apparatus.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Distilled.
3. Sigma sample purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.7$;

$\delta x_{H_2} = \pm 3\text{-}5\%$.

REFERENCES:

COMPONENTS :

1. Hydrogen; H_2; [1333-74-0]
2. Water; H_2O; [7732-18-5]
3. D-Glucitol, (Sorbitol); $C_6H_{14}O_6$; [50-70-4]

ORIGINAL MEASUREMENTS:

Wisniak, J.; Hershkowitz, M.; Leibowitz, R.; Stein, S.

J. Chem. Engng. Data, 1974, *19*, 247 -9.

EXPERIMENTAL VALUES :

T/K	*P*/bar	Conc./mol l^{-1} (soln)	10^4 Mole fraction of hydrogen in liquid, $10^4 x_{H_2}$
393.15	55.16	0.5	9.43
353.15	6.859	2.0	1.22
	13.79	2.0	2.29
	20.68	2.0	3.25
	27.58	2.0	4.54
	34.47	2.0	5.44
	41.37	2.0	6.47
	48.26	2.0	7.61
	55.16	2.0	8.53
373.15	6.895	2.0	1.23
	13.79	2.0	2.22
	20.68	2.0	3.21
	27.58	2.0	4.37
	34.47	2.0	5.28
	41.37	2.0	6.32
	48.26	2.0	7.47
	55.16	2.0	8.50
393.15	6.895	2.0	1.45
	13.79	2.0	2.52
	20.68	2.0	3.83
	27.58	2.0	5.30
	34.47	2.0	6.46
	41.37	2.0	7.89
	48.26	2.0	8.98
	55.16	2.0	10.24

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Methane; CH_4; [74-82-8]	Colin L. Young, Department of Physical Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. October 1980.

CRITICAL EVALUATION:

The most extensive data on this system are those of Tsang *et al.* (1) who made measurements up to 138 MPa at temperatures between 92.3 K and 180.0 K. The mixture critical line and the pressure-temperature locus of solid-liquid-vapor equilibrium were also determined. Their measurements were carried out using proven apparatus and experimental technique and are classified as recommended.

The limited results of Augood (2) at 111.7 K are broadly consistent with those of Tsang *et al.* but the scatter is very great and therefore Augood's data are classified as doubtful. The results of Freeth and Verschoyle (3) at 90.6 K show considerable scatter and are somewhat smaller than would be expected from an extrapolation of the data of Tsang *et al.* (1) and are therefore classified as doubtful. The data of Steckel and Tsin (4) were presented in small graphical form and are not considered further.

The data of Fastovskii and Gonikberg (5) appear to be in reasonable agreement with those of Tsang *et al.* (1) although they are considerably less precise. Similarly the measurements of Kirk and Ziegler (6) are in reasonable agreement with those of Tsang *et al.* (1) but show more scatter and are restricted to pressures below 13 MPa. The limited data of Benham and Katz (7) at 116.5 K, 144.3 K and 172 K are also in fair agreement with those of Tsang *et al.* (1) but are limited to pressure below 16 MPa. The data of Sagara *et al.* (8) give mole fraction solubilities which are slightly greater than those of Tsang *et al.* (1). The data of Fastovskii and Gonikberg (5), Kirk and Ziegler (6), Benham and Katz (7) and Sagara *et al.* (8) are all classified as tentative but all thought to be considerably less reliable than the measurements of Tsang *et al.* (1).

The data of Yorizane *et al.* (9) deviate considerably from the data of Tsang *et al.* (1) at pressure below 10 MPa but are in fair agreement at the pressures above 10 MPa. The former data are therefore classified as doubtful.

References:

1. Tsang, C. Y.; Clancy, P.; Calado, J. C. G.; Streett, W. B. *Chem. Eng. Comm.* 1980, *6*, 365-383.
2. Augood, D. R. *Trans. Instn. Chem. Engnrs.* 1957, *35*, 394.
3. Freeth, F. A.; Verschoyle, T. T. H. *Proc. Roy. Soc.* A 1931, *130*, 453.
4. Steckel, F. A.; Tsin, N. M. *Zh. Khim. Prom.* 1939, *16*, 24.
5. Fastovskii, V. G.; Gonikberg, M. G. *Acta Physicochim. U.S.S.R.* 1940, *12*, 485.
6. Kirk, B. S.; Ziegler, W. T. *Adv. Cryogenic Engng.* 1965, *10*, 160.
7. Benham, A. L.; Katz, D. L. *Am. Inst. Chem. Engnrs. J.* 1957, *3*, 33.
8. Sagara, H.; Arai, Y.; Saito, S. *J. Chem. Eng. Japan* 1972, *5*, 339.
9. Yorizane, M.; Yoshimura, S.; Mazouka, H.; Toyama, A. *Proc. ICECI* 1968, p.59. *Heywood Temple, London.*

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Freeth, F. A.; Verschoyle, T. T. H.;

Proc. Roy. Soc. A 1931, *130*, 453-463.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
90.66	17.11	0.0038	0.9835	90.63	100.64	0.0559	0.9882
90.68	17.18	-	0.9790	90.67	129.89	0.0819	0.9846
90.64	21.90	0.0070	0.9854	90.62	129.92	0.0760	0.9683
90.67	26.97	-	0.9873	90.61	166.97	0.0784	0.9789
90.63	30.13	-	0.9857	90.65	168.99	0.0890	0.9783
90.65	36.89	0.0056	0.9799	90.64	188.55	0.1016	-
90.63	44.47	-	0.9895	90.67	198.34	0.1020	0.9789
90.65	46.71	0.0064	0.9863	90.63	208.14	-	0.9769
90.63	46.81	-	0.9895	90.62	208.15	0.0958	0.9787
90.66	56.35	0.0170	0.9875				
90.66	56.56	0.0107	0.9885				
90.68	80.61	0.0383	0.9905				

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static equilibrium cell fitted with liquid and vapor sampling parts and magnetically operated stirrer. Pressure measured on pressure balance (dead weight gauge). Temperature measured with platinum resistance thermometer. Gas analysed by combustion and absorption. See ref. 1 and source, few details given.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Crude sample passed through fuming sulfuric acid, ordinary sulfuric acid and potassium hydroxide solution fractionally distilled six times.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/\text{bar} = \pm 0.1$;

δx_{H_2}, $\delta y_{H_2} = \pm 0.005$.

REFERENCES:

1. Verschoyle, T. T. H.;
Phil. Trans. A 1931, *230*, 189.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Fastovskii, V. G.; Gonikberg, M. G.
Acta Physicochim. U.S.S.R.
1940, *12*, 485-488 and
Zh. Fiz. Khim.
1940, *14*, 426.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
90.5	49	5.0	0.024	110.2	78	7.9	0.064
90.5	76	7.7	0.036	110.2	90	9.1	0.077
90.5	102	10.3	0.050	110.2	97	9.8	0.085
90.5	139	14.1	0.064	110.2	103	10.4	0.087
90.5	164	16.6	0.081	110.2	138	14.0	0.111
90.5	171	17.3	0.082	110.2	141	14.3	0.119
90.5	221	22.4	0.097	110.2	187	18.9	0.156
103.3	39	4.0	0.022	122.2	36	3.6	0.032
103.3	77	7.8	0.063	122.2	77	7.8	0.063
103.3	104	10.5	0.092	122.2	96	9.7	0.092
103.3	111	11.2	0.099	122.2	112	11.3	0.099
103.3	146	14.8	0.075	122.2	140	14.2	0.116
103.3	175	17.7	0.105	122.2	187	18.9	0.162
103.3	234	23.7	0.138	127.2	37	3.7	0.038
110.2	32	3.2	0.033	127.2	62	6.3	0.067
110.2	49	5.0	0.042	127.2	85	8.6	0.093
110.2	66	6.7	0.058	127.2	131	13.3	0.143

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow method described in ref. (1) which could not be obtained by compiler.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/MPa = \pm 0.1$;
$\delta x_{H_2} = \pm 0.002$ (estimated by compiler).

REFERENCES:

1. Sokolov, A. A.
"Methods for investigating native gases", 1932 (Russian).

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Benham, A. L.; Katz, D. L.
Am. Inst. Chem. Engnrs. J.
1957, *3*, 33-36.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
172	34.5	0.0170	0.1583
	68.95	0.0877	0.4060
	88.25	0.1255	0.4631
	103.4	0.1622	0.4678
144.3	34.5	0.0343	0.6392
	68.95	0.0781	0.7618
	102.7	0.1310	0.7931
	137.2	0.1805	0.7823
116.5	33.8	0.0318	0.9279
	102.7	0.0950	0.9466
	158.6	0.1394	0.9383

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow system described in ref. 1. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Vapor recirculated by high pressure magnetic pump. Cell charged under pressure. Samples of each phase expanded to room temperature and pressure; analysed by gas density measurements. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

1. Purity better than 99.5 mole per cent; further purified to remove water vapour.
2. Purity better than 99.0 mole per cent; further purified to remove water and higher hydrocarbons.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta P/\text{bar} = \pm 0.5\%$;

δx_{H_2}, $\delta y_{H_2} = \pm 0.5\%$.

REFERENCES:

1. Aroyan, H. J.; Katz, D. L.
Ind. Eng. Chem. 1951, *43*, 185.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Augood, D. R.

Trans. Instn. Chem. Engnrs., 1957, *35*, 394-408.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig+	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
111.7	2600	18.03	0.121	0.942
	1500	10.44	0.091	0.940
	330	2.38	0.022	-

+ psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The methane was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. National Coal Board sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = ±4% (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Kirk, B. S.; Ziegler, W. T.
Int. Adv. Cryog. Eng.
1965, *10*, 160-170.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
90.74	20.32	0.0143	0.99028	116.57	126.32	0.1188	0.9432
	40.73	0.0275	0.99193	116.49	101.32	0.0967	0.9466
	61.07	0.0394	0.99183	116.52	81.0	0.0771	0.9469
90.70	126.9	0.0748	0.98794	116.49	40.67	0.0382	0.9360
90.69	101.3	0.0612	0.98997	116.48	40.67	0.0383	0.9357
	80.99	0.0497	0.99128		20.44	0.0192	0.9018
90.74	50.87	0.0336	0.99242	110.03	126.5	0.108	0.9599
	30.52	0.0212	0.99201	109.92	101.47	0.0880	0.9629
	10.25	0.00761	0.98523	109.96	81.13	0.0711	0.9641
103.06	101.60	0.0789	0.9760	110.02	60.94	0.0532	0.9637
103.07	81.19	0.0634	0.9776	110.00	45.94	0.0407	0.9608
103.06	60.79	0.0480	0.9778	109.99	30.48	0.0275	0.9531
103.08	30.43	0.0252	0.9735	110.01	15.17	0.0134	0.9249
103.07	15.30	0.0126	0.9598				

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Single flow apparatus with two-compartment equilibrium cell. Pressure measured with Bourdon gauge. Temperature measured with a platinum resistance thermometer. Pure hydrogen bubbled through liquid methane. Samples analysed by gas chromatography. Details in source ref. and ref. 1.

SOURCE AND PURITY OF MATERIALS:

1. Purified gas, traces of nitrogen and oxygen.

2. Phillips research grade; purity 99.57 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$; $\delta P/\text{bar} = \pm 0.03$;

δx_{H_2}, $\delta y_{H_2} = \pm 2\%$.

REFERENCES:

1. Kirk, B. S. *Ph.D. Thesis*, Georgia Institute of Technology, 1964.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Yoshimura, S.; Masuoko, H.; Toyama, A.

Proc. ICECI, 1968, *p.59, Heywood Temple, London.*

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
163.15	20	2.03	-	0.136
	20	2.03	-	0.132
	30	3.04	0.011	0.341
	40	4.05	0.030	0.456
	50	5.07	0.028	0.521
	60	6.08	0.047	0.521
	80	8.11	0.081	0.569
	100	10.13	0.140	0.608
	120	12.16	0.178	0.599
	140	14.19	0.286	0.576
	150	15.20	0.286	0.550
143.15	10	1.01	0.003	0.152
	20	2.03	0.008	0.510
	30	3.04	0.035	0.682
	40	4.05	0.055	0.693
	50	5.07	0.064	0.745
123.15	20	2.03	0.020	0.886
	30	3.04	0.038	0.931
	40	4.05	0.038	0.909
	50	5.07	0.056	0.902
103.15	10	1.01	0.004	0.930
	15	1.52	0.010	0.953
	20	2.03	0.013	0.962
	30	3.04	0.030	0.968
	50	5.07	0.050	0.963

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:

1. Purity 99.99 mole per cent or better.
2. Purity 99.93 mole per cent oxygen and nitrogen being principle impurities.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.03$ up to 7.5 MPa; δx_{H_2}, $\delta y_{H_2} = \pm 2\%$.
(estimated by compiler.)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Sagara, H.; Arai, Y.; Saito, S.
J. Chem. Eng. Japan 1972, *5*, 339-348.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
103.05	20.0	0.0142	0.953	143.05	59.9	0.0684	0.779
	41.3	0.0337	0.967		79.7	0.0992	0.802
	61.2	0.0569	0.969		101.5	0.127	0.810
	82.0	0.0708	0.970	172.05	87.5	0.136	0.435
	91.2	0.0819	0.969		103.6	0.201	0.429
123.15	10.2	0.00730	0.683	173.65	35.7	0.0168	0.148
	20.3	0.0192	0.818		40.6	0.0257	0.206
	40.3	0.0385	0.886		60.7	0.0709	0.362
	60.6	0.0616	0.904		71.0	0.0938	0.406
	81.8	0.0816	0.911		81.7	0.124	0.424
	101.8	0.101	0.908		83.8	0.131	0.424
143.05	10.7	0.00310	0.214		100.5	0.190	0.420
	20.2	0.0168	0.541		103.4	0.205	0.411
	40.7	0.0477	0.721		108.3	0.225	0.401

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static stainless steel cell of capacity 5 × 10^5 mm^3 fitted with magnetic stirrer and sampling valves. Cell enclosed in cryostat. Temperature measured with thermocouple. Pressure measured using Bourdon gauge. Gases added to cell and equilibrated. Samples of liquid and gas withdrawn and analysed using a gas chromatograph with thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Nippon Sanso Co. Ltd. sample; purity 99.99 mole per cent.

2. Takachiho Chemical Industry Co. Ltd. sample; purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;

$\delta x_{H_2} = \delta y_{H_2} = \pm 1\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Tsang, C. Y .; Clancy, P.;
Calado, J. C. G.; Streett, W. B.
Chem. Eng. Comm. 1980, *6*, 365-383.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
92.3	0.22	0.0018	0.9084
	0.31	0.0023	0.9257
	0.38	0.0031	0.9509
	0.45	0.0035	0.9561
	0.52	0.0040	0.9625
	0.59	0.0044	0.9672
	0.65	0.0050	0.9722
	0.79	0.0060	0.9770
	1.14	0.0085	0.9821
	1.48	0.0113	0.9857
	1.83	0.0140	0.9875
	2.18	0.0163	0.9888
	2.87	0.0209	0.9904
	3.56	0.0251	0.9917
	4.22	0.0293	--
	5.63	0.0382	0.9914
	7.02	0.0461	0.9904
	10.42	0.0647	0.9893
	13.91	0.0826	0.9860
	17.47	0.0988	0.9821
	20.83	0.1134	0.9791
	27.87	0.1416	0.9707
	41.56	0.1926	0.9546
92.3	55.26	0.2393	0.9386
	69.07	0.2836	0.9233
	82.96	0.3300	0.8998
	97.01	0.3780	0.8808
	110.77	0.4324	0.8571
	125.08	0.4967	0.8264
	131.38	0.5361	0.7983
	134.58	0.5591	0.7918
	137.98	0.5875	0.7563
100.0	0.51	0.0041	0.9175
	0.60	0.0050	0.9285
	0.67	0.0055	0.9358
	0.77	0.0063	0.9420
	1.12	0.0094	--
	1.40	0.0116	0.9607
	1.67	0.0140	0.9667
	1.96	0.0163	0.9717
	2.86	0.0230	0.9758
	3.56	0.0283	0.9786
	4.23	0.0331	0.9814
	4.92	0.0388	0.9819
	5.63	0.0436	0.9819

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetically operated pump. Pressure measured with manganin pressure gauge. Temperature measured with platinum resistance thermometer. Samples of liquid gas analysed using a thermal conductivity gas analyser.

SOURCE AND PURITY OF MATERIALS:

1. Matheson ultra high purity sample, purity 99.999 mole per cent or better.
2. Matheson sample, purity 99.99 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/MPa = \pm 0.5\%$;
δx_{H_2}, δy_{H_2} = ±0.005 (but may be as large as ±0.02 near critical point).

REFERENCES:

1. Streett, W. B.; Calado, J. C. G. *J. Chem. Thermodyn.* 1978, *10*, 1089.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Tsang, C. Y.; Clancy, P.;

Calado, J. C. G.; Streett, W. B.

Chem. Eng. Comm. 1980, *6*, 365-383.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
100.0	7.04	0.0530	0.9824
	10.42	0.0753	0.9796
	13.94	0.0965	0.9742
	17.32	0.1162	0.9705
	20.91	0.1396	0.9660
	24.35	0.1579	0.9607
	27.71	0.1755	0.9553
	41.74	0.2449	0.9280
	55.37	0.3080	0.9016
	68.95	0.3813	0.8733
	82.44	0.4637	0.8327
	89.78	0.5324	0.8037
	93.17	0.5777	0.7574
	94.58	0.6103	0.7396
	95.61	--	0.7096
110.0	0.34	0.0021	0.7252
	0.45	0.0032	0.8355
	0.56	--	0.8649
	0.58	0.0046	--
	0.78	0.0068	0.8867
	1.11	0.0096	0.8958
	1.49	0.0136	0.9228
	1.83	0.0165	0.9308
	2.18	0.0198	0.9391
	2.82	0.0252	0.9485
	3.56	0.0318	0.9541
	4.98	0.0442	0.9607
	6.37	0.0556	--
	7.78	0.0672	0.9632
	9.07	0.0780	0.9632
	13.97	0.1153	0.9593
	17.34	0.1417	0.9497
	20.86	0.1684	0.9422
	27.64	0.2164	0.9264
	34.70	0.2674	0.9050
	41.54	0.3152	0.8837
	44.89	0.3413	0.8690
	48.31	0.3703	0.8505
	48.86	0.3755	0.8509
	51.86	0.4012	0.8325
	53.20	0.4145	0.8229
	55.29	0.4361	0.8181
	55.39	0.4372	0.8108
	57.32	0.4592	0.8017
	58.85	0.4768	0.7973
	62.28	0.5402	0.7634
	63.58	0.5830	0.7053
	63.90	0.6065	0.6902
120.0	0.79	0.0062	0.7178
	1.13	0.0101	0.7893
	1.51	0.0138	0.8300
	2.18	0.0206	0.8741
	3.58	0.0345	0.9104
	5.65	0.0549	0.9280
	7.20	0.0702	0.9325
120.0	9.54	0.0942	0.9315
	12.22	0.1204	0.9351
	13.95	0.1362	0.9292
	17.53	0.1710	0.9182
	20.94	0.2027	0.9104
	24.21	0.2332	0.8982
	27.82	0.2693	0.8878
	31.29	0.3031	0.8685
	34.58	0.3384	0.8437
	38.17	0.3819	0.8325
	41.52	0.4293	0.8035
	43.51	0.4651	0.7839
	44.87	0.4963	0.7560
	46.73	0.5746	0.6941
130.0	0.81	0.0053	0.6245
	1.48	0.0139	0.7572
	2.17	0.0212	0.8128
	2.87	0.0289	0.8478
	4.20	0.0444	0.8656
	5.66	0.0602	0.8774
	6.99	0.0748	0.8850
	9.75	0.1070	0.8927
	12.49	0.1394	0.8894
	15.26	0.1719	0.8867
	20.97	0.2386	0.8649
	24.41	0.2834	0.8447
	27.63	0.3295	0.8254
	31.07	0.3874	0.7935
	33.20	0.4320	0.7617
	34.01	0.4521	0.7456
	35.60	--	0.7305
	36.27	--	0.6363
140.0	1.59	0.0124	--
	1.85	0.0152	0.5782
	2.49	--	0.6558
	2.89	0.0285	--
	3.18	--	0.7291
	2.89	0.0285	0.7200
	4.26	0.0464	0.7628
	5.66	0.0635	0.7971
	8.33	0.0998	0.8243
	11.15	0.1386	0.8305
	13.90	0.1780	0.8276
	17.28	0.2278	0.8138
	20.24	0.2746	0.7929
	21.17	0.2912	0.7856
	22.95	0.3242	0.7674
	25.83	0.3923	0.7288
	27.85	0.4751	0.6652
150.0	1.55	0.0089	0.4428
	3.22	0.0325	0.6511
	4.26	0.0468	0.6910
	5.58	0.0657	0.7193
	7.01	0.0871	0.7329
	8.47	0.1102	0.7449

(cont.)

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Tsang, C. Y.; Clancy, P.;
Calado, J. C. G.; Streett, W. B.
Chem. Eng. Comm. 1980, *6*, 365-383.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
150.0	9.70	0.1311	0.7492	170.0	3.74	0.0271	0.2436
	12.52	0.1784	0.7468		4.44	0.0405	0.3137
	15.38	0.2305	0.7366		5.76	0.0662	0.3995
	17.77	0.2782	0.7115		7.10	0.0949	0.4481
	20.21	0.3449	0.6780		8.56	0.1307	0.4750
	20.90	0.3695	0.6605		9.78	0.1617	0.4816
	21.59	0.3985	0.6392		11.14	0.2066	0.4754
	22.41	0.4708	0.5860		11.79	0.2275	0.4647
159.2	2.43	0.0146	0.2661		12.58	0.2702	0.4384
	2.84	0.0204	0.3363		12.82	0.2933	0.4147
	3.68	0.0355	0.4505	180.0	4.76	0.0332	0.1608
	5.07	0.0582	0.5457		5.30	0.0460	0.1953
	6.26	0.0793	0.5950		5.80	0.0589	0.2242
	8.71	0.1231	0.6384		6.19	0.0700	0.2399
	10.43	0.1569	0.6491		6.73	0.0873	0.2581
	11.75	0.1838	0.6491		7.21	0.1023	0.5159
	12.79	0.2059	0.6466		7.77	0.1241	0.2726
	14.03	0.2364	0.6357		8.33	0.1517	0.2667
	15.27	0.2725	0.6181		8.67	0.1810	0.2528
	16.06	0.3006	0.6030				
	16.64	0.3238	0.5842				
	17.32	0.3629	0.5527				

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Ethane; C_2H_6; [74-84-0]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

This system has been investigated by five groups. The data of Levitskaya (1) and Levitskaya and Pryannikov, (2) are rejected since they are of low precision and deviate considerably from more recently published data. The data of Hiza *et al.* (3), which cover the temperature range 107 to 190 K and pressures between 2 and 15 MPa, and those of Cohen *et al.* (4), which cover the range 144 to 200 K and pressures between 0.7 and 140 MPa, are in good agreement. Both sets of data give K-values which are in good agreement with those quoted by Williams and Katz (5). The mole fraction solubility data of Sagara *et al.* (6) are somewhat smaller than those of Hiza *et al.* (3) and Cohen *et al.* (4). Sagara *et al.* (6) data are more limited than those of refs. (3) and (4) and cover the temperature range 148 to 223 K and pressure between 2 and 8 MPa, and are classified as doubtful. Williams and Katz (5) data are only presented in graphical form and in the form of K-values (K = mole fraction in gas phase/mole fraction in liquid phase). The data of Hiza *et al.* (3) and Cohen *et al.* (4) are classified as tentative.

References:

1. Levitskaya, E. P. *Zh. Tekh. Fiz.* 1941, *11*, 197.
2. Levitskaya, E. P.; Pryannikov, K. *Zh. Tekh. Fiz.* 1939, *9*, 1849.
3. Hiza, M. J.; Heck, C. K.; Kidnay, A. J. *Adv. Cryogenic Engng.* 1968, *13*, 343.
4. Cohen, A. E.; Hipkin, H. G.; Koppany, C. R. *Chem. Engng. Progr. Symp. Ser.* 1967, *no. 81*, *63*, 10.
5. Williams, R. B.; Katz, D. L. *Ind. Eng. Chem.* 1954, *46*, 2512.
6. Sagara, H.; Arai, Y.; Saito, S. *J. Chem. Eng. Japan* 1972, *5*, 339.

COMPONENTS:

1. Hydrogen; H_2; [1334-74-0]
2. Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Williams, R.B.; Katz, D.L.

Ind. Eng. Chem. 1954, *46*, 2512-20.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	K-value of hydrogen	K-value of ethane
283.15	34.5	12.1	0.922
	69.0	6.45	0.657
	137.9	3.21	0.567
	172.4	2.135	0.632
255.37	17.2	48.8	0.896
	34.5	24.4	0.534
	69.0	12.2	0.347
	137.9	6.12	0.264
	275.8	2.82	0.296
	413.7	1.853	0.616
227.59	17.2	75.4	0.424
	34.5	36.8	0.246
	69.0	18.1	0.148
	137.9	9.05	0.113
	275.8	4.49	0.116
	551.6	2.17	0.219
199.82	17.2	101.2	0.150
	34.5	49.0	0.0850
	69.0	24.3	0.0545
	137.9	12.4	0.0432
	275.8	6.35	0.0463

AUXILIARY INFORMATION

METHOD: /APPARATUS/PROCEDURE:

Flow system described in ref. (1). Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Vapor recirculated by high pressure magnetic pump.

Cell charged under pressure. Samples of each phase expanded to room temperature and pressure analysed by gas density measurements. Details ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole %. Dried.
2. Phillips Petroleum Co. pure grade, purity 99.7 mole %, dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta P/\text{bar} = \pm 0.5\%$;

$\delta K/K < 0.01$.

REFERENCES:

1. Aroyan, H.J.; Katz, D.L. *Ind. Eng. Chem.* 1951, *43*, 185.

COMPONENTS

1. Hydrogen; H_2; [1334-74-0]
2. Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS

Williams, R.B.; Katz, D.L.

Ind. Eng. Chem. 1954, *46*, 2512-20

EXPERIMENTAL VALUES:

T/K	*P*/bar	K-value of hydrogen	K-value of ethane
199.92	551.6	3.38	0.0750
172.04	17.2	124.4	0.0362
	34.5	62.2	0.0206
	69.0	31.3	0.0143
	137.9	16.3	0.0127
	275.8	8.75	0.0157
	551.6	4.86	0.0277
144.26	17.2	160	0.00462
	34.5	83.0	0.00314
	69.0	43.2	0.00266
	137.9	23.6	0.00272
	275.8	13.1	0.00432
	551.6	7.45	0.00934
152.04	17.2	238	-
	34.5	129	-
	69.0	70.8	-
	137.9	40.0	-
	275.8	22.7	-
	551.6	13.5	-
138.15	17.2	320	-
	34.5	179	-
	69.0	100	-
	137.9	57.4	-
	275.8	33.3	-
	551.6	19.8	-

COMPONENTS:

1. Hydrogen, H_2; [1333-74-0]
2. Ethane, C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Cohen, A.E.; Hipkin, H.G.;

Koppany, C.R.

Chem. Eng. Prog. Symp. Ser. No. 81, 1967, *63*,10-17.

VARIABLES:

Temperature, pressure.

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
144.21	9.20	0.0036	0.9933
144.21	21.00	0.0062	0.9967
144.21	34.40	0.0118	0.9975
144.21	51.04	0.0185	0.9979
144.15	68.32	0.0258	0.9975
143.48	104.66	0.0378	0.9951
143.42	137.21	0.0454	0.9979
158.15	7.38	0.0033	0.9728
158.15	21.11	0.0103	0.9884
158.21	34.83	0.0175	0.9928
158.21	51.59	0.0266	0.9939
158.21	68.80	0.0345	0.9956
158.21	103.77	0.0470	0.9953
158.15	137.21	0.0545	0.9944
171.93	7.08	0.0036	0.9398
171.93	21.02	0.0078	0.9769
171.93	34.69	0.0169	0.9815
171.87	51.36	0.0256	0.9852
171.87	69.53	0.0355	0.9878
171.87	103.6	0.0510	0.9887
171.98	137.2	0.0674	0.9890
199.32	7.66	0.0043	0.7290
199.32	20.68	0.0135	0.8870
199.32	34.84	0.0235	0.9284
199.32	51.90	0.0341	0.9453
199.32	67.91	0.0470	0.9528
199.54	103.4	0.0700	0.9600
199.65	137.9	0.0897	0.9618

METHOD /APPARATUS/PROCEDURE :

Equilibrium established in cell by recirculating vapor through external flow line at room temperature. Pressure measured with dead weight gauge. Temperature measured with platinum resistance thermometer. Liquid and vapor samples analysed by gas chromatography using thermal conductivity and flame ionisation detectors. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

1. Air Reduction Corp. sample "bone-dry" grade minimum purity 99.8 mole per cent. Dried over molecular sieve.

2. CP grade from Matheson, purity 99 mole per cent. Dried over molecular sieve.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/bar = \pm 0.07$ or 1% whichever greater; $\delta x_{H_2} \simeq \delta y_{H_2} \simeq 3\%$ at high concentration varying to ±0.001 at 0.01 and 0.0003 at 0.0005.

REFERENCES:

1. H.G. Hipkin, *Am. Inst. Chem. Eng.J.* 1966, *12*,484.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Hiza, M.J.; Heck, C.K. Kidnay, A.J.

Adv. Cryogenic Eng. 1968, *13*, 343-355.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p/10^5$Pa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
189.55	25.2	-	0.9327
189.55	25.5	0.0145	-
189.57	41.4	0.0239	0.9538
189.59	60.9	0.0354	0.9640
189.73	91.9	-	0.9706
189.59	102.7	0.0570	0.9718
189.73	121.8	-	0.9730
189.55	145.4	0.0775	0.9739
189.58	153.5	-	0.9741
169.40	24.6	0.0121	0.9779
169.40	40.7	0.0193	0.9846
169.39	61.0	0.0286	0.9876
169.43	89.9	0.0409	0.9890
169.43	121.6	-	0.9895
169.46	146.2	-	0.9892
169.41	149.9	0.0651	0.9894
149.43	19.0	0.00745	-
149.44	20.3	0.00787	-
149.69	22.0	-	0.99424
149.62	39.3	-	0.99611
149.41	40.0	0.0150	-
149.09	60.2	0.0226	-
149.52	60.8	-	0.99670
149.68	89.2	-	0.99690
149.31	91.2	0.0332	-

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow cell described in detail in ref. (1). Temperature measured with platinum resistance thermometer and pressure measured with Bourdon gauge. Cell charged with components, vapor recirculated and vapor and liquid samples withdrawn and analysed by gas chromatography. Details of apparatus in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Purity 99.96 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/10^5 Pa = \pm 0.1$; δx_{H_2}, $\delta(1-y_{H_2}) = \pm 2\text{-}3\%$

REFERENCES:

1. Herring, R.N.; Barrick, P.L. *Int. Adv. Cryogenic Engng*, 1965, *10*, 151.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Ethane; C_2H_6; [74-84-0]	Hiza, M.J. Heck, C.K.; Kidnay, A.J. *Adv. Cryogenic Eng.* 1968, *13*, 343-355.

EXPERIMENTAL VALUES:

T/K	$p/10^5$Pa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
149.54	120.5	0.0414	-
149.78	148.6	0.0507	-
130.00	5.02	-	0.99742
130.00	6.35	-	0.99786
130.00	10.13	-	0.99855
130.00	10.59	-	0.99863
129.74	25.6	0.00769	-
130.00	26.73	-	0.999254
130.00	40.53	-	0.999377
129.58	51.3	0.0154	-
130.00	60.79	-	0.999422
129.49	80.9	0.0223	-
130.00	91.8	-	0.999395
129.59	113.3	0.0299	-
130.00	121.9	-	0.999328
129.78	148.2	0.0368	-
130.00	151.7	-	0.999207
122.00	5.83	-	0.999106
122.00	10.45	-	0.999444
122.00	10.51	-	0.999446
121.91	25.7	0.00670	-
122.00	26.41	-	0.999697
122.00	40.92	-	0.999731
121.91	51.5	0.0126	-
122.00	59.6	-	0.999738
121.86	80.6	0.0191	-
122.00	81.7	-	0.999724
121.71	109.8	0.0249	-
122.00	113.4	-	0.999675
122.00	137.2	-	0.999619
122.00	143.3	-	0.999605
121.84	156.0	0.0326	-
108.00	10.4	-	0.9999349
108.00	25.9	-	0.9999571
108.00	42.4	-	0.9999608
107.83	61.3	0.0114	-
108.00	61.6	-	0.9999574
108.00	84.7	-	0.9999467
107.76	91.0	0.0160	-
108.00	111.5	-	0.9999300
107.85	122.8	0.0201	-
108.00	146.1	-	0.999889
107.85	152.9	0.0237	-

Additional vapor-liquid equilibrium data in source. Vapor composition at 130.00 K and below were determined in a single-pass flow apparatus.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Sagara, H.; Arai, Y.; Saito, S

J. Chem. Eng. Japan 1972, *5*, 339-348.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
148.15	20.3	0.00618	0.986
	40.5	0.0122	0.991
	60.8	0.0156	0.994
	81.1	0.0221	0.995
173.15	20.3	0.00888	0.964
	40.5	0.0168	0.977
	60.8	0.0240	0.983
	81.1	0.0336	0.985
198.15	20.3	0.0108	0.881
	40.5	0.0210	0.930
	60.8	0.0319	0.947
	81.1	0.0448	0.951
223.15	20.3	0.0118	0.688
	40.5	0.0257	0.812
	60.8	0.0412	0.862
	81.1	0.0557	0.884

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static stainless steel cell of capacity 5 × 10^5 mm^3 fitted with magnetic stirrer and sampling valves. Cell enclosed in cryostat. Temperature measured with thermocouple. Pressure measured using Bourdon gauge. Gases added to cell and equilibrated. Samples of liquid and gas withdrawn and analysed using a gas chromatograph with thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Nippon Sanso Co. Ltd. sample; purity 99.99 mole per cent.
2. Takochiho Chemical Industry Co. Ltd. sample; purity 99.7 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;

$\delta x_{H_2} = \delta y_{H_2} = \pm 1\%$.

REFERENCES:

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1334-74-0] 2. Propane; C_3H_8; [74-98-6]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

This system has been investigated by five groups of workers. Benham and Katz (1) presented a limited amount of data as part of a more general study of ternary and multicomponent systems containing hydrogen and propane. Their binary data are not considered further here. Frolich *et al.* (2) studied the hydrogen + propane system but there is some uncertainty as to the interpretation of their data when both components are gases at 298.15 K. Their data give mole fraction solubilities which are considerably greater than those derived by interpolation from the data of Williams and Katz (3), Trust and Kurata (4) and Buriss *et al.* (5). The data of Frolich *et al.* (2) are therefore classified as doubtful. Williams and Katz (3) studied this system between 88.7 K and 297 K at pressures up to 55 MPa but presented their results in terms of K-values (i.e., mole fraction in the liquid phase divided by mole fraction in the gas phase). Trust and Kurata (4) studied the system between 98 K and 348 K at pressures up to 20 MPa. Buriss *et al.* (5) studied the system between 273 K and 348 K up to pressures of 55 MPa. There is good agreement between the data of Trust and Kurata (4) and Williams and Katz (3). The mole fraction solubility data of Buriss *et al.* (5) are slightly smaller than those of the other two groups of workers at pressures above 7 MPa when the data are interpolated. In view of the need to convert Williams and Katz K-values into mole fractions and the interpolation needed because of the different temperatures employed, it is difficult to make a more precise evaluation.

The data of the three groups, (3), (4) and (5) are classified as tentative.

References:

1. Benham, A. L.; Katz, D. L. *Am. Inst. Chem. Engnrs. J.* 1957, *3*, 33.

2. Frolich, P. K.; Trauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.

3. Williams, R. B.; Katz, D. L. *Ind. Eng. Chem.* 1954, *46*, 2512.

4. Trust, D. B.; Kurata, F. *Am. Inst. Chem. Engnrs. J.* 1971, *17*, 86.

5. Buriss, W. L.; Hsu, N. T.; Reamer, H. H.; Sage, B. H. *Ind. Eng. Chem.* 1953, *45*, 210.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A.

Ind. Eng. Chem. 1931, *23*, 548-550.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/MPa	Solubility*, *S*	Mole fraction of hydrogen in liquid,† x_{H_2}
298.15	1.0	4.25	0.0152
	2.0	8.5	0.0300
	3.0	12.7	0.0442
	4.0	17.0	0.0583
	5.0	21.2	0.0717
	6.0	25.45	0.0848
	7.0	29.7	0.0976
	8.0	33.95	0.110
	9.0	38.2	0.122
	10.0	42.45	0.134
	18.04	91.5	0.250

* 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:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Propane; C_3H_8; [74-98-6]	Buriss, W. L.; Hsu, N. T.; Reamer, H. H.; Sage, B. H. *Ind. Eng. Chem.* 1953, *45*, 210-213.
VARIABLES:	**PREPARED BY:**
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
277.59	34.5	0.025	0.810	310.93	241.3	0.241	0.841
	69.0	0.052	0.882		275.8	0.275	0.842
	103.4	0.079	0.909		310.3	0.310	0.841
	137.9	0.10	0.921		344.7	0.346	0.840
	172.4	0.131	0.929		413.7	0.415	0.822
	206.8	0.156	0.932		482.6	0.493	0.793
	241.3	0.181	0.933		543.3	0.666	0.666
	275.8	0.206	0.935	344.26	34.5	0.012	0.142
	310.3	0.231	0.936		69.0	0.071	0.437
	344.7	0.255	0.934		103.4	0.128	0.534
	413.7	0.303	0.931		138.0	0.186	0.581
	482.6	0.350	0.925		172.4	0.245	0.593
	551.6	0.399	0.922		206.8	0.319	0.591
310.93	34.5	0.024	0.534		236.5	0.477	0.477
	69.0	0.062	0.717	360.93	69.0	0.075	0.235
	103.4	0.099	0.780		86.2	0.121	0.277
	137.9	0.136	0.814		103.4	0.190	0.278
	172.4	0.171	0.829		108.9	0.244	0.244
	206.8	0.206	0.835				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell. Pressure measured with pressure balance. Temperature measured using platinum resistance thermometer. Details of apparatus in refs. 1 and 2. Coexisting liquid and gas phase properties determined using vapor density at atmospheric pressure.

SOURCE AND PURITY OF MATERIALS:

1. Matheson Chemical Co. electrolytic sample; purity 99.8 mole per cent; oxygen main impurity.
2. Phillips Petroleum sample. Stated purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/\mathrm{bar} = \pm 0.015$;

δx_{H_2}, $\delta y_{H_2} = \pm 0.001$.

REFERENCES:

1. Sage, B. H.; Lacey, W. N. *Trans. Am. Inst. Mining Met. Engrs.* 1940, *136*, 136.
2. Sage, B. H.; Lacey, W. N. *Trans. Am. Inst. Mining Met. Engrs.* 1948, *174*, 102.

COMPONENTS:

1. Hydrogen; H_2; [1334-74-0]
2. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Williams, R.B.; Katz, D.L.

Ind. Eng. Chem. 1954, *46*, 2512-20.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p/10^5$Pa	K-values of hydrogen
297.04	17.24	52.0
	34.47	26.0
	68.95	13.2
	137.90	6.85
	275.79	3.62
	551.58	1.825
283.15	17.24	60.8
	34.47	30.4
	68.95	15.3
	137.90	7.85
	275.79	4.15
	551.58	2.27
255.37	17.24	78.4
	34.47	39.4
	68.95	19.8
	137.90	10.1
	275.79	5.40
	551.58	3.00
277.59	17.24	100
	34.47	51.0
	68.95	26.0
	137.90	13.3

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system described in ref. (1). Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Vapor recirculated by high pressure magnetic pump. Cell charged under pressure. Samples of each phase expanded to room temperature and pressure; analysed by gas density measurements. K-values of propane given in source.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole %. Dried.
2. Phillips Petroleum Co. purity 99.8 mole %.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta p/Pa = \pm 0.5\%$; $\delta K < 1\%$.

REFERENCES:

1. Aroyan, H.J.; Katz, D.L.; *Ind. Eng. Chem.*, 1951, *43*, 185.

COMPONENTS:

1. Hydrogen; H_2; [1334-74-0]
2. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Williams, R.B.; Katz, D.L.

Ind. Eng. Chem. 1954, *46*, 2512-20.

EXPERIMENTAL VALUES:

T/K	$p/10^5$Pa	K-values of hydrogen
277.59	275.79	6.95
	551.58	3.95
199.82	17.24	123
	34.47	63.8
	68.95	32.9
	137.90	16.9
	275.79	9.08
	551.58	5.11
172.04	17.24	158
	34.47	82
	68.95	43.6
	137.90	22.5
	275.79	12.1
	551.58	7.0
144.26	17.24	214
	34.47	114
	68.95	61.3
	137.90	33.3
	275.79	18.6
	551.58	10.8
116.48	17.24	330
	34.47	177
	68.95	96.1
	137.90	55.5
	275.79	32.3
	551.58	19.5
88.71	17.24	664
	34.47	366
	68.95	204
	137.90	120
	275.79	71.9
	551.58	45.7

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Propane; C_3H_8; [74-98-6]	Trust, D. B.; Kurata, F. *Am. Inst. Chem. Engnrs. J.* 1971, *17*, 86-91.
VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	p/psia	p/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
98.15	250	1.72	0.0021	-
	1000	6.89	0.0056	-
	1500	10.34	0.0074	-
	2250	15.51	0.0108	-
	3000	20.68	0.0134	-
113.15	300	2.07	0.0027	-
	1000	6.89	0.0093	-
	1700	11.72	0.0147	-
	2600	17.93	0.0214	-
123.15	250	1.72	0.0031	-
	1000	6.89	0.0110	-
	2000	13.79	0.0207	-
	2500	17.24	0.0242	-
	3000	20.68	0.0281	-
148.15	150	1.03	0.0025	-
	300	2.07	0.0052	-
	600	4.14	0.0106	-
	900	6.21	0.0154	-
	1300	8.96	0.0218	-
	1700	11.72	0.0274	-
	2100	14.48	0.0329	-
	2800	19.31	0.0443	-
	3000	20.68	0.0473	-

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell (0.1 dm^3 capacity) fitted with magnetic stirrer. Temperature measured with platinum resistance thermometer. Pressure measured with Bourdon gauge. Contents charged into cell, equilibrated, samples withdrawn and analysed by gas chromatography. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.93 mole per cent.

2. Purity 99.91 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta p/MPa = \pm 0.02$;

δx_{H_2}, δy_{H_2} = ±1 to 2%.

REFERENCES:

1. Sinor, J. E.; Schindler, D. L.; Kurata, F.
Am. Inst. Chem. Engnrs. J.
1966, *12*, 353.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Trust, D. B.; Kurata, F.

Am. Inst. Chem. Engnrs. J.

1971, *17*, 86-91.

EXPERIMENTAL VALUES:

T/K	p/psia	p/MPa	Mole fraction of hydrogen	
			in liquid, x_{H_2}	in vapor, y_{H_2}
173.15	250	1.72	0.0061	0.99783
	300	2.07	0.0077	0.99812
	500	3.45	0.0121	0.99865
	1000	6.89	0.0241	0.99899
	2000	13.79	0.0441	0.99901
	2500	17.24	0.0545	-
	2600	17.93	-	0.99888
	2900	19.99	0.0618	0.99884
	3000	20.68	0.0645	0.99880
198.15	250	1.72	-	0.98712
	270	1.86	0.00908	-
	500	3.45	0.01659	0.99300
	1000	6.89	0.03159	0.99530
	1500	10.34	-	0.99581
	2000	13.79	-	0.99602
	2500	17.24	0.07220	0.99592
	3000	20.68	0.08468	0.99570
223.15	200	1.38	0.00777	0.95620
	500	3.45	0.02047	0.97422
	750	5.17	0.02952	0.98127
	1000	6.89	0.03960	0.98585
	1500	10.34	0.05761	-
	2000	13.79	0.07418	0.98892
	2500	17.24	0.08869	0.99069
	3000	20.68	0.10750	0.98964
248.15	250	1.72	0.01065	0.8333
	500	3.45	0.02427	0.91859
	1000	6.89	0.04751	0.96270
	1500	10.34	-	0.97140
	2000	13.79	0.09034	0.97500
	2500	17.24	-	0.98720
	3000	20.68	0.13400	0.97860
273.15	300	2.07	0.01342	0.7245
	500	3.45	0.02373	0.8063
	1000	6.89	0.05220	0.8970
	1500	10.34	0.07724	0.91912
	2000	13.79	0.10920	0.92840
	2500	17.24	0.13400	0.93192
	3000	20.68	0.15860	0.93344
298.15	250	1.72	0.00884	-
	400	2.76	-	0.5760
	500	3.45	0.02486	-
	1000	6.89	0.06020	0.8002
	1500	10.34	0.09712	0.8455
	2000	13.79	0.1239	0.8573
	2500	17.24	0.1649	0.8793
	3000	20.68	0.1945	0.8868
323.15	500	3.45	0.02284	0.3884
	1000	6.89	0.06794	0.6013
	1500	10.34	0.11140	0.6976
	2000	13.79	0.15470	0.7341
	2500	17.24	0.20100	0.7602
	3000	20.68	0.24460	0.7750
348.15	750	5.17	0.03819	0.2587
	1000	6.89	0.06804	0.3840
	1250	8.62	0.09755	0.4300
	1500	10.34	0.13050	0.4892
	2250	15.51	0.23650	0.5223
	2700	18.62	-	0.5231
	3000	20.68	0.35260	-

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Butane; C_4H_{10}; [106-97-8]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

This system has been investigated by five groups. The data of Aroyan and Katz (1), which cover the temperature range 144 K to 297 K and pressures up to 54 MPa, the data of Klink *et al.* (2), which cover the temperature range 328 K to 394 K and pressures up to 17 MPa and the data of Nelson and Bonnell (3), which cover the temperature range 297 K to 389 K and pressure up to 10 MPa are in satisfactory agreement. An exact comparison of the three sets of data is impossible because the work was not carried out at one common temperature.

The data of Augood (4) agree within experimental error with that of Aroyan and Katz (1). However, in view of the poor precision of Augood data for this system, his data are classified as doubtful. Frolich *et al.* (5) studied this system at 298 K at pressures up to 10 MPa. Their results, which are classified as doubtful, yield mole fraction solubilities which are significantly larger than those of Aroyan and Katz (1) and Nelson and Bonnell (3).

The data of Aroyan and Katz (1), Nelson and Bonnell (3) and Klink *et al.* (2) are classified as tentative.

References:

1. Aroyan, H. J.; Katz, D. L. *Ind. Eng. Chem.* 1951, *43*, 185.
2. Klink, A. E.; Chen, H. Y.; Amick, A. H. Jr. *Am. Inst. Chem. Engnrs. J.* 1975, *21*, 1142.
3. Nelson, E. E.; Bonnell, W. S. *Ind. Eng. Chem.* 1943, *35*, 204.
4. Augood, D. *Trans. Instn. Chem. Engnrs.* 1957, *35*, 394.
5. Frolich, P. K.; Trauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

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*, 548-550.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility*, S	Mole fraction of hydrogen in liquid,† x_{H_2}
298.15	1.0	2.7	0.0115
	2.0	5.4	0.0227
	3.0	8.15	0.0338
	4.0	10.85	0.0445
	5.0	13.6	0.0552
	6.0	16.3	0.0654
	7.0	19.0	0.0755
	8.0	21.7	0.0853
	9.0	24.4	0.0949
	10.0	27.15	0.104

* 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:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Nelson, E. E.; Bonnell, W. S.

Ind. Eng. Chem. 1943, *35*, 204-9.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
297.05	22.5	0.020	0.832
	79.6	0.062	-
	104.4	0.074	-
355.35	43.2	0.040	0.627
	61.6	0.063	-
	69.9	0.070	-
	94.8	0.099	0.833
	107.2	0.111	-
388.75	39.1	0.032	-
	49.5	0.051	0.420
	66.8	0.075	-
	71.9	0.083	-
	93.0	0.111	0.624

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Rocking stainless steel bomb fitted with sampling tube. Pressure measured by Bourdon gauge. Temperatures measured by iron-constantan thermocouple. Bomb charged with hydrocarbon, heated to desired temperature. Charged with hydrogen, equilibrated. Composition of liquid and gas samples estimated from change in volume on removal of hydrogen by oxidation. Source reference contains details.

SOURCE AND PURITY OF MATERIALS:

1. Commercially pure. Purity estimated as > 99.5 mole per cent.

2. Purity estimated as > 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.2$; $\delta x_{H_2} = \pm 5\%$; $\delta y_{H_2} = \pm 7\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Aroyan, H.J.; Katz, D.L.

Ind. Eng. Chem. 1951, *43*, 185-9

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid x_{H_2}	in vapor y_{H_2}
297.04	22.41	0.019	0.869
	77.91	0.062	0.954
	104.46	0.080	0.964
	233.39	0.216	0.975
	275.86	0.341	0.974
277.59	21.37	0.016	0.931
	54.68	0.036	0.967
	164.79	0.111	0.983
	286.13	0.182	0.984
	541.2	0.302	-
260.93	21.10	0.0165	0.958
	56.68	0.040	0.979
	166.16	0.105	0.989
	274.41	0.163	0.989
	289.58	0.162	0.989
	501.94	0.260	0.990
	524.00	0.268	0.988
	534.34	0.274	0.988
244.26	21.72	0.015	0.979
	58.47	0.036	0.990

cont.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Recirculating vapor flow system based on that described in ref. (1). Details of present apparatus in source. 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 gas density measurements.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9%, dried over anhydrous $CaSO_4$
2. Phillips Petroleum Co., pure grade purity > 99.0 mole %, major impurity 2-methylpropane.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3\text{-}0.5$; $\delta P/\text{bar} = \pm 1.3$;

$\delta x_{H_2} = \pm 0.0025$; $\delta y_{H_2} = \pm 0.001$.

REFERENCES:

1. Dodge, B.F.; Dunbar, A.K.;
J. Am. Chem. Soc. 1927, *49*, 591.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Aroyan, H.J.; Katz, D.L.

Ind. Eng. Chem. 1951, *43*, 185-9.

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid x_{H_2}	Mole fraction of hydrogen in vapor y_{H_2}
244.26	136.52	0.074	0.993
	288.20	0.1445	0.994
	513.66	0.229	0.995
227.59	27.65	0.017	0.992
	55.16	0.030	0.994
	140.65	0.070	0.996
	262.00	0.119	0.996
	441.27	0.180	0.997
199.82	23.24	0.013	0.998
	55.57	0.024	0.998
	99.97	0.040	0.998
	193.7	0.071	0.998
	282.0	0.096	0.996
	482.6	0.146	0.9985
172.04	20.7	0.010	1.00
	20.7	0.008	-
	57.6	0.020	1.00
	129.6	0.037	-
	129.6	0.038	-
	293.0	0.073	1.00
	508.8	0.116	1.00
144.26	37.6	0.010	1.00
	141.3	0.030	1.00
	286.1	0.050	
	286.1	0.053	
	493.0	0.067	1.00

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Augood, D. R.

Trans. Instn. Chem. Engnrs., 1957, *35*, 394-408.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig$^+$	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
273.2	2740	18.99	0.127	0.982
	1300	9.07	0.073	0.955
	1300	9.07	0.070	0.963
213.6	2715	18.82	0.087	0.996
	2715	18.82	0.081	-
	2640	18.31	0.074	-
	1300	9.07	0.054	-
	1300	9.07	0.047	-

$^+$ psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The butane was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. Shell Petroleum sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = ±4% (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Klink, A. E.; Chen, H. Y.; Amick, A. H. Jr.

Am. Inst. Chem. Eng. J. 1975, *21*, 1142.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	$P^\dagger$/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
327.65	31.27	25.13	0.025	0.777
	42.54	36.15	0.036	0.828
	49.28	55.85	0.047	0.863
	68.69	61.54	0.063	0.879
	83.76	76.20	0.074	0.896
	84.67	92.48	0.086	0.903
	104.31	96.11	0.094	0.910
	117.42	108.75	0.110	0.916
	130.31	121.28	0.123	0.922
	138.04	128.70	0.128	0.924
	138.21	128.94	0.129	0.925
	157.77	147.81	0.147	0.930
	168.47	156.02	0.160	0.932
344.25	27.78	19.11	0.022	0.638
	41.77	32.69	0.036	0.741
	54.97	45.53	0.053	0.791
	69.30	59.40	0.068	0.825
	83.46	73.05	0.081	0.846
	96.79	85.89	0.098	0.860
	106.28	95.20	0.109	0.871
	111.01	99.81	0.113	0.875
	124.64	112.76	0.129	0.881
	139.81	127.30	0.141	0.888

(cont.)

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static cell fitted with stirrer. Pressure measured with dead weight piston gauge-diaphragm differential pressure indicator combination. Samples analysed by gas chromatography using a squalane column. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Ultra-pure sample; purity 99.999 mole per cent.

2. Instrument grade sample; purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.05$;

δx_{H_2}, $\delta y_{H_2} = \pm 0.04$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Butane; C_4H_{10}; [106-97-8]	Klink, A. E.; Chen, H. Y.; Amick, A. H. Jr. *Am. Inst. Chem. Eng. J.* 1975, *21*, 1142.

EXPERIMENTAL VALUES:

T/K	P/bar	$p^{\dagger}$/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
344.25	150.84	137.80	0.159	0.891
	166.53	152.67	0.173	0.894
360.95	27.93	15.62	0.021	0.483
	41.17	28.42	0.037	0.619
	56.17	43.16	0.058	0.706
	68.09	54.56	0.069	0.743
	83.19	68.91	0.090	0.772
	98.68	83.93	0.108	0.799
	110.85	95.66	0.122	0.814
	123.56	107.82	0.134	0.825
	138.47	122.07	0.158	0.835
	149.97	132.92	0.166	0.839
	167.88	149.76	0.193	0.843
377.55	28.34	11.76	0.019	0.322
	41.74	24.46	0.037	0.480
	54.03	36.22	0.053	0.566
	65.68	47.43	0.071	0.621
	77.78	59.04	0.084	0.662
	90.25	71.09	0.106	0.695
	103.21	83.51	0.119	0.719
	117.64	97.28	0.143	0.739
	128.59	107.70	0.153	0.750
	141.40	119.54	0.175	0.753
	154.61	132.02	0.195	0.759
	167.38	143.97	0.217	0.760
394.25	34.31	11.23	0.021	0.213
	48.62	25.07	0.049	0.367
	61.46	37.17	0.066	0.444
	77.17	52.27	0.095	0.514
	88.65	63.41	0.109	0.555
	101.50	75.79	0.135	0.588
	112.87	86.65	0.149	0.609
	125.33	98.74	0.172	0.632
	138.91	111.58	0.193	0.637
	138.99	111.63	0.194	0.638
	152.89	124.77	0.228	0.633
	168.76	140.24	0.266	0.615

$p^{\dagger}$ partial pressure of hydrogen.

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Alkanes; C_5 to C_{14}	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

The solubility of hydrogen in n-alkanes at low pressures is treated separately. Data on the solubility of hydrogen in n-alkanes at high pressures are relatively scarce and it is not possible to recommend any data.

Hydrogen + Pentane

This system has been investigated by Frolich *et al.* (1). Their data were presented in graphical form and are classified as doubtful.

Hydrogen + Hexane

This system has been investigated by three groups of workers. Frolich *et al.* (1) presented their data at 298 K in a graphical form which are classified as doubtful. Nichols *et al.* (2) made an extensive study of this system over the temperature range 277 K to 477 K and at pressures up to 70 MPa. Sattler (3) investigated this system at 308 K at pressures up to 15 MPa and his mole fraction solubility data are considerably smaller than those obtained by interpolation of Nichols *et al.* data (2). Frolich *et al.* (1) data are larger than either Nichols *et al.* (2) or Sattler (3) when any reasonable estimate of the temperature dependence of solubility is used for extrapolation. A comparison with the low pressure data of Walter *et al.* (4) and Katayama and Nitta (5) when extrapolated to 308 K would indicate that Sattler's values (3) are too small, whereas Nichols' *et al.* (2) mole fractions are too large. However, such a comparison relies on an extrapolation to 1 atmosphere partial pressure and an extrapolation or interpolation to 308 K and must be made with caution. The data of Sattler (3) and Nichols *et al.* (2) must nevertheless be considered in disagreement with each other and the low pressure data and are therefore classified as doubtful.

Hydrogen + Heptane
Deuterium + Heptane

Lachowicz (6), (7) studied the solubility of hydrogen and deuterium in heptane between 298 K and 323 K at pressures between 10 MPa and 30 MPa and found no difference in the solubility of the isotopes within the experimental error of about one per cent. The data of Lachowicz *et al.* (7) were given in graphical form and in terms of linear equations. Therefore no data table is given and the data are not evaluated in detail here. The equations given may be rewritten as:

$$\ln x_{H_2},\ 298.15\ K = 6.94 \times (p/\text{atm})$$

$$\ln x_{H_2},\ 310.65\ K = 7.44 \times (p/\text{atm})$$

$$\ln x_{H_2},\ 323.15\ K = 7.89 \times (p/\text{atm}).$$

(cont.)

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Alkanes; C_5 to C_{14}	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

The deuterium solubilities were identical, in terms of mole fractions to the hydrogen solubilities.

Peter and Reinhartz (8) studied hydrogen and heptane in the pressure range 424 K to 499 K at pressures up to 30 MPa. Although detailed comparison of the work of Lachowicz *et al.* (7) with that of Peter and Reinhartz (8) is not possible because of the difference in the temperature range studied, these two studies are, at least, in qualitative agreement. The data of Peter and Reinhartz (8) are classified as tentative.

Hydrogen + Octane
Deuterium + Octane

Lachowicz (6), (7) studied the solubility of hydrogen and deuterium in octane between 298 K and 323 K at pressures between 5 MPa and 30 MPa and found no difference in the solubility of the isotopes within the experimental error of about one per cent (as in the case of heptane + hydrogen or + deuterium).

Lachowicz *et al.* (7) presented their data in graphical form and in terms of linear equations. The data were not compiled or evaluated in detail. The equations given may be rewritten as

$$\ln x_{H_2},\ 298.15\ K = 6.78 \times (p/\mathrm{atm})$$

$$\ln x_{H_2},\ 310.65\ K = 7.38 \times (p/\mathrm{atm})$$

$$\ln x_{H_2},\ 323.15\ K = 7.89 \times (p/\mathrm{atm})$$

The deuterium solubilities were identical, in terms of mole fractions, to the hydrogen solubilities.

The hydrogen + octane system has also been studied by Frolich *et al.* (1) and by Connolly (9). Connolly (9) studied the system between 463 K and 553 K and reported his data as K-values (mole fraction in the gas phase divided by mole fraction in the liquid phase). The temperature range of these results is sufficiently different from that both of other high pressure studies on this system and from low pressure measurements, to make meaningful comparison impossible. The data are classified as tentative.

The data of Frolich *et al.* (1) were presented in graphical form and are classified as doubtful.

Hydrogen + Decane

This system has been investigated by three groups of workers. The most recent data by Sebastian *et al.* (10) are thought to be reliable and cover the temperature range 462 K to 583 K and pressures up to 25 MPa.

(cont.)

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Alkanes; C_5 to C_{14}	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

The considerably less extensive data of Sokolov and Polyakov (11) cover the temperature range 358 K to 483 K and pressure up to 30 MPa and are consistent with the data of Sebastian *et al.* (10).

Nederbragt (12) made some preliminary measurements on this system but was mainly concerned with the solubility of decane in the gas phase. His data are rejected.

The data of Sebastian *et al.* (10) and Sokolov and Polyakov (11) are both classified as tentative.

The gas-liquid critical temperature of decane is 617.7 K (13) and Young (14) has made a preliminary observation of gas-gas immiscibility in this system. The phase behaviour of this system needs to be further investigated and extreme caution needs to be exercised in extrapolating the solubility data to temperatures above 583 K.

Hydrogen + Dodecane
Hydrogen + 2-Methylpropane

The data of Dean and Tooke (15) are the only set of data on these systems. These workers' data on the system hydrogen + 2,2,4-trimethylpentane appear to be consistent with other data on that system. Therefore their data are classified as tentative for the hydrogen + dodecane system.

Hydrogen + Tetradecane

The data of Sokolov and Polyakov (11) are classified as tentative as their data appear to be reliable for the hydrogen + decane system (see above) and there are no other data available for this system.

Hydrogen + Hexadecane

The recent data of Chao and coworker appear to be reliable and the data of this group for this system are therefore classified as tentative.

Hydrogen + 2,2,4-Trimethylpentane

The data of Dean and Tooke (15) and Peter and Reinhartz (8) are classified as tentative on the basis of the experimental techniques used and the agreement between the two sets at the common temperature of 423.95 K. The temperature range of the data of Laugier *et al.* (16) do not overlap with those of the measurements of Dean and Tooke (15) or Peter and Reinhartz (8).

References:

1. Frolich, P. K.; Trauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.
2. Nichols, W. B.; Reamer, H. H.; Sage, B. H. *Am. Inst. Chem. Engnrs. J.* 1957, *3*, 262.
3. Sattler, *Z. Tech. Physik.* 1940, *21*, 410.

(cont.)

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Alkanes; C_5 to C_{14}	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

References (cont.)

4. Walters, J. A.; Mortimer, G. A.; Clements, H. E. *J. Chem. Engng. Data* 1970, *15*, 174.
5. Katayama, T.; Nitta, T. *J. Chem. Engng. Data* 1976, *21*, 194.
6. Lachowicz, S. K. *Thesis, University of London,* Dec. 1954.
7. Lachowicz, S. K.; Newitt, D. M.; Weale, K. E. *Trans. Faraday Soc.* 1955, *51*, 1198.
8. Peter, S.; Reinhartz, K. *Z. Phys. Chem.* 1960, *24*, 10.
9. Connolly, J. F. *Amer. Petr. Inst. Report* 1965, *45, (III)*, 62.
10. Sebastian, H. M.; Simnick, J. J.; Lin, H. M.; Chao, K.-C. *J. Chem. Engng. Data* 1980, *25*, 68.
11. Sokolov, B. I.; Polyakov, A. A. *Zh. Prikl. Khim.* 1977, *50*, 1403.
12. Nederbragt, G. W. *Appl. Sci. Res.* 1948, *A1*, 237.
13. Ambrose, D. "Vapour-Liquid Critical Properties", 1980, N.P.L. Rep. 107. Teddington, U.K.
14. Young, C. L. Unpublished results.
15. Dean, M. R.; Tooke, J. W. *Ind. Eng. Chem.* 1946, *38*, 389.
16. Laugier, S.; Richon, D.; Renon, H. *J. Chem. Engng. Data* 1980, *25*, 274.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Pentane; C_5H_{12}; [109-66-0]

ORIGINAL MEASUREMENTS:

Frolich, P.K.; Tauch, E.J.; Hogan, J.J.; Peer, A.A.

Ind. Eng. Chem. 1931, *23*, 548-550

VARIABLES:
Pressure

PREPARED BY:
C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/MPa	Solubility *	Mole fraction of hydrogen in liquid,+ x_{H_2}
298.15	1.0	2.4	0.0113
	2.0	4.5	0.0209
	3.0	6.7	0.0308
	4.0	9.0	0.0410
	5.0	11.35	0.0511
	6.0	13.6	0.0606
	7.0	15.8	0.0698
	8.0	17.95	0.0785
	9.0	19.95	0.0865
	10.0	21.9	0.0942

* 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 the vapor pressure of the 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. Pentane purity 98 to 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Frolich, P.K.; Tauch, E.J.; Hogan, J.J.; Peer, A.A.

Ing. Eng. Chem. 1931, *23*, 548-550.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility*	Mole fraction of hydrogen+ in liquid, x_{H_2}
298.15	1.0	1.85	0.0098
	2.0	3.65	0.0193
	3.0	5.5	0.0287
	4.0	7.3	0.0378
	5.0	9.1	0.0467
	6.0	10.95	0.0556
	7.0	12.8	0.0644
	8.0	14.6	0.0728
	9.0	16.4	0.0811
	10.0	18.25	0.0894
	11.0	20.1	0.0976

* 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 the vapor pressure of the liquid and the solubility of the gas at atmospheric pressure. Details in source.

SOURCE AND PURITY OF MATERIALS:

Stated that the materials used were the highest purity available. Purity of hexane 98 to 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Sattler, H.;

Z. Tech. Physik, 1940, *21*, 410-413.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Kuenen Coefficient S	Mole fraction of hydrogen in liquid x_{H_2}
308.35	51.0	8.84	0.03289
	51.5	8.96	0.03332
	94.1	16.09	0.05829
	132.6	22.54	0.07980
	137.0	23.30	0.08227
	138.0	23.63	0.08333
	148.3	25.23	0.08848
	151.7	25.96	0.09080

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking bomb with liquid sampling attachment. Solvent and hydrogen charged into evacuated cell. Amount of solvent in liquid sample estimated gravimetrically and hydrogen in liquid stripped out and estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.2$;

$\delta x_{H_2} = \pm 2\%$. (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Nichols, W. B.; Reamer, H. H.;
Sage, B. H.
Am. Inst. Chem. Engnrs. J.
1957, *3*, 262-7.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
277.59	500	3.447	0.028	0.996
	1000	6.895	0.054	0.998
	1500	10.34	0.078	0.998
	2000	13.79	0.099	0.998
	2500	17.24	0.120	0.998
	3000	20.68	0.140	0.998
	3500	24.13	0.160	0.998
	4000	27.58	0.179	0.998
	4500	31.03	0.199	0.998
	5000	34.47	0.218	0.998
	6000	41.37	0.256	0.998
	7000	48.26	0.294	0.998
	8000	55.16	0.334	0.998
	9000	62.05	0.376	0.998
	10000	68.95	0.422	0.998
310.93	500	3.447	0.031	0.986
	1000	6.895	0.059	0.992
	1500	10.34	0.084	0.994
	2000	13.79	0.108	0.995
	2500	17.24	0.131	0.995
	3000	20.68	0.153	0.995
	3500	24.13	0.175	0.995

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

PVT cell charged with mixture of known composition. Pressure measured with pressure balance and temperature measured with platinum resistance thermometer. Bubble point and dew point determined for various compositions from discontinuities in the pressure-volume isotherm. Co-existing liquid and gas phase properties determined by graphical means. Details in ref. (1) and source.

SOURCE AND PURITY OF MATERIALS:

1. Commercial electrolytic grade sample, purified by passage over platinum wire, dried, final purity 99.9 mole per cent.

2. Phillips Petroleum Co. sample, stated purity 99.7 mole per cent, dried and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/MPa = \pm 0.001$;
δx_{H_2}, δy_{H_2} = ±0.001.

REFERENCES:

1. Sage, B. H.; Lacey, W. N. *Trans. Am. Inst. Mining. Met. Engnrs.* 1940, *136*, 136.

1. Hydrogen; H_2; [1333-74-0]

2. Hexane; C_6H_{14}; [110-54-3]

Nichols, W. B.; Reamer, H. H.;
Sage, B. H.
Am. Inst. Chem. Engnrs. J.
1957, *3*, 262-7.

EXPERIMENTAL VALUES:

T/K	*P*/psia	*P*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
310.93	4000	27.58	0.196	0.995
	4500	31.03	0.217	0.995
	5000	34.47	0.238	0.995
	6000	41.37	0.279	0.995
	7000	48.26	0.322	0.995
	8000	55.16	0.366	0.995
	9000	62.05	0.412	0.995
	10000	68.95	0.461	0.995
344.26	500	3.447	0.034	0.961
	1000	6.895	0.064	0.978
	1500	10.34	0.092	0.983
	2000	13.79	0.119	0.986
	2500	17.24	0.144	0.987
	3000	20.68	0.169	0.988
	3500	24.13	0.193	0.988
	4000	27.58	0.216	0.988
	4500	31.03	0.230	0.988
	5000	34.47	0.262	0.988
	6000	41.37	0.309	0.988
	7000	48.26	0.356	0.988
	8000	55.16	0.405	0.988
	9000	62.05	0.456	0.988
	10000	68.95	0.511	0.988
377.59	500	3.447	0.036	0.904
	1000	6.895	0.070	0.946
	1500	10.34	0.102	0.960
	2000	13.79	0.132	0.966
	2500	17.24	0.160	0.969
	3000	20.68	0.187	0.971
	3500	24.13	0.215	0.973
	4000	27.58	0.241	0.974
	4500	31.03	0.267	0.974
	5000	34.47	0.293	0.974
	6000	41.37	0.345	0.974
	7000	48.26	0.396	0.974
	8000	55.16	0.450	0.974
	9000	62.05	0.508	0.974
	10000	68.95	0.570	0.973
410.93	500	3.447	0.038	0.797
	1000	6.895	0.078	0.886
	1500	10.34	0.115	0.914
	2000	13.79	0.149	0.927
	2500	17.24	0.181	0.934
	3000	20.68	0.213	0.939
	3500	24.13	0.244	0.942
	4000	27.58	0.274	0.944
	4500	31.03	0.304	0.945
	5000	34.47	0.334	0.946
	6000	41.37	0.393	0.946
	7000	48.26	0.451	0.945
	8000	55.16	0.511	0.944
	9000	62.05	0.576	0.941
	10000	68.95	0.649	0.931
444.26	500	3.447	0.037	0.606
	1000	6.895	0.086	0.772
	1500	10.34	0.132	0.826
	2000	13.79	0.172	0.851
	2500	17.24	0.210	0.865

(cont.)

1. Hydrogen; H_2; [1333-74-0]
2. Hexane; C_6H_{14}; [110-54-3]

Nichols, W. B.; Reamer, H. H.; Sage, B. H.
Am. Inst. Chem. Engnrs. J.
1957, *3*, 262-7

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
444.26	3000	20.68	0.249	0.873
	3500	24.13	0.285	0.878
	4000	27.58	0.322	0.882
	4500	31.03	0.359	0.884
	5000	34.47	0.394	0.885
	6000	41.37	0.461	0.884
	7000	48.26	0.528	0.880
	8000	55.16	0.597	0.865
	9000	62.05	0.691	0.815
	9200†	63.43	0.768	0.768
477.59	500	3.447	0.032	0.310
	1000	6.895	0.103	0.568
	1500	10.34	0.165	0.656
	2000	13.79	0.224	0.700
	2500	17.24	0.283	0.722
	3000	20.68	0.341	0.736
	3500	24.13	0.396	0.745
	4000	27.58	0.448	0.749
	4500	31.03	0.500	0.750
	5000	34.47	0.555	0.747
	5920†	40.82	0.688	0.688

† critical point

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Heptane; C_7H_{16}; [142-82-5]

ORIGINAL MEASUREMENTS:

Peter S.; Reinhartz, K.

Z. Phys. Chem. 1960, *24*, 103-18.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$P/10^5$Pa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}	T/K	$P/10^5$Pa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
424.15	24.5	0.030	0.824	471.65	196.1	0.272	0.905
	49.0	0.062	0.903		294.2	0.377	0.915
	98.1	0.121	0.942		392.2	0.469	0.914
	147.1	0.171	0.952		490.3	0.554	0.908
	196.1	0.216	0.957		588.4	0.633	0.898
	294.2	0.295	0.962		686.5	0.710	0.883
	392.2	0.363	0.964	498.85	24.5	0.023	0.355
	588.4	0.482	0.965		49.0	0.077	0.638
	784.5	0.572	0.964		98.1	0.170	0.758
471.65	24.5	0.020	0.561		147.1	0.252	0.794
	49.0	0.074	0.752		196.1	0.329	0.813
	98.1	0.150	0.854		245.2	0.401	0.825
	147.1	0.216	0.890		294.2	0.468	0.829
					343.2	0.537	0.816

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static steel equilibrium cell fitted with magnetic stirrer and sampling ports. Temperature measured with a platinum resistance thermometer. Samples withdrawn after equilibrium established. The hydrocarbon component frozen out in a dry ice/acetone bath, hydrogen estimated volumetrically.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade, purity 99.9 mole per cent, 0.05 mole per cent methane.

2. Phillips Petroleum Co. sample; pure grade, minimum purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{H_2} = \pm 3\%$; $\delta y_{H_2} = \pm 0.005$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Frolich, P.K.; Tauch, E.J.;
Hogan, J.J.; Peer, A.A.

Ind. Eng. Chem.
1931, *23*, 548-550.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility,*	Mole fraction of hydrogen in liquid,+ x_{H_2}
298.15	1.0	1.4	0.0093
	2.0	2.75	0.0181
	3.0	4.15	0.0270
	4.0	5.6	0.0361
	5.0	7.0	0.0447
	6.0	8.4	0.0532
	7.0	9.85	0.0618
	8.0	11.3	0.0702
	9.0	12.7	0.0783
	10.0	14.1	0.0861
	11.0	15.5	0.0939
	12.0	17.0	0.102
	13.0	18.4	0.110
	14.0	19.8	0.117
	15.0	21.3	0.125
	16.0	22.8	0.132
	17.0	24.3	0.140
	18.0	25.75	0.147
	19.0	27.2	0.154

* 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 the vapor pressure of the 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. Purity of octane 98 to 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Connolly, J.F.,

Amer. Petr. Inst. Report, 1965, *45 (III)*, 62-67.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	K values $K_{C_8H_{18}}$	 K_{H_2}
463.15	4.55	1.000	114.2
	6.89	0.705	79.8
	13.8	0.387	42.5
	20.7	0.273	29.2
	27.6	0.212	22.4
	34.5	0.175	18.2
	51.7	0.127	12.5
	68.9	0.130	9.57
	103.4	0.079+	-
473.15	5.51	1.000	86.6
	6.89	0.832	71.3
	13.8	0.464	38.9
	20.7	0.331	26.9
	27.6	0.261	20.7
	34.5	0.216	16.9
	51.7	0.158	11.7
	68.9	0.128	8.98
	103.4	0.099+	6.2+
483.15	6.62	1.000	66.3
	6.89	0.970	64.4
	13.8	0.555	35.5
	20.7	0.400	24.8
	27.6	0.318	19.1
	34.5	0.265	15.6
	51.7	0.194	10.9

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sample of known composition confined over mercury. Mixture compressed at constant temperature. Dew point and bubble point determined visually. Data smoothed.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.5$;
$\delta K/K = \pm 1\%$.
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Connolly, J.F.

Amer. Petr. Inst. Report, 1965, *45 (III)*, 62-67.

EXPERIMENTAL VALUES:

T/K	P/bar	K values $K_{C_8H_{18}}$	 K_{H_2}
483.15	68.9	0.159	8.39
	103.4	0.123	5.87
	137.9	0.106+	
493.15	7.93	1.000	50.0
	13.8	0.653	31.7
	20.7	0.475	22.4
	27.6	0.380	17.4
	34.5	0.320	14.2
	51.7	0.237	10.0
	68.9	0.195	7.76
	103.4	0.154	5.47
	137.9	0.133	4.30
503.15	9.38	1.000	37.5
	13.8	0.759	27.7
	20.7	0.560	20.0
	27.6	0.452	15.7
	34.5	0.384	12.9
	51.7	0.287	9.11
	68.9	0.237	7.12
	103.4	0.188	5.04
	137.9	0.163+	3.97+
513.15	11.0	1.000	28.1
	13.8	0.863	24.1
	20.7	0.647	17.6
	27.6	0.527	13.9
	34.5	0.450	11.5
	51.7	0.343	8.19
	68.9	0.287	6.42
	103.4	0.228+	4.59+
523.15	12.9	1.000	20.7
	13.8	0.960	20.0
	20.7	0.742	15.0
	27.6	0.614	12.0
	34.5	0.532	10.0
	51.7	0.414	7.23
	68.9	0.350	5.71
	103.4	0.286	4.11
	137.9	0.253+	3.28+
533.15	15.0	1.000	14.9
	20.7	0.835	12.1
	27.6	0.704	9.93
	34.5	0.613	8.44
	51.7	0.487	6.21
	68.9	0.420	4.95
	103.4	0.351	3.57+
543.15	17.4	1.000	10.2
	20.7	0.915	9.40
	27.6	0.793	7.93
	34.5	0.706	6.80
	51.7	0.579	5.07
	68.9	0.516	4.06
	103.4	0.453	2.96
	137.9	0.422+	2.36+
553.15	27.6	0.879	5.68
	34.5	0.802	4.98
	51.7	0.691	3.80
	68.9	0.631	3.08

\+ obtained by extrapolation by authors.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Sokolov, B. I.; Polyakov, A. A.
Zh. Prikl. Khim. 1977, *50*, 1403-5.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
358.15	40.5	0.036
	101.3	0.086
	202.6	0.158
	304.0	0.221
408.15	40.5	0.044
	101.3	0.105
	202.6	0.191
	304.0	0.260
483.15	40.5	0.060
	101.3	0.147
	202.6	0.250
	304.0	0.345

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with stirrer. Solvent placed in cell then pressurized with hydrogen at room temperature, heated to experimental temperature and equilibrated. Liquid samples removed and cooled; analysed by stripping gas out and measuring volume evolved. Remaining liquid estimated gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1 and 2 "Pure" grade samples.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{H_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Sebastian, H. M.; Simnick, J. J.;
Lin, H. M.; Chao, K-C.
J. Chem. Eng. Data 1980, *25*, 68-70.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
462.5	1.4477	0.14669		
	19.01	1.926	0.0251	0.9216
	29.15	2.954	0.0408	0.9446
	49.4	5.01	0.0678	0.9676
	99.6	10.09	0.1309	0.9823
	148.3	15.03	0.1890	0.9860
	200.0	20.27	0.2406	0.9877
	251.9	25.52	0.2832	0.9891
503.4	3.485	0.3531		
	19.16	1.941	0.0289	0.8021
	32.46	3.289	0.0511	0.8786
	51.1	5.18	0.0818	0.9207
	99.9	10.12	0.1550	0.9539
	149.5	15.15	0.2202	0.9657
	201.7	20.44	0.2760	0.9706
	250.4	25.37	0.3324	0.9740
543.0	7.132	0.7226		
	19.35	1.961	0.0286	0.6025
	30.92	3.133	0.0533	0.7367
	48.8	4.94	0.0903	0.8198
	99.5	10.08	0.1799	0.9001
	149.2	15.12	0.2582	0.9266

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Airco sample, purity 99.95 mole per cent.

2. Aldrich Chemical Co. sample, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.003$ (below 3.5 MPa), ± 0.02 (above 3.5 MPa); δx_{H_2}, $\delta y_{H_2} = \pm 1\%$.

REFERENCES:

1. Simnick, J. J.; Lawson, C. C.; Lin, H. M.; Chao, K-C. *Am. Inst. Chem. Engnrs. J.* 1977, *23*, 469.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Sebastian, H. M.; Simnick, J. J.; Lin, H. M.; Chao, K-C.

J. Chem. Eng. Data 1980, *25*, 68-70.

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
543.0	199.7	20.23	0.3249	0.9391
	251.8	25.51	0.3825	0.9446
583.5	13.378	1.3555		
	49.9	5.06	0.1059	0.6355
	99.7	10.10	0.2220	0.7825
	150.1	15.21	0.3247	0.8303
	201.7	20.44	0.4098	0.8505
	243.7	24.69	0.5013	0.8581

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Dodecane (isomeric mixture); $C_{12}H_{26}$;

ORIGINAL MEASUREMENTS:

Dean, M. R.; Tooke, J. W.

Ind. Eng. Chem. 1946, *38*, 389-393.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
366.5	36.2	0.0373	0.99831
	70.33	0.0684	0.99900
	139.6	0.124	0.99929
	209.3	0.169	0.99932
	277.9	0.215	0.99930
	347.2	0.254	0.99930
422.0	36.2	0.0442	0.9868
	80.33	0.0789	0.999227
	139.6	0.147	0.99520
	209.3	0.200	0.99602
	277.9	0.250	0.99633
	347.2	0.299	0.99652

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell fitted with sampling valve which could be used for gas or liquid sample. Pressure measured with Bourdon gauge, temperature measured with mercury in glass thermometer. Hydrocarbon placed in cell, pressurized with hydrogen. Agitated and equilibrated samples withdrawn and hydrocarbon component frozen out in liquid nitrogen; hydrogen estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic commercial sample, purity better than 99.8 mole per cent.
2. Isomeric mixture prepared by polymerization of isobutylene.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.2$ (up to 70 bar); ± 1.0 (up to 400 bar); $\delta x_{H_2} = \pm 1\%$; $\delta y_{H_2} = \pm 0.1\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Tetradecane; $C_{14}H_{30}$; [629-59-4]

ORIGINAL MEASUREMENTS:

Sokolov, B. I.; Polyakov, A. A.
Zh. Prikl. Khim. 1977, *50*, 1403-5.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
328.15	40.5	0.033
	101.3	0.083
	202.6	0.146
	304.0	0.210
403.15	40.5	0.042
	101.3	0.104
	202.6	0.190
	304.0	0.258
473.15	40.5	0.059
	101.3	0.131
	202.6	0.250
	304.0	0.326

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with stirrer. Solvent placed in cell then pressurized with hydrogen at room temperature, heated to experimental temperature and equilibrated. Liquid samples removed and cooled; analysed by stripping gas out and measuring volume evolved. Remaining liquid estimated gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1 and 2 "Pure" grade samples.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{H_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Lin, H.-M.; Sebastian, H.M.; Chao, K.-C.

J. Chem. Engng. Data. 1980, *25*, 252-257.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction in liquid, x_{CH_4}	Mole fraction in vapor, y_{CH_4}
461.65	20.05	2.032	0.0311	0.99666
	29.90	3.030	0.0468	0.99782
	50.0	5.07	0.0757	0.99850
	101.7	10.30	0.1428	0.99909
	149.5	15.15	0.1978	0.99929
	199.5	20.21	0.2468	0.99939
	249.4	25.27	0.2928	0.99945
542.25	19.83	2.009	0.0407	0.9648
	30.24	3.064	0.0617	0.9759
	50.7	5.14	0.1007	0.9849
	101.8	10.31	0.1854	0.99187
	149.7	15.17	0.2515	0.99362
	199.7	20.23	0.3104	0.99450
	248.9	25.22	0.3597	0.99503
622.85	19.97	2.023	0.0497	0.8083
	29.92	3.032	0.0764	0.8663
	50.4	5.11	0.1293	0.9179
	100.1	10.14	0.2354	0.9553
	150.9	15.29	0.3201	0.9665
	200.7	20.34	0.3903	0.9713
	249.3	25.26	0.4458	0.9757

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Airco sample, purity 99.95 mole per cent or better.
2. Matheson Coleman and Bell sample purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.01$; δx_{H_2}, $\delta y_{H_2} < \pm 1.0\%$

REFERENCES:

1. Simnick, J.J.; Lawson, C.C.; Lin, H.M.; Chao, K.C.

   Am. Inst. Chem. Engnrs. J. 1977, *23*, 469.

COMPONENTS:	ORIGINAL MEASUREMENTS
1. Hydrogen; H_2; [1333-74-0] 2. Hexadecane; $C_{16}H_{34}$; [544-76-3]	Lin, H.-M.; Sebastian, H.M.; Chao, K.-C. *J. Chem. Engng. Data.* 1980, *25*, 252-257.

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	Mole fraction in liquid, x_{CH_4}	Mole fraction in vapor, y_{CH_4}
664.05	19.69	1.995	0.0513	0.6054
	30.02	3.042	0.0857	0.7205
	50.2	5.087	0.1488	0.8224
	100.7	10.20	0.2782	0.8977
	100.4	10.17	0.2759	0.8988
	150.4	15.24	0.3724	0.9271
	199.9	20.25	0.4511	0.9378
	250.5	25.38	0.5192	0.9452

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 2-Methylpropane; C_4H_{10}; [75-28-5]

ORIGINAL MEASUREMENTS:

Dean, M. R.; Tooke, J. W.

Ind. Eng. Chem. 1946, *38*, 389-393.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
310.9	34.47	0.0275	0.8631	338.7	206.8	0.197	0.9018
	68.95	0.0592	0.9191	366.5	34.47	0.0225	0.407
	103.4	0.0872	0.9423		68.95	0.0709	0.615
	137.9	0.1112	0.9521		103.4	0.109	0.719
	172.4	0.142	0.9571		137.9	0.156	0.758
	206.8	0.179	0.9551		172.4	0.192	0.758
338.7	34.47	0.0274	0.697		206.8	0.247	0.565
	68.95	0.0676	0.824	394.3	68.95	0.082	0.370
	103.4	0.0847	0.867		86.18	0.117	0.406
	137.9	0.129	0.887		103.4	0.162	0.424
	172.4	0.169	0.879				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell fitted with sampling valve which could be used for gas or liquid samole. Pressure measured with Bourdon gauge, temperature measured with mercury in glass thermometer. Hydrocarbon placed in cell, pressurized with hydrogen. Agitated and equilibrated samples withdrawn and hydrocarbon component frozen out in liquid nitrogen; hydrogen estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic commercial sample; purity better than 99.8 mole per cent.

2. Phillips Petroleum sample; purity 99.5 mole percent; major impurity n-butane.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 2$ (up to 70 bar); ± 10 (up to 400 bar); $\delta x_{H_2} = \pm 1\%$; $\delta y_{H_2} = \pm 0.1\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 2,2,4 - Trimethylpentane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Dean , M. R.; Tooke, J. W.
Ind. Eng. Chem. 1946, *38*, 389-393.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
310.9	12.1	0.0090	0.98950
	36.2	0.0272	0.99602
	70.33	0.0517	0.99764
	139.3	0.0971	0.99831
	208.6	0.132	0.99838
	276.5	0.166	0.99840
	346.5	0.198	0.99832
366.5	17.1	0.0165	0.9490
	40.2	0.0404	0.9765
	71.36	0.0710	0.9855
	104.8	0.0974	0.9888
	142.7	0.130	0.9910
366.5	208.6	0.174	0.9922
	276.5	0.218	0.9930
	348.5	0.258	0.9936
423.4	12.8	0.0122	0.6897
	37.9	0.0468	0.8969
	70.33	0.0910	0.9334
	106.2	0.129	0.9511
	141.0	0.167	0.9601
	208.6	0.238	0.9676
	275.1	0.292	0.9725
	349.2	0.355	0.9748

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell fitted with sampling valve which could be used for gas or liquid sample. Pressure measured with Bourdon gauge, temperature measured with mercury in glass thermometer. Hydrocarbon placed in cell, pressurized with hydrogen. Agitated and equilibrated samples withdrawn and hydrocarbon component frozen out in liquid nitrogen; hydrogen estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic commercial sample; purity better than 99.8 mole per cent.

2. Rohm and Haas Co. sample; "pure" sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\mathrm{bar} = \pm 2$ (up to 70 bar); ± 10 (up to 400 bar); $\delta x_{H_2} = \pm 1\%$; $\delta y_{H_2} = \pm 0.1\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2,2,4 - Trimethylpentane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Peter, S.; Reinhartz, K.

Z. Phys. Chem. 1960, *24*, 103-18.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
423.95	24.5	0.029	0.832
	49.0	0.062	0.911
	73.5	0.093	0.934
	98.1	0.122	0.946
	147.1	0.178	0.955
	196.1	0.227	0.966
	294.2	0.314	0.971
	392.3	0.388	0.972
	588.4	0.509	0.971
	784.5	0.604	0.966
	980.7	0.683	0.960
	1078.8	0.707	0.958
471.65	24.5	0.029	0.591
	49.0	0.072	0.758
	73.5	0.114	0.824
	98.1	0.153	0.854
	147.1	0.225	0.886
	196.1	0.290	0.903
471.65	294.2	0.397	0.914
	392.3	0.488	0.920
	490.3	0.570	0.916
	588.4	0.646	0.905
	686.5	0.742	0.881
	711.0	0.816	0.816
499.35	29.4	0.032	0.460
	49.0	0.076	0.604
	73.5	0.127	0.703
	98.1	0.173	0.754
	147.1	0.261	0.806
	196.1	0.340	0.828
	245.2	0.413	0.839
	294.2	0.483	0.843
	343.2	0.557	0.840
	372.6	0.601	0.825
	387.4	0.729	0.729

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static steel equilibrium cell fitted with magnetic stirrer and sampling ports. Temperature measured with a platinum resistance thermometer. Samples withdrawn after equilibrium established. The hydrocarbon component frozen out in a dry ice/acetone bath, hydrogen estimated volumetrically.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade. purity 99.9 mole per cent, 0.05 mole per cent methane.
2. Shell AG sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{H_2} = \pm 3\%$; $\delta y_{H_2} = \pm 0.005$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2,2,4- Trimethylpentane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Laugier, S.; Richon, D.; Renon, H.

J. Chem. Engng. Data. 1980, *25*, 274-276.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
226.0	3.0	-	0.445
	6.2	0.110	0.676
	11.9	0.217	0.780
	18.0	0.312	0.829
	24.6	-	0.847
	24.8	0.421	-
	31.4	0.499	0.849
	36.8	0.580	-
250.0^a	3.15	0.039	-
	8.00	0.171	-
	10.20	0.232	-
	13.00	-	0.704
	15.05	0.345	-
	16.05	0.373	-
	17.05	0.402	-
	17.40	-	0.697
	18.10	0.428	-
	19.75	0.467	-
	20.00	-	0.651
	20.40	0.496	0.636
		0.524	0.550

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

1. L'Air Liquide sample, purity better than 99.95 mole per cent.
2. Fluka sample, guaranteed purity 99.5 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.04$;
$\delta x_{H_2} = \pm 0.009$; $\delta y_{H_2} = \pm 0.012$

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2,2,4-Trimethylpentane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Laugier, S.; Richon, D.; Renon, H.

J. Chem. Engng. Data. 1980, *25*, 274-276.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
250.0^b	4.90	-	0.473
	5.05	0.093	-
	7.80	-	0.623
	10.40	-	0.670
	14.40	0.335	0.708
	18.70	0.444	-

a) First set of experiments

b) Second set of experiments

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Cyclohexane; C_6H_{12}; [110-82-7]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

This system, like hydrogen + benzene, has been studied fairly extensively under a wide range of conditions. The two most extensive studies are that of Berty, Reamer and Sage (1) who studied the system between 310 K and 407 K up to pressures of 62 MPa and that of Krichevskii and Sorina (2) who studied the system between 293 K and 333 K up to pressures of 67 MPa. While it is not possible to carry out a precise comparison because the system was not studied at a common temperature, there are some small discrepancies between the results of these workers. The limited data of Sattler (3) at 308 K agrees with that obtained by interpolation of Krichevskii and Sorina (2). The data of Thomson and Edmister (4) which was studied at 339 K and 394 K up to pressures of 69 MPa agree with the data of Krichevskii and Sorina (2) at the lower temperature and with that of Berty *et al.* (1) at the higher temperature. Comparison of the data of Ipatiev and Levina (5) with that of Krichevskii and Sorina (2) and Berty *et al.* (1) indicates that Ipatiev and Levina (5) data are slightly too low (as has been observed elsewhere; see, for example, the evaluation of hydrogen + 1,3-dimethylbenzene). The data of Brainard and Williams (6) were determined as part of a study of the quaternary system, hydrogen + benzene + cyclohexane + hexane. While it appears that their data are slightly high at 366 K the extent of their data is too limited for a meaningful comparison in view of the interpolation needed in both pressure and temperature. Frolich *et al.* (7) presented their data in graphical form and the mole fraction solubilities calculated from their results are almost 10 per cent greater than those of Krichevskii and Sorina (2).

The data of Ipatiev and Levina (5) and Frolich *et al.* (7) are classified as doubtful whereas those of Berty *et al.* (1), Krichevskii and Sorina (2), Sattler (3) and Thompson and Edmister (4) are classified as tentative.

References:

1. Berty, T. E.; Reamer, H. H.; Sage, B. H. *J. Chem. Engng. Data* 1966, *11*, 25.
2. Krichevskii, I. R.; Sorina, G. A. *Zh. Fiz. Khim.* 1958, *32*, 2080.
3. Sattler, H. *Z. Tech. Physik.* 1940, *21*, 410.
4. Thompson, R. E.; Edmister, W. C. *Am. Inst. Chem. Engnrs. J.* 1965, *11*, 457.
5. Ipatiev, V. V.; Levina, M. I. *Zh. Fiz. Khim.* 1935, *6*, 632.

(cont.)

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Cyclohexane; C_6H_{12}; [110-82-7]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

References (cont.)

6. Brainard, A. J.; Williams, G. B. *Am. Inst. Chem. Engnrs. J.* 1967, *13*, 60.
7. Frolich, P. K.; Trauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.;
Hogan, J. J.; Peer, A. A.
Ind. Eng. Chem. 1931, *23*, 548-550.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility*, S	Mole fraction of hydrogen in liquid,† x_{H_2}
298.15	1.0	1.0	0.0044
	2.0	2.0	0.0088
	3.0	3.0	0.013
	4.0	3.9	0.017
	5.0	4.9	0.021
	6.0	5.9	0.025
	7.0	6.9	0.030
	8.0	7.9	0.034
	9.0	8.9	0.038
	10.0	9.9	0.042
	11.0	10.9	0.046
	12.0	11.9	0.050
	13.0	13.0	0.055
	14.0	14.0	0.059
	15.0	15.05	0.063
	16.0	16.1	0.067
	17.0	17.2	0.071
	18.0	18.25	0.075

* 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:

Stated that the materials were the highest purity available. Purity of cyclohexane 98 to 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Ipatiev, V.V.; Levina, M.I.

Zhur. Fiz. Khim. 1935, *6*, 632-9.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	44.1	0.01801
	91.2	0.03401
	196.1	0.06813
	294.2	0.09889
423.15	44.1	0.03236
	91.2	0.06836
	196.1	0.1400
513.15	294.2	0.3668

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Hydrocarbon added to cell then pressurized at temperature of measurement. After 1-2 hours liquid samples removed. Analysed by stripping out hydrogen at low pressure.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Prepared by high pressure (150-200 atm) hydrogenation of benzene at 280°C in presence of nickel catalyst. Boiling pt. 80.6°C Density at 15°C = 0.7835.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 2\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Cyclohexane; C_6H_{12}; [110-82-7]	ORIGINAL MEASUREMENTS: Sattler, H.; *Z. Tech. Physik*, 1940, *21*, 410-413
VARIABLES: Pressure	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Kuenen Coefficient S	Mole fraction of hydrogen in liquid x_{H_2}
308.35	54.9	6.21	0.02280
	95.6	10.73	0.03875
	96.1	10.84	0.03913
	146.8	16.53	0.05848
	147.1	16.51	0.05841
	147.1	16.42	0.05811

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Rocking bomb with liquid sampling attachment. Solvent and hydrogen charged into evacuated cell. Amount of solvent in liquid sample estimated gravimetrically and hydrogen in liquid stripped out and estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.2$;

$\delta x_{H_2} = \pm 2\%$. (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Krichevskii, I.R. and Sorina, G.A.

Zhur. Fiz. Khim. 1958, *32*, 2080-6

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
293.15	49.6	0.0215	313.15	50.6	0.0216
	59.9	0.0257		59.8	0.0259
	77.5	0.0307		68.7	0.0299
	109.4	0.0438		75.1	0.0322
	119.6	0.0478		94.2	0.0407
	144.9	0.0526		99.1	0.0435
	187.5	0.0718		119.6	0.0510
	188.5	0.0691		150.0	0.0602
	272.6	0.0945		158.1	0.0651
	300.9	0.103		188.5	0.0731
	318.2	0.102		198.6	0.0796
	334.4	0.114		233.0	0.0910
	379.0	0.117		280.7	0.105
	382.0	0.119		296.9	0.112
	403.3	0.129		359.7	0.133
	424.6	0.130		379.0	0.139
	448.9	0.136		389.1	0.141
	479.3	0.149		436.7	0.152
	512.7	0.151		457.0	0.155
	547.2	0.162		462.0	0.165
	601.9	0.176		491.4	0.171
	609.0	0.177		539.0	0.177
	643.4	0.184		565.4	0.186
	658.6	0.188		601.9	0.196

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with stirrer. Pressure measured with Bourdon gauge. Samples of liquid and vapor phases analysed by stripping out hydrogen and estimating volumetrically

SOURCE AND PURITY OF MATERIALS:

1. Dried by passing through silica gel and calcium chloride
2. Boiling point 80.1°C at 0.9710 bar; $n_4^{20} = 1.4263$

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 1$ (up to 300 bar), ± 5 (above 300 bar); $\delta x_{H_2} = \pm 0.0003$ or 1% (whichever is greater) (estimated by compiler).

REFERENCES:

COMPONENTS

1. Hydrogen; H_2; [1333-74-0]

2. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Krichevskii, I.R. and Sorina, G.A.

Zhur. Fiz. Khim. 1958, *32*, 2080-6

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
313.15	677.9	0.217	333.15	363.8	0.156
333.15	50.1	0.0262		400.2	0.164
	71.1	0.0367		417.5	0.170
	92.2	0.0462		434.7	0.170
	117.5	0.0571		445.8	0.178
	154.0	0.0746		474.2	0.189
	181.4	0.0841		486.4	0.192
	207.7	0.0941		513.7	0.202
	229.0	0.0983		545.1	0.214
	245.2	0.108		576.5	0.217
	251.3	0.110		603.9	0.266
	260.4	0.114		653.5	0.241
	290.8	0.125		667.7	0.246
	329.3	0.141			

T/K	P/bar	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in vapor, y_{H_2}
293.15	50.2	0.99738	313.15	491.4	0.99666
	50.2	0.99728		599.8	0.99653
	99.1	0.99830		603.9	0.99654
	99.1	0.99821		688.0	0.99621
	197.6	0.99858		688.0	0.99584
	299.9	0.99864	333.15	50.1	0.9854
	379.0	0.99853		50.1	0.9858
	379.0	0.99867		102.3	0.99203
	558.3	0.99834		104.4	0.99192
	662.7	0.99803		193.5	0.99402
313.15	49.0	0.99133		193.5	0.99416
	50.1	0.99236		289.8	0.99465
	124.6	0.99559		290.8	0.99466
	125.6	0.99572		388.1	0.99460
	196.6	0.99655		388.1	0.99471
	198.6	0.99681		484.3	0.99451
	277.6	0.99691		486.4	0.99441
	279.7	0.99713		574.5	0.99429
	352.6	0.99713		576.5	0.99392
	434.7	0.99702		688.0	0.99321
	436.7	0.99689		688.0	0.99296
	491.4	0.99665			

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Thompson, R. E.; Edmister, W. C.
Am. Inst. Chem. Engnrs. J.
1965, *11*, 457-461.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
338.7	6.88	0.00362	0.9027
	13.78	0.00710	0.9523
	34.60	0.0182	0.9773
	34.58	-	0.9793
	68.66	0.0345	0.9880
	116.8	0.0563	0.99132
	207.0	0.102	0.99320
	413.4	0.178	0.99390
	690.4	0.262	0.99358
	690.4	-	0.99315
394.3	6.98	0.00317	0.451
	13.78	0.00802	0.237
	34.47	0.0225	0.101
	68.94	0.0456	0.0565
	117.2	0.0774	0.0377
	206.8	0.131	0.0269
	413.4	0.236	0.0213
	689.4	0.350	0.0188

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibrium cell fitted with glass fiber packing and grooved cone to assist equilibrium being established. Pressure measured with dead weight tester and temperature with thermocouple. Sample analysed by freezing out hydrocarbon and gas measured volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.8 mole per cent.
2. Phillips Petroleum sample, purity 99.94 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\text{bar} = \pm 0.1\%$, δx_{H_2}, δy_{H_2} = ±3% (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Berty, T. E.; Reamer, H. H.;
Sage, B. H.
J. Chem. Engng. Data 1966, *11*,
25-30.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
310.9	34.5	0.0135	0.9921	344.3	413.7	0.1760	0.9920
	68.9	0.0269	0.9949		482.6	0.2030	0.9919
	103.4	0.0400	0.9964		551.6	0.2273	0.9918
	137.9	0.0530	0.9969		620.5	0.2520	0.9917
	172.4	0.0658	0.9970	377.6	34.5	0.0189	0.9350
	206.8	0.0784	0.9971		68.9	0.0384	0.9622
	241.3	0.0906	0.0072		103.4	0.0574	0.9716
	275.8	0.1028	0.9973		137.9	0.0760	0.9763
	310.3	0.1145	0.9973		172.4	0.0941	0.9789
	344.7	0.1260	0.9972		206.8	0.1119	0.9804
	413.7	0.1480	0.9970		241.3	0.1281	0.9815
	482.6	0.1692	0.9967		275.8	0.1446	0.9822
	551.6	0.1893	0.9960		310.3	0.1599	0.9827
344.3	34.5	0.0157	0.9734		344.7	0.1758	0.9830
	68.9	0.0316	0.9851		413.7	0.2058	0.9832
	103.4	0.0473	0.9888		482.6	0.2362	0.9834
	137.9	0.0627	0.9903		551.6	0.2644	0.9835
	172.4	0.0774	0.9912	407.6	34.5	0.0244	0.8582
	206.8	0.0927	0.9915		68.9	0.0466	0.9196
	241.3	0.1068	0.9919		103.4	0.0697	0.9402
	275.8	0.1215	0.9920		137.9	0.0914	0.9503
	310.3	0.1357	0.9920		172.4	0.1118	0.9564
	344.7	0.1494	0.9920		206.8	0.1340	0.9603

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static PVT cell fitted with dead weight pressure balance and platinum resistance thermometer. Bubble point determined from discontinuity in slope of pv isotherm. Gas phase compositions determined by analysis using partial condensation techniques. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic hydrogen passed over hot platinum wire. Final purity better than 99.86 mole per cent.

2. Phillips Petroleum research grade sample. Purity 99.94 mole per cent minimum. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P/\text{bar} = \pm 0.03$;

δx_{H_2}, $\delta y_{H_2} = \pm 0.001$.

REFERENCES:

1. Sage, B. H.; Lacey, W. N.
Trans. Am. Inst. Mining Met. Engnrs. 1940, *136*, 136.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Cyclohexane; C_6H_{12}; [110-82-7]	Berty, T. E.; Reamer, H. H.; Sage, B. H. *J. Chem. Engng. Data* 1966, *11*, 25-30.

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
407.6	241.3	0.1505	0.9630
	275.8	0.1673	0.9651
	310.3	0.1858	0.9664
	344.7	0.2020	0.9673
	413.7	0.2343	0.9681
	482.6	0.2652	0.9681
	551.6	0.2919	0.9683

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Cyclohexane; C_6H_{12}; [110-82-7]	ORIGINAL MEASUREMENTS: Brainard, A. J.; Williams, G. B. *Am. Inst. Chem. Engnrs. J.* 1967, *13*, 60-69.
VARIABLES: Temperature, pressure	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
366.48	146.86	0.0853	0.985
	37.92	0.0231	0.959
422.04	139.07	0.1097	0.949
	37.78	0.0300	0.859

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell. Pressure measured with Bourdon gauge. Analysis of samples carried out by expanding into an expansion cylinder and freezing out the hydrocarbon; hydrogen measured volumetrically and then hydrocarbon estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Matheson ultrapure sample, purity better than 99.998 mole per cent.
2. Phillips Petroleum sample, purity 99.99 mole per cent; 2,4-dimethylpentane and 2,2-dimethylpentane major impurities

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/\text{bar} = \pm 0.15$;

δx_{H_2}, δy_{H_2} = ±1.0% (estimated by compiler).

REFERENCES:

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Methylcyclohexane; C_7H_{14}; [108-87-2]	ORIGINAL MEASUREMENTS: Ipatiev, V.V.; Levina, M.I. *Zhur. Fiz. Khim.* 1935, *6*, 632-9.
VARIABLES: Pressure.	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	44.1	0.02250
	91.2	0.04400
	196.1	0.08264
	294.2	0.1398

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Hydrocarbon added to cell then pressurized at temperature of measurement. After 1-2 hours liquid samples removed. Analysed by stripping out hydrogen at low pressure.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Prepared by high pressure (150-200 atm) hydrogenation of toluene at 280°C in presence of nickel catalyst.
   Boiling pt. 100.8°C.
   Density at 15°C = 0.7783.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 2\%$.
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methylcyclohexane; C_7H_{14};
[108-87-2]

ORIGINAL MEASUREMENTS:

Peter, S.; Reinhartz, K.

Z. Phys. Chem. 1960, *24*, 103-18.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
424.15	24.5	0.022	0.925
	49.0	0.044	0.955
	98.1	0.085	0.965
	147.1	0.124	0.970
	196.1	0.161	0.972
	294.2	0.226	0.974
	490.3	0.335	0.977
	686.5	0.421	0.978
	882.6	0.492	0.978
471.65	24.5	0.023	0.707
	49.0	0.055	0.858
	98.1	0.112	0.912
	147.1	0.163	0.925
	196.1	0.209	0.931
471.65	294.2	0.292	0.938
	490.3	0.363	0.941
	686.5	0.519	0.938
	882.6	0.597	0.935
498.85	24.5	0.017	0.464
	49.0	0.054	0.735
	98.1	0.121	0.855
	147.1	0.180	0.885
	196.1	0.233	0.893
	294.2	0.329	0.899
	392.3	0.411	0.900
	588.4	0.543	0.899
	784.5	0.638	0.882

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static steel equilibrium cell fitted with magnetic stirrer and sampling ports. Temperature measured with a platinum resistance thermometer. Samples withdrawn after equilibrium established. The hydrocarbon component frozen out in a dry ice/acetone bath, hydrogen estimated volumetrically.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade, purity 99.9 mole per cent, 0.05 mole per cent methane.

2. Phillips Petroleum Co. sample; pure grade, minimum purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{H_2} = \pm 3\%$; $\delta y_{H_2} = \pm 0.005$ (estimated by compiler).

REFERENCES:

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. Decahydronaphthalene, (Decalin); $C_{10}H_{18}$; [91-17-8]	ORIGINAL MEASUREMENTS: Sokolov, B. I.; Polyakov, A. A. *Zh. Prikl. Khim.* 1977, *50*, 1403-5.
VARIABLES: Temperature, pressure	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
338.15	40.5	0.014
	101.3	0.038
	202.6	0.076
	304.0	0.123
398.15	40.5	0.020
	101.3	0.054
	202.6	0.105
	304.0	0.158
473.15	40.5	0.025
	101.3	0.069
	202.6	0.136
	304.0	0.195

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static equilibrium cell with stirrer. Solvent placed in cell then pressurized with hydrogen at room temperature, heated to experimental temperature and equilibrated. Liquid samples removed and cooled; analysed by stripping out gas and measuring volume evolved. Remaining liquid estimated gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1 and 2 "Pure" grade samples.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{H_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1,1'-Bicyclohexyl; $C_{12}H_{22}$; [92-51-3]

ORIGINAL MEASUREMENTS:

Sebastian, H. M.; Yao, J.; Lin, H.-M.; Chao, K.-C.

J. Chem. Engng. Data 1978, *23*, 167.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
462.15	20.3	0.0181	0.9842	621.75	20.3	0.0211	0.6117
	30.4	0.0262	0.9889		30.4	0.0382	0.7322
	50.7	0.0443	0.9929		50.7	0.0686	0.8296
	101.3	0.0810	0.9958		101.3	0.1398	0.9060
	152.0	0.1158	0.9969		152.0	0.1975	0.9298
	202.7	0.1418	0.9974		202.7	0.2578	0.9445
	253.3	0.1718	0.9977		253.3	0.3112	0.9533
541.85	20.3	0.0212	0.8988	701.65	20.3	0.0054	0.0602
	30.4	0.0329	0.9312		30.4	0.0289	0.2463
	50.7	0.0543	0.9558		50.7	0.0793	0.4885
	101.3	0.1031	0.9748		101.3	0.1818	0.6720
	152.0	0.1480	0.9813		152.0	0.2680	0.7467
	202.7	0.1899	0.9845		202.7	0.3494	0.7857
	253.3	0.2268	0.9866		253.3	0.4239	0.8050

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. Air Products Co. sample; purity 99.95 mole per cent.

2. Fischer Scientific Co. sample; purity about 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.7$; $\delta P/\text{bar} = \pm 0.3$;

δx_{H_2}, δy_{H_2} = ±1% (estimated by compiler).

REFERENCES:

1. Simnick, J. J.; Lawson, C. C.; Lin, H.-M.; Chao, K.-C. *Am. Inst. Chem. Engnrs. J.* 1977, *23*, 469.

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Ethene; C_2H_4; [74-85-1]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

This system has been investigated by four groups. The early data of Likhter and Tikhonovich (1) are of limited accuracy; the mole fraction of hydrogen in the liquid was found to be proportional to the fugacity of hydrogen, f, up to 8 MPa. The constants, k, in the equation

$$f = kx$$

were 1450, 1607, 1845 and 2152 atm at 188, 178, 168 and 158 K, respectively. It appears that the mole fraction solubilities from these equations are higher than more recent data. The mole fraction solubility data of Hiza *et al.* (2) which cover the temperature range 121 to 170 K and pressures between 2 and 15 MPa are consistently a few per cent higher than those given by Sagara *et al.* (3) which cover the temperature range 123 to 248 K and pressures between 2 and 8 MPa. Both sets of data are classified as tentative.

The data of Williams and Katz (4) are mostly reported as K-values (K = gas phase mole fraction/liquid phase mole fraction) or in graphical form. K-values calculated from the data of Sagara *et al.* (3) are in agreement with those quoted by Williams and Katz (4).

References:

1. Likhter, A. I.; Tikhonovich, N. P. *Zh. Tekh. Fiz.* 1939, *9*, 1916.
2. Hiza, M. J.; Heck, C. K.; Kidnay, A. J. *Chem. Eng. Progr. Symp. Ser.* 1968, *64*, *no. 88*, 57.
3. Sagara, H.; Arai, Y.; Saito, S. *J. Chem. Engng. Japan* 1972, *5*, 339.
4. Williams, R. B.; Katz, D. L. *Ind. Eng. Chem.* 1954, *46*, 2512.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Ethene, (Ethylene); C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Williams, R.B.; Katz, D.L.

Ind. Eng. Chem. 1954, *46*, 2512-20.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	*p*/psi	*p*/10^5Pa	K value of hydrogen
255.37	500	34.47	17.1
	1000	68.95	8.10
	2000	137.90	3.94
241.48	500	34.47	23.1
	1000	68.95	11.25
	2000	137.90	5.50
	4000	275.79	2.43
227.59	250	17.24	56.0
	500	14.47	28.2
	1000	68.95	14.4
	2000	137.90	7.35
	4000	275.79	3.51
199.82	250	17.24	84.2
	500	34.47	41.3
	1000	68.95	21.2
	2000	137.90	10.8
	4000	275.79	5.75
172.04	250	17.24	123.6
	500	34.47	62.0
	1000	68.95	31.8
	2000	137.90	16.5

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system described in ref. (1). Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Vapor recirculated by high pressure magnetic pump. Cell charged under pressure. Samples of each phase expanded to room temperature and pressure; analysed by gas density measurements. K-values for ethylene given in source.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole %. Dried.
2. 99.6% pure as estimated by mass spectrometry.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta p/\text{psi} = \pm 0.5\%$; $\delta K < 1\%$.

REFERENCES:

1. Aroyan, H.J.; Katz, D.L. *Ind. Eng. Chem.*, 1951, *43*, 185.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Ethene, (Ethylene); C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Williams, R.B.; Katz, D.L.

Ind. Eng. Chem. 1954, *46*, 2512-20

EXPERIMENTAL VALUES:

T/K	*p*/psi	*p*/10^5Pa	K value of hydrogen
172.04	4000	275.79	8.82
	8000	551.58	4.95
158.15	250	17.24	147
	500	34.47	75.1
	1000	68.95	38.6
	2000	137.90	20.2
	4000	275.79	10.9
	8000	551.58	6.25
144.26	250	17.24	188
	500	34.47	96.4
	1000	68.95	50.3
	2000	137.90	26.6
	4000	275.79	14.60
	8000	551.58	8.75
116.48	250	17.24	308
	500	34.47	159
	1000	68.95	82.7
	2000	137.90	44.8
	4000	275.79	28.5
	8000	551.58	18.7

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Ethene; C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Hiza, M. J.; Heck, C. K.; Kidnay, A. J.

Chem. Eng. Progr. Symp. Ser. No. 88 <u>1968</u>, *64*, 57-65.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
169.90	23.8	0.0117	0.9460	129.62	33.9	0.00929	-
169.93	48.4	0.0235	0.9696	130.0	43.8	-	0.99811
169.72	61.6	0.0303	-	129.85	61.0	0.0161	-
	62.6	-	0.9733	130.00	76.4	-	0.99831
169.75	81.1	-	0.9764	129.82	80.4	0.0205	-
169.73	105.4	0.0507	-	130.00	92.8	-	0.99831
	106.9	-	0.9784	129.78	105.7	0.0266	-
169.72	136.8	0.0638	-	130.00	129.5	-	0.99818
169.76	147.9	-	0.9796	129.79	131.2	0.0320	-
149.71	30.4	-	0.9884	122.00	10.76	-	0.99813
149.93	31.7	0.0121	-		25.58	-	0.99896
149.68	56.1	-	0.99177		37.0	0.00800	-
149.84	60.2	0.0224	-		39.28	-	0.999142
149.69	77.4	0.0289	-	121.79	61.10	0.0133	-
149.67	84.1	-	0.99249	122.00	71.33	-	0.999223
149.55	94.2	0.0340	-	121.77	90.69	0.0192	-
149.70	113.0	-	0.99269	122.00	100.1	-	0.999166
150.00	133.2	-	0.99275	121.77	120.6	0.0246	-
149.55	149.5	0.0512	-	122.00	131.7	-	0.999060
130.0	23.15	-	0.99736	121.69	159.1	0.0310	-

Additional vapor compositions in source at lower temperatures including vapor-solid equilibrium data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Closed loop flow system with pump at ambient temperature. Temperature measured with platinum resistance thermometer and pressure with Bourdon gauge. Samples of both phases analysed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

1. Purified (no other details given).

2. Research grade, purity 99.98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.1$ (up to 100 bar); ± 0.3 (above 100 bar); $\delta x_{H_2} = \pm 2\%$; $\delta(1-y_{H_2}) = \pm 3\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Ethene; C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Sagara, H.; Arai, Y.; Saito, S.
J. Chem. Engng. Japan 1972, *5*,
339-348.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
123.15	20.3	0.00531	0.996
	40.5	0.00932	0.997
	60.8	0.0127	0.998
	81.1	0.0146	0.998
148.15	20.3	0.00743	0.979
	40.5	0.0131	0.985
	60.8	0.0185	0.988
	81.1	0.0266	0.990
173.15	20.3	0.00865	0.921
	40.5	0.0164	0.954
	60.8	0.0281	0.964
	81.1	0.0361	0.968
198.15	20.3	0.0100	0.747
	40.5	0.0207	0.863
	60.8	0.0370	0.890
	81.1	0.0489	0.909
223.15	20.3	0.00843	0.438
	40.5	0.0265	0.673
	60.8	0.0448	0.760
	81.1	0.0603	0.797
248.15	30.4	0.00988	0.209
	81.1	0.0212	0.331

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static stainless steel cell of capacity 5×10^5 mm^3 fitted with magnetic stirrer and sampling valves. Cell enclosed in cryostat. Temperature measured with thermocouple. Pressure measured using Bourdon gauge. Gases added to cell and equilibrated. Samples of liquid and gas withdrawn and analysed using a gas chromatograph with thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Nippon Sanso Co. Ltd. sample; purity 99.99 mole per cent.

2. Takachiho Chemical Co. Ltd. sample; purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/bar = \pm 0.1$;

δx_{H_2}, δy_{H_2} = ±1%.

REFERENCES:

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Olefins	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

Apart from the ethene + hydrogen system, no hydrogen + olefin system has been studied at high pressures by more than one group. Therefore the evaluations are limited to inferring the reliability or otherwise of the data from the evaluation of solubility data on other systems by the same workers.

Hydrogen + Propene

This system has been studied by Williams and Katz (1) and their data are classified as tentative on the basis of the evaluation of these workers' results for the systems ethene, ethane and propane + hydrogen.

Hydrogen + 1-Hexene, + 1-Heptene, + 1-Octene

Sokolov and Polyakov's data (2) on hydrogen + decane appears to be reliable (see evaluation), therefore their data on 1-hexene, 1-heptene and 1-octene + hydrogen are expected to be fairly reliable and are classified as tentative.

References:

1. Williams, R. B.; Katz, D. L. *Ind. Eng. Chem.* 1954, *46*, 2512.

2. Sokolov, B. I.; Polyakov, A. A. *Zh. Prikl. Khim.* 1977, *50*, 1403.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Propene, (Propylene); C_3H_6; [115-07-1]

ORIGINAL MEASUREMENTS:

Williams, R.B.; Katz, D.L.

Ind. Eng. Chem. 1954, *46*, 2512-20

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	p/psi	$p/10^5$Pa	K value of hydrogen
297.04	250	17.24	46.0
	500	34.47	24.9
	1000	68.95	13.4
	2000	137.90	7.12
	4000	275.79	3.67
	8000	551.58	1.81
283.15	250	17.24	57.0
	500	34.47	30.9
	1000	68.95	16.1
	2000	137.90	8.39
	4000	275.79	4.38
	8000	551.58	2.31
255.37	250	17.24	79.4
	500	34.47	40.4
	1000	68.85	21.1
	2000	137.90	11.0
	4000	275.79	5.82
	8000	551.58	3.20
277.59	250	17.24	112
	500	34.47	57.6
	1000	68.95	29.2
	2000	137.90	14.7

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system described in ref. (1). Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Vapor recirculated by high pressure magnetic pump. Cell charged under pressure. Samples of each phase expanded to room temperature and pressure; analysed by gas density measurements. K-values for propene given in source.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole %. Dried.
2. Stated purity better than 99 mole %.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta p/\text{psi} = \pm 0.5\%$; $\delta K < 1\%$.

REFERENCES:

1. Aroyan, H.J.; Katz, D.L.
Ind. Eng. Chem. 1951, *43*, 185.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0]	Williams, R.B.; Katz, D.L.
2. 1-Propene, (Propylene); C_3H_6; [115-07-1]	*Ind. Eng. Chem.* 1954, *46*, 2512-20.

EXPERIMENTAL VALUES:

T/K	p/psi	$p/10^5$Pa	K value of hydrogen
277.59	4000	275.79	7.65
	8000	551.58	4.31
199.82	250	17.24	156
	500	34.47	79.6
	1000	68.95	40.2
	2000	137.90	20.3
	4000	275.79	10.4
	8000	551.58	5.93
172.04	250	17.24	201
	500	34.47	103
	1000	68.95	52.9
	2000	137.90	27.1
	4000	275.79	14.7
	8000	551.58	8.63
158.15	250	17.24	306
	500	34.47	159
	1000	68.95	82.8
	2000	137.90	43.2
	4000	275.79	23.2
	8000	551.58	13.8
144.26	250	17.24	596
	500	34.47	318
	1000	68.95	165
	2000	137.90	89.0
	4000	275.79	48.5
	8000	551.58	28.6

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1-Hexene; C_6H_{12}; [592-41-6]

ORIGINAL MEASUREMENTS:

Sokolov, B. I.; Polyakov, A. A.

Zhur. Prikl. Khim. 1977, *50*, 1403-5.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
333.15	40.5	0.040
	101.3	0.086
	202.6	0.159
	304.0	0.228
403.15	40.5	0.047
	101.3	0.114
	202.6	0.215
	304.0	0.303
443.15	40.5	0.050
	101.3	0.141
	202.6	0.263
	304.0	0.380

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with stirrer. Solvent placed in cell then pressurized with hydrogen at room temperature, heated to experimental temperature and equilibrated. Liquid samples removed and cooled; analysed by stripping gas out and measuring volume evolved. Remaining liquid estimated gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1 and 2 "Pure" grade samples.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{H_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1-Heptene; C_7H_{14}; [592-76-7]

ORIGINAL MEASUREMENTS:

Sokolov, B. I.; Polyakov, A. A.
Zhur. Prikl. Khim. 1977, *50*, 1403-5.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
333.15	40.5	0.028
	101.3	0.073
	202.6	0.137
	304.0	0.201
403.15	40.5	0.041
	101.3	0.108
	202.6	0.190
	304.0	0.261
473.15	40.5	0.049
	101.3	0.146
	202.6	0.255
	304.0	0.353

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with stirrer. Solvent placed in cell then pressurized with hydrogen at room temperature, heated to experimental temperature and equilibrated. Liquid samples removed and cooled; analysed by stripping gas out and measuring volume evolved. Remaining liquid estimated gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1 and 2 "Pure" grade samples.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{H_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1-Octene; C_8H_{16}; [111-66-0]

ORIGINAL MEASUREMENTS:

Sokolov, B. I.; Polyakov, A. A.
Zh. Prikl. Khim. 1977, *50*, 1403-5.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
328.15	40.5	0.024
	101.3	0.070
	202.6	0.120
	304.0	0.186
393.15	40.5	0.038
	101.3	0.094
	202.6	0.179
	304.0	0.243
463.15	40.5	0.049
	101.3	0.131
	202.6	0.255
	304.0	0.318

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with stirrer. Solvent placed in cell then pressurized with hydrogen at room temperature, heated to experimental temperature and equilibrated. Liquid samples removed and cooled; analysed by stripping gas out and measuring volume evolved. Remaining liquid estimated gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1 and 2 "Pure" grade samples.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;
$\delta x_{H_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Benzene; C_6H_6; [71-43-2]	Colin Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

This system has been studied fairly extensively under a wide range of conditions. The data of Brainard and Williams (1) were determined as part of a study of the quaternary system hydrogen + benzene + cyclohexane + hexane. While it appears that their data are consistent with those of Connolly (2) and Thompson and Edmister (3) the data are too limited for a meaningful comparison in view of the interpolation in pressure and temperature needed for such a comparison. Hence the Brainard and Williams (1) results are not considered further.

The data of Connolly (2) cover the temperature range 433 K to 533 K and pressures up to 18 MPa. These data are in reasonable agreement with those of Thompson and Edmister (3) at the common temperature of 433 K. The latter data cover the temperature range 339 K to 433 K and when interpolated to 345.75 K are in fair agreement with the data of Sattler (4).

The data of Ipatiev and Levina (5) cover the temperature range from 298 K to 513 K and the mole fractions in the liquid are smaller than the values given by Connolly (2) and Thompson and Edmister (3). It appears, in general, that Ipatiev and Levina (5) data are slightly too small (see, for example, evaluation of hydrogen + 1,3-dimethylbenzene). Therefore, in the present evaluation the data of Ipatiev and Levina (5) are classified as doubtful.

The higher pressure data of Ipatiev and coworkers (6) are more or less consistent with the work of Ipatiev and Levina (5).

The data of Krichevskii and Efremova (7) are limited to the temperature of 288.15 K and are slightly smaller than values obtained by extrapolation of the data of either Ipatiev and Levina (5) or Thompson and Edmister (3). The data of Krichevskii and Efremova (7) are classified as doubtful.

This system was also studied by Frolich *et al.* (8) but no table or graph of result was given. It was stated that the curve of solubility of hydrogen in benzene coincided with that of hydrogen in isopropyl alcohol. (The curve was a plot of Ostwald coefficient x pressure against pressure.) The data are not considered further in the present context.

The data of Connolly (2), Thompson and Edmister (3) and Sattler (4) are classified as tentative.

References:

1. Brainard, A. J.; Williams, G. B. *Am. Inst. Chem. Engnrs. J.* 1967, *13*, 60.
2. Connolly, J. F. *J. Chem. Phys.* 1962, *36*, 2897.
3. Thompson, R. E.; Edmister, W. C. *Am. Inst. Chem. Engnrs. J.* 1965, *11*, 457.

(cont.)

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Benzene; C_6H_6; [71-43-2]	Colin Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

References (cont.)

4. Sattler, H. *Z. Tech. Physik.* 1940, *21*, 410.

5. Ipatiev, V. V.; Levina, M. I. *Zh. Fiz. Khim.* 1935, *6*, 632.

6. Ipatiev, V. V.; Teodorovich, V. P.; Brestkin, A. P.; Artemovich, V. S. *Zh. Fiz. Khim.* 1948, *22*, 834.

7. Krichevskii, I. R.; Efremova, G. D. *Zh. Fiz. Khim.* 1948, *22*, 1116.

8. Frolich, P. K.; Trauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Benzene; C_6H_6; [71-43-2]	Ipatiev, V.V.; Levina, M.I. *Zhur. Fiz. Khim.* 1935, *6*, 632-9.

VARIABLES:	PREPARED BY:
Temperature, pressure.	C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction* of hydrogen in liquid, x_{H_2}
298.15	49.0	0.01253
	98.1	0.02516
	294.2	0.07140
373.15	49.0	0.01842
	98.1	0.03694
	294.2	0.1063
423.15	49.0	0.02496
	98.1	0.05497
	196.1	0.1058
	294.2	0.1563
473.15	49.0	0.02760
	98.1	0.06327
	196.1	0.1313
	294.2	0.1976
513.15	49.0	0.04553
	98.1	0.07320
	196.1	0.1682
	294.2	0.2455

* calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Hydrocarbon added to cell then pressurized at temperature of measurement. After 1-2 hours liquid samples removed. Analysed by stripping out hydrogen at low pressure.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Fractionally crystalised, distilled. Boiling pt. 80.2°C, Melting pt. 5.3°C, Density (at 15°C) = 0.8803.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 2\%$.
(estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Benzene, C_6H_6; [71-43-2]	Sattler, H.; *Z. Tech. Physik*, 1940, *21*, 410-413.
VARIABLES:	PREPARED BY:
Temperature, pressure	C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Kuenen coefficient *S*	Mole fraction of hydrogen in liquid, x_{H_2}
308.15	50.5	4.15	0.01427
	54.9	4.33	0.01487
	98.8	7.88	0.02674
	99.7	8.06	0.02734
	100.2	8.19	0.02777
	147.3	11.77	0.03943
	147.8	11.55	0.03872
345.75	51.0	5.28	0.01808
	54.4	5.78	0.01976
	104.9	10.97	0.03684
	106.9	11.25	0.03775
	145.1	15.11	0.05005
	151.0	15.73	0.05200

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking bomb with liquid sampling attachment. Solvent and hydrogen charged into evacuated cell. Amount of solvent in liquid sample estimated gravimetrically. Amount of hydrogen in liquid stripped out and estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.2$; $\delta x_{H_2} = \pm 2\%$. (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen, H_2; [1333-74-0]

2. Benzene, C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Krichevskii, I. R.; Efremova, G. D.

Zhur. Fiz. Khim. 1948, *22*, 1116-25.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
288.15	50.1	0.0114
	99.1	0.0228
	199	0.0436
	235	0.0509
	242	0.0520
	285	0.0608
	298	0.0642
	393	0.0851
	435	0.0904
	460	0.0969
	493	0.102

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 hydrogen 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:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.35\%$;

$\delta x_{H_2} = \pm 0.5\%$

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Ipat'ev, V.V.; Teodorovich, V.P.;
Brestkin, A.P.; Artemovich, V.S.
Zh. Fiz. Khim. 1948, *22*, 834-845.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Solubility$^+$, S / cm^3 g^{-1}	Mole fraction of hydrogen in liquid x_{H_2}	in vapour, y_{H_2}
298	250	25.3	18.3	0.060	0.9984
	500	50.7	36.9	0.114	0.9982
	1000	101.3	75.0	0.207	0.9976
323	250	25.3	20.8	0.067	0.9980
	500	50.7	42.0	0.127	0.9964
	1000	101.3	85.0	0.229	0.9948
	2000	202.7	172.0	0.375	0.9920
	3000	304.0	262.5	0.461	0.9888
343	250	25.3	23.5	0.076	0.9929
	500	50.7	47.5	0.142	0.9939
	1000	101.3	96.5	0.252	0.9921
	2000	202.7	195.0	0.406	0.9878
	3000	304.0	300.0	0.511	0.9830
373	250	25.3	28.5	0.090	0.9844
	500	50.7	59.0	0.170	0.9861
	1000	101.3	125.0	0.303	0.9858
	2000	202.7	264.0	0.480	0.9764
	3000	304.0	420.0	0.594	0.9668
423	250	25.3	42.5	0.129	0.9505
	500	50.7	87.5	0.234	0.9588
	1000	101.3	180.0	0.385	0.9528
	2000	202.7	382.0	0.571	0.9230

$^+$ Volume of hydrogen, reduced to 273k and 101.3kPa, dissolved unit mass of benzene.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Single pass flow method

SOURCE AND PURITY OF MATERIALS:

No details available

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; δx_{H_2}, $\delta y_{H_2} = \pm$ 4% estimated by compiler

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Benzene; C_6H_6; [71-43-2]	Connolly, J. F. *J. Chem. Phys.* 1962, *36*, 2897-2904.
VARIABLES:	**PREPARED BY:**
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
433.15	20.94	0.00890	0.6147	483.15	32.42	0.01387	0.3902
	32.38	0.01615	0.7376		40.97	0.02136	0.4921
	52.12	0.02846	0.8285		57.99	0.03605	0.6147
	90.18	0.05145	0.8897		95.77	0.06764	0.7376
	115.11	0.06601	0.9081		178.03	0.13175	0.8285
443.15	19.00	0.00715	0.4921	493.15	38.72	0.01825	0.3902
	25.88	0.01182	0.6147		49.37	0.02824	0.4921
	40.30	0.02149	0.7376		70.95	0.04811	0.6147
	65.79	0.03822	0.8285		120.78	0.09212	0.7376
	117.13	0.07053	0.8897	503.15	46.24	0.02425	0.3902
	152.19	0.09159	0.9081		59.70	0.03779	0.4921
453.15	23.13	0.00938	0.4921		87.49	0.06510	0.6147
	31.80	0.01562	0.6147		155.94	0.12863	0.7376
	49.99	0.02853	0.7376	513.15	37.21	0.01253	0.2027
	83.15	0.05139	0.8285		55.51	0.03282	0.3902
	153.71	0.09734	0.8897		72.67	0.05147	0.4921
463.15	22.47	0.00801	0.3902		109.53	0.09030	0.6147
	28.07	0.01233	0.4921	523.15	35.83	0.00741	0.0998
	38.89	0.02061	0.6147		43.80	0.01725	0.2027
	61.91	0.03787	0.7376		86.66	0.06839	0.4921
	105.58	0.06937	0.8285		141.96	0.13163	0.6147
473.15	33.94	0.01621	0.4921	533.15	41.58	0.01041	0.0998
	47.46	0.02718	0.6147		82.67	0.06602	0.3902
	76.80	0.05042	0.7376		114.70	0.10802	0.4921
	135.78	0.09478	0.8285				

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Lime-glass capillary in which mixture could be pressurized over mercury. Details in refs. 1 and 2. Dew point and bubble point observed visually.

SOURCE AND PURITY OF MATERIALS:

No details given.

Both substances thought to be better than 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.1$ per cent;

$\delta x_{H_2} = \pm 0.00005$; $\delta y_{H_2} = \pm 0.0005$ (estimated by compiler).

REFERENCES:

1. Connolly, J. F.; Kandalic, G. A. *Phys. Fluids* 1960, *3*, 463.
2. Connolly, J. F. *Phys. Fluids* 1961, *4*, 1494.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Thompson, R. E.; Edmister, W. C.
Am. Inst. Chem. Engnrs. J.
1965, *11*, 457-461.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen	
		in liquid, x_{H_2}	in vapor, y_{H_2}
338.7	5.25	0.00166	0.875
	13.40	-	0.9500
	34.69	0.0117	0.9797
	34.68	-	0.9802
	70.74	0.0238	0.9889
	70.74	-	0.9887
	117.7	0.0389	0.99150
	117.7	-	0.99157
	172.9	0.0536	0.99321
	275.8	0.0812	0.99425
	482.5	0.131	0.99503
	689.3	0.176	0.99494
	689.3	0.180	0.99557
394.3	6.69	0.00186	0.514
394.3	13.86	0.00536	0.753
	34.43	0.0153	0.897
	69.15	0.0321	0.9443
	69.15	-	0.9429
	117.3	0.0541	0.9621
	117.3	-	0.9617
	206.8	0.0937	0.9732
	206.8	-	0.9736
	413.3	0.167	0.9792
	688.3	0.243	0.9820
433.1	29.45	0.0144	0.708
	41.49	0.0214	0.794
	53.64	0.0291	0.833
	90.25	0.0506	0.890

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibrium cell fitted with glass fiber packing and grooved cone to assist equilibrium being established. Pressure measured with dead weight tester and temperature with thermocouple. Sample analysed by freezing out hydrocarbon and gas measured volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.8 mole per cent.
2. Phillips Petroleum sample, purity 99.94 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\mathrm{bar} = \pm 0.1\%$;

δx_{H_2}, δy_{H_2} = ±3% (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Brainard, A. J.; Williams, G. B.
Am. Inst. Chem. Engnrs. J.
1967, *13*, 60-69.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
366.48	77.91	0.0332	0.977
	33.16	0.0142	0.956
422.04	139.89	0.0785	0.949
	36.68	0.0200	0.851

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell. Pressure measured with Bourdon gauge. Analysis of samples carried out by expanding into an expansion cylinder and freezing out the hydrocarbon; hydrogen measured volumetrically and then hydrocarbon estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Matheson ultrapure sample, purity better than 99.998 mole per cent.

2. Phillips Petroleum sample, purity 99.89 mole per cent; major impurity toluene.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/\text{bar} = \pm 0.15$;

δx_{H_2}, δy_{H_2} = ±1.0% (estimated by compiler).

REFERENCES:

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Methylbenzene; C_7H_8; [108-88-3]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

This system has been studied at elevated pressures by Ipatiev and Levina (1) and more recently by Simnick *et al.* (2). The data of Ipatiev and Levina (1) cover the temperature range 208 K to 573 K and pressures up to 29 MPa (although the data at any one temperature are not extensive) whereas that of Simnick *et al.* (2) cover the temperature range range 461 K to 575 K and pressures up to 25 MPa. There is broad agreement between these two sets of data although Ipatiev and Levina (1) mole fraction solubility data are, in general, slightly smaller than those of Simnick *et al.* (2).

The gas-liquid critical temperature of methylbenzene is 591.8 K (3) and it is probable that this system exhibits the phenomenon of gas-gas immiscibility (4) above this temperature. Furthermore, methylbenzene may thermal decompose (5) or react with hydrogen at temperatures above 550 K and workers investigating this system should be aware of these possibilities.

The data of Simnick *et al.* (2) are classified as tentative.

References:

1. Ipatiev, V. V.; Levina, M. I. *Zhur. Fiz. Khim.* 1935, *6*, 632.
2. Simnick, J. J.; Sebastian, H. M.; Lin, H. M.; Chao, K.-C. *J. Chem. Engng. Data* 1978, *23*, 339.
3. Ambrose, D. "Vapour-Liquid Critical Properties", 1980, N.P.L. Rep. 107. Teddington, U.K.
4. Schneider, G. M. *Chem. Soc. Spec. Per. Report No. 22*, Vol. 2, ed. McGlashan, M. L., Chapter 4, 1978.
5. Johns, I. B.; McElhill, E. A.; Smith, J. O. *J. Chem. Engng. Data* 1962, *7*, 277.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Methylbenzene, (toluene); C_7H_8; [108-88-3]	Ipatiev, V.V.; Levina, M.I. *Zhur. Fiz. Khim.* 1935, *6*, 632-9.
VARIABLES:	PREPARED BY:
Temperature, pressure.	C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
208.15	49.0	0.00629
	98.1	0.01251
217.15	98.1	0.01435
248.15	49.0	0.01010
	98.1	0.01984
273.15	49.0	0.01259
	98.1	0.02456
298.15	49.0	0.01539
	98.1	0.02911
	294.2	0.08077
373.15	49.0	0.02094
	98.1	0.04140
423.15	49.0	0.02651
	98.1	0.05265
	196.1	0.1076
	294.2	0.1579
473.15	49.0	0.02977
	98.1	0.06643
	196.1	0.1382
	294.2	0.1964
513.15	49.0	0.03155
	98.1	0.07717
	196.1	0.1661
	294.2	0.2388
573.15	98.1	0.09311

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Hydrocarbon added to cell then pressurized at temperature of measurement. After 1-2 hours liquid samples removed. Analysed by stripping out hydrogen at low pressure.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Washed with water and sodium hydroxide solution. Dried and distilled. Boiling pt. 110.0°C.; Density at 15°C = 0.8655.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$ up to 250°C, ±1.0 at 300°C; $\delta x_{H_2} = \pm 2\%$. (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methylbenzene, (toluene); C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Simnick, J.J.; Sebastian, H.M.; Lin, H.M.; Chao, K.-C.

J. Chem. Engng. Data. 1978, *23*, 339-340.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
461.83	20.3	0.0113	0.6674
	30.3	0.0187	0.7678
	50.4	0.0342	0.8425
	101.1	0.0704	0.9064
	151.9	0.1023	0.9284
	202.9	0.1331	0.9374
	253.7	0.1645	0.9430
502.15	20.2	0.0082	0.3491
	30.3	0.0181	0.5356
	50.7	0.0375	0.6863
	100.6	0.0812	0.8182
	152.2	0.1227	0.8645
	203.0	0.1649	0.8831
	252.6	0.2015	0.8905
542.15	30.4	0.0120	0.2100
	51.1	0.0385	0.4555
	100.8	0.0977	0.6668
	151.6	0.1545	0.7357
	202.8	0.2088	0.7789
	253.1	0.2581	0.7986
575.15	50.2	0.0332	0.2410
	101.2	0.1196	0.4824
	151.7	0.2005	0.5527
	205.1	0.2844	0.5890
	253.5	0.3935	0.6145

AUXILIARY INFORMATION

METHOD: /APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separate under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. Air Products, minimum purity 99.95 mole per cent.

2. Fischer Scientific Co. sample, designated high purity reagent grade, no impurity detected by GC.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.5\%$; δx_{H_2}, $\delta y_{H_2} = \pm 0.001$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methylbenzene, (Toluene); C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Laugier, S.; Richon, D.; Renon, H.

J. Chem. Engng. Data. 1980, *25*, 274-276.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of Hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
269.0	3.46	0.019	-
	6.23	-	0.521
	7.60	0.070	-
	10.30	-	0.668
	12.90	0.128	-
	14.05	-	0.718
	15.35	-	0.733
	16.20	0.172	-
	22.25	-	0.789
	22.30	0.232	-
	28.10	-	0.796
	28.40	0.289	-
	32.30	0.327	-
	32.70	-	0.792
295.0	6.45	-	0.385
	7.40	0.074	-
	10.10	-	0.527
	13.00	0.162	-
	18.05	0.237	-
	18.40	-	0.648
	20.00	-	0.665
	22.95	0.311	-
	23.00	-	0.673
	23.90	-	0.686
	25.70	-	0.689
	28.45	0.415	-
	28.90	-	0.675
	30.80	0.514	-

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

1. L'Air Liquide sample, purity better than 99.95 mole per cent.

2, Merck sample, guaranteed purity 99.5 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.04$; $\delta x_{H_2} = \pm 0.009$; $\delta y_{H_2} = \pm 0.012$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1,3-Dimethylbenzene; C_8H_{10};
[108-38-3]

EVALUATOR:

Colin L. Young,
School of Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

August 1980

CRITICAL EVALUATION:

This system has been investigated at elevated pressures by Ipatiev and Levina (1), Sattler (2) and more recently by Simnick *et al.* (3). The data of Ipatiev and Levina (1) cover the temperature range 298 K to 513 K at pressures up to 20 MPa. The data of Sattler (2) are restricted to 308 K and pressures near 15 MPa whereas the data of Simnick *et al.* (3) are estensive and cover the temperature range 462 K to 582 K and pressures up to 25 MPa. The data of Simnick *et al.* (3) are considered the most reliable and are classified as tentative. The mole fraction solubility data of Ipatiev and Levina are, in general, smaller than those interpolated from the data of Simnick *et al.* (3).

The gas-liquid critical temperature of 1,3-dimethylbenzene is 617 K (4) and above this temperature this system may exhibit the phenomenon of gas-gas immiscibility (5). 1,3-Dimethylbenzene also probably decomposes slowly above about 550 K and/or reacts with hydrogen. Workers investigating this system at high temperatures should be aware of the existence of possible reactions of "unusual" phase behaviour.

References:

1. Ipatiev, V. V.; Levina, M. I. *Zhur. Fiz. Khim.* 1935, *6*, 632.

2. Sattler, H. *Z. Tech. Physik.* 1940, *21*, 410.

3. Simnick, J. J.; Sebastian, H. M.; Lin, H. M.; Chao, K.-C. *J. Chem. Thermodyn.* 1979, *11*, 531.

4. Ambrose, D. "Vapour-Liquid Critical Properties", 1980, N.P.L. Rep. 107. Teddington, U.K.

5. Schneider, G. M. *Chem. Soc. Spec. Per. Report No. 22*, Vol. 2, ed. McGlashan, M. L., Chapter 4, 1978.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,3 - Dimethylbenzene, (m-xylene) C_8H_{10}; [108-38-3]

ORIGINAL MEASUREMENTS:

Ipatiev, V.V.; Levina, M.I.

Zhur. Fiz. Khim. 1935, *6*, 632-9

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	49.0	0.01678
	98.1	0.03322
	294.2	0.08950
373.15	49.0	0.02360
	98.1	0.04439
423.15	49.0	0.02451
	98.1	0.05593
	196.1	0.1116
473.15	49.0	0.03300
	98.1	0.06926
	196.1	0.1360
513.15	49.0	0.03917
	98.1	0.08500
	196.1	0.1673

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Hydrocarbon added to cell then pressurized at temperature of measurement. After 1-2 hours liquid samples removed. Analysed by stripping out hydrogen at low pressure.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Meta isomer distilled from mixture of isomers, sulfonated and steam distilled. Dried and then fractionally distilled. Boiling pt. 138.5°C. Density at 15°C = 0.8590.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 2\%$.
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,3-Dimethylbenzene, (*m*-Xylene); C_8H_{10}; [108-38-3]

ORIGINAL MEASUREMENTS:

Sattler, H.;

Z. Tech. Physik, 1940, *21*, 410-413

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Kuenen Coefficient S	Mole fraction of Hydrogen in liquid, x_{H_2}
308.15	147.8	11.52	0.05178
	148.3	11.61	0.05216
	149.7	11.65	0.05233
	152.7	11.87	0.05326

AUXILIARY INFORMATION

METHOD: /APPARATUS/PROCEDURE:

Rocking bomb with liquid sampling attachment. Solvent and hydrogen charged into evacuated cell. Amount of solvent in liquid sample estimated gravimetrically and hydrogen in liquid stripped out and estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.2$;

$\delta x_{H_2} = \pm 2\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,3-Dimethylbenzene, (*m*-xylene); C_8H_{10}; [108-38-3]

ORIGINAL MEASUREMENTS:

Simnick, J. J.; Sebastian, H. M.; Lin, H. M.; Chao K.-C.

J. Chem. Thermodyn.,

<u>1979</u>, *11*, 531-7.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
462.4	0.3193*	0	0
	1.986	0.0134	0.8264
	3.04	0.0217	0.8809
	5.08	0.0373	0.9227
	10.07	0.0735	0.9550
	15.23	0.1092	0.9644
	20.21	0.1416	0.9698
	25.13	0.1724	0.9720
502.3	0.6960*	0	0
	1.996	0.0131	0.6148
	3.04	0.0231	0.7353
	5.10	0.0420	0.8332
	10.09	0.0856	0.9087
	15.20	0.1309	0.9264
	20.34	0.1676	0.9409
	25.26	0.2041	0.9477
542.6	1.321*	0	0
	1.986	0.0091	0.2870
	3.05	0.0221	0.4842
	5.07	0.0465	0.6659
	10.07	0.1034	0.7974
	15.27	0.1550	0.8562
	20.28	0.2042	0.8769
	25.44	0.2494	0.8899

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Air Products sample, purity 99.95 mole per cent.
2. Aldrich Chemical Co. gold label grade, purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/MPa = \pm 0.02$;

δx_{H_2}, δy_{H_2} = ±1% (estimated by compiler)

REFERENCES:

1. Sebastian, H. M.; Simnick, J. J.; Lin H-M.; Chao K.-C. *J. Chem. Engng. Data*, <u>1978</u>, *23*, 305-8.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1,3-Dimethylbenzene, (*m*-xylene); C_8H_{10}; [108-38-3] contd.	Simnick, J. J.; Sebastian, H. M.; Lin H. M.; Chao K.-C. *J. Chem. Thermodyn.*, <u>1979</u>, *11*, 531-7.
VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
582.1	2.269*	0	0
	3.04	0.0142	0.1741
	5.01	0.0470	0.3901
	10.09	0.1257	0.6147
	15.13	0.1959	0.7077
	20.33	0.2560	0.7545
	25.44	0.3241	0.7851

* Vapor pressure of *m*-xylene.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,3,5-Trimethylbenzene, (mesitylene); C_9H_{12}; [108-67-8]

ORIGINAL MEASUREMENTS:

Ipatiev, V.V.; Levina, M.I.

Zhur, Fiz. Khim. 1935, *6*, 632-9.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction* of hydrogen in liquid, x_{H_2}
298.15	49.0	0.01508
	98.1	0.03390
	294.1	0.08968
423.15	98.1	0.06002
473.15	98.1	0.07403
513.15	98.1	0.08808

* Calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Hydrocarbon added to cell then pressurized at temperature of measurement. After 1-2 hours liquid sample removed. Analysed by stripping out hydrogen at low pressure.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Sample made from acetone using catalyst and hydrochloric acid at high pressure. Purified. Boiling pt. 135.0°C, density = 0.7783 at 15°C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 2\%$.

(estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1-Methylethylbenzene, (*Iso*propylbenzene); C_9H_{12}; [98-82-8]	Sokolov, B. I.; Polyakov, A. A. *Zh. Prikl. Khim.* 1977, *50*, 1403-5.
VARIABLES:	**PREPARED BY:**
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
343.15	40.5	0.020
	101.3	0.047
	202.6	0.089
	304.0	0.131
413.15	40.5	0.025
	101.3	0.062
	202.6	0.119
	304.0	0.174
488.15	40.5	0.033
	101.3	0.094
	202.6	0.180
	304.0	0.287

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with stirrer. Solvent placed in cell then pressurized with hydrogen at room temperature, heated to experimental temperature and equilibrated. Liquid samples removed and cooled; analysed by stripping out gas and measuring volume evolved. Remaining liquid estimated gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1 and 2 "Pure" grade samples.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{H_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,2,3,4-Tetrahydronaphthalene, (Tetralin); $C_{10}H_{12}$; [119-64-2]

ORIGINAL MEASUREMENTS:

Simnick, J. J.; Lawson, C. C.; Lin, H. M.; Chao, K. C.
Am. Inst. Chem. Engnrs. J.
1977, *23*, 469-476.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
462.75	20.3	0.0118	0.9652
	30.4	0.0176	0.9748
	50.7	0.0297	0.9828
	101.3	0.0571	0.9897
	152.0	0.0823	0.9927
	202.6	0.1051	0.990
	253.3	0.1289	0.9948
541.85	20.3	0.0143	0.8028
	30.4	0.0221	0.8676
	50.7	0.0373	0.9155
	101.3	0.0732	0.9538
	152.0	0.1046	0.9657
	202.6	0.1373	0.9714
	253.3	0.1640	0.9748
621.75	50.7	0.0452	0.7066
	101.3	0.0925	0.8346
	152.0	0.1390	0.8827
	202.6	0.1884	0.9038
	253.3	0.2314	0.9167
662.25	50.7	0.0482	0.4810
	101.3	0.1170	0.7008
	152.0	0.1760	0.7808
	202.6	0.2303	0.8174
	253.3	0.2824	0.8399

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. Air products sample, stated purity 99.95 mole per cent.

2. Aldrich Chemical Co., purity about 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.1\%$ or ± 0.3 whichever is the greater;

δx_{H_2}, δy_{H_2} = ±1%.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1-Methylnaphthalene; $C_{11}H_{10}$; [90-12-0]

ORIGINAL MEASUREMENTS:

Sokolov, B. I.; Polyakov, A. A.
Zhur. Prikl. Khim. 1977, *50*, 1403-5.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}
328.15	40.5	0.010
	101.3	0.023
	202.6	0.046
	304.0	0.071
393.15	40.5	0.014
	101.3	0.029
	202.6	0.057
	304.0	0.089
473.15	40.5	0.019
	101.3	0.045
	202.6	0.090
	304.0	0.132

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with stirrer. Solvent placed in cell then pressurized with hydrogen at room temperature, heated to experimental temperature and equilibrated. Liquid samples removed and cooled; analysed by stripping out gas and measuring volume evolved. Remaining liquid estimated gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1 and 2 "Pure" grade samples.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{H_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Methylnaphthalene; $C_{11}H_{10}$; [90-12-0]

ORIGINAL MEASUREMENTS:

Yao, J.; Sebastian, H.M.; Lin, H.M.; Chao, K.C.

Fluid Phase Equilbria, 1978, *1*, 293-304.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
462.15	0.250	0.0253	0.0	0.0
	20	2.03	0.0103	0.9863
	30	3.04	0.0153	0.9906
	50	5.07	0.0250	0.9939
	100	10.13	0.0479	0.9965
	150	15.20	0.0692	0.9974
	200	20.27	0.0887	0.9978
	250	25.33	0.1060	0.9980
541.85	1.68	0.170	0.0	0.0
	20	2.03	0.0127	0.9007
	30	3.04	0.0202	0.9360
	50	5.07	0.0342	0.9596
	100	10.13	0.0641	0.9778
	150	15.20	0.0931	0.9838
	200	20.27	0.1191	0.9867
	250	25.33	0.1452	0.9883
621.75	6.34	0.642	0.0	0.0
	20	2.03	0.0132	0.6153
	30	3.04	0.0225	0.7384
	50	5.07	0.0406	0.8368
	100	10.13	0.0814	0.9113
	150	15.20	0.1180	0.9350

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gaseous components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. Air Products sample, purity 99.95 mole per cent or better.
2. Distilled, purity 98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05°C$; $\delta P/MPa = \pm 1\%$ or ± 0.02 (whichever is greater); δx_{H_2}, $\delta y_{H_2} = \pm 0.5\%$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1-Methylnaphthalene; $C_{11}H_{10}$; [90-12-0]	Yao, J.; Sebastian, H.M.; Lin, H.M.; Chao, K.C. *Fluid Phase Equilibrium*, 1978, *1*, 293-304

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
621.75	150	20.27	0.1564	0.9481
	250	25.33	0.1923	0.9541
701.65	17.33	1.756	0.0	0.0
	30	3.04	0.0184	0.3084
	50	5.07	0.0459	0.5169
	100	10.13	0.1051	0.7111
	150	15.20	0.1615	0.7881
	200	20.27	0.2126	0.8263
	250	25.33	0.2590	0.8500

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Methylnaphthalene; $C_{11}H_{10}$; [90-12-0]

ORIGINAL MEASUREMENTS:

Lin, H.M.; Sebastian, H.M.; Chao, K.C.

Fluid Phase Equilibria, 1980, *4*, 321

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
730.05	50.2	5.09	0.0431	0.3717
	76.2	7.72	0.0842	0.5350
	96.4	9.77	0.1149	0.6103
	126.5	12.82	0.1593	0.6806
	151.0	15.30	0.1916	0.7229
	176.2	17.85	0.2252	0.7478
	199.8	20.24	0.2604	0.7703
	248.7	25.20	0.3070	0.7850
	274.2	27.78	0.3362	0.7954

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/MPa = \pm 0.02$;
δx_{H_2}, $\delta y_{H_2} < 1.0\%$
(estimated by compiler).

REFERENCES:

1. Simnick, J.J.; Lawson, C.C.; Lin, H.M.; Chao, K.C.

   Am. Inst. Chem. Engnrs. J. 1977, *23*, 469.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1,1'-Methylenebisbenzene,
   (Diphenylmethane); $C_{13}H_{12}$;
   [101-81-5]

ORIGINAL MEASUREMENTS:

Simnick, J. J.; Liu, K. D.; Lin, H.-M.; Chao, K.-C.

Ind. Eng. Chem., Process. Des. Dev. 1978, *17*, 204.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen		T/K	P/bar	Mole fraction of hydrogen	
		in liquid, x_{H_2}	in vapor, y_{H_2}			in liquid, x_{H_2}	in vapor, y_{H_2}
462.75	20.3	0.0123	0.9903	621.75	20.3	0.0184	0.7362
	30.4	0.0183	0.9935		30.4	0.0296	0.8144
	50.7	0.0300	0.9963		50.7	0.0516	0.8825
	101.3	0.0591	0.9980		101.3	0.0985	0.9362
	152.0	0.0830	0.9985		152.0	0.1450	0.9533
	202.7	0.1055	0.9988		202.7	0.1880	0.9615
	253.3	0.1240	0.9989		253.3	0.2272	0.9675
541.85	20.3	0.0159	0.9390	701.65	30.4	0.0306	0.4497
	30.4	0.0244	0.9580		50.7	0.0630	0.6360
	50.7	0.0408	0.9741		101.3	0.1380	0.7881
	101.3	0.0785	0.9861		152.0	0.2030	0.8469
	152.0	0.1105	0.9895		202.7	0.2577	0.8799
	202.7	0.1416	0.9912		253.3	0.3056	0.8964
	253.3	0.1724	0.9921				

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. Air Products sample with minimum purity of 99.95 mole per cent.

2. Aldrich Chemical Co. sample purified by vacuum distillation, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.7$; $\delta P/\text{bar} = \pm 0.3$;

δx_{H_2}, δy_{H_2} = ±1% (estimated by compiler).

REFERENCES:

1. Simnick, J. J.; Lawson, C. C.; Lin, H.-M.; Chao, K.-C. *Am. Inst. Chem. Engnrs. J.* 1977, *23*, 469.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 9,10-Dihydrophenanthrene; $C_{14}H_{12}$; [776-35-2]	Sebastian, H.M.; Simnick, J.J. Lin, H.M.; Chao, K-C. *J. Chem. Eng. Data.* 1979, *24*, 343-5.
VARIABLES:	**PREPARED BY:**
Temperature, pressure	C.L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
461.45	1.968	0.0093	0.99776
	3.071	0.0141	0.99860
	5.022	0.0231	0.99920
	10.11	0.0446	0.99957
	15.23	0.0649	0.99964
	20.37	0.0843	0.99973
	25.54	0.1032	0.99971
542.15	2.038	0.0126	0.9796
	3.037	0.0191	0.9864
	5.030	0.0308	0.9916
	10.06	0.0595	0.9953
	15.21	0.0868	0.9967
	20.28	0.1139	0.9971
	25.16	0.1374	0.9974
622.85	2.044	0.0156	0.8992
	3.027	0.0233	0.9306
	4.774	0.0375	0.9548
	10.18	0.0769	0.9769
	15.21	0.1121	0.9834
	20.54	0.1462	0.9867
	25.40	0.1720	0.9888

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Airco sample, purity 99.95 mole per cent or better.
2. Sample prepared by zone refining of Aldrich sample.

   Further purified by distillation under nitrogen at reduced pressure. Final purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/MPa = \pm 0.02$; $\delta x_{H_2}, \delta y_{H_2} = \pm 1\%$ (at 3 lower temperatures) ±2%(at 703.05K) (estimated by compiler).

REFERENCES:

1. Sebastian, H.M.; Simnick, J.J. Lin, H.M.; Chao, K-C.
   J. Chem. Engng. Data. 1978, *23*, 305-8.

COMPONENTS	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1338-74-0] 2. 9,10- Dihydrophenanthrene; $C_{14}H_{12}$; [776-35-2]	Sebastian, H.M.; Simnick, J.J. Lin, H-M.; Chao, K-C. *J. Chem. Eng. Data.* 1979, *24*, 343-5.

EXPERIMENTAL VALUES:

T/K	*P*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
703.05+	2.021	0.0161	0.6500
	3.024	0.0280	0.7597
	5.037	0.0492	0.8497
	10.15	0.0984	0.9191
	15.27	0.1446	0.9443
	20.34	0.1815	0.9575
	25.27	0.2184	0.9629

\+ Some conversion of dihydrophenanthrene to phenanthrene occured at this temperature. The percentage conversion was about 4-5 per cent and this amount was thought to not to alter the results from the true equilibrium conditions substantially.

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; 2. Carbon monoxide; CO; 3. Hydrocarbons	Colin L. Young, Department of Physical Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. November 1980

CRITICAL EVALUATION:

The only study of gas solubility for these systems for which numerical details have been published is that of Trust and Kurata (1) whose data are classified as tentative.

Tyvina and coworkers (2-5) have made extensive measurements for some hydrogen + carbon monoxide + hydrocarbon systems but, in general, report numerical values for gas-liquid critical properties and graphs for gas-liquid equilibria data. These data are not considered further here except for inclusion of the reference and title of papers.

1. Trust, D. B.; Kurata, F. *Am. Inst. Chem. Engnrs. J.* 1971, *17*, 86-91.

2. Tyvina, T. N.; Kharchenko, A. A.; Pryanikova, R. O. Phase-volume relations in the toluene-carbon monoxide-hydrogen system. *Zh. Prikl. Khim.* 1976, *49*, 1638-1640 (*J. Appl. Chem. USSR* 1976, *49*, 1665-1667).

3. Tyvina, T. N.; Kharchenko, A. A.; Pryanikova, R. O. Phase and volume relations in the propylene-carbon monoxide-hydrogen system. *Zh. Prikl. Khim.* 1976, *49*, 1640-1642 (*J. Appl. Chem. USSR* 1976, *49*, 1667-1669).

4. Tyvina, T. N.; Kharchenko, A. A.; Pryanikova, R. O. Phase and volume relations in the toluene-propylene-carbon monoxide-hydrogen mixture. *Zh. Prikl. Khim.* 1977, *50*, 186-188 (*J. Appl. Chem. USSR* 1977, *50*, 186-188).

5. Naumova, A. A.; Tyvina, T. N.; Kharchenko, A. A. Phase and volume relations in the system isobutylene-carbon monoxide-hydrogen. *Zh. Prikl. Khim.* 1979, *52*, 1416-1419 (*J. Appl. Chem. USSR* 1979, *52*, 1347-1349).

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methanol; CH_4O; [67-56-1]

EVALUATOR:

Colin L. Young,
Department of Physical Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

October 1980

CRITICAL EVALUATION:

The high pressure solubility of hydrogen in methanol has been studied by a number of workers but it is not possible to recommend any particular set of data. Measurements at 25 °C (298.15 K) have been carried out by Frolich *et al.* (1) at pressures up to 19 MPa, by Ipat'ev *et al.* (2) at the pressure of 10.1 MPa and by Krichevskii and Efremova (3) at pressures up to 60 MPa. The isolated value of Ipat'ev *et al.* (2) is in reasonable agreement with the values of Krichevskii and Efremova (3) but is not considered further in view of its isolated nature. The data of Krichevskii and Efremova (3) are 10-15 per cent higher than those of Frolich *et al.* (1) but are in reasonable agreement but slightly lower than values given by Michels *et al.* (4) at 297.55 K. Therefore the values of Frolich *et al.* (1) are classified as doubtful.

The data of Michels *et al.* (4) over the temperature range 297 K to 373 K and pressures up to 8.1 MPa are in reasonable agreement with the data of Krichevskii *et al.* (5) at the temperature of 294 K, 363 K and 413 K and pressures up to 30 MPa and therefore both sets of data and those of Krichevskii and Efremova (3) are classified as tentative.

The data of Yorizane *et al.* are of low precision and the mole fractions appear to be too large when compared with the data of Michels *et al.* (4) and the low pressure data of Katayama and Nitta (7).

References

1. Frolich, K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.
2. Ipat'ev, V. V.; Druzhina-Artemovich, S. I.; Tikhomirova, V. I. *Zh. Obshchei Khim.* 1931, *1*, 594.
3. Krichevskii, I. R.; Efremova, G. D. *Zh. Fiz. Khim.* 1951, *25*, 577.
4. Michels, A.; de Graaff, W.; van der Somme, J. *Appl. Sci. Res.* 1953, *A4*, 105-8.
5. Krichevskii, I. R.; Zhavoronokov, N. M.; Tsiklis, D. S. *Zh. Fiz. Khim.* 1937, *9*, 317.
6. Yorizane, M.; Sadamoto, S.; Masuoka, H.; Eto, Y. *Kogyo Kagaku Zasshi* 1969, *72*, 2174-7.
7. Katayama, T.; Nitta, T. *J. Chem. Engng. Data* 1976, *21*, 194-6.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Methanol,(Methyl alcohol); CH_4O; [67-56-1]	Frolich, P.K.; Tauch, E.J.; Hogan, J.J.; Peer, A.A. *Ind. Eng. Chem.* 1931, *23*, 548-550.
VARIABLES:	**PREPARED BY:**
Pressure	C.L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility*	Mole fraction of hydrogen in liquid,+ x_{CH_4O}
298.15	1.0	0.9	0.0015
	2.0	1.8	0.0030
	3.0	2.55	0.0042
	4.0	3.35	0.0055
	5.0	4.15	0.0069
	6.0	4.9	0.0081
	7.0	5.8	0.0096
	8.0	6.7	0.0110
	9.0	7.5	0.0123
	10.0	8.3	0.0136
	11.0	9.1	0.0149
	12.0	9.9	0.0162
	13.0	10.55	0.0172
	14.0	11.45	0.0187
	15.0	12.25	0.0200
	16.0	13.0	0.0212
	17.0	13.8	0.0225
	18.0	14.5	0.0236
	19.0	15.3	0.0248

* Data taken from graph in original article. Volume of gas measured at 101.325 kPa 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 the vapor pressure of the liquid and the solubility of the gas at atmospheric pressure. Details in source.

SOURCE AND PURITY OF MATERIALS:

Stated that materials were the highest purity available.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Krichevskii, I. R.; Zhavoronokov, N. M.; Tsiklis, T. S.
Zh. Fiz. Khim. 1937, *9*, 317-328.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Solubility[#], S /cm^3 g^{-1}	Mole fraction[*] of hydrogen, x_{H_2}
294	76	7.7	8.1	0.0114
294	178	18.0	19.5	0.0271
294	179	18.1	19.7	0.0274
294	272	27.6	29.7	0.0407
363	71	7.2	11.1	0.0157
363	74	7.5	11.7	0.0165
363	134	13.6	20.6	0.0286
363	186	18.8	29.2	0.0401
363	300	30.4	46.5	0.0624
413	78	7.9	16.0	0.0186
413	196	19.9	39.9	0.0540
413	281	28.5	57.7	0.0762

[#] measured at 273.15 K and at a pressure of 101.3 kPa.

[*] calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

No details available. Numerical data taken from Stephan and Stephan (ref. (1)).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

1. Stephan, H.; Stephan, T. *Solubilities of Inorganic and Organic Compounds, Vol. 1,* Pergamon, Oxford, 1963, p.540.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Methanol; CH_4O; [67-56-1]	Krichevskii, I. R.; Efremova, G. D. *Zh. Fiz. Khim.* 1951, *25*, 577-583.
VARIABLES:	PREPARED BY:
Pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen, x_{H_2}
298.2	48.2	4.88	0.00748
	91.7	9.29	0.0142
	113	11.4	0.0175
	129	13.1	0.0198
	147	14.9	0.0227
	168	17.0	0.0255
	183	18.5	0.0275
	212	21.5	0.0316
	246	24.9	0.0362
	260	26.3	0.0374
	292	29.6	0.0411
	424	43.0	0.0555
	437	44.3	0.0581
	493	50.0	0.0640
	507	51.4	0.0656
	582	59.0	0.0747

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

No details available.
Numerical data taken from Stephan and Stephan (ref. (1)).

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

1. Stephan, H.; Stephan, T. *Solubilities of Inorganic and Organic Compounds, Vol. 1*, Pergamon, Oxford, 1963, p.541.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methanol; CH_3OH; [67-56-1]

ORIGINAL MEASUREMENTS:

Michels, A.; de Graaff, W.; van der Somme, J.

Appl. Sci. Res. 1953, *A4*, 105-8.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
297.55	152	0.0253	-	348.15	405	-	0.9931
	304	0.0475	-		507	0.0917	-
	405	0.0594	-		608	-	0.9938
	507	0.0726	-		811	0.1386	0.9939
	608	0.0831	-	372.45	101	-	0.9604
	811	0.1058	-		122	-	0.9646
322.55	304	0.0519	-		152	-	0.9734
	507	0.0798	-		203	-	0.9763
	811	0.1224	-		253	-	0.9790
348.15	85	0.0184	0.9801		304	0.0635	0.9821
	123	0.0256	0.9845		405	-	0.9847
	152	-	0.9869		507	0.1046	-
	253	-	0.9905		608	-	0.9871
	304	0.0587	-		811	0.1566	0.9892

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

One pass flow method. Hydrogen passed through methanol for several hours. Samples of both phases analysed by passing through silica gel and collecting hydrogen in calibrated flask. Methanol determined from increase in weight of silica gel adsorption vessel. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.5$; δx_{H_2}, $\delta y_{H_2} = \pm 2\%$ (estimated by compiler).

REFERENCES:

1. Michels, A.; Skelton, G. F.; Dumoulin, E. *Physica* 1950, *16*, 831.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Methanol; CH_3OH; [67-56-1]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Sadamoto, S.; Masuoka, H.; Eto, Y.

Kogyo Kagaku Zasshi 1969, *72*, 2174-7.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
273.15	1.11	0.005
	3.14	0.011
	5.17	0.015
258.15	1.01	0.005
	2.03	0.007
	3.04	0.009
	5.07	0.013
243.15	1.01	0.003
	2.03	0.005
	3.04	0.006
	4.05	0.007
	5.07	0.008

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

Vapor-liquid equilibrium cell. Details given in source. (Original in Japanese.)

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 0.001$

(estimated by compiler).

REFERENCES:

COMPONENTS:	EVALUATOR:
1. Hydrogen; H ; [1333-74-0] 2. C_2 to C_{16}Alcohols,ethers and esters	Colin L. Young. Department of Chemistry, University of Melbourne Parkville, Victoria, 3052 AUSTRALIA:

The most extensive study of the solubility of hydrogen in alcohols at high pressures is that of Brunner (1). Androsov and Loktev (2) studied the solubility of hydrogen, carbon monoxide and ethyne (acetylene) in several aliphatic alcohols and hydrocarbons. However, even in the deposited article the data were presented in unclear graphs and therefore the data are not considered further. Frolich *et al* (3) have studied the solubility of hydrogen in 1-propanol, 2-propanol and 1-butanol. The data for 1-butanol are in fair agreement with those of Brunner (1) whereas the hydrogen solubilities for the other two alcohols are about 10 per cent smaller than those of Brunner (1). The solubility of hydrogen in 1-butanol and 2-methyl - 1-propanol have also been studied by Tyvina *et al* (4). The latter data cover the temperature range 313 K to 473 K and pressures up to 30 MPa whereas those of Brunner (1) are restricted to a temperature range of 298 K to 373 K and pressures below 10 MPa. The interpolated values in overlapping ranges of temperatures and pressures from these two sets of data are only in fair agreement, the mole fraction of hydrogen in the liquid given by Tyvina *et al* (4) being about 5 per cent smaller than those of Brunner (1). Schroder (5) investigated the solubility of hydrogen in 1-butanol at 323.15 K at pressures up to 5 MPa and his results are in good agreement with those of Brunner (1). However,the numerical data of Schroder were not available to us and are not considered further.

Brunner (1) quoted partial molar volumes of hydrogen at infinite dilution, V^{∞} and partial molar heats of solution, Δh, where these were calculated from the equation.

$$\ln\ (p_{H_2}/\text{bar})/x_{H_2} = \ln H/\text{bar} + V^{\infty} p_{H_2}/RT$$

$$\left(\frac{\partial \ln x_{H_2}}{\partial(1/T)}\right)_p = \frac{-\Delta h}{R}$$

where *H* is Henry's law constant at zero partial pressures of hydrogen.

Values of $H/10^5$Pa, $V^{\infty}/\text{cm}^3\ \text{mol}^{-1}$ and $\Delta h/\text{J mol}^{-1}$ are given below for Brunner data. Values in parentheses are those calculated from other worker's data as indicated in the footnotes of the table.

Alcohol	T/K	$H/10^5$Pa	$V^{\infty}/\text{cm}^3\ \text{mol}^{-1}$	$\Delta h/\text{J mol}^{-1}$
1,2-Ethanediol	298.15	24700	31	
	323.15	20750	35	5850
	373.15	15390	36	
1-Propanol	298.15	4125	36	
	323.15	3681	35	4920
	373.15	2783	35	
	298.15	(4403) a		
	253.15	(5550) b		
	273.15	(4970) b		
	298.15	(4270) b		
2-Propanol	298.15	3693	34	
	323.15	3160	37	5750
	373.15	2324	48	
	298.15	(4300) a		
	298.15	(3760) e		

Alcohol	T/K	$H/10^5$Pa	V^∞/cm^3 mol^{-1}	Δh/J mol^{-1}
2-Methoxyethanol	298.15	6941	18	6780
	323.15	5620	23	
	373.15	4006	23	
1-Butanol	298.15	3609	36	4695
	323.15	3154	41	
	373.15	2470	43	
	298.15	(3597) a		
	253.15	(4770) b		
	273.15	(4320) b		
	298.15	(3750) b		
	323.15	(3090) c		
	323.15	(3670) d		
	373.15	(2740) d		
	298.15	(3800) f		
2-Methyl-1-propanol	298.15	3545	26	6200
	323.15	2921	48	
	373.15	2257	50	
	323.15	(3100) d		
	373.15	(2500) d		
2-Butanol	298.15	3729	17	6510
	323.15	3178	23	
	373.15	2212	37	
2-Ethoxyethanol	298.15	4448	42	5780
	323.15	3735	50	
	373.15	2785	51	
1-Pentanol	298.15	3375	24	4880
	323.15	2881	36	
	373.15	2269	36	
	298.15	(3730) f		
1-Hexanol	298.15	2948	37	4270
	323.15	2536	40	
	373.15	2080	26	
	298.15	(3320) f		
2-Butoxyethanol	298.15	3169	36	5290
	323.15	2754	41	
	373.15	2070	38	
2-Ethyl-1-hexanol	298.15	2529	35	5110
	323.15	2146	40	
	373.15	1708	42	
	393.15	1512	55	
1,3-Propanediol	298.15	1558	19	5045
	323.15	1360	20	
	373.15	1038	25	
1,4-Butanediol	298.15	1167	13	5030
	323.15	1009	19	
	373.15	777.3	22	
1,2-Dimethoxyethane	298.15	272.6	32	6480
	323.15	224.9	38	
	373.15	161.4	59	

Alcohol	T/K	$H/10^5$Pa	$V^{\infty}/cm^3\ mol^{-1}$	$\Delta h/J\ mol^{-1}$
2,2'-Oxybisethanol	298.15	1312	23	
	323.15	1099	25	5980
	373.15	808.8	30	
2-(2-Methoxyethoxy) ethanol	298.15	580.8	23	
	323.15	473.9	26	6805
	373.15	334.8	32	
2,2'-[1,2-ethanediylbis-(oxy)]bisethanol	298.15	971.2	19	
	323.15	796.0	24	6910
	373.15	555.7	31	
2-[2-(2-methoxyethoxy)-ethoxy]ethanol	298.15	500.7	21	
	323.15	406.8	25	6910
	373.15	286.2	32	

a) values for data of Frolich *et al* (3) quoted by Brunner (1)

b) values for low pressure data of Katayama and Nitta (6) quoted by Brunner (1)

c) values for data of Schröder (5) quoted by Brunner (1)

d) values for data of Tyvina *et al*(4) quoted by Brunner (1).

e) Values for low pressure data of Puri and Ruether (6) calculated by evaluator.

f) values for low pressure data of Makranczy *et al* (7) calculated by evaluator.

There are some discrepancies between Henry's law constants calculated from the data of Brunner and from low pressure measurements. However, some of the discrepancy arises from the extrapolation of Brunner data to low pressures. The data of Brunner are classified as tentative.

REFERENCES:

1. Brunner, E. *J.Chem.Thermodynamics*, 1980, *12*, 993.;
   Brunner, E. *Ber Bunsenges. Phys. Chem.* 1979, *83*, 715.
2. Androsov, D.I.; Loktev, S.M. *Zh. Fiz. Khim.* 1978, *52*, 1348. Complete article VINITI No. 4463-77.
3. Frolich, K.; Tauch, E.J.; Hogan, J.J.; Peer, A.A.; *Ind. Eng. Chem.* 1931, *23*, 548.
4. Tyvina, T.N.; Valuev, K.I.; Vasileva, I.I.; Sokolov, B.I.; Kharchenko, A.A.; *Zhur. Prikl. Khim.* 1977, *50*, 2578.
5. Schröder, W. *Z. Naturforsch.* 1969, *24B*, 500.
6. Puri, P.S.; Ruether, J.A. *Can. J. Chem. Eng.* 1974, *7*, 41.
7. Makranczy, J.; Rusz, L. Balog-Megyery, K.; *Hung. J. Ind. Chem.* 1979, *7*, 41.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1,2-Ethanediol; $C_2H_6O_2$; [107-21-1]	Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1979, *83*, 715-721.

VARIABLES:	PREPARED BY:
Temperature, pressure	C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
298.15	25.3	10.03
	51.5	20.26
	69.6	26.95
	85.9	32.73
323.15	26.8	12.69
	48.3	22.30
	62.6	28.78
	89.7	40.40
373.15	39.4	25.02
	55.4	34.71
	75.0	46.85
	87.4	53.88

* total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1-Propanol; C_3H_8O; [71-23-8]	Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1979, *83*, 715-721.

VARIABLES:	PREPARED BY:
Temperature, pressure	C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
298.15	0.03	0	0
	24.6	24.5	58.24
	49.8	49.8	115.3
	77.4	77.3	176.0
	99.3	99.3	220.0
323.15	0.11	0	0
	23.7	23.6	62.96
	36.0	35.9	94.90
	51.8	51.7	135.7
	74.7	74.6	191.5
	106.0	105.9	266.0
373.15	1.11	0	0
	22.9	21.8	74.41
	47.5	46.4	162.0
	86.2	85.1	289.1
	97.7	96.4	327.0

+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref.(1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$ (estimated by compiler).

REFERENCES.

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 2-Propanol; C_3H_8O; [67-63-0]

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.;
Hogan, J. J.; Peer, A. A.
Ind. Eng. Chem. 1931, *23*, 548-550.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility*, S	Mole fraction of hydrogen in liquid,† x_{H_2}
298.15	1.0	0.75	0.0024
	2.0	1.5	0.0047
	3.0	2.22	0.0066
	4.0	3.0	0.0093
	5.0	3.7	0.0115
	6.0	4.4	0.0136
	7.0	5.2	0.0161
	8.0	5.9	0.0182
	9.0	6.65	0.0205
	10.0	7.4	0.0227
	11.0	8.15	0.0250
	12.0	8.9	0.0272
	13.0	9.6	0.0293
	14.0	10.35	0.0315
	15.0	11.1	0.0337
	16.0	11.85	0.0359
	17.0	12.6	0.0381
	18.0	13.3	0.0401
	19.0	14.05	0.0423

† Calculated by compiler.
* Data taken from graph in original article. Volume of gas measured at 101.325 kPa 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:

Stated that the materials were the highest purity available.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Propanol; C_3H_8O; [67-63-0]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem.

1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
298.15	0.057	0	0
	7.51	7.45	20.68
	10.2	10.1	27.71
	10.8	10.7	29.33
	15.9	15.8	42.40
	20.2	20.1	53.85
	21.2	21.2	56.58
	36.5	36.4	96.26
	45.1	45.0	116.5
	45.2	45.2	117.4
	63.5	63.4	163.4
	74.2	74.1	188.6
	97.2	97.2	245.4
323.15	0.234	0	0
	6.98	6.74	21.20
	12.2	11.9	37.14
	24.3	24.1	74.67
	27.0	26.8	84.69
	40.4	40.1	121.1
	53.3	53.1	160.8
	73.3	73.1	219.3
	83.1	82.8	245.3
	92.4	92.1	245.5

\+ total pressure * partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample, purity 99.7 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler).

REFERENCES:

1. Brunner, E.
Ber. Bunsenges. Phys. Chem.
1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Propanol; C_3H_8O; [67-63-0]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1979, *83*, 715-721.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
373.15	1.98	0	0
	9.35	7.37	31.98
	12.0	10.0	42.89
	26.1	24.1	102.1
	30.9	28.9	120.1
	36.7	34.7	142.9
	61.7	59.8	240.3
	89.2	87.3	344.6

\+ total pressure

* partial pressure

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 2-Methoxyethanol; $C_3H_8O_2$; [109-86-4]	Brunner, E. *Ber. Bunsenges. Phys. Chem.* <u>1979</u>, *83*, 715-721.
VARIABLES: Temperature, pressure	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.02	0	0
	34.2	34.2	49.00
	56.9	56.9	82.00
	101.0	101.0	143.0
323.15	0.06	0	0
	33.6	33.6	59.11
	56.5	56.5	98.65
	71.6	71.6	125.3
	81.0	80.9	139.9
373.15	0.46	0	0
	27.5	27.0	67.00
	45.4	44.9	110.0
	87.8	87.4	211.7

+ total pressure * partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$;
$\delta x_{H_2} = \pm 2.0\%$
(estimated by compiler)

REFERENCES:

1. Brunner, E.
Ber. Bunsenges. Phys. Chem. <u>1978</u>, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,3-Propanediol; $C_3H_8O_2$; [504-63-2]

ORIGINAL MEASUREMENTS:

Brunner, E.
J. Chem. Thermodyn. 1980, *12*,
993-1002.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	p^*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	1.93	0.001238
	4.507	0.002868
	4.674	0.002960
	7.26	0.004621
	10.31	0.006502
323.15	1.706	0.001250
	4.519	0.003281
	7.53	0.005486
	10.32	0.007404
373.15	1.877	0.001808
	4.607	0.004343
	7.58	0.007135
	10.22	0.009577

* total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Messer-Griesheim sample, purity 99.997 mass per cent.
2. Riedel-de-Haem sample, purity 99.5 mass per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.2\%$;
$\delta x_{H_2} = \pm 2\%$.

REFERENCES:

1. Brunner, E.
   Ber. Bunsenges. Phys. Chem.
   1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Butanol; $C_4H_{10}O$; [71-36-3]

ORIGINAL MEASUREMENTS:

Tyvina, T. N.; Valuev, K. I.; Vasil'eva, I. I.; Sokolov, B. I.; Kharchenko, A. A.

Zh. Prikl. Khim. 1977, *50*, 2578-2581;

J. Appl. Chem. USSR 1977, *50*, 2446-2449.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
313.2	300	30.4	0.0750	0.9992
	200	20.3	0.0512	0.9991
	100	10.1	0.0268	0.9989
	50	5.07	0.0135	0.9985
	25	2.53	0.0065	0.9980
	10	1.01	0.0013	0.9942
353.2	300	30.4	0.0889	0.9959
	200	20.3	0.0614	0.9955
	100	10.1	0.0320	0.9941
	50	5.07	0.0162	0.9925
	25	2.53	0.0082	0.9899
	10	1.01	0.0032	0.9763
	4	0.405	0.0013	0.9386
393.2	300	30.4	0.1090	0.9895
	200	20.3	0.0752	0.9884
	100	10.1	0.0387	0.9839
	50	5.07	0.0194	0.9778
	25	2.53	0.0098	0.9561
	10	1.01	0.0032	0.8902
	4	0.405	0.0009	-

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The compositions of coexisting phases were determined by analysis and a static apparatus was employed. However, other details and references given in the source are ambiguous.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.8 mole per cent.

2. Analytical grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 4\%$

$\delta(1-y_{H_2}) = \pm 6\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Butanol; $C_4H_{10}O$; [71-36-3]	Tyvina, T. N.; Valuev, K. I.; Vasil'eva, I. I.; Sokolov, B. I.; Kharchenko, A. A. *Zh. Prikl. Khim.* 1977, *50*, 2578-2581; *J. Appl. Chem. USSR* 1977, *50*, 2446-2449.

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
433.2	300	30.4	0.1419	0.9761
	200	20.3	0.0984	0.9744
	100	10.1	0.0503	0.9622
	50	5.07	0.0251	0.9253
	25	2.53	0.0117	0.8642
	10	1.01	0.0032	0.7371
473.2	300	30.4	0.1769	0.9595
	200	20.3	0.1230	0.9566
	100	10.1	0.0620	0.9068
	50	5.07	0.0282	0.8213
	25	2.53	0.0107	0.7056

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1-Butanol; $C_4H_{10}O$; [71-36-3]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.01	0	0
	5.79	5.78	15.95
	9.08	9.05	24.92
	13.41	13.40	36.87
	13.42	13.41	36.97
	28.5	28.5	76.00
	77.1	77.1	199.0
	80.7	80.7	209.6
	97.3	97.3	248.8
323.15	0.04	0	0
	4.92	4.88	15.61
	8.33	8.29	25.99
	11.71	11.67	36.69
	15.61	15.57	48.44
	21.7	21.7	67.34
	25.4	25.3	78.02
	30.4	30.4	92.93
	43.5	43.5	130.5
	68.2	68.2	200.6
	99.3	99.7	288.0

+ total pressure * partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.

2. Merck AG sample, purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler).

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1-Butanol; $C_4H_{10}O$; [71-36-3]	Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1979, *83*, 715-721.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
373.15	0.51	0	0
	9.82	9.28	37.93
	12.83	12.29	50.24
	18.8	18.23	71.39
	21.7	21.1	82.43
	22.3	21.8	85.04
	28.9	28.4	111.0
	30.4	29.9	120.2
	33.8	33.3	129.4
	78.0	77.5	287.4

+ total pressure

* partial pressure

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 2-Methyl-1-propanol,(*iso*butane); $C_4H_{10}O$; [78-83-1]

ORIGINAL MEASUREMENTS:

Tyvina, T. N.; Valuev, K. I.; Vasil'eva, I. I.; Sokolov, B. I.; Kharchenko, A. A.
Zh. Prikl. Khim. 1977, *50*, 2578-2581;
J. Appl. Chem. USSR 1977, *50*, 2446-2449.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
313.2	300	30.4	0.0830	0.9987
	200	20.3	0.0572	0.9983
	100	10.1	0.0300	0.9978
	50	5.07	0.0155	0.9968
	25	2.53	0.0080	0.9954
	10	1.01	-	0.9913
	4	0.405	-	0.9800
353.2	300	30.4	0.0965	0.9938
	200	20.3	0.0680	0.9932
	100	10.1	0.0345	0.9912
	50	5.07	0.0175	0.9887
	25	2.53	0.0085	0.9850
	10	1.01	0.0030	0.9645
	4	0.405	0.0014	0.9080
393.2	300	30.4	0.1194	0.9842
	200	20.3	0.0820	0.9831
	100	10.1	0.0427	0.9767
	50	5.07	0.0217	0.9678
	25	2.53	0.0105	0.9324
	10	1.01	0.0036	0.8574
	4	0.405	0.0007	0.7148

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The compositions of coexisting phases were determined by analysis and a static apparatus was employed. However, other details and references given in the source are ambiguous.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.8 mole per cent.

2. Analytical grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 4\%$;
$\delta(1-y_{H_2}) = \pm 6\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 2-Methyl-1-propanol, (*iso*butane); $C_4H_{10}O$; [78-83-1]	Tyvina, T. N.; Valuev, K. I.; Vasil'eva, I. I.; Sokolov, B. I.; Kharchenko, A. A. *Zh. Prikl. Khim.* 1977, *50*, 2578-2581; *J. Appl. Chem. USSR* 1977, *50*, 2446-2449.

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
433.2	300	30.4	0.1579	0.9650
	200	20.3	0.1096	0.9622
	100	10.1	0.0565	0.9430
	50	5.07	0.0270	0.8921
	25	2.53	0.0118	0.8013
	10	1.01	0.0026	0.6476
	4	0.405	0.0007	0.4572
473.2	300	30.4	0.2015	0.9350
	200	20.3	0.1407	0.9245
	100	10.1	0.0698	0.8641
	50	5.07	0.0302	0.7454
	25	2.53	0.0089	0.5775

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Methyl-1-propanol, (*iso*-butanol); $C_4H_{10}O$; [78-83-1]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.02	0	0
	26.5	26.5	74
	52.8	52.8	145
	97.2	97.2	263
323.15	0.07	0	0
	34.5	34.4	113
	82.5	82.4	255
373.15	0.75	0	0
	26.5	25.8	111
	88.9	88.2	354

\+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler).

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Butanol; $C_4H_{10}O$; [78-92-2]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem.
1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
298.15	0.02	0	0
	28.1	28.1	75
	52.1	52.1	139
	76.8	76.8	205
	98.6	98.6	261
323.15	0.11	0	0
	30.0	30.1	93
	50.7	50.6	158
	98.6	98.5	300
373.15	0.75	0	0
	19.8	19.1	85.1
	52.6	51.8	226.6
	100.0	99.3	419.0

\+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$;
$\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler).

REFERENCES:

1. Brunner, E.
   Ber. Bunsenges. Phys. Chem.
   1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,2-Dimethoxyethane, (ethylene glycol dimethyl ether); $C_4H_{10}O_2$; [110-71-4]

ORIGINAL MEASUREMENTS:

Brunner, E.

J. Chem. Thermodyn. 1980, *12*, 993-1002.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	p^*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	0.009	0.0
	1.159	0.004189
	4.582	0.01623
	7.43	0.02570
	9.53	0.03272
323.15	0.0288	0.0
	1.707	0.007352
	1.782	0.007757
	4.479	0.01880
	4.916	0.02085
	7.08	0.02947
	9.82	0.04028
373.15	0.165	0.0
	2.127	0.01183
	2.219	0.01280
	4.516	0.02583
	7.96	0.04501
	9.73	0.05473

* total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Messer-Griesheim sample, purity 99.997 mass per cent.
2. BASF Akteingesellschaft sample, purity 99.7 mass per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.2\%$; $\delta x_{H_2} = \pm 2\%$.

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Ethoxyethanol; $C_4H_{10}O_2$; [110-80-5]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.007	0	0
	23.9	23.9	52.41
	40.4	40.4	86.61
	59.3	59.3	124.7
	108.2	108.2	216.0
323.15	0.03	0	0
	26.2	26.2	67.92
	41.4	41.4	104.9
	66.0	66.0	160.1
	75.6	75.6	184.8
	103.0	103.0	240.10
373.15	0.31	0	0
	56.1	55.8	188.0
	101.7	101.4	326.0
	102.0	101.7	323.0

+ total pressure, * partial pressure,

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample purity 99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$;
$\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler).

REFERENCES:

1. Brunner, E.

   Ber. Bunsenges. Phys. Chem. 1978, *82*, 798.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1,4-Butanediol; $C_4H_{10}O_2$; [110-63-4]	Brunner, E. *J. Chem. Thermodyn.* 1980, *12*, 993-1002.
VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	p^*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	1.542	0.001320
	4.46	0.003827
	7.58	0.006535
	7.86	0.006794
	9.89	0.008470
323.15	2.169	0.002149
	3.608	0.003559
	4.648	0.004535
	5.080	0.005000
	6.27	0.006155
	6.41	0.006221
	9.60	0.009300
373.15	2.529	0.003243
	5.25	0.006668
	5.47	0.006937
	8.03	0.01014
	8.13	0.01034
	9.42	0.01187

* total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Messer-Griesheim sample, purity 99.997 mass per cent.
2. BASF Akteingesellschaft sample, purity 99.7 mass per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.2\%$; $\delta x_{H_2} = \pm 2\%$.

REFERENCES:

1. Brunner, E.
Ber. Bunsenges. Phys. Chem. 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2,2'-Oxybisethanol, (ethylene glycol); $C_4H_{10}O_3$; [111-46-6]

ORIGINAL MEASUREMENTS:

Brunner, E.

J. Chem. Thermodyn. 1980, *12*, 993-1002.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	p^*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	1.916	0.001452
	4.547	0.003411
	7.29	0.005417
	8.91	0.006557
	9.99	0.007358
323.15	2.744	0.002478
	3.958	0.003533
	7.63	0.006733
	9.96	0.008741
373.15	2.41	0.002932
	6.60	0.007970
	8.07	0.009687
	9.99	0.01189

* total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Messer-Griesheim sample, purity 99.997 mass per cent.
2. BASF Akteingesellschaft sample, purity 99.7 mass per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.2\%$; $\delta x_{H_2} = \pm 2\%$.

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Pentanol, $C_5H_{12}O$; [71-41-0]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber.Bunsenges. Phys. Chem. 1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.003	0	0
	27.2	27.2	80
	59.7	59.7	171
	78.6	78.6	230
	98.0	98.0	279
323.15	0.02	0	0
	25.4	25.4	87
	55.3	55.3	181
	88.4	88.4	288
373.15	0.25	0	0
	33.4	33.2	143
	60.5	60.3	256
	79.7	79.5	333

\+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample, purity 98.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES.

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-(2-Methoxyethoxy)ethanol, (diethylene glycol, monomethyl ether); $C_5H_{12}O_3$; [111-77-3]

ORIGINAL MEASUREMENTS:

Brunner, E.

J. Chem. Thermodyn. 1980, *12*, 993-1002.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	p^*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	3.4×10^{-5}	0.0
	1.441	0.002478
	4.185	0.007176
	6.97	0.01176
	10.19	0.01691
323.15	2.0×10^{-4}	0.0
	1.486	0.003119
	4.32	0.008947
	7.25	0.01489
	10.41	0.02107
373.15	3.5×10^{-3}	0.0
	2.11	0.006214
	3.96	0.01153
	7.27	0.02085
	10.63	0.02991

* total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Messer-Griesheim sample, purity 99.997 mass per cent.
2. BASF Akteingesellschaft sample, purity 99.7 mass per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.2\%$; $\delta x_{H_2} = \pm 2\%$.

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H ; [1333-74-0]
2. 1-Hexanol; $C_6H_{14}O$; [111-27-3]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.001	0	0
	30.1	30.1	99.50
	57.0	56.9	182.2
	57.1	57.1	185.0
	79.9	79.9	251.9
	98.7	98.7	305.8
323.15	0.01	0	0
	34.0	34.0	113.5
	44.3	44.2	164.6
	66.6	66.6	250.4
	83.1	83.0	296.4
	103.4	103.4	374.1
373.15	0.11	0	0
	32.6	32.5	155.2
	73.7	73.6	340.4
	87.1	87.0	406.2
	102.4	102.3	478.2

\+ total pressure,

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample, purity better than 98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.

(estimated by compiler)

REFERENCES:

1. Brunner, E.

   Ber. Bunsenges. Phys. Chem. 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Butoxyethanol; $C_6H_{14}O_2$; [111-76-2]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.002	0	0
	44.1	44.1	134.1
	63.8	63.8	191.1
	70.7	70.7	208.6
	84.4	84.4	248.4
323.15	0.008	0	0
	34.4	34.4	120.7
	35.5	35.5	124.5
	56.8	56.8	195.4
	77.1	77.0	260.8
	102.7	102.7	336.7
373.15	0.09	0	0
	36.2	36.2	170.1
	65.9	65.8	303.1
	84.0	83.9	381.5

\+ total pressure * partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$ (estimated by compiler)

REFERENCES:

1. Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2,2'-[1,2-Ethanediylbis(oxy)]bis-ethanol, (triethylene glycol); $C_6H_{14}O_4$; [112-27-6]

ORIGINAL MEASUREMENTS:

Brunner, E.

J. Chem. Thermodyn. 1980, *12*, 993-1002.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	p^*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	2.05	0.002096
	4.617	0.004710
	6.97	0.007076
	10.06	0.01009
323.15	1.994	0.002502
	4.456	0.005517
	7.67	0.009398
	10.41	0.01261
373.15	2.59	0.004600
	4.574	0.008050
	7.48	0.01296
	9.97	0.01705

* total pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Messer-Griesheim sample, purity 99.997 mass per cent.
2. BASF Akteingesellschaft sample, purity 99.7 mass per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.2\%$; $\delta x_{H_2} = \pm 2\%$.

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 2-[2-(2-Methoxyethoxy)-ethoxy]-ethanol, (Triethylene glycol monomethyl ether); $C_7H_{16}O_4$; [112-35-6]	Brunner, E. *J. Chem. Thermodyn.* 1980, *12*, 993-1002.
VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	p^*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
298.15	1.759	0.003469
	4.649	0.009193
	6.83	0.01349
	10.26	0.01993
323.15	1.66	0.004061
	3.138	0.007623
	6.68	0.01598
	10.33	0.02447
373.15	1.805	0.006270
	3.76	0.01280
	6.81	0.02303
	10.30	0.03399

* total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Messer-Griesheim sample, purity 99.997 mass per cent.
2. BASF Akteingesellschaft sample, purity 99.7 mass per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.2\%$;
$\delta x_{H_2} = \pm 2\%$.

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 2-Ethoxy-1-hexanol; $C_8H_{18}O$; [104-76-7]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1979, *83*, 715-721.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.0002	0	0
	19.72	19.72	75.80
	34.3	34.3	132.1
	44.2	44.2	170.8
	77.4	77.4	289
	94.6	94.6	343
323.15	0.002	0	0
	50.3	50.3	222
	97.8	97.8	410
373.15	0.04	0	0
	62.6	62.6	349
	96.5	96.5	524
393.15	0.11	0	0
	26.9	26.7	171.3
	46.1	46.0	287.7

+ total pressure, * partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen.

Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity better than 98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$

(estimated by compiler)

REFERENCES:

1. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978 *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon Monoxide; CO; [630-08-0]
3. Alcohols

ORIGINAL MEASUREMENTS:

Loktev, S. M.; Androsov, D. I.; Zuev, A. A.
Zh. Prikl. Khim. 1978, *51*, 2023-2027;
J. Appl. Chem. USSR 1978, *51*, 1914-1917.

VARIABLES:

Temperature, pressure, gaseous composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Mole fraction of hydrogen in gas before saturation	Total pressure p/atm	Total pressure p/MPa	Bunsen coefficients α_{H_2}	Bunsen coefficients α_{CO}
315	0.690	20	2.03	0.77	0.73
		40	4.05	1.62	1.40
		60	6.08	2.20	1.80
		80	8.11	2.85	2.15
		100	10.13	3.55	2.91
	0.515	20	2.03	0.55	1.10
		40	4.05	1.17	2.00
		60	6.08	1.63	2.97
		80	8.11	2.12	4.00
		100	10.13	2.87	4.90
	0.43	20	2.03	0.46	1.25
		40	4.05	0.95	2.33
		60	6.08	1.47	3.55
		80	8.11	1.91	4.67
		100	10.13	2.30	5.70
371	0.69	20	2.03	1.06	0.72
		40	4.05	2.06	1.52
		60	6.08	2.98	2.16
		80	8.11	3.99	2.83
		100	10.13	4.67	3.55

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Liquid saturated with gaseous mixture by bubbling gas through liquid in a stirred vessel. Samples of liquid analysed by volumetric technique and gas chromatography.

SOURCE AND PURITY OF MATERIALS:

1, 2. Purity approximately 99 mole per cent.

3. Mixture of C_{12} to C_{16} aliphatic alcohols (industrial product).

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta p/p = \pm 0.01$;
$\delta\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon Monoxide; CO; [630-08-0]
3. Alcohols

ORIGINAL MEASUREMENTS:

Loktev, S. M.; Androsov, D. I.; Zuev, A. A.
Zh. Prikl. Khim. 1978, *51*, 2023-2027;
J. Appl. Chem. USSR 1978, *51*, 1914-1917.

EXPERIMENTAL VALUES:

T/K	Mole fraction of hydrogen in gas before saturation	Total pressure p/atm	Total pressure p/MPa	Bunsen coefficients α_{H_2}	Bunsen coefficients α_{CO}
371	0.485	20	2.03	0.80	1.25
		40	4.05	1.60	2.30
		60	6.08	2.38	3.42
		80	8.11	2.91	4.54
		100	10.13	3.49	5.45
	0.57	20	2.03	0.68	1.43
		40	4.05	1.34	2.74
		60	6.08	2.02	4.06
		80	8.11	2.60	5.16
		100	10.13	3.35	6.20
457	0.69	40	4.05	3.10	1.74
		60	6.08	4.59	2.47
		80	8.11	5.82	3.07
		100	10.13	7.00	4.07
	0.515	20	2.03	1.15	1.52
		40	4.05	2.12	2.81
		60	6.08	3.16	4.19
		80	8.11	4.14	5.60
		100	10.13	4.86	6.70
	0.43	20	2.03	0.97	1.78
		40	4.05	1.82	3.30
		60	6.08	2.78	4.82
		80	8.11	3.58	6.30
		100	10.13	4.51	7.70

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon monoxide; CO; [630-08-0]
3. Ethyne (acetylene); C_2H_2; [74-86-2]
4. Alcohols

ORIGINAL MEASUREMENTS:

Loktev, S. M.; Androsov, D. I.; Zuev, A. A.
Zh. Prikl. Khim. 1978, *51*, 2023-2027;
J. Appl. Chem. USSR 1978, *51*, 1914-1917.

VARIABLES:

Temperature, pressure, gaseous composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Mole fractions in gaseous phase before saturation			Total pressure		Bunsen coefficients		
	y'_{H_2}	y'_{CO}	$y'_{C_2H_2}$	p/atm	p/MPa	α_{H_2}	α_{CO}	$\alpha_{C_2H_2}$
315	0.56	0.435	0.0061	20	2.03	0.59	0.95	0.36
				40	4.05	1.23	1.91	0.68
				60	6.08	1.75	2.68	0.91
				80	8.11	2.37	3.60	1.00
				100	10.13	3.04	4.40	1.15
	0.80	0.190	0.0078	20	2.03	0.86	0.41	0.56
				40	4.05	1.70	0.81	1.00
				60	6.08	2.56	1.18	1.28
				80	8.11	3.25	1.54	1.44
				100	10.13	4.20	1.86	1.60
	0.245	0.745	0.0075	20	2.03	0.29	1.63	0.43
				40	4.05	0.56	3.21	0.81
				60	6.08	0.88	4.80	1.05
				80	8.11	1.08	6.06	1.33
				100	10.13	1.41	7.20	1.46
	0.25	0.74	0.0103	20	2.03	0.31	1.55	0.60
				40	4.05	0.56	3.20	1.10
				60	6.08	0.86	4.71	1.46
				80	8.11	1.10	5.92	1.74
				100	10.13	1.41	7.12	1.99

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Liquid saturated with gaseous mixture by bubbling gas through liquid in a stirred vessel. Samples of liquid analysed by volumetric technique and gas chromatography.

SOURCE AND PURITY OF MATERIALS:

1, 2, 3. Purity approximately 99 mole per cent.

4. Mixture of C_{12} to C_{16} aliphatic alcohols (industrial product).

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta p/p = \pm 0.01$;
$\delta\alpha = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Carbon monoxide; CO; [630-08-0] 3. Ethyne (acetylene); C_2H_2; [74-86-2] 4. Alcohols	Loktev, S. M.; Androsov, D. I.; Zuev, A. A. *Zh. Prikl. Khim.* 1978, *51*, 2023-2027; *J. Appl. Chem. USSR* 1978, *51*, 1914-1917.

EXPERIMENTAL VALUES:

T/K	Mole fractions in gaseous phase before saturation			Total pressure		Bunsen coefficients		
	y'_{H_2}	y'_{CO}	$y'_{C_2H_2}$	p/atm	p/MPa	α_{H_2}	α_{CO}	$\alpha_{C_2H_2}$
315	0.516	0.485	0.0095	20	2.03	0.54	1.13	0.52
				40	4.05	1.16	2.23	0.89
				60	6.08	1.73	3.11	1.21
				80	8.11	2.21	3.86	1.45
				100	10.13	2.70	4.57	1.65
371	0.56	0.435	0.0061	20	2.03	0.83	1.01	0.17
				40	4.05	1.72	2.05	0.32
				60	6.08	2.45	3.11	0.45
				80	8.11	3.30	4.00	0.56
				100	10.13	3.85	5.22	0.66
	0.80	0.19	0.0078	20	2.03	1.16	0.45	0.25
				40	4.05	2.26	0.90	0.47
				60	6.08	3.37	1.45	0.64
				80	8.11	4.24	1.95	0.79
				100	10.13	5.20	2.31	0.85
	0.245	0.745	0.0075	20	2.03	0.43	1.75	0.20
				40	4.05	0.72	3.75	0.37
				60	6.08	1.05	5.04	0.50
				80	8.11	1.45	6.81	0.614
				100	10.13	1.86	7.90	0.73
	0.250	0.740	1.03	40	4.05	0.79	3.55	0.45
				60	6.08	1.17	5.10	0.63
				80	8.11	1.54	6.86	0.80
				100	10.13	1.75	7.70	0.87
	0.516	0.485	0.95	20	2.03	0.84	1.15	0.27
				40	4.05	1.59	2.31	0.50
				60	6.08	2.25	3.39	0.67
				80	8.11	2.82	4.08	0.79
				100	10.13	3.50	5.40	0.87
457	0.56	0.435	0.0061	20	2.03	1.17	1.37	0.09
				40	4.05	2.32	2.73	0.18
				60	6.08	3.25	4.02	0.25
				80	8.11	4.48	5.12	0.32
				100	10.13	5.20	6.15	0.37
	0.80	0.19	0.0078	20	2.03	1.76	0.65	0.18
				40	4.05	3.30	1.21	0.32
				60	6.08	4.91	1.68	0.42
				80	8.11	6.22	2.28	0.52
				100	10.13	7.36	2.80	0.59
	0.245	0.745	0.0075	20	2.03	0.57	2.31	0.14
				40	4.05	1.12	4.48	0.26
				60	6.08	1.57	6.28	0.35
				80	8.11	2.07	8.18	0.45
				100	10.13	2.50	9.75	0.50
	0.25	0.74	0.0103	20	2.03	0.61	2.25	0.21
				40	4.05	1.05	4.30	0.38
				60	6.08	1.50	6.37	0.52
				80	8.11	1.96	7.85	0.65
				100	10.13	2.43	9.60	0.72
	0.516	0.485	0.0095	20	2.03	1.13	1.43	0.18
				40	4.05	2.21	2.84	0.35
				60	6.08	3.27	4.00	0.46
				80	8.11	4.04	5.50	0.54
				100	10.13	4.75	6.75	0.64

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. *m*-Cresol; C_7H_8O; [108-39-4]

ORIGINAL MEASUREMENTS:

Simnick, J.J.; Sebastian, H.M.,
Lin, H.M.; Chao, K.C.

J. Chem. Thermodyn., 1979, *11*, 531-7.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	p/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	 in vapour, y_{H_2}
462.1	0.07046*	0	0
	2.037	0.0076	0.9643
	3.04	0.0115	0.9752
	5.05	0.0188	0.9847
	10.13	0.0370	0.9916
	15.34	0.0546	0.9939
	20.16	0.0698	0.9949
	25.40	0.0877	0.9955
502.9	0.1842*	0	0
	2.037	0.0089	0.9001
	3.03	0.0136	0.9303
	5.06	0.0225	0.9578
	10.16	0.0442	0.9772
	15.10	0.0649	0.9828
	20.27	0.0846	0.9859
	25.30	0.1090	0.9879
541.8	0.4283*	0	0
	2.047	0.0094	0.7756
	3.04	0.0154	0.8420
	5.09	0.0266	0.8992
	10.15	0.0538	0.9439
	15.13	0.0800	0.9602
	20.31	0.1039	0.9671
	25.26	0.1255	0.9725

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Air Products sample, purity 99.95 mole per cent.

2. Aldrich Chemical Co., gold label grade, purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta p/MPa = \pm 0.02$

δx_{H_2}, δy_{H_2} = ±1% (estimated by compiler)

REFERENCES:

1. Sebastian, H.M.; Simnick, J.J.; Lin, H-M.; Chao, K-C.
J. Chem. Engng. Data, 1978, *23*, 305-8.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. *m*-Cresol; C_7H_8O; [108-39-4]

ORIGINAL MEASUREMENTS:

Simnick, J.J.; Sebastian, H.M., Lin, H.M.; Chao, K.C.

J. Chem. Thermodyn. 1979, *11*, 531-7.

T/K	p/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in vapour, y_{H_2}
582.1	0.8759*	0	0
	2.027	0.0081	0.5161
	3.02	0.0156	0.6671
	5.07	0.0295	0.7900
	10.14	0.0624	0.8846
	15.20	0.0939	0.9163
	20.27	0.1227	0.9318
	25.33	0.1509	0.9421
624.5	1.577*	0	0
	2.027	0.0043	0.1840
	3.06	0.0137	0.4003
	5.06	0.0314	0.5960
	10.11	0.0751	0.7668
	15.17	0.1141	0.8298
	20.23	0.1522	0.8633
	25.26	0.1833	0.8849
662.0	2.681*	0	0
	3.05	0.0046	0.0734
	5.07	0.0296	0.3259
	10.12	0.0875	0.5742
	15.22	0.1413	0.6812
	20.25	0.1935	0.7374
	25.37	0.2354	0.7733

* Vapor pressure of *m*-cresol.

COMPONENTS:

(1) Hydrogen; H_2; [1333-74-0]

(2) 4-Methyl-1,3-dioxolan-2-one or propylene carbonate; $C_4H_6O_3$; [108-32-7]

ORIGINAL MEASUREMENTS:

Schmack, P; Bittrich, H.-J.

Wiss. Z. Tech. Hochsch. Chem. Leuna-Merseburg 1966, *8* (2-3), 182 - 186.

Chem. Abstr. 1967, *66*, 6095u.

VARIABLES:

T/K: 278.15 - 333.15
P/kPa: 101.325, 892 - 1034
(1, 8.8 - 10.2 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	P/atm	Bunsen Coefficient α/cm^3(STP) cm^{-3}atm^{-1}	P/atm	Bunsen Coefficient α/cm^3(STP)cm^{-3}atm^{-1}
278.15	1.0	0.0258	9.3	0.0295
283.15	1.0	0.0290	9.3	0.0312
288.15	1.0	0.0308	9.5	0.0319
293.15	1.0	0.0284	8.8	0.0340
298.15	1.0	0.0320	9.6	0.0342
303.15	1.0	0.0314	9.1	0.0367
308.15	1.0	0.0314	10.1	0.0378
313.15	1.0	0.0341	10.2	0.0388
318.15	1.0	0.0405	9.3	0.0425
323.15	1.0	0.0368	9.0	0.0427
328.15	1.0	0.0382	9.1	0.0438
333.15	1.0	0.0431	9.2	0.0472

The authors give the enthalpy of solution of hydrogen in propylene carbonate as (6200 ± 2500) J mol^{-1}.

At 298.15 K and 1 atm partial pressure hydrogen the mole fraction solubility is 1.2 x 10^{-4}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two methods were used. The apparatus used for the solubility measurements at one atm is modeled after the apparatus of Schay *et al.* (1). It consists of an absorption flask with magnetic stirrer that is connected to a Hg manometer, a gas buret with Hg leveling bulb, and a water jet vacuum pump. Gas volume changes in the apparatus are calibrated with respect to pressure and temperature. The solubility can be determined at several temperature with one charging of gas and solvent.

For the measurements near 10 atm a rocking autoclave apparatus similar to that of Dean and Tooke (2) is used The saturated liquid is transferred to a buret system at one atm for analysis.

SOURCE AND PURITY OF MATERIALS:

(1) Hydrogen. No information.

(2) Propylene carbonate. Prepared from propylene glycol and phosgene at VEB Leuna-Werke "Walter Ulbricht". Boiling point/^{0}C = 235, n_D^{25} = 1.4196, ρ_4^{25}/g cm^{-3} = 1.206, and ε^{25} = 65.

ESTIMATED ERROR:

δT/K = ±0.2
$\delta\alpha/\alpha$ = 0.12 at 1 atm
0.08 at 10 atm

REFERENCES:

1. Schay, G.; Székely, Gy.; Rácz, Gy.; Traply, G. *Periodica Polytech. (Budapest)* 1958, *2*, 1 - 24.

2. Dean, A. R.; Tooke, J. W. *Ind. Eng. Chem.* 1946, *38*, 389.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
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*, 108-110.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	$\alpha^{\dagger}$ vol/vol
283.15	83.4	0.00661	1.75
	95.1	0.00808	2.14
	98.9	0.00800	2.12
	99.6	0.00796	2.11
	112.9	0.00897	2.38
	120.2	0.00965	2.56
298.15	75.6	0.00673	1.78
	87.3	0.00789	2.09
	95.1	0.00912	2.42
	109.3	0.01043	2.77
	113.8	0.01021	2.71
	126.6	0.01154	3.07
323.15	76.0	0.00852	2.26
	89.3	0.00961	2.55
	95.1	0.01073	2.85
	100.1	0.01084	2.88
	112.6	0.01203	3.20
	121.6	0.01351	3.60
	141.8	0.01532	4.09

† quoted in original paper, appears to be volume of gas at T/K = 273.15 and P = 1 atmosphere adsorbed 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. Dried and oxygen removed; purity 99.8 mole per cent.
2. Distilled; purity 99.9 mole per cent determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;

$\delta x_{H_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Pentanedioic acid, dimethyl ester, (Dimethyl glutarate); $C_7H_{12}O_4$; [1119-40-0]

ORIGINAL MEASUREMENTS:

Shakova, S. F.; Zubchenko, Yu. P.; Kaplan, L. K. *Khim. Prom.* 1973, *49*, 108-110.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_{H_2}	$\alpha^{\dagger}$ vol/vol
313.15	43.7	0.0123	1.89
	71.4	0.0194	3.01
	98.6	0.0264	4.12
	126.3	0.0339	5.33
	128.5	0.0354	5.59

† quoted in original paper, appears to be the volume of gas T/K = 273.15 and *P* = 1 atmosphere adsorbed 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. Dried and oxygen removed, purity 99.8 mole per cent.
2. Analytical grade sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;
$\delta x_{H_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
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*, 108-110.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	$\alpha^{\dagger}$ vol/vol
298.15	70.1	0.0177	2.14
	85.8	0.0214	2.59
	87.3	0.0218	2.64
	104.0	0.0268	3.26
	118.1	0.0291	3.55
	139.7	0.0340	4.17
323.15	85.3	0.0259	3.15
	106.9	0.0320	3.91
	115.7	0.0345	4.23
	140.2	0.0412	5.09
	141.8	0.0427	5.28
343.15	89.8	0.0311	3.80
	111.8	0.0383	4.72
	145.2	0.0500	6.23
	155.9	0.0527	6.59

† quoted in original paper, appears to be volume of gas at T/K = 273.15 and P = 1 atmosphere adsorbed 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. Dried and oxygen removed; purity 99.8 mole per cent.
2. Distilled and dried; purity 99.4 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;

$\delta x_{H_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Amines

EVALUATOR:

Colin L. Young
Department of Chemistry,
University of Melbourne,
Parkville, 3052, Victoria,
Australia: June, 1980

CRITICAL EVALUATION:

The solubility of hydrogen in amines at elevate pressures has been studied by Moore and Otto (1) and by Brunner (2). The former workers (1) only worked up to 2 MPa and found that, within experimental error, mole fraction solubility was linear with pressure and quoted equations for Henry's law constants. Brunner (2) on the other hand studied solubilities up to 10 MPa and found a slightly non-linear relationship between pressure and mole fraction solubility. He evaluated the limiting slope of pressure-mole fraction solubility graphs as pressure tends to zero to obtain Henry's law constants which can be compared with those of Moore and Otto (1). There is only fair agreement between the two groups for the systems studied by both i.e. ethanamine, 1,2-ethanediamine and 1- propanamine. The Henry's law values of Moore and Otto (1) are 5-10% larger than those of Brunner (2). This could be partly due to Moore and Otto's assumption that there is a linear relationship between pressure and mole fraction solubility. From Brunners data it appears that this assumption could lead to Henry's law constant being 2-5% larger than when estimated allowing for the small non-linearity of mole fraction solubility as a function of pressure.

Brunner (2) also quoted partial molar volumes of hydrogen at infinite dilution, V^{∞} and partial molar heats of solution Δh where these were calculated from the equations.

$$\ln p_{H_2}/x_{H_2} = \ln H + V^{\infty} p_{H_2}/RT \qquad (1)$$

$$\left.\frac{\partial \ln x_{H_2}}{\partial (1/T)}\right|_{p} = -\frac{\Delta h}{R} \qquad (2)$$

where H is Henry's law constant at zero partial pressure of hydrogen.

Values of $H/10^5$Pa, $V^{\infty}/\mathrm{cm^3 mol^{-1}}$ and $\Delta h/\mathrm{J\ mol^{-1}}$ are given below for hydrogen in amines. The values calculated from the data of Moore and Otto (1) are given in parentheses.

Amine	T/K	$H/10^5$Pa	$V^{\infty}/\mathrm{cm^3 mol^{-1}}$	$\Delta h/\mathrm{J\ mol^{-1}}$
Methanamine	203.2	(13647)		
	213.2	(12028)		
	223.2	(10609)		
	233.2	(9373)		
	243.2	(8305)		
	253.2	(7380)		
	263.2	(6580)		
	273.2	(5891)		
	283.2	(5294)		
	293.2	(4775)		
	303.2	(4322)		
Ethanamine	203.2	(9063)		
	213.2	(8191)		
	223.2	(7348)		
	233.2	(6499)		
	243.2	(5751)		
	253.2	(5151)		
	263.2	(4676)		

Amine	T/K	$H/10^5$Pa	V^∞/cm^{3}mol^{-1}	Δh/J mol^{-1}
Ethanamine	273.2	(4293)		
	283.2	(3946)		
	293.2	(3585)		
	303.2	(3174)		
	298.15	3020	35	
	323.15	2420	41	8140
	373.15	1540	50	
1,2-Ethanediamine	293.2	(15430)		
	303.2	(13500)		
	298.15	13820	17	
	323.15	10540	22	9770
	373.15	6280	33	
1-Propanamine	203.2	(7800)		
	213.2	(6931)		
	223.2	(6193)		
	233.2	(5561)		
	243.2	(5016)		
	253.2	(4548)		
	263.2	(4142)		
	273.2	(3788)		
	283.2	(3480)		
	293.2	(3209)		
	303.2	(2970)		
	298.15	2930	22	
	323.15	2400	26	8860
	373.15	1680	34	
2-Propanamine	298.15	2585	20	
	323.15	2117	21	
	373.15	1368	24	
1,2-Propanediamine	243.2	(13539)		
	253.2	(10267)		
	263.2	(10658)		
	273.2	(9577)		
	283.2	(8675)		
	293.2	(7916)		
	303.2	(7263)		
1,3-Propanediamine	298.15	9400	35	
	323.15	9370	39	8650
	373.15	4680	47	
Pyrrolidine	298.15	4616	31	
	323.15	3815	35	7200
	373.15	2585	42	
Piperidine	298.15	3890	38	
	323.15	3170	42	6580
	373.15	2280	50	
1-Methylpyrrolidine	298.15	2400	36	
	323.15	2080	39	5390
	373.15	1555	45	
N,N-dimethyl-1,3-propanediamine	298.15	3120	32	
	323.15	2600	37	6520
	373.15	1840	48	
1-Methylpiperidine	298.15	2390	40	
	323.15	2090	42	5080
	373.15	1590	47	
N,N-Diethylethanamine	298.15	1675	28	
	323.15	1370	33	5285
	373.15	1085	42	

Amine	T/K	$H/10^5$Pa	V^∞/cm^{3}mol^{-1}	Δh/J mol^{-1}
1,6-Hexanediamine	298.15	4027	23	
	323.15	3354	25	6860
	373.15	2860	27	
N-(3-aminopropyl)-1,3-propanediamine	298.15	6530	28	
	323.15	5010	34	8180
	373.15	3357	46	
N,N-Dimethylcyclohexanamine	298.15	2413	39	
	323.15	2090	44	5055
	373.15	1605	52	
N-Butyl-1-butanamine	298.15	1763	34	
	323.15	1463	40	5555
	373.15	1120	51	
N-(2-aminoethyl)-N-(3-aminopropyl)-1,3- propanediamine	298.15	5715	19	
	323.15	4520	22	7720
	373.15	3060	29	
N-N-dibutyl-1-Butanamine	298.15	1360	31	
	323.15	1170	36	4615
	373.15	933	46	

The data of Moore and Otto (1) are classified as doubtful whereas those of Brunner (2) are classified as tentative.

REFERENCES:

1. Moore, R.G.; Otto, F.D. *Can. J. Chem. Eng.* 1972, *50*, 355.

2. Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methanamine; CH_5N; [74-89-5]

ORIGINAL MEASUREMENTS:

Moore, R.G.; Otto, F.D.

Can. J. Chem. Engng. 1972, *50*, 355-60.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Mole fraction of hydrogen in liquid, x_{H_2} *
203.2	0.00007425
213.2	0.00008424
223.2	0.00009551
233.2	0.0001081
243.2	0.0001220
253.2	0.0001373
263.2	0.0001540
273.2	0.0001720
283.2	0.0001914
293.2	0.0002122
303.2	0.0002344

* at a partial pressure of 101.3 kPa

cont.

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

Recirculating flow apparatus fitted with magnetic pump. Amine saturated with hydrogen for a minimum of 8 hr. Samples of liquid withdrawn and amine frozen out, hydrogen released collected in calibrated gas buret. Amount of amine determined gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.999 mole per cent. Dried.
2. Matheson sample, purity 98.0 mole per cent. Dried. Fractionally distilled under vacuum.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 4\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methanamine; CH_5N; [74-89-5]

ORIGINAL MEASUREMENTS:

Moore, R.G.; Otto, F.D.

Can. J. Chem. Engng. 1972, *50* 355-60.

DATA taken from deposited document

		Total Pressure	Partial pressure of hydrogen		Solubility +	Mole fraction of hydrogen
T/°C	T/K	P/atm	P/atm	P/MPa		x_{H_2}
-24.67	248.48	4.17	3.77	0.382	0.3473	0.004811
-24.73	248.42	9.42	9.01	0.913	0.8548	0.01183
-24.73	248.42	9.42	9.01	0.913	0.8533	0.01181
-24.95	248.20	9.41	9.01	0.913	0.8332	0.01153
-24.70	248.45	17.43	17.02	1.725	1.5722	0.02174
-24.70	248.45	17.45	17.04	1.727	1.5826	0.02188
-24.95	248.20	17.41	17.01	1.724	1.5985	0.02210
-24.95	248.20	17.40	17.00	1.723	1.6226	0.02243
-24.81	248.34	17.40	17.00	1.723	1.5960	0.02207
-24.95	248.20	10.29	9.89	1.002	0.9435	0.01306
-60.49	212.66	7.84	7.80	0.790	0.4824	0.006680
-60.49	212.66	7.87	7.83	0.793	0.4787	0.006629
-61.30	211.85	13.93	13.89	1.407	0.8289	0.01147
-61.52	211.63	13.93	13.89	1.407	0.8265	0.01144
-61.67	211.48	20.07	20.03	2.030	1.1671	0.01615
-61.61	211.54	20.07	20.03	2.030	1.1766	0.01628
-62.16	210.99	16.70	16.67	1.689	0.9767	0.01352
-62.16	210.99	16.70	16.67	1.689	0.9734	0.01347
-62.35	210.80	15.99	15.95	1.616	0.9652	0.01336
-36.51	236.64	10.79	10.58	1.072	0.8773	0.01214
-36.51	236.64	10.79	10.58	1.072	0.8502	0.01177
-35.12	238.03	11.50	11.27	1.188	0.9534	0.01319
-35.24	237.91	8.82	8.60	0.871	0.7149	0.009896
-35.24	237.91	8.82	8.60	0.871	0.7154	0.009904
-34.60	238.55	14.40	14.17	1.436	1.1894	0.01645
-34.66	238.49	14.40	14.17	1.436	1.1782	0.01630
-34.02	239.13	19.03	18.79	1.904	1.5744	0.02177
-34.02	239.13	19.03	18.79	1.904	1.5712	0.02173
-0.21	272.94	14.04	12.72	1.289	1.5700	0.02171
-0.21	272.94	14.04	12.72	1.289	1.5758	0.02179
-0.37	272.78	20.96	19.65	1.991	2.4257	0.03350
-0.37	272.78	20.96	19.65	1.991	2.4373	0.03366
20.14	253.01	17.65	14.69	1.488	2.2523	0.03111
22.75	250.40	21.07	17.81	1.805	2.8261	0.03901
22.75	250.40	21.07	17.81	1.805	2.8058	0.03873

\+ Volume of hydrogen (cm^3) reduced to 101.31Pa and 273.15k dissolved by 1 gm of methanamine

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Ethanamine; C_2H_7N; [74-04-7]

ORIGINAL MEASUREMENTS:

Moore, R.G.; Otto, F.D.

Can. J. Chem. Engng. 1972, *50*, 355-60.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	10^4x Mole fraction of hydrogen* in liquid, $10^4 x_{H_2}$
203.2	1.118
213.2	1.237
223.2	1.379
233.2	1.559
243.2	1.762
253.2	1.967
263.2	2.167
273.2	2.360
283.2	2.568
293.2	2.826
303.2	3.192

*at a partial pressure of 101.3 kPa

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating flow apparatus fitted with magnetic pump. Amine saturated with hydrogen for a minimum of 8 hr. Samples of liquid withdrawn and amine frozen out, hydrogen released collected in calibrated gas buret. Amount of amine determined gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.999 mole per cent. Dried.
2. Matheson sample, purity 98.5 mole per cent. Dried. Fractionally distilled under vacuum.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 4\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Ethanamine; C_2H_7N; [74-04-7]	Moore, R.G.; Otto, F.D. *Can. J. Chem. Engng.* <u>1972</u>, *50*, 355-60.

DATA taken from deposited document

		Total pressure	Partial pressure of hydrogen		Solubility +	Mole fraction of hydrogen
T/°C	T/K	P/atm	P/atm	P/MPa		x_{H_2}
-24.11	249.04	11.34	11.21	1.136	1.0720	0.02152
-24.11	249.04	11.34	11.21	1.136	1.0561	0.02120
-24.53	248.62	14.76	14.63	1.482	1.3688	0.02746
-24.53	248.62	14.75	14.61	1.480	1.3563	0.02721
-24.28	248.87	17.84	17.70	1.793	1.6553	0.03319
-24.28	248.87	17.84	17.70	1.793	1.6502	0.03309
-24.00	249.15	10.56	10.42	1.056	0.9911	0.01990
-24.00	249.15	10.56	10.42	1.056	0.9748	0.01957
-24.11	249.04	14.30	14.16	1.435	1.3388	0.02686
-61.39	211.76	11.44	11.43	1.158	0.7063	0.01419
-61.76	211.39	13.68	13.67	1.385	0.8347	0.01676
-61.76	211.39	13.68	13.68	1.386	0.8083	0.01623
-68.01	205.14	18.35	18.34	1.858	1.0480	0.02104
-68.17	204.98	17.26	17.25	1.748	0.9882	0.01984
-68.17	204.98	17.26	17.25	1.748	0.9906	0.01989
-68.17	204.98	17.67	17.67	1.790	1.0112	0.02030
-68.17	204.98	17.67	17.67	1.790	0.9806	0.01969
-61.03	212.12	17.28	17.27	1.750	1.0728	0.02153
-61.03	212.12	17.28	17.27	1.750	1.0359	0.02080
-60.84	212.31	17.69	17.68	1.791	1.0887	0.02185
-60.84	212.31	17.69	17.68	1.791	1.0895	0.02187
-61.06	212.09	15.14	15.13	1.533	0.9393	0.01887
-61.06	212.09	15.14	15.13	1.533	0.9242	0.01856
-60.62	212.53	18.08	18.06	1.830	1.1250	0.02258
-60.62	212.53	18.08	18.06	1.830	1.0991	0.02206
-35.64	237.51	17.33	17.26	1.749	1.4336	0.02876
-35.64	237.51	17.33	17.26	1.749	1.4207	0.02850
-35.12	238.03	15.90	15.83	1.604	1.3062	0.02621
-35.12	238.03	15.90	15.83	1.604	1.3169	0.02642
-36.54	236.61	13.99	13.83	1.401	1.1307	0.02269
0.11	273.29	20.66	20.17	2.044	2.3784	0.04762
-0.29	272.86	17.93	17.45	1.768	2.0514	0.04110
-0.29	272.86	17.93	17.45	1.768	2.0601	0.04127
22.42	295.57	16.37	15.10	1.530	2.1873	0.04381
22.65	295.80	20.82	19.55	1.981	2.8407	0.05682
22.65	295.80	20.82	19.55	1.981	2.8538	0.05708
22.90	296.05	18.21	16.92	1.714	2.4654	0.04935

\+ Volume of hydrogen (cm^3), reduced to 101.31Pa and 273.15K, dissolved by 1 gram of ethanamine.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Ethanamine (Aminoethane) C_2H_7N; [75-04-7].

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure.

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	1.42	0	0
	53.0	51.6	164
	87.7	86.3	267
323.15	3.41	0	0
	52.8	49.5	193
	88.4	85.1	319
373.15	13.3	0	0
	58.6	45.6	283
	98.5	85.8	510

+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given
2. Fluka AG sample, purity 99 per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$;
$\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1, 2-Ethanediamine; $C_2H_8N_2$; [107-15-3]	Moore, R.G.; Otto, F.D. *Can. J. Chem. Engng.* 1972, *50*, 355-60.

VARIABLES:	PREPARED BY:
Temperature	C.L. Young

EXPERIMENTAL VALUES:

T/K	10^4x Mole fraction of hydrogen in liquid, $10^4 x_{H_2}$ *
293.2	0.6567
303.2	0.7506

* at a partial pressure of 101.3kPa

DATA taken from deposited document

		Total pressure	Partial pressure of hydrogen		Solubility +	Mole fraction of hydrogen
T/°C	T/K	P/atm	P/atm	P/MPa		x_{H_2}
26.38	299.53	14.46	14.44	1.463	0.3849	0.01031
26.38	299.53	14.46	14.44	1.463	0.3845	0.01030
25.43	298.58	18.01	17.99	1.823	0.4735	0.01268
25.88	299.03	21.20	21.18	2.146	0.5613	0.01503
25.88	299.03	21.20	21.18	2.146	0.5670	0.01518
33.13	306.28	21.69	21.65	2.194	0.6355	0.01701
33.13	306.28	21.69	21.65	2.194	0.6338	0.01697
33.61	306.76	18.11	18.08	1.832	0.5250	0.01406
33.61	306.76	18.11	18.08	1.832	0.5263	0.01409

\+ Volume of hydrogen (cm^3), reduced to 101.3kPa and 273.15k, dissolved by 1 gram of 1,2-ethanediamine

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating flow apparatus fitted with magnetic pump. Amine saturated with hydrogen for a minimum of 8 hr. Samples of liquid withdrawn and amine frozen out, hydrogen released collected in calibrated gas buret. Amount of amine determined gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.999 mole per cent. Dried.
2. Fischer Scientific sample purity 98.0 mole per cent. Dried. Fractionally distilled under vacuum.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 4\%$.

(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,2-Ethanediamine, (1,2-Diaminoethane); $C_2H_8N_2$; [107-15-3]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.02	0	0
	53.4	53.3	38.51
	73.7	73.7	52.8
323.15	0.07	0	0
	22.5	22.5	22.21
	30.5	30.5	28.65
	50.2	50.1	47.00
	85.2	85.1	79.1
373.15	0.56	0	0
	30.3	29.7	46.36
	57.6	57.1	87.5
	80.7	80.2	120.8

\+ total pressure

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Propanamine; C_3H_9N; [107-10-8]

ORIGINAL MEASUREMENTS:

Moore, R.G.; Otto, F.D.

Can. J. Chem. Engng. 1972, *50*, 355-60.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	10^4x Mole fraction of hydrogen in liquid, $10^4 x_{H_2}$ *
203.2	1.299
213.2	1.462
223.2	1.636
233.2	1.822
243.2	2.020
253.2	2.228
263.2	2.446
273.2	2.675
283.2	2.912
293.2	3.158
303.2	3.412

* Smoothed values quoted in original publication at a partial pressure of 101.31Pa.

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating flow apparatus fitted with magnetic pumps. Amine saturated with hydrogen for a minimum of 8 hr. Samples of liquid withdrawn and amine frozen out, hydrogen released collected in calibrated gas buret. Amount of amine determined gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.999 mole per cent. Dried.
2. Eastman Organic Chemicals sample, purity 98.0 mole per cent. Dried. Fractionally distilled under vacuum.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 4\%$.

(estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1-Propanamine; C_3H_9N; [107-10-8]	Moore, R.G.; Otto, F.D. *Can. J. Chem. Engng.* 1972, *50*, 355-60.

DATA taken from deposited document

		Total pressure	Partial pressure of hydrogen		Solubility +	Mole fraction of hydrogen
T/°C	T/K	P/atm	P/atm	P/MPa		x_{H_2}
-24.61	248.54	4.20	4.17	0.423	0.3374	0.008891
-24.67	248.48	11.14	11.11	1.126	0.9211	0.02423
-24.67	248.48	11.14	11.11	1.126	0.9171	0.02413
-24.67	248.48	11.09	11.06	1.121	0.8955	0.02356
-27.34	245.81	13.94	13.92	1.410	1.1345	0.02983
-24.67	248.48	17.26	17.23	1.746	1.3981	0.03673
-24.67	248.48	17.26	17.23	1.746	1.3923	0.03658
-23.29	249.66	10.58	10.54	1.068	0.8584	0.02259
-23.29	249.66	10.58	10.54	1.068	0.8498	0.02236
-23.34	249.81	14.11	14.08	1.427	1.1386	0.02994
-23.34	249.81	14.11	14.08	1.427	1.1281	0.02966
-24.67	248.48	17.18	17.15	1.738	1.3885	0.03648
-24.67	248.48	17.18	17.15	1.738	1.3796	0.03625
-61.79	211.36	16.65	16.65	1.687	0.8949	0.02354
-61.79	211.36	16.65	16.65	1.687	0.9170	0.02412
-61.42	211.73	18.42	18.42	1.866	1.0095	0.02655
-61.42	211.73	18.42	18.42	1.866	1.0031	0.02638
-62.01	211.14	15.89	15.89	1.610	0.8717	0.02293
-62.73	210.42	17.41	17.41	1.764	0.9430	0.02481
-67.92	205.23	18.44	18.44	1.868	0.9300	0.02447
-67.28	205.87	17.59	17.59	1.782	0.8904	0.02343
-67.28	205.87	17.49	17.49	1.772	0.8841	0.02326
-36.28	236.87	18.86	18.84	1.909	1.3766	0.03617
-36.28	236.87	18.86	18.84	1.909	1.3811	0.03629
-36.16	236.99	12.29	12.28	1.244	0.8778	0.02309
-36.16	236.99	12.29	12.28	1.244	0.8791	0.02313
-36.22	236.93	12.29	12.27	1.243	0.8801	0.02316
-27.20	245.95	16.91	16.88	1.710	1.3431	0.03529
-27.20	245.95	16.91	16.88	1.710	1.3196	0.03468
0.11	273.04	13.93	13.80	1.398	1.4063	0.03695
0.11	273.04	13.93	13.80	1.398	1.4091	0.03702
0.03	273.12	20.73	20.60	2.087	2.0965	0.05498
0.03	273.12	20.73	20.60	2.087	2.1044	0.05519
21.87	251.28	15.27	14.92	1.512	1.8117	0.04755
21.87	251.28	15.27	14.92	1.512	1.8227	0.04784

+ Volume of hydrogen (cm^3), reduced to 101.3kPa and 273.15K, dissolved by 1 gram of 1-propanamine

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Propanamine (Aminopropane)
   C_3H_9N; [107-10-8]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.41	0	0
	28.7	28.3	95.3
	49.5	49.1	167
	86.7	86.3	287
323.15	1.10	0	0
	27.6	26.5	109
	54.3	53.2	217
	75.1	74.0	298
373.15	4.91	0	0
	19.3	14.4	84.8
	51.5	46.7	270
	73.7	69.0	394

\+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$;
$\delta x_{H_2} = \pm 2.0\%$
(estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 2-Propanamine (2-Amino propane); C_3H_9N; [75-31-0]	Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798-805.
VARIABLES: Temperature, pressure	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5Pa$	$p^*/10^5Pa$	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.78	0	0
	10.1	9.32	35.9
	19.0	18.3	70.9
	43.7	43.1	163
	73.7	72.9	278
323.15	1.92	0	0
	30.8	28.9	136
	51.4	49.5	232
	70.4	68.5	318
	79.6	77.8	364
373.15	7.54	0	0
	40.7	34.4	247
	55.6	48.3	350
	73.0	65.8	469

\+ total pressure,

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1, 2-Propanediamine; $C_3H_{10}N_2$; [78-90-0]

ORIGINAL MEASUREMENTS:

Moore, R.G.; Otto, F.D.

Can. J. Chem. Engng. 1972, *50*, 355-60.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	10^4x Mole fraction of hydrogen in liquid, $10^4 x_{H_2}$ *
243.2	0.7484
253.2	0.8475
263.2	0.9507
273.2	1.058
283.2	1.168
293.2	1.280
303.2	1.395

* at a partial pressure of 101.3 kPa

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating flow apparatus fitted with magnetic pump. Amine saturated with hydrogen for a minimum of 8 hr. Samples of liquid withdrawn and amine frozen out, hydrogen released collected in calibrated gas buret. Amount of amine determined gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.999 mole per cent. Dried.
2. Union Carbide sample, purity 97.8 mole per cent. Dried. Fractionally distilled under vacuum.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 4\%$.

(estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. 1, 2-Propanediamine; $C_3H_{10}N_2$;	Moore, R.G.; Otto, F.D. *Can. J. Chem. Engng.* 1972, *50* 355-60.

DATA taken from deposited document

		Total pressure	Partial pressure of hydrogen		Solub-ility +	Mole fract-of hydrogen
$T/^{\circ}C$	T/K	P/atm	P/atm	P/MPa		x_{H_2}
-23.89	249.26	7.54	7.54	0.754	0.1811	0.005987
-24.14	249.01	10.44	10.44	1.058	0.2566	0.008479
-24.45	248.70	13.85	13.85	1.465	0.3456	0.01142
-24.78	248.37	13.79	13.79	1.397	0.3400	0.01123
-24.45	248.70	18.82	18.82	1.907	0.4610	0.01522
-17.06	256.09	17.56	17.56	1.779	0.4590	0.01516
-17.06	256.09	17.56	17.56	1.779	0.4585	0.01514
-18.41	254.74	16.00	16.00	1.621	0.4160	0.01374
-18.41	254.74	16.00	16.00	1.621	0.4189	0.01384
-12.08	261.07	13.17	13.17	1.334	0.3701	0.01222
0.11	273.26	16.65	16.65	1.687	0.5286	0.01745
0.11	273.26	16.65	16.65	1.687	0.5296	0.01748
- 0.43	272.72	18.16	18.15	1.839	0.5735	0.01893
- 0.43	272.72	18.16	18.15	1.839	0.5724	0.01889
10.74	290.89	13.27	13.27	1.345	0.4755	0.01570
10.74	290.89	13.27	13.27	1.345	0.4670	0.01542
10.41	290.56	17.18	17.18	1.741	0.6131	0.02024
10.41	290.56	17.18	17.18	1.741	0.6110	0.02017
10.56	290.71	18.48	18.48	1.872	0.6640	0.02191
10.56	290.71	18.48	18.48	1.872	0.6634	0.02189
10.36	290.51	17.71	17.70	1.793	0.6378	0.02105

+ Volume of hydrogen (cm^3) reduced to 101.3kPa and 273.15k, dissolved by 1 gram of amine

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. 1,3-Diaminopropane, $C_3H_{10}N_2$; [109-76-2]	ORIGINAL MEASUREMENTS: Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798-805.
VARIABLES: Temperature, pressure	PREPARED BY: C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	p^*10^5Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.006	0	0
	38.9	38.0	39.8
	97.2	97.2	94.9
323.15	0.03	0	0
	50.0	50.0	65.3
	94.2	94.2	118.2
373.15	0.27	0	0
	54.8	54.5	109.5
	76.9	76.6	150.4

+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.	SOURCE AND PURITY OF MATERIALS: 1. No details given. 2. BASF Aktiengesellschaft sample purity 98 mole per cent.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$. (estimated by compiler)
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Methylpyrrolidine; $C_5H_{11}N$; [120-94-5].

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.15	0	0
	31.7	31.6	128.5
	65.6	65.5	256
	98.0	97.9	374
323.15	0.40	0	0
	30.3	29.9	141.5
	59.7	59.3	269
	99.2	98.8	439
373.15	1.95	0	0
	32.6	30.7	193.2
	84.9	83.1	485

\+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 99 per cent 0.4 weight per cent water.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Pyrrolidine; C_4H_9N; [123-75-1]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^{+}/10^5$Pa	$p^{*}/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.08	0	0
	45.3	45.2	95.5
	102.7	102.6	207.4
323.15	0.27	0	0
	36.7	36.4	93.3
	88.5	88.2	216.8
373.15	1.53	0	0
	42.0	40.5	151.5
	93.4	91.9	327

\+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Piperidine, $C_5H_{11}N$; [100-89-4]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber Bunsenges. Phys. Chem. 1978, *82* 798-805

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
298.15	0.04	0	0
	40.2	40.2	99.2
	87.0	87.0	204
323.15	0.14	0	0
	45.4	45.3	136.7
	98.2	98.1	283
373.15	0.85	0	0
	28.1	27.3	116.7
	51.1	50.5	210.7

+ total pressure.

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample, purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler.)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. N,N-dimethyl-1,3-propanediamine, (1-Dimethylamino-3-propylamine); $C_5H_{14}N_2$; [109-55-7].	Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798-805.
VARIABLES:	**PREPARED BY:**
Temperature, pressure	C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.008	0	0
	44.2	44.2	137.9
	69.6	69.6	210
	105.1	105.1	313
323.15	0.04	0	0
	56.5	56.5	208
	82.9	82.9	299
373.15	0.34	0	0
	67.3	67.0	337
	93.6	93.3	457
	95.9	95.6	464

\+ total pressure

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$;
$\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Methylpiperidine; $C_6H_{14}N_2$; [109-55-7]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^{+}/10^5$Pa	$p^{*}/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
298.15	0.05	0	0
	27.8	27.8	113
	50.1	50.1	197
	103.0	103.0	385
323.15	0.17	0	0
	29.6	29.4	136
	53.4	53.2	240
	98.9	98.7	422
373.15	1.03	0	0
	50.6	49.6	298
	98.0	97.0	557

\+ total pressure.

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Merck AG sample, purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.

(estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. N,N-Diethylethanamine, (Triethylamine); $C_6H_{15}N$; [121-44-8]	Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798-805.
VARIABLES: Temperature, pressure.	PREPARED BY: C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
293.15	0.09	0	0
	34.1	34.0	199.5
	52.8	52.7	308.0
	93.8	93.7	535
323.15	0.37	0	0
	21.1	20.7	149.1
	50.1	49.7	349.6
	82.2	81.9	560
373.15	1.40	0	0
	26.9	25.5	230.9
	94.5	93.2	798
	98.8	97.5	836

\+ total pressure.

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.	1. No details given. 2. BASF Aktiengesellschaft sample purity 99.5 mole per cent.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$. (estimated by compiler).
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,6-Hexanediamine, (1,6-Diaminohexane); $C_6H_{16}N_2$; [124-09-4]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber Bunsenges. Phys. Chem. 1978, *82*, 798-805

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4 x_{H_2}$
298.15	0.002	0	0
	95.3	95.3	232.0
	147.9	147.9	348.7
	202.7	202.6	469.6
	301.9	301.9	672
323.15	0.009	0	0
	49.4	49.4	144.1
	147.9	147.9	425.8
	301.9	301.9	810
373.15	0.03	0	0
	49.4	49.4	169.7
	49.4	49.4	171.2
	147.9	147.9	490.9
	147.9	147.9	488.6
	300.9	300.9	948

+ total pressure.

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS: 1. Hydrogen; H_2; [1333-74-0] 2. N-(3-aminopropyl)- 1,3-propane diamine),(Bis-(3-aminopropyl)-amine); $C_6H_{17}N_3$; [56-18-8]	ORIGINAL MEASUREMENTS: Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798-805.
VARIABLES: Temperature, pressure	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4\ x_{H_2}$
298.15	0.0004	0	0
	61.0	61.0	91.0
	97.4	97.4	143
323.15	0.003	0	0
	47.4	47.4	91.6
	85.5	85.5	161
373.15	0.008	0	0
	42.1	42.1	120
	99.5	99.5	267

+ total pressure

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.	SOURCE AND PURITY OF MATERIALS: 1. No details given. 2. BASF Aktiengesellschaft sample, purity 99.2 mole per cent.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$ (estimated by compiler).
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. N,N-Dimethylcyclohexanamine, (Dimethylaminocyclohexane); $C_8H_{17}N$; [98-94-2]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.003	0	0
	50.4	50.4	198
	83.0	83.0	315
323.15	0.01	0	0
	41.6	41.6	190
	79.4	79.4	351
373.15	0.14	0	0
	48.9	48.8	288
	89.0	48.9	506

+ total pressure

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$;
$\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. N-Butyl-1-butanamine, (Dibutylamine); $C_8H_{19}N$; [111-92-2]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges. Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.004	0	0
	39.9	39.9	219
	72.7	72.7	388
	92.3	92.3	487
323.15	0.02	0	0
	23.8	23.8	159
	54.7	54.7	354
	75.7	75.7	482
373.15	0.19	0	0
	20.7	20.5	179
	50.2	50.0	421
	83.9	83.8	681

\+ total pressure

* partial pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample, purity 98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/\mathrm{MPa} = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$
(estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. N-(2-aminoethyl)-N-(3-aminopropyl)-1,3-propanediamine, (N,N-Bis-(3-aminopropyl)-ethylenediamine; $C_8H_{22}N_4$; [41240-13-5]	Brunner, E. *Ber. Bunsenges. Phys. Chem.* 1978, *82*, 798-805.
VARIABLES:	**PREPARED BY:**
Temperature, pressure.	C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.0001	0	0
	31.5	31.5	55.0
	60.9	60.9	106
	91.5	91.5	157
323.15	0.0001	0	0
	44.8	44.8	98
	87.3	87.3	189
373.15	0.0007	0	0
	44.3	44.3	142
	83.9	83.9	264

+ total pressure.

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.	1. No details given. 2. BASF Aktiengesellschaft sample, purity 98.2 mole per cent.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$. (estimated by compiler)
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. N,N-Dibutyl-1-butanamine, (Tri-n-butylamine); $C_{12}H_{27}N$; [102-82-9]

ORIGINAL MEASUREMENTS:

Brunner, E.

Ber. Bunsenges, Phys. Chem. 1978, *82*, 798-805.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	$p^+/10^5$Pa	$p^*/10^5$Pa	10^4x Mole fraction of hydrogen, $10^4x_{H_2}$
298.15	0.0004	0	0
	43.8	43.8	315
	75.5	75.5	522
	90.6	90.6	630
323.15	0.002	0	0
	44.0	44.0	363
	75.0	75.0	607
373.15	0.03	0	0
	44.1	44.1	453
	76.8	76.8	759

\+ total pressure,

* partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with stirrer. After equilibrium established liquid sample withdrawn and analysed by stripping out hydrogen. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. BASF Aktiengesellschaft sample purity 98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x_{H_2} = \pm 2.0\%$.
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Quinoline; C_9H_7N; [91-22-5]

ORIGINAL MEASUREMENTS:

Sebastian, H.M., Simnick, J.J.; Lin, H-M.; Chao, K.-C.

J. Chem. Engng. Data. 1978, *23*, 305-8

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_{H_2}	gas, y_{H_2}	T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_{H_2}	gas, y_{H_2}
462.45	0.3156	0.0000	0.0000	621.75	7.397	0.0000	0.0000
	20.14	0.0072	0.9845		20.32	0.0097	0.6029
	30.46	0.0110	0.9893		30.52	0.0169	0.7282
	50.65	0.0180	0.9930		50.65	0.0308	0.8278
	101.3	0.0359	0.9963		101.7	0.0652	0.9040
	152.4	0.0527	0.9972		151.7	0.0965	0.9345
	202.7	0.0700	0.9977		201.9	0.1290	0.9465
	253.0	0.0857	0.9978		253.0	0.1532	0.9539
541.85	1.943	0.0000	0.0000	701.65	19.81	0.0000	0.0000
	20.27	0.0095	0.8959		30.66	0.0118	0.2607
	30.39	0.0147	0.9277		50.65	0.0332	0.5107
	50.72	0.0252	0.9558		102.0	0.0837	0.7143
	100.99	0.0495	0.9757		151.3	0.1294	0.7939
	152.4	0.0730	0.9821		201.6	0.1708	0.8333
	202.7	0.0946	0.9861		252.7	0.2071	0.8634
	253.0	0.1160	0.9878				

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. Air products sample, minimum purity 99.95 mole per cent.

2. Fisher Scientific Co. sample, distilled over zinc under helium, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.5\%$; δx_{H_2}, $\delta y_{H_2} = \pm 0.001$.

(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1-Methyl-2-pyrrolidinone, (N-methylpyrrolidinone); C_5H_9NO; [872-50-4]

ORIGINAL MEASUREMENTS:

Shakhova, S. F.; Zubchenko, Yu. P.; Kaplan, L. K. *Khim. Prom.* 1973, *49*, 108-110.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_{H_2}	$\alpha^{\dagger}$ vol/vol
283.15	66.2	0.0079	1.84
	74.6	0.0088	2.06
	78.4	0.0092	2.16
	87.2	0.0103	2.42
	96.2	0.0114	2.67
	122.6	0.0142	3.35
298.15	60.3	0.0082	1.92
	69.6	0.0095	2.22
	83.9	0.0108	2.52
	98.1	0.0129	3.02
	107.1	0.0144	3.38
	118.1	0.0156	3.67
	130.4	0.0172	4.05
323.15	72.1	0.0117	2.74
	77.5	0.0122	2.87
	96.7	0.0152	3.59
	105.0	0.0162	3.82
	112.8	0.0174	4.10
	116.7	0.0181	4.28
	137.3	0.0214	5.07

† quoted in original paper, appears to be volume of gas at T/K = 273.15 and *P* = 1 atmosphere adsorbed 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. Dried and oxygen removed; purity 99.8 mole per cent.
2. Distilled; purity 99.9 mole per cent determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;

$\delta x_{H_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. 1,5-Dimethyl-2-pyrrolidinone, (5-methyl-N-methylpyrrolidinone); $C_6H_{11}NO$; [5075-92-3]

ORIGINAL MEASUREMENTS:

Shakhova, S. F.; Zubchenko, Yu. P.; Kaplan, L. K. *Khim. Prom.* 1973, *49*, 108-110.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	$\alpha^{\dagger}$ vol/vol
283.15	80.5	0.0128	2.65
	94.1	0.0149	3.09
	113.8	0.0178	3.70
298.15	76.5	0.0135	2.80
	99.1	0.0169	3.51
	127.5	0.0223	4.66
323.15	76.5	0.0158	3.28
	95.7	0.0194	4.04
	122.6	0.0257	5.37

† quoted in original paper, appears to be volume of gas at T/K = 273.15 and P = 1 atmosphere adsorbed 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. Dried and oxygen removed; purity 99.8 mole per cent.

2. Distilled; purity 99.3 mole per cent determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;

$\delta x_{H_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Tetrafluoromethane, (Perfluoromethane); CF_4; [75-73-0]

ORIGINAL MEASUREMENTS:

Shiau, J.F.; Ziegler, W.T.

J. Chem. Engng. Data. 1980, *25*, 239-246.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid x_{H_2}	in vapor y_{H_2}
164.99	20.13	2.0397	0.01644	-
	40.30	4.083	0.03545	0.8780
	40.30	4.083	0.03511	0.8788
	40.30	4.083	0.03517	0.8784
	59.91	6.070	0.05437	0.9059
	80.19	8.125	0.07115	0.91434
	100.06	10.139	0.08965	0.91985
	100.04	10.137	0.0998	0.92016
	119.99	12.158	-	0.92332
149.98	20.05	2.0316	0.01433	0.91299
	40.30	4.083	0.02923	0.94665
	59.76	6.055	0.04377	0.95667
	80.04	8.110	0.05886	0.96057
	100.06	10.139	0.07011	0.96259
	120.06	12.165	0.08446	0.96305
135.01	20.19	2.046	0.01198	0.96946
	40.30	4.083	0.02355	0.98018
	60.17	6.097	0.03399	0.98324
	80.11	8.117	0.04475	0.98441
	100.11	10.144	0.05578	0.98466
	120.05	12.164	0.06287	0.98441

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Single pass flow apparatus with two compartment equilibrium cell. Temperature measured with platinum resistance thermometer; pressure measured with Bourdon gauge. Pure hydrogen bubbled through liquid fluorocarbon. Samples analysed by gas chromatography. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

1. Airco sample, purity 99.97 mole per cent.
2. Du Pont de Nemours Inc. sample, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$; $\delta P/\mathrm{MPa} = \pm 0.5\%$
$\delta x_{H_2} = \pm 2.0\%$; $\delta(1-y_{H_2}) = \pm 2.5\%$

REFERENCES:

1. Kirk, B.S.; Ziegler, W.T. *Adv. Cryogen. Eng.* 1965, *10*, 160

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0]	Shiau, J.F.; Ziegler, W.T.
2. Tetrafluoromethane, (Perfluoromethane); CF_4; [75-73-0]	*J. Chem. Engng. Data.* 1980, *25*, 239-246.

EXPERIMENTAL VALUES:

			Mole fraction of hydrogen	
T/K	P/atm	P/MPa	in liquid x_{H_2}	in vapor y_{H_2}
119.94	20.06	2.033	0.008981	0.991922
	40.01	4.054	0.01793	0.994517
	60.38	6.118	0.02576	0.995034
	79.91	8.097	0.03216	0.995020
	100.08	10.141	0.03970	0.994854
	119.98	12.157	0.04657	0.994569
105.01	20.07	2.034	0.006356	0.998655
	40.19	4.072	0.01201	0.998904
	60.18	6.098	0.01704	0.998905
	79.93	8.099	0.02179	0.998907
	99.99	10.131	0.02629	0.998716
	120.00	12.159	0.03048	0.998537
94.94	20.14	2.041	0.004676	0.9996676
	20.21	2.048	0.004692	0.9996570
	20.09	2.036	0.004682	0.9996722
	40.37	4.090	0.008833	0.9997177
	60.17	6.097	0.01262	0.9996845
	80.04	8.110	0.01572	0.9996921
	100.06	10.139	0.01846	0.9995534
	119.94	12.153	0.02136	0.9994568
	119.38	12.096	0.02114	0.9994667
	119.38	12.096	0.02123	0.9994664

COMPONENTS:

1. Hydrogen; H_3; [1333-74-0]
2. Chlorotrifluoromethane; $CClF_3$; [75-72-9]

ORIGINAL MEASUREMENTS:

Shiau, J.F.; Ziegler, W.T.

J. Chem. Engng. Data. 1980, *25*, 239-246.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
219.99	20.20	2.047	0.01630	0.7883
	20.67	2.094	0.01620	0.7850
	20.06	2.033	0.01616	0.7811
	39.90	4.043	0.03481	0.8758
	59.90	6.060	0.05340	0.90199
	79.91	8.097	0.07213	0.91845
	99.98	10.130	0.08984	0.92646
	119.99	12.158	0.10487	0.93239
	119.99	12.158	0.10585	0.93267
205.03	20.20	2.047	0.01544	0.8872
	40.10	4.063	0.02213	0.93180
	59.90	6.069	0.04773	0.94861
	79.91	8.097	0.06412	0.95539
	100.15	10.148	0.07869	0.95898
	120.02	12.161	0.09365	0.96117
189.97	20.09	2.036	0.01407	0.94449
	40.16	4.069	0.02920	0.96707
	59.76	6.055	0.04201	0.97460
	79.90	8.096	-	0.97710
	80.25	8.131	0.05480	0.97724
	99.91	10.123	0.06890	0.97898
	119.98	12.157	0.08200	0.97976

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Single pass flow apparatus with two compartment equilibrium cell. Temperature measured with platinum resistance thermometer; pressure measured with Bourdon gauge. Pure hydrogen bubbled through liquid fluorocarbon. Samples analysed by gas chromatography. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Airco sample, purity 99.97 mole per cent.
2. Du Pont de Nemours inc. sample purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$; $\delta P/MPa = \pm 0.5\%$

$\delta x_{H_2} = \pm 2.0\%$; $\delta(1-y_{H_2}) = \pm 3\%$

REFERENCES:

1. Kirk, B.S.; Ziegler, W.T.

   Adv. Cryogen.Eng. 1965, *10*, 160.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Chlorotrifluoromethane; $CClF_3$; [75-72-9]

ORIGINAL MEASUREMENTS:

Shiau, J.F.; Ziegler, W.T.

J. Chem. Engng. Data. 1980, *25*, 239-246.

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
175.02	20.06	2.036	0.01212	0.97632
	40.37	4.090	0.02448	0.98622
	59.97	6.076	0.03647	0.98858
	79.70	8.076	0.04673	0.98972
	99.91	10.123	0.05716	0.99026
	119.88	12.157	0.06864	0.990397
160.02	20.13	2.040	0.01055	0.992078
	40.17	4.070	0.02018	0.994890
	59.77	6.056	0.03090	0.995764
	79.63	8.069	0.03909	0.996097
	100.05	10.138	0.04790	0.996199
	119.99	12.158	0.05681	0.996087
145.02	20.26	2.053	0.008783	0.997836
	40.23	4.076	0.01667	0.998583
	59.97	6.076	0.02446	0.998700
	79.50	8.055	0.03182	0.998746
	99.84	10.116	0.03889	0.998704
	119.92	12.151	0.04553	0.998637
134.97	20.09	2.036	0.007477	0.999263
	20.06	2.033	0.007453	0.999251
	20.06	2.033	0.007382	0.999252
	40.17	4.070	0.01419	0.999473
	59.83	6.062	0.02051	0.999511
	79.63	8.069	0.02674	0.999497
	99.84	10.116	0.03311	0.9994633
	119.91	12.150	0.03894	0.999408
	120.02	12.161	0.03894	0.999413

COMPONENTS:

1. Hydrogen, H_2; [1333-74-0]
2. Benzo [b] thiophene, (Thianaphthene); C_8H_6S; [95-15-8]

ORIGINAL MEASUREMENTS:

Sebastian, H.M.; Simnick, J.J.; Lin, H.M.; Chao, K.C.

Can. J. Chem. Engng. 1978, *56*, 743-6

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/MPa	Mole fraction of hydrogen in liquid x_{H_2}	Mole fraction of hydrogen in gas y_{H_2}
460.9	2.002	0.0076	0.9768
	2.912	0.0113	0.9836
	5.084	0.0197	0.9904
	10.055	0.0372	0.9944
	15.10	0.0546	0.9958
	20.37	0.0714	0.9965
	25.30	0.0864	0.9970
541.1	0.2691*	0.0000	0.0000
	2.020	0.0096	0.8626
	3.085	0.0155	0.9070
	5.030	0.0264	0.9384
	10.042	0.0503	0.9653
	15.23	0.0756	0.9750
	20.34	0.0995	0.9801
	25.33	0.1211	0.9835
621.2	0.9825*	0.0000	0.0000
	2.012	0.0082	0.5045
	3.033	0.0165	0.6635
	5.029	0.0313	0.7923
	10.096	0.0670	0.8839
	15.23	0.1012	0.9156

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell. Composition of samples found by stripping out gas and estimating volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure measured with Bourdon gauge. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Air Products sample, minimum purity 99.95 mole per cent.
2. Aldrich sample, zone refined and colourless sections used combined with fraction obtained by distillation.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; δx_{H_2}, $\delta y_{H_2} = \pm 1\%$.

REFERENCES:

1. Simnick, J.J. Lawson, C.C.; Lin, H.M.; Chao, K.C.

   Am. Inst. Chem. Engnrs. J. 1977, *23*, 469.

COMPONENTS	ORIGINAL MEASUREMENTS
1. Hydrogen, H_2; [1333-74-0] 2. Benzo [b] thiophene, (Thianaphthene); C_8H_6S; [95-15-8]	Sebastian, H.M.; Simnick, J.J. Lin, H.M.; Chao, K.C. *Can. J. Chem. Engng.* 1978, *56*, 743-6.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
621.2	20.31	0.1307	0.9330
	25.30	0.1585	0.9425
702.7	3.071	0.0087	0.1834
	5.049	0.0315	0.4148
	10.062	0.0861	0.6565
	15.13	0.1431	0.7601
	20.19	0.1836	0.8060
	25.33	0.2260	0.8437

* vapor pressure of pure thianaphthene.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Tributyl phosphate; $C_{12}H_{27}PO_4$; [126-73-8]	Shakhova, S. F.; Zubchenko, Yu. P.; Kaplan, L. K. *Khim. Prom.* 1973, *49*, 108-110.
VARIABLES:	PREPARED BY:
Pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	$\alpha^{\dagger}$ vol/vol
313.15	22.8	0.0171	1.50
	42.3	0.0292	2.59
	59.4	0.0403	3.62
	83.1	0.0557	5.08
	98.6	0.0649	5.98
	104.8	0.0681	6.29
	116.7	0.0769	7.17

† quoted in original paper, appears to be volume of gas at T/K = 273.15 and P = 1 atmosphere adsorbed by unit volume of liquid at room temperature.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Mixture stirred with ball in rocking autoclave. Sample of liquid analysed by a volumetric method. Details in source.	1. Dried and oxygen removed, purity 99.8 mole per cent. 2. Analytical grade sample.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{H_2} = \pm 5\%$ (estimated by compiler).
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Octamethylcyclotetrasiloxane; $C_8H_{24}O_4Si_4$; [556-67-2]

ORIGINAL MEASUREMENTS:

Cannon, P.; St. Pierre, L.E.; Miller, A.A.

J. Chem. Engng. Data. 1960, *5*, 236.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	*p*/MPa	Mole fraction of hydrogen in liquid
303.5	0.77	0.058
	1.55	0.115
	2.14	0.161

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Automatic gravimetric sorption balance. Mass of hydrogen determined directly. Correction for buoyancy made. Pressure measured with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Purified by distillation, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.01$; $\delta x = \pm 0.001$

(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Hydrocarbon Blend (Heavy naphtha)

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A.

Ind. Eng. Chem. 1931, *23*, 548-550.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Solubility, S^*
298.15	10	1.0	0.75
	20	2.0	1.5
	30	3.0	2.25
	40	4.1	3.0
	50	5.1	3.7
	60	6.1	4.4
	70	7.1	5.1
	80	8.1	5.8
	90	9.1	6.5
	100	10.1	7.2
	110	11.1	7.9
	120	12.2	8.6
	130	13.2	9.3
	140	14.2	10.0
	150	15.2	10.7
	160	16.2	11.4
	170	17.3	12.1
	180	18.3	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. Hydrogen 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. Hydrogen; H_2; [1333-74-0]

2. Hydrocarbon Blend (Gas oil)

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A.

Ind. Eng. Chem. 1931, *23*, 548-550.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	Solubility, *S**
298.15	10	1.0	0.67
	20	2.0	1.34
	30	3.0	2.01
	40	4.1	2.68
	50	5.1	3.35
	60	6.1	4.02
	70	7.1	4.69
	80	8.1	5.36
	90	9.1	6.03
	100	10.1	6.70
	110	11.1	7.37
	120	12.2	8.04
	130	13.2	8.71
	140	14.2	9.38
	150	15.2	10.35
	160	16.2	10.72
	170	17.3	11.39
	180	18.3	12.06

* 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. Hydrogen 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:

1. Hydrogen; H_2; [1333-74-0]

2. Solvent Refined Coal Recycle Oil

ORIGINAL MEASUREMENTS:

Prather, J. W.; Ahangar, A. M.;
Pitts, W. S.; Henley, J. P.;
Tarrer, A. R.; Guln, J. A.
Ind. Eng. Chem. Process. Des. Dev.
1977, *16*, 267-270.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P_{H_2} /psia	P_{H_2} /MPa	Solubility, S (g of H_2/10^4g of oil)	T/K	P_{H_2} /psia	P_{H_2} /MPa	Solubility, S (g of H_2/10^4g of oil)
473.15	1104	7.61	11.59	573.15	1289	8.89	12.29
	1089	7.51	10.74		1974	13.61	20.57
	1051	7.25	10.88		1994	13.75	19.44
	2124	14.64	19.72		1979	13.64	19.46
	2084	14.37	19.29		2891	19.93	30.50
	2043	14.09	20.68		2899	19.99	27.78
	3130	21.58	29.73		2882	19.87	28.90
	2959	20.40	26.33		3170	21.86	34.23
	2845	19.62	24.93	673.15	1105	7.62	15.86
573.15	639	4.41	5.58		1048	7.23	16.50
	614	4.23	6.38		1820	12.55	26.30
	599	4.13	6.28		1758	12.12	26.51
	1204	8.30	12.47		2291	15.80	35.36
					2267	15.63	33.22

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell of 1 U.S. gallon capacity. Pressure measured with Bourdon gauge and temperature with thermocouple. Samples of liquid and vapor analysed by volumetric methods and gas chromatography, respectively.

SOURCE AND PURITY OF MATERIALS:

1. Linde sample, purity 99.995 mole per cent.
2. Wilsonville recycle solvent. Detailed description given in ref. (1).

ESTIMATED ERROR:

$\delta T/K = \pm 1\%$; $\delta S = \pm 4\text{-}6\%$.

REFERENCES:

1. S.R.C. Tech. Report No. 7. *Analysis of Operations, Solvent Refined Coal Pilot Plant,* Southern Services Inc. Wilsonville 1975.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Creosote Oil

ORIGINAL MEASUREMENTS:

Prather, J. W.; Ahangar, A. M.;
Pitts, W. S.; Henley, J. P.;
Tarrer, A. R.; Guln, J. A.
Ind. Eng. Chem. Process. Des. Dev.
1977, *16*, 267-270.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P_{H_2} /psia	P_{H_2} /MPa	Solubility, S (g of $H_2/10^4$g of oil)	T/K	P_{H_2} /psia	P_{H_2} /MPa	Solubility, S (g of $H_2/10^4$g of oil)
373.15	510	3.52	2.95	473.15	2003	13.81	13.05
	515	3.55	3.00		2007	13.84	14.08
	1015	7.00	5.97		2009	13.85	13.66
	1015	7.00	5.92		2507	17.29	17.20
	1515	10.45	7.78		2946	20.31	19.54
	1513	10.43	8.27		2999	20.68	19.80
	2015	13.89	11.66	573.15	506	3.49	3.7
	2013	13.88	11.62		526	3.63	3.95
	2015	13.89	12.00		986	6.80	8.06
	2515	17.34	15.48		1005	6.93	7.42
	2512	17.32	15.56		1025	7.07	7.62
	2512	17.32	14.79		1487	10.25	11.14
	2765	19.06	17.57		1504	10.37	11.73
	2961	20.42	17.16		1528	10.54	10.38
	3015	20.79	19.00		1987	13.70	15.83
	3015	20.79	17.30		2002	13.80	16.37
473.15	507	3.50	4.26		2496	17.21	19.74
	534	3.68	4.76		2497	17.22	19.73
	600	4.14	5.03		2945	20.31	23.21
	1008	6.95	7.16		2986	20.59	23.88
	1009	6.96	6.95		3060	21.10	22.25
	1011	6.97	6.60	673.15	385	2.65	4.32
	1509	10.40	12.65		390	2.69	3.60
	1509	10.40	11.29		448	3.09	3.68
	1567	10.80	12.54				(cont.)

AUXILIARY INFORMATION

METHOD 'APPARATUS/PROCEDURE:

Stirred equilibrium cell of 1 U.S. gallon capacity. Pressure measured with Bourdon gauge and temperature with thermocouple. Samples of liquid and vapor analysed by volumetric methods and gas chromatography, respectively.

SOURCE AND PURITY OF MATERIALS:

1. Linde sample, purity 99.995 mole per cent.
2. Allied Chemical Co. sample 24-CB; boiling range 175 to 350 °C. Density at 293.15 K = 1.096 g cm^{-3}. Detailed analysis in source.

ESTIMATED ERROR:

$\delta T/K = \pm 1\%$; $\delta S = \pm 4-6\%$.

REFERENCES.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Creosote Oil

ORIGINAL MEASUREMENTS:

Prather, J. W.; Ahangar, A. M.;
Pitts, W. S.; Henley, J. P.;
Tarrer, A. R.; Guln, J. A.
Ind. Eng. Chem. Process. Des. Dev.
1977, *16*, 267-270.

EXPERIMENTAL VALUES:

T/K	P_{H_2} /psia	P_{H_2} /MPa	Solubility, S (g of $H_2/10^4$g of oil)	T/K	P_{H_2} /psia	P_{H_2} /MPa	Solubility, S (g of $H_2/10^4$g of oil)
673.15	850	5.86	8.45	673.15	1899	13.09	17.63
	864	5.96	8.24		2387	16.46	21.81
	865	5.96	7.55		2403	16.57	22.98
	1380	9.51	13.08		2420	16.69	23.93
	1388	9.57	14.22		2875	19.82	26.96
	1858	12.81	18.61		2892	19.94	29.16
	1867	12.87	17.23		2979	20.54	28.99

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Santowax R;

ORIGINAL MEASUREMENTS:

Grove, N.H.; Whiteley, F.J.; Woolmer, R.N.

J. Appl. Chem. 1960, *10*, 101-109.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Solubility*	Ostwald coefficient
505	1.81	8.4	0.183
508	4.66	16.0	0.136
511	2.48	9.7	0.156
514	1.89	8.7	0.184
521	1.72	8.2	0.192
595	2.04	16.3	0.346
598	5.12	35.3	0.298
602	1.91	13.4	0.305
604	1.99	17.2	0.377
604	2.70	22.3	0.358
677	5.33	55.0	0.466
680	2.77	31.7	0.517
680	2.00	20.5	0.464
681	2.04	27.0	0.600
684	1.97	26.6	0.611

* moles of hydrogen 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. Pressure on both sides of transducer kept approximately equal. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. No details given.

2. Analysis by infrared 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 Limited.

ESTIMATED ERROR:

$\delta T/K = \pm 1$; $\delta P/\text{bar} = \pm 0.01$;

$\delta x_{H_2} = \pm 10\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Jojoba Oil

ORIGINAL MEASUREMENTS:

Wisniak, J.; Stein, S.

J. Amer. Oil Chem. Soc. 1974, *51*, 482.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Kuenen coefficient, S	†Mole fraction of hydrogen in liquid, x_{H_2}	T/K	P/bar	Kuenen coefficient, S	†Mole fraction of hydrogen in liquid, x_{H_2}
323.15	7.6	0.44	0.0118	423.15	34.5	3.11	0.0776
	13.8	0.84	0.0222		41.4	3.70	0.0910
	20.7	1.21	0.0324		48.3	4.32	0.105
	27.6	1.61	0.0417		55.2	4.90	0.116
	34.5	2.00	0.0513	473.15	7.6	0.80	0.0212
	41.4	2.41	0.0611		13.8	1.49	0.0387
	48.3	2.78	0.0700		20.7	2.20	0.0562
	55.2	3.18	0.0792		27.6	2.83	0.0711
373.15	7.6	0.56	0.0150		34.5	3.58	0.0882
	13.8	1.06	0.0280		41.4	4.29	0.104
	20.7	1.50	0.0400		48.3	4.98	0.119
	27.6	2.00	0.0513		55.2	5.64	0.132
	34.5	2.51	0.0635	523.15	7.6	0.91	0.0240
	41.4	3.00	0.0750		13.8	1.69	0.0437
	48.3	3.49	0.0863		20.7	2.46	0.0624
	55.2	3.97	0.0970		27.6	3.23	0.0803
423.15	7.6	0.68	0.0181		34.5	4.01	0.0979
	13.8	1.28	0.0333		41.4	4.80	0.115
	20.7	1.88	0.0484		48.3	5.58	0.131
	27.6	2.50	0.0634		55.2	6.37	0.147

† Reported in source, calculated assuming a molecular weight of 606 for the jojoba oil.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static equilibrium cell. Liquid phase sample analysed by allowing hydrogen to bubble out at atmospheric pressure in a gas buret system.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole per cent.
2. Prepared by crushing jojoba seeds. Details of composition in source.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\text{bar} = \pm 0.2$;

$\delta S = \pm 1\text{-}2\%$; $\delta x_{H_2} = \pm 1\text{-}2\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2, [1333-74-0]
2. Carbon Monoxide; CO; [630-08-0]
3. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Trust, D.B.; Kurata, F.

Am. Inst. Chem. Engnrs. J. 1971, *17*, 86-91.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	p/MPa	Liquid composition Mole fractions x_{H_2}	x_{CO}	$x_{C_3H_8}$	Vapor composition Mole fractions y_{H_2}	y_{CO}	$y_{C_3H_8}$
223.15	3.447	0.0051	0.0724	0.9225	0.1933	0.7830	0.0237
		0.0092	0.0533	0.9375	0.3752	0.6095	0.0153
		0.0164	0.0191	0.9645	0.7607	0.2253	0.0140
		0.0180	0.0115	0.9705	0.8474	0.1414	0.0112
	6.895	0.0051	0.1683	0.8266	0.0702	0.8987	0.0311
		0.0107	0.1421	0.8472	0.1642	0.8087	0.0271
		0.0180	0.1052	0.8768	0.3628	0.6132	0.0240
		0.0300	0.0540	0.9160	0.6625	0.3176	0.0199
	13.790	0.0080	0.3384	0.6536	0.0422	0.9083	0.0495
		0.0081	0.3316	0.6603	0.0436	0.9077	0.0487
		0.0325	0.2186	0.7489	0.3000	0.6674	0.0326
		0.0525	0.1072	0.8403	0.5877	0.3927	0.0196
		0.0672	0.0411	0.8917	0.8378	0.1477	0.0145
273.15	3.447	0.0043	0.0670	0.9287	0.1001	0.6797	0.2202
		0.0134	0.0405	0.9461	0.3701	0.4258	0.2041
		0.0178	0.0276	0.9546	0.5157	0.2919	0.1924
		0.0222	0.0165	0.9613	0.6188	0.1878	0.1934
	6.895	0.0226	0.1008	0.8766	0.2916	0.5702	0.1382
		0.0297	0.0774	0.8929	0.4295	0.4455	0.1250
		0.0434	0.0509	0.9057	0.6610	0.2280	0.1110
	13.790	0.0530	0.1976	0.7494	0.3204	0.5754	0.1042
		0.0546	0.1862	0.7592	0.3279	0.5548	0.1173
		0.0634	0.1632	0.7734	0.4246	0.4920	0.0834

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell (0.1 dm^3 capacity) fitted with magnetic stirrer. Temperature measured with platinum resistance thermometer. Pressure measured with Bourdon gauge. Contents charged into cell, equilibriated, samples withdrawn and analysed by gas chromatography. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.93 mole per cent.
2. Purity 99.79 mole per cent.
3. Purity 99.91 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta p/MPa = \pm 0.02$; δx, $\delta y = \pm 1\text{-}2\%$.

(estimated by compiler).

REFERENCES:

1. Sinor, J.E.; Schindler, D.L.; Kurata, F.

   Am. Inst. Chem. Engnrs. J. 1966, *12*, 353.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon Monoxide; CO; [630-08-0]
3. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Trust, D.B.; Kurata, F.

Am. Inst. Chem. Engnrs. J. 1971, *17*, 86-91.

EXPERIMENTAL VALUES:

T/K	p/MPa	Liquid compositions Mole fraction			Vapor compositions Mole fractions		
		x_{H_2}	x_{CO}	$x_{C_3H_8}$	y_{H_2}	y_{CO}	$y_{C_3H_8}$
273.15	13.790	0.0670	0.1595	0.7735	0.4608	0.4709	0.0683
		0.0864	0.0952	0.8184	0.6366	0.3004	0.0630
		0.0918	0.0952	0.8130	0.6372	0.2920	0.0708
323.15	3.447	0.0047	0.0366	0.9587	0.0339	0.3363	0.6298
		0.0085	0.0266	0.9649	0.1595	0.2609	0.5796
		0.0094	0.0259	0.9647	0.1652	0.2389	0.5959
		0.0161	0.0100	0.9739	0.3152	0.1063	0.5785
	6.895	0.0110	0.1225	0.8665	0.0685	0.5072	0.4243
		0.0260	0.0867	0.8873	0.2298	0.4111	0.3591
		0.0430	0.0493	0.9077	0.4053	0.2389	0.3558
	13.790	0.0697	0.2491	0.6812	0.1589	0.4203	0.4208
		0.1069	0.1208	0.7723	0.3807	0.2655	0.3538

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]
3. Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Cosway, H. F.; Katz, D. L.

Am. Inst. Chem. Engnrs. J.

1959, *5*, 46-50.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Mole fractions in liquid			Mole fractions in gas		
x_{H_2}	x_{N_2}	x_{CH_4}	y_{H_2}	y_{N_2}	y_{CH_4}
	T/K = 199.8	P/psia = 500		P/MPa = 3.45	
0.0343	0.0000	0.9657	0.6392	0.0000	0.3608†
0.0286	0.0998	0.8716	0.4337	0.2191	0.3472
0.0155	0.2739	0.7106	0.1677	0.5080	0.3243
0.00302	0.4176	0.5794	0.0236	0.6793	0.2971
0.0000	0.4900	0.5100	0.0000	0.7300	0.2700*
0.0000	0.5090	0.4910	0.0000	0.7520	0.2480§
	T/K = 144.3	P/psia = 1000		P/MPa = 6.89	
0.0781	0.0000	0.9219	0.7618	0.0000	0.2382†
0.0832	0.0000	0.9168	0.7601	0.0000	0.2399
0.0826	0.0617	0.8557	0.6735	0.0838	0.2427
0.0849	0.1791	0.7360	0.5002	0.2377	0.2621
0.0915	0.3733	0.5352	0.3130	0.4291	0.2579
0.0932	0.3912	0.5156	0.3005	0.4413	0.2582
0.0926	0.4137	0.4937	0.2758	0.4637	0.2605
0.1157	0.5354	0.3489	-	-	-

† Data quoted in original but taken from Benham, A. L.; Katz, D. L. *Am. Inst. Chem. Engnrs. J.* 1957, *3*, 33.

(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 and 2. No details given.

3. Phillips Petroleum Co. sample.

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. Hydrogen; H_2; [1333-74-0] 2. Nitrogen; N_2; [7727-37-9] 3. Methane; CH_4; [74-82-8]	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. Hydrogen; H_2; [1333-74-0]
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:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Mole fractions in liquid			Mole fractions in gas		
x_{H_2}	x_{CH_4}	$x_{C_2H_6}$	y_{H_2}	y_{CH_4}	$y_{C_2H_6}$
	T/K = 199.8		P/psia = 500	P/MPa = 3.45	
0.0187	0.0000	0.9813	0.9166	0.0000	0.0834[†]
0.0133	0.2942	0.6925	0.4623	0.4586	0.0791
0.0134	0.3255	0.6611	0.3940	0.5230	0.0830
0.0120	0.3859	0.6021	0.3062	0.6153	0.0786
0.0101	0.4325	0.5575	0.2308	0.6913	0.0779
0.0000	0.6600	0.3400	0.0000	0.9300	0.0700[*]
	T/K = 199.8		P/psia = 1000	P/MPa = 6.89	
0.0390	0.0000	0.9610	0.9476	0.0000	0.0524[†]
0.0382	0.0000	0.9618	0.9483	0.0000	0.0517
0.0351	0.0441	0.9208	0.9325	0.0324	0.0351
0.0400	0.1153	0.8447	0.8372	0.1102	0.0526
0.0376	0.4957	0.4667	0.4579	0.4862	0.0559
	T/K = 144.3		P/psia = 500	P/MPa = 3.45	
0.0120	0.0000	0.9880	0.9969	0.0000	0.0031[†]
0.0167	0.5224	0.4609	0.8154	0.1819	0.00272
0.0175	0.7608	0.2217	0.7412	0.2572	0.00164
0.0327	0.9203	0.0470	0.6915	0.3080	0.0051
0.0343	0.9637	0.0000	0.6392	0.3608	0.0000[§]

(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. sample.

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:

1. Hydrogen; H_2; [1333-74-0]
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.

EXPERIMENTAL VALUES:

Mole fractions in liquid			Mole fractions in gas		
x_{H_2}	x_{CH_4}	$x_{C_2H_6}$	y_{H_2}	y_{CH_4}	$y_{C_2H_6}$
	T/K = 144.3		P/psia = 500	P/MPa = 6.89	
0.0225	0.0000	0.9775	0.9974	0.0000	0.0026[†]
0.0242	0.1115	0.8643	0.9710	0.0266	0.00231
0.0296	0.3504	0.6200	0.9115	0.0856	0.00290
0.0313	0.4081	0.5607	0.9009	0.0968	0.00230
0.0487	0.7571	0.1942	0.8233	0.1754	0.00136
0.0643	0.8732	0.0625	0.7929	0.2065	0.00061
0.0832	0.9168	0.0000	0.7601	0.2399	0.0000
0.0781	0.9219	0.0000	0.7618	0.2382	0.0000[§]

[†] Data quoted in original but taken from Williams, R. B.; Katz, D. L. *Ind. Eng. Chem.* 1954, *46*, 2512.

[*] Data quoted in original but taken from Bloomer, O. T.; Gami, D. C.; Parent, J. D. *Inst. Gas Tech. Res. Bull.* 1953, *22*, 1.

[§] Data quoted in original but taken from Benham, A. L.; Katz, D. L. *Am. Inst. Chem. Engnrs. J.* 1957, *3*, 33.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Cohen, A.E.; Hipkin, H.G.; Koppany, C.R.

Chem. Eng. Prog. Symp. Ser. No. 81. 1967, *63*, 10-17.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p/10^5$Pa	Liquid composition Mole fractions x_{H_2}	x_{CH_4}	$x_{C_2H_6}$	Vapor compositions Mole fractions y_{H_2}	y_{CH_4}	$y_{C_2H_2}$
115.3	137.2	0.0754	0.597	0.328	0.964	0.0357	0.00016
116.3	103.4	0.0819	0.611	0.307	0.963	0.0367	0.00023
116.3	69.77	0.0379	0.638	0.324	0.963	0.0368	0.00031
116.3	53.31	0.0301	0.640	0.330	0.962	0.0384	0.00017
116.3	34.65	0.0192	0.628	0.353	0.954	0.0461	0.00006
116.1	14.12	0.00793	0.648	0.344	0.905	0.0947	0.00026
116.2	13.49	0.00462	0.275	0.720	0.957	0.0431	0.00020
116.2	35.38	0.00584	0.278	0.716	0.980	0.0206	0.00048
116.2	51.57	0.0116	0.248	0.740	0.983	0.0171	0.00030
116.2	68.95	0.0129	0.250	0.737	0.985	0.0154	0.00021
116.2	101.7	0.0204	0.240	0.740	0.986	0.0140	0.00032
116.2	136.9	0.0362	0.211	0.753	0.986	0.0137	0.00035
116.5	13.93	0.00389	0.0960	0.900	0.985	0.0153	0.00029
116.4	34.01	0.00958	0.0890	0.901	0.992	0.0077	0.00019
116.4	51.41	0.0117	0.0803	0.908	0.994	0.0063	0.00019
116.5	67.70	0.0168	0.0788	0.904	0.995	0.0054	0.00022
116.5	103.4	0.0258	0.0717	0.902	0.995	0.0048	0.00018
116.4	135.5	0.0312	0.0637	0.905	0.996	0.0044	0.00026
142.3	14.45	0.0100	0.412	0.578	0.673	0.324	0.0025
144.0	36.00	0.0188	0.516	0.465	0.817	0.181	0.0016
144.0	51.68	0.0313	0.518	0.451	0.862	0.136	0.0017
144.1	68.86	0.0416	0.491	0.467	0.883	0.115	0.00166
144.1	102.7	0.0573	0.438	0.505	0.907	0.0910	0.00161
144.0	137.2	0.0574	0.440	0.503	0.944	0.0535	0.00206
144.1	103.4	0.0473	0.280	0.673	0.944	0.0540	0.00201

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibrium established in cell by recirculating vapor through external flow line at room temperature. Pressure measured with dead weight gauge. Temperature measured with platinum resistance thermometer. Liquid and vapor samples analysed by gas chromatography using thermal conductivity and flame ionisation detectors. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Air Reduction Corp. bone dry sample, purity 99.8 mole per cent or better. Dried.
2. High purity sample. Dried.
3. Matheson CP grade purity 99.0 mole per cent. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{MPa} = \pm 0.007$ or 1% whichever greater; $\delta x, \delta y \simeq 3\%$ (greater when x or y less than 0.01)

REFERENCES:

1. Hipkin, H.G.
Am. Inst. Chem. Eng. J. 1966, *12*, 484.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Methane; CH_6; [74-82-8] 3. Ethane; C_2H_6; [74-84-0]	Cohen, A.E.; Hipkin, H.G.; Koppany, C.R. *Chem. Eng. Prog. Symp. Ser. No. 81.* <u>1967</u>, *63*, 10-17.

EXPERIMENTAL VALUES:

		Liquid compositions			Vapor compositions		
		Mole fractions			Mole fractions		
T/K	$p/10^5$Pa	x_{H_2}	x_{CH_4}	$x_{C_2H_6}$	y_{H_2}	y_{CH_4}	$y_{C_2H_2}$
144.1	69.88	0.0340	0.267	0.699	0.935	0.0633	0.00196
144.0	51.68	0.0241	0.264	0.712	0.930	0.0682	0.00234
144.1	34.39	0.0149	0.237	0.748	0.913	0.0852	0.00241
144.1	15.07	0.00523	0.222	0.773	0.852	0.144	0.00420
143.8	13.87	0.00604	0.0842	0.910	0.936	0.0579	0.00559
144.2	34.14	0.00777	0.0806	0.911	0.972	0.0261	0.00248
144.1	68.38	0.0118	0.0744	0.914	0.983	0.0147	0.00180
144.1	136.2	0.0201	0.0729	0.907	0.988	0.00956	0.00199
172.2	13.89	0.00620	0.207	0.787	0.561	0.404	0.0348
172.2	34.28	0.0180	0.210	0.772	0.804	0.179	0.0170
172.2	51.62	0.0291	0.203	0.768	0.856	0.130	0.0137
172.2	69.94	0.0385	0.187	0.774	0.889	0.0985	0.0119
172.2	103.4	0.0584	0.162	0.780	0.919	0.0695	0.0114
172.1	137.6	0.0630	0.163	0.774	0.943	0.0450	0.0115
172.1	136.5	0.0712	0.100	0.829	0.953	0.0356	0.0109
172.1	103.4	0.0641	0.0982	0.838	0.951	0.0378	0.0112
171.5	68.78	0.0388	0.0835	0.877	0.946	0.0417	0.0122
172.0	51.64	0.0266	0.0725	0.901	0.941	0.0450	0.0140
171.5	34.52	0.0180	0.0597	0.922	0.931	0.0513	0.0178
172.2	14.89	0.0140	0.0360	0.950	0.892	0.0717	0.0362
172.1	35.67	0.0222	0.624	0.354	0.494	0.492	0.0141
172.1	34.65	0.0194	0.527	0.454	0.569	0.415	0.0160
172.1	52.63	0.0344	0.475	0.500	0.695	0.292	0.0126
172.1	68.63	0.0448	0.471	0.484	0.743	0.246	0.0105
172.1	102.4	0.0660	0.417	0.517	0.800	0.188	0.0122
172.0	137.9	0.0892	0.372	0.539	0.840	0.148	0.0117
199.6	25.74	-	0.472	0.528	-	0.906	0.0940
199.7	35.93	0.0122	0.444	0.544	0.222	0.696	0.0816
199.7	42.71	0.0208	0.391	0.588	0.308	0.585	0.107
199.7	56.32	0.0197	0.338	0.642	0.453	0.487	0.060
199.8	70.31	0.0480	0.416	0.536	0.530	0.416	0.0535
199.8	84.44	0.203	0.469	0.328	0.582	0.365	0.0531
199.8	87.22	0.0745	0.411	0.514	0.635	0.318	0.0471
199.8	111.72	0.116	0.411	0.473	0.657	0.294	0.0487
199.7	123.40	0.0827	0.368	0.549	0.689	0.264	0.0469
199.7	83.47	0.0475	0.323	0.630	0.653	0.296	0.0511
199.8	61.73	0.0388	0.276	0.685	0.6351	0.305	0.0595
199.8	48.21	0.0241	0.238	0.738	0.616	0.318	0.0656
199.8	34.99	0.0191	0.186	0.795	0.566	0.347	0.0865
240.5	125.5	0.104	0.266	0.630	0.496	0.313	0.201
240.5	110.7	0.0901	0.245	0.665	0.516	0.297	0.187
240.5	96.53	0.0676	0.228	0.704	0.525	0.288	0.187
240.5	82.74	0.0590	0.210	0.731	0.496	0.300	0.204
240.5	69.44	0.0415	0.178	0.781	0.454	0.310	0.236
240.5	57.80	0.0348	0.164	0.801	0.432	0.306	0.262
240.5	43.04	0.0202	0.110	0.870	0.390	0.294	0.316
240.7	47.90	-	0.387	0.613	-	0.731	0.269
240.7	57.76	0.0148	0.395	0.590	0.115	0.645	0.240
240.5	69.97	0.0348	0.348	0.617	0.196	0.596	0.208
240.5	83.05	0.0560	0.346	0.598	0.289	0.486	0.225
240.5	96.53	0.0766	0.320	0.603	0.342	0.438	0.220
255.4	55.85	0.0222	0.136	0.842	0.301	0.298	0.401
255.5	68.41	0.0405	0.130	0.829	0.389	0.253	0.358
255.4	83.52	0.0666	0.123	0.810	0.446	0.223	0.331
255.4	104.8	0.0845	0.117	0.798	0.523	0.169	0.308
255.4	43.04	-	0.267	0.733	-	0.568	0.432
255.4	58.68	0.0173	0.258	0.725	0.144	0.477	0.379
255.4	68.95	0.0264	0.232	0.742	0.221	0.415	0.364
255.4	48.14	-	0.286	0.714	-	0.529	0.471

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Cohen, A.E. Hipkin, H.G.
Koppany, C.R.

Chem. Eng. Prog. Symp. Ser. No. 81, 1967, *63*, 10-17.

EXPERIMENTAL VALUES:

		Liquid compositions Mole fraction			Vapor compositions Mole fractions		
T/K	$P/10^5$Pa	x_{H_2}	x_{CH_4}	$x_{C_2H_6}$	y_{H_2}	y_{CH_4}	$y_{C_2H_6}$
255.4	54.30	0.0088	0.250	0.741	0.066	0.559	0.375
255.4	70.39	0.0280	0.288	0.684	0.177	0.469	0.354
255.4	83.90	0.0595	0.300	0.640	0.248	0.406	0.346
255.4	98.94	0.1180	0.315	0.567	0.327	0.362	0.311
255.4	111.01	0.1020	0.266	0.632	0.342	0.339	0.319

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Ethene; C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Sagara, H.; Arai, Y.; Saito, S.
J. Chem. Engng. Japan 1972, *5*, 339-348.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	x_{H_2}	x_{CH_4}	$x_{C_2H_4}$	y_{H_2}	y_{CH_4}	$y_{C_2H_4}$
123.15	20.3	0.00698	0.189	0.804	0.934	0.0633	0.00243
		0.00756	0.321	0.672	0.908	0.0898	0.00258
		0.00930	0.476	0.515	0.877	0.122	0.00111
		0.0118	0.625	0.363	0.856	0.143	0.00088
		0.0177	0.826	0.157	0.842	0.157	0.00061
	40.5	0.0113	0.194	0.795	0.959	0.0386	0.00202
		0.0131	0.309	0.678	0.944	0.0541	0.00207
		0.0187	0.493	0.489	0.923	0.0756	0.00104
		0.0254	0.631	0.344	0.914	0.0850	0.00056
		0.0346	0.814	0.152	0.896	0.104	0.00051
	60.8	0.0171	0.193	0.790	0.965	0.0327	0.00193
		0.0170	0.326	0.657	0.954	0.0450	0.00141
		0.0263	0.501	0.473	0.937	0.0622	0.00051
		0.0328	0.631	0.337	0.931	0.0687	0.00044
		0.0504	0.803	0.147	0.911	0.0887	0.00060
	81.1	0.0251	0.193	0.782	0.970	0.0283	0.00183
		0.0321	0.384	0.584	0.953	0.0457	0.00083
		0.0388	0.491	0.470	0.943	0.0559	0.00083
		0.0527	0.617	0.331	0.937	0.0628	0.00032
		0.0678	0.782	0.150	0.922	0.0774	0.00030
148.15	20.3	0.00828	0.178	0.814	0.799	0.180	0.0217
		0.00717	0.280	0.713	0.725	0.254	0.0212
		0.00722	0.382	0.611	0.657	0.325	0.0176
		0.0107	0.518	0.471	0.570	0.415	0.0147
		0.0124	0.668	0.319	0.493	0.495	0.0123
		0.0149	0.856	0.129	0.400	0.594	0.00655

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static stainless steel cell of capacity 5 × 10^5 mm^3 fitted with magnetic stirrer and sampling valves. Cell enclosed in cryostat. Temperature measured with thermocouple. Pressure measured using Bourdon gauge. Gases added to cell and equilibrated. Samples of liquid and gas withdrawn and analysed using a gas chromatograph with thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Nippon Sanso Co. Ltd. sample, purity 99.99 mole per cent.
2. Takachiho Chemical Industry Co. Ltd. sample, purity 99.9 mole per cent.
3. Takachiho Chemical Industry Co. Ltd. sample, purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; δx_{H_2}, δx_{CH_4}, $\delta x_{C_2H_4}$, δy_{H_2}, δy_{CH_4}, $\delta y_{C_2H_4}$ = ±1%.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Ethene; C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Sagara, H.; Arai, Y.; Saito, S.

J. Chem. Engng. Japan 1972, *5*, 339-348.

EXPERIMENTAL VALUES:

T/K	P/bar	x_{H_2}	x_{CH_4}	$x_{C_2H_4}$	y_{H_2}	y_{CH_4}	$y_{C_2H_4}$
148.15	40.5	0.0165	0.174	0.809	0.883	0.102	0.0155
		0.0168	0.282	0.701	0.841	0.145	0.0148
		0.0212	0.373	0.606	0.801	0.185	0.0143
		0.0249	0.511	0.464	0.747	0.241	0.0119
		0.0304	0.653	0.317	0.708	0.283	0.00915
		0.0386	0.835	0.126	0.651	0.344	0.00479
	60.8	0.0260	0.177	0.797	0.911	0.0767	0.0123
		0.0278	0.280	0.692	0.877	0.133	0.0100
		0.0333	0.368	0.599	0.847	0.142	0.0110
		0.0369	0.508	0.456	0.810	0.181	0.00846
		0.0436	0.649	0.307	0.772	0.221	0.00712
		0.0641	0.815	0.121	0.729	0.268	0.00320
	81.1	0.0332	0.169	0.798	0.926	0.0647	0.00905
		0.0376	0.274	0.688	0.894	0.0957	0.00985
		0.0437	0.368	0.589	0.871	0.121	0.00863
		0.0502	0.498	0.452	0.842	0.151	0.00754
		0.0638	0.631	0.305	0.804	0.189	0.00688
		0.0924	0.789	0.118	0.746	0.232	0.00443
173.15	20.3	0.00875	0.0886	0.903	0.752	0.168	0.0807
		0.00856	0.260	0.731	0.491	0.429	0.0800
		0.00808	0.400	0.592	0.329	0.600	0.0712
		0.00811	0.403	0.589	0.317	0.611	0.0724
		0.00439	0.599	0.397	0.131	0.808	0.0609
	40.5	0.0188	0.0902	0.891	0.857	0.0941	0.0488
		0.0197	0.251	0.729	0.711	0.243	0.0453
		0.0237	0.389	0.587	0.607	0.346	0.0479
		0.0271	0.602	0.371	0.449	0.514	0.0374
		0.0278	0.712	0.260	0.386	0.585	0.0286
	60.8	0.0314	0.0898	0.879	0.893	0.0696	0.0376
		0.0328	0.250	0.718	0.787	0.178	0.0352
		0.0391	0.376	0.585	0.699	0.263	0.0380
		0.0482	0.581	0.371	0.585	0.384	0.0314
		0.0522	0.687	0.260	0.520	0.452	0.0279
	81.1	0.0418	0.0938	0.864	0.910	0.0579	0.0325
		0.0465	0.243	0.710	0.820	0.147	0.0329
		0.0557	0.365	0.580	0.748	0.219	0.0334
		0.0693	0.566	0.365	0.639	0.330	0.0306
		0.0781	0.665	0.257	0.591	0.383	0.0269
198.15	20.3	0.00988	0.0327	0.957	0.644	0.101	0.254
		0.00843	0.0882	0.903	0.494	0.255	0.251
		0.00589	0.155	0.839	0.314	0.437	0.248
		0.00374	0.226	0.770	0.170	0.592	0.239
		0.00318	0.236	0.761	0.141	0.626	0.233
	40.5	0.0238	0.0912	0.885	0.700	0.160	0.140
		0.0221	0.0916	0.886	0.705	0.147	0.149
		0.0227	0.139	0.838	0.629	0.226	0.145
		0.0198	0.312	0.669	0.400	0.468	0.132
		0.0186	0.392	0.589	0.330	0.541	0.129
		0.0116	0.576	0.413	0.145	0.741	0.114
	60.8	0.0375	0.116	0.846	0.743	0.144	0.114
		0.0379	0.286	0.676	0.569	0.320	0.111
		0.0393	0.384	0.577	0.492	0.409	0.0999
		0.0383	0.561	0.401	0.328	0.577	0.0956
		0.0380	0.686	0.276	0.216	0.698	0.0861
	81.1	0.0537	0.212	0.734	0.714	0.193	0.0932
		0.0564	0.284	0.660	0.642	0.263	0.0951
		0.0651	0.509	0.426	0.445	0.462	0.0934
		0.0743	0.666	0.260	0.296	0.617	0.0874
223.15	20.3	0.00632	0.0329	0.961	0.309	0.136	0.555
		0.00497	0.0519	0.943	0.227	0.208	0.565
		0.00378	0.0745	0.922	0.153	0.282	0.565

(cont.)

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Ethene; C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Sagara, H.; Arai, Y.; Saito, S.
J. Chem. Engng. Japan 1972, *5*,
339-348.

EXPERIMENTAL VALUES:

T/K	*P*/bar	x_{H_2}	x_{CH_4}	$x_{C_2H_4}$	y_{H_2}	y_{CH_4}	$y_{C_2H_4}$
223.15	40.5	0.0241	0.0914	0.885	0.482	0.190	0.328
		0.0204	0.122	0.858	0.428	0.258	0.314
		0.0172	0.192	0.791	0.302	0.386	0.311
		0.0131	0.259	0.728	0.200	0.499	0.301
248.15	30.4	0.00554	0.0332	0.961	0.115	0.106	0.780
		0.00392	0.0532	0.943	0.0708	0.166	0.763
		0.00389	0.0498	0.946	0.0775	0.157	0.766
		0.00179	0.0689	0.929	0.0333	0.219	0.748
	40.5	0.0168	0.0498	0.933	0.233	0.123	0.644
		0.0135	0.0806	0.906	0.174	0.191	0.635
		0.00600	0.143	0.851	0.0629	0.315	0.623

x_{H_2}, x_{CH_4} and $x_{C_2H_4}$ mole fraction of hydrogen, methane and ethene in liquid phase, respectively.

y_{H_2}, y_{CH_4} and $y_{C_2H_4}$ mole fraction of hydrogen, methane and ethene in gas phase, respectively.

COMPONENTS:

1. Hydrogen, H_2; [1337-74-0]
2. Methane; CH_4; [74-82-8]
3. Propene; C_3H_6; [115-07-1]

ORIGINAL MEASUREMENTS:

Benham, A.L.; Katz, D.L.

Am. Inst. Chem. Engnrs.J. 1957, *3*, 33-36.

VARIABLES:

Composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Liquid composition Mole fractions. x_{H_2}	x_{CH_4}	$x_{C_3H_6}$	Vapor compositions Mole fractions y_{H_2}	y_{CH_4}	$y_{C_3H_6}$
199.82	34.47	0.00728	0.5126	0.4801	0.1493	0.8337	0.0170
		0.00986	0.4115	0.5786	0.2933	0.6909	0.0158
		0.0136	0.00	0.9864	0.9872	0.00	0.0128

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Recirculating vapor flow system described in ref. 1. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Vapor recirculated by high pressure magnetic pump. Cell charged under pressure. Samples of each phase expanded to room pressure and analysed by mass spectrometer.

SOURCE AND PURITY OF MATERIALS:

1. Purity better than 99.5 mole per cent; further purified to remove water.
2. Purity better than 99.0 mole per cent; further purified to remove water and higher hydrocarbons.
3. Purity better than 99.0 mole per cent; further purified to remove water and higher hydrocarbons.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta P/\text{bar} = \pm 0.5\%$;

$\delta x_{H_2}; \delta x_{CH_4}, \delta x_{C_3H_6}, \delta y_{H_2}, \delta y_{CH_4}, \delta y_{C_3H_6} = \pm 0.5\%$

REFERENCES:

1. Aroyan, H.J.; Katz, D.L. *Ind. Eng. Chem.* 1951, *43*, 185.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Propane, C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Benham, A.L.; Katz, D.L.

Am. Inst. Chem. Engnrs. J. 1957, *3*, 33-36.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

		Liquid composition Mole fraction			Vapor composition Mole fraction		
T/K	P/bar	x_{H_2}	x_{CH_4}	$x_{C_3H_8}$	y_{H_2}	y_{CH_4}	$y_{C_3H_8}$
255.37	34.47	0.0015	0.2583	0.7402	0.0398	0.8408	0.1194
		0.00329	0.2357	0.7610	0.0831	0.8026	0.1143
		0.00717	0.2098	0.7830	0.1396	0.7329	0.1275
		0.00907	0.1613	0.8296	0.2790	0.6070	0.1140
		0.0113	0.1367	0.8520	0.3726	0.5208	0.1066
		0.0131	0.1172	0.8698	0.4576	0.4337	0.1087
		0.0100	0.0797	0.9103	0.5875	0.3166	0.0959
		0.0230	0.0000	0.9770	0.9070	0.0000	0.0930
199.82	34.47	0.0000	0.620	0.380	0.0000	0.9870	0.0130
		0.00452	0.4958	0.4997	0.1436	0.8443	0.0121
		0.00645	0.4499	0.5436	0.2213	0.7673	0.0114
		0.00683	0.4238	0.5694	0.2457	0.7421	0.0122
		0.0109	0.2493	0.7398	0.5980	0.3925	0.0095
		0.0122	0.2140	0.7738	0.6872	0.3046	0.0082
		0.0116	0.1607	0.8277	0.6783	0.3104	0.0113
		0.0155	0.0000	0.9845	0.9902	0.0000	0.00976
144.26	34.47	0.0086	0.0000	0.9914	0.999+	0.0000	0.0000
		0.00789	0.0859	0.9062	0.9573	0.0379	0.0048
		0.0179	0.4367	0.5454	0.8340	0.1592	0.0068
		0.0285	0.8707	0.1008	-	-	-
		0.0343	0.9657	0.0000	0.6392	0.3608	0.0000

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Recirculating vapor flow system described in ref. 1. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Vapor recirculated by high pressure magnetic pump. Cell charged under pressure. Samples of each phase expanded to room pressure and analysed by mass spectrometer.

SOURCE AND PURITY OF MATERIALS:

1. Purity better than 99.5 mole per cent; further purified to remove water and higher hydrocarbons.
2. Purity better than 99.0 mole per cent; further purified to remove water vapor.
3. Purity better than 99.0 mole per cent; further purified to remove water vapor.

ESTIMATED ERROR:

$\delta T/K = \pm 0.06$; $\delta P/\mathrm{bar} = \pm 0.5\%$;
$\delta x_{H_2}, \delta x_{CH_4}, \delta x_{C_3H_8}, \delta y_{H_2}, \delta y_{CH_4}, \delta y_{C_3H_8}, = \pm 0.5\%$.

REFERENCES:

1. Aroyan, H.J.; Katz, D.L.
Ind. Eng. Chem. 1951, *43*, 185

COMPONENTS

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS

Benham, A.L.; Katz, D.L.;

Am. Inst. Chem. Engnrs. J., 1957, *3*, 33-36

EXPERIMENTAL VALUES:

		Liquid composition Mole fractions			Vapor composition Mole fractions		
T/K	*P*/bar	x_{H_2}	x_{CH_4}	$x_{C_3H_8}$	y_{H_2}	y_{CH_4}	$y_{C_3H_8}$
255.37	68.95	0.0000	0.5300	0.4700	0.0000	0.9030	0.0970
		0.0202	0.3277	0.6521	0.2554	0.6609	0.0837
		0.0267	0.2570	0.7163	0.4549	0.4777	0.0674
		0.0275	0.2430	0.7295	0.4689	0.4578	0.0733
		0.0309	0.1790	0.7901	0.5895	0.3457	0.0648
		0.0379	0.1303	0.8318	0.6657	0.2657	0.0686
		0.0475	0.0000	0.9525	0.9408	0.0000	0.0592
199.82	68.95	0.0302	0.0000	0.9698	0.9931	0.0000	0.0069
		0.0276	0.1470	0.8254	0.8562	0.1339	0.0099
		0.0327	0.3428	0.6245	0.6182	0.3681	0.0137
		0.0327	0.4637	0.5036	-	-	-
		0.0366	0.5844	0.3790	0.4323	0.5301	0.0376
144.26	68.95	0.0163	0.0000	0.9837	0.999+	0.0000	0.0000
		0.0179	0.1014	0.8807	0.9900	0.0037	0.0063
		0.0300	0.5593	0.4107	0.8770	0.1204	0.0026
		0.0296	0.5784	0.3920	0.8770	0.1204	0.0026
		0.0312	0.5914	0.3774	0.8666	0.1307	0.0027
		0.0597	0.8122	0.1281	0.8008	0.1961	0.0031
		0.0781	0.9219	0.0000	0.7618	0.2382	0.0000

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Ethene; C_2H_4; [74-85-1]
3. Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Sagara, H.; Arai, Y.; Saito, S.
J. Chem. Engng. Japan 1972, *5*,
339-348.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	x_{H_2}	$x_{C_2H_4}$	$x_{C_2H_6}$	y_{H_2}	$y_{C_2H_4}$	$y_{C_2H_6}$
148.15	20.3	0.00621	0.220	0.774	0.983	0.00640	0.0104
		0.00675	0.423	0.570	0.981	0.0112	0.00802
		0.00597	0.432	0.562	0.980	0.0126	0.00782
		0.00587	0.636	0.358	0.977	0.0174	0.00576
		0.00736	0.704	0.288	0.975	0.0195	0.00510
		0.00642	0.704	0.290	0.977	0.0191	0.00396
	40.5	0.0123	0.220	0.768	0.990	0.00393	0.00651
		0.0123	0.222	0.766	0.990	0.00394	0.00625
		0.0121	0.439	0.549	0.988	0.00752	0.00455
		0.0129	0.424	0.564	0.987	0.00785	0.00472
		0.0132	0.637	0.350	0.986	0.0107	0.00332
		0.0116	0.693	0.296	0.985	0.0115	0.00318
	60.8	0.0162	0.219	0.765	0.993	0.00310	0.00425
		0.0160	0.434	0.550	0.990	0.00606	0.00408
		0.0163	0.639	0.345	0.990	0.00819	0.00232
		0.0162	0.693	0.291	0.989	0.00848	0.00227
	81.1	0.0229	0.218	0.759	0.994	0.00266	0.00355
		0.0269	0.426	0.547	0.993	0.00445	0.00266
		0.0205	0.630	0.350	0.990	0.00778	0.00252
		0.0256	0.686	0.288	0.991	0.00785	0.00159
173.15	20.3	0.00816	0.224	0.768	0.954	0.0218	0.0240
		0.00922	0.455	0.536	0.943	0.0394	0.0179
		0.00919	0.608	0.383	0.933	0.0526	0.0143
		0.00896	0.710	0.281	0.932	0.0577	0.0108
		0.00800	0.764	0.229	0.931	0.0604	0.00904

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static stainless steel cell of capacity 5 × 10^5 mm^3 fitted with magnetic stirrer and sampling valves. Cell enclosed in cryostat. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Gases added to cell and equilibrated. Samples of liquid and gas withdrawn and analysed using a gas chromatograph with thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Nippon Sanso Co. Ltd. sample, purity 99.99 nole per cent.
2. Takachiho Chemical Co. Ltd. sample, purity 99.5 mole per cent.
3. Takachiho Chemical Co. Ltd. sample, purity 99.7 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/bar = \pm 0.1$; δx_{H_2}, $\delta x_{C_2H_4}$, $\delta x_{C_2H_6}$, δy_{H_2}, $\delta y_{C_2H_4}$, $\delta y_{C_2H_6}$ = ±1%.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Ethene; C_2H_4; [74-85-1] 3. Ethane; C_2H_6; [74-84-0]	Sagara, H.; Arai, Y.; Saito, S. *J. Chem. Engng. Japan* <u>1972</u>, *5*, 339-348.

EXPERIMENTAL VALUES:

T/K	P/bar	x_{H_2}	$x_{C_2H_4}$	$x_{C_2H_6}$	y_{H_2}	$y_{C_2H_4}$	$y_{C_2H_6}$
173.15	40.5	0.0148	0.219	0.767	0.972	0.0120	0.0159
		0.0163	0.457	0.526	0.965	0.0230	0.0117
		0.0158	0.606	0.378	0.960	0.0310	0.00950
		0.0155	0.705	0.280	0.962	0.0315	0.00676
		0.0154	0.753	0.231	0.960	0.0344	0.00579
	60.8	0.0256	0.215	0.759	0.978	0.00934	0.0123
		0.0241	0.454	0.522	0.972	0.0180	0.00969
		0.0265	0.600	0.374	0.970	0.0231	0.00695
		0.0253	0.702	0.273	0.969	0.0257	0.00525
		0.0281	0.741	0.231	0.968	0.0272	0.00519
	81.1	0.0330	0.217	0.750	0.980	0.00806	0.0116
		0.0352	0.449	0.516	0.975	0.0161	0.00848
		0.0341	0.597	0.369	0.974	0.0200	0.00624
		0.0334	0.694	0.273	0.973	0.0222	0.00467
		0.0350	0.732	0.233	0.973	0.0231	0.00398
198.15	20.3	0.0106	0.161	0.829	0.852	0.0480	0.100
		0.0102	0.265	0.725	0.843	0.0717	0.0852
		0.00970	0.494	0.497	0.816	0.124	0.0604
		0.0104	0.501	0.482	0.805	0.132	0.0631
		0.0104	0.615	0.375	0.787	0.161	0.0517
		0.0100	0.703	0.287	0.764	0.191	0.0453
	40.5	0.0221	0.160	0.818	0.913	0.0274	0.0592
		0.0214	0.261	0.718	0.902	0.0428	0.0557
		0.0205	0.501	0.478	0.888	0.0734	0.0388
		0.0217	0.501	0.477	0.888	0.0742	0.0376
		0.0210	0.608	0.371	0.879	0.0910	0.0303
		0.0215	0.691	0.288	0.872	0.103	0.0256
	60.8	0.0320	0.158	0.810	0.935	0.0201	0.0453
		0.0320	0.264	0.704	0.930	0.0302	0.0395
		0.0349	0.487	0.479	0.914	0.0559	0.0303
		0.0318	0.488	0.480	0.917	0.0544	0.0286
		0.0351	0.603	0.362	0.908	0.0677	0.0240
		0.0332	0.683	0.284	0.898	0.0811	0.0210
	81.1	0.0449	0.160	0.795	0.944	0.0164	0.0397
		0.0437	0.260	0.697	0.940	0.0250	0.0347
		0.0449	0.479	0.476	0.928	0.0469	0.0251
		0.0467	0.479	0.474	0.932	0.0455	0.0226
		0.0488	0.592	0.359	0.922	0.0573	0.0208
		0.0472	0.671	0.282	0.917	0.0648	0.0179
223.15	20.3	0.0105	0.223	0.767	0.575	0.150	0.275
		0.0103	0.328	0.662	0.542	0.221	0.238
		0.00947	0.524	0.466	0.520	0.315	0.165
		0.00879	0.713	0.278	0.428	0.456	0.116
	40.5	0.0258	0.223	0.752	0.762	0.0818	0.156
		0.0256	0.327	0.647	0.737	0.125	0.138
		0.0255	0.522	0.453	0.706	0.193	0.101
		0.0273	0.685	0.288	0.656	0.272	0.0730
	60.8	0.0411	0.221	0.738	0.807	0.0651	0.128
		0.0427	0.317	0.640	0.806	0.0920	0.101
		0.0421	0.507	0.451	0.780	0.143	0.0767
		0.0423	0.670	0.288	0.737	0.208	0.0549
	81.1	0.0558	0.216	0.728	0.850	0.0508	0.0991
		0.0573	0.316	0.627	0.837	0.0746	0.0880
		0.0587	0.502	0.439	0.813	0.121	0.0657
		0.0585	0.661	0.280	0.778	0.173	0.0487

x_{H_2}, $x_{C_2H_4}$ and $x_{C_2H_6}$ mole fractions of hydrogen, ethene and ethane in liquid phase, respectively.

y_{H_2}, $y_{C_2H_4}$ and $y_{C_2H_6}$ mole fractions of hydrogen, ethene and ethane in vapor phase, respectively.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Ethene (Ethylene); C_2H_4; [74-85-1]
3. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Sagara, H; Mihara, S.; Arai, Y.; Saito, S.

J. Chem. Engng. Japan 1975, *8*, 98-104.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

		Mole fractions in liquid			Mole fractions in vapor		
T/K	P/MPa	x_{H_2}	$x_{C_2H_4}$	$x_{C_3H_8}$	y_{H_2}	$y_{C_2H_4}$	$y_{C_3H_8}$
173.2	2.03	0.00782	0.454	0.538	0.962	0.0371	0.00108
		0.00845	0.519	0.473	0.955	0.0430	0.00147
		0.00845	0.681	0.311	0.947	0.0525	0.00059
	4.05	0.0171	0.473	0.510	0.976	0.0231	0.00090
		0.0162	0.681	0.303	0.970	0.0292	0.00048
	6.08	0.0244	0.465	0.510	0.982	0.0173	0.00064
		0.0249	0.672	0.303	0.977	0.0221	0.00042
	8.11	0.0314	0.453	0.516	0.985	0.0145	0.00060
		0.0333	0.666	0.301	0.980	0.0194	0.00037
198.2	2.03	0.00823	0.332	0.659	0.910	0.0835	0.00652
		0.00813	0.412	0.580	0.894	0.101	0.00565
		0.00976	0.705	0.285	0.821	0.175	0.00348
	4.05	0.0181	0.399	0.583	0.939	0.0570	0.00392
		0.0185	0.700	0.281	0.907	0.0912	0.00208
	6.08	0.0288	0.392	0.579	0.955	0.0420	0.00326
		0.0323	0.678	0.290	0.933	0.0658	0.00159
	8.11	0.0378	0.388	0.574	0.962	0.0352	0.00291
		0.0427	0.667	0.290	0.942	0.0564	0.00164
223.2	2.03	0.00916	0.434	0.557	0.705	0.269	0.0259
		0.0104	0.804	0.185	0.542	0.446	0.0117
	4.05	0.0222	0.414	0.564	0.853	0.132	0.0152
		0.0261	0.787	0.186	0.742	0.251	0.00613
	6.08	0.0360	0.372	0.592	0.896	0.0917	0.0122
		0.0397	0.743	0.217	0.815	0.179	0.00539

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static stainless steel cell of capacity 5 × 10^5 mm^3 fitted with magnetic stirrer and sampling valves. Cell enclosed in cryostat. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Gases added to cell and equilibrated. Samples of liquid and gas withdrawn and analysed using a gas chromatograph with thermal conductivity detector. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.99 mole per cent.
2. Purity 99.5 mole per cent.
3. Purity 99.7 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.01$; δx_{H_2}, $\delta x_{C_2H_4}$, $\delta x_{C_3H_8}$, δy_{H_2}, $\delta y_{C_2H_4}$, $\delta y_{C_3H_8} = \pm 1\%$.

REFERENCES:

1. Sagara, H.; Arai, Y.; Saito, S. *J. Chem. Engng. Japan* 1972, *5*, 339.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Ethene (Ethylene); C_2H_4; [74-85-1] 3. Propane; C_3H_8; [74-98-6]	Sagara, H; Mihara, S.; Arai, Y.; Saito, S. *J. Chem. Engng. Japan* 1975, *8*, 98-104.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid			Mole fractions in vapor		
		x_{H_2}	$x_{C_2H_4}$	$x_{C_3H_8}$	y_{H_2}	$y_{C_2H_4}$	$y_{C_3H_8}$
223.2	8.11	0.0474	0.364	0.588	0.915	0.0742	0.0108
		0.0531	0.691	0.256	0.856	0.138	0.00588
248.2	2.03	0.0101	0.334	0.656	0.541	0.370	0.0891
		0.00780	0.541	0.451	0.363	0.568	0.0693
		0.00583	0.704	0.290	0.226	0.723	0.0504
	4.05	0.0246	0.318	0.657	0.748	0.202	0.0502
		0.0250	0.519	0.456	0.640	0.318	0.0420
		0.0223	0.705	0.273	0.517	0.452	0.0310
	6.08	0.0419	0.312	0.646	0.821	0.140	0.0386
		0.0435	0.503	0.454	0.733	0.235	0.0324
		0.0414	0.689	0.270	0.639	0.336	0.0248
	8.11	0.0562	0.298	0.646	0.854	0.114	0.0325
		0.0586	0.656	0.285	0.713	0.264	0.0231

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Propene (Propylene); C_3H_6; [115-07-1]
3. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Sagara, H.; Mihara, S.; Arai, Y.; Saito, S.

J. Chem. Engng. Japan 1975, *8*, 98-104.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid x_{H_2}	$x_{C_3H_6}$	$x_{C_3H_8}$	Mole fractions in vapor y_{H_2}	$y_{C_3H_6}$	$y_{C_3H_8}$
173.2	2.03	0.00705	0.246	0.747	0.998	0.00066	0.00132
		0.00828	0.492	0.499	0.998	0.00116	0.00098
		0.00625	0.749	0.244	0.998	0.00175	0.00068
	4.05	0.0134	0.237	0.749	0.998	0.00047	0.00117
		0.0139	0.490	0.496	0.998	0.00089	0.00086
		0.0135	0.750	0.237	0.998	0.00135	0.00048
	6.08	0.0196	0.246	0.734	0.999	0.00039	0.00099
		0.0204	0.489	0.491	0.998	0.00082	0.00075
		0.0198	0.739	0.241	0.998	0.00116	0.00042
	8.11	0.0317	0.241	0.727	0.999	0.00041	0.00100
		0.0255	0.476	0.498	0.999	0.00074	0.00066
		0.0253	0.737	0.237	0.999	0.00096	0.00037
198.2	2.03	0.00907	0.252	0.739	0.990	0.00329	0.00664
		0.00909	0.523	0.468	0.989	0.00616	0.00445
		0.00890	0.746	0.245	0.989	0.00849	0.00244
	4.05	0.0175	0.241	0.741	0.994	0.00188	0.00401
		0.0193	0.521	0.459	0.994	0.00362	0.00267
		0.0172	0.736	0.246	0.993	0.00520	0.00174
	6.08	0.0257	0.235	0.739	0.995	0.00150	0.00346
		0.0253	0.514	0.461	0.995	0.00290	0.00222
		0.0221	0.728	0.250	0.994	0.00437	0.00136
	8.11	0.0305	0.244	0.725	0.996	0.00143	0.00320
		0.0337	0.502	0.464	0.995	0.00271	0.00212
		0.0319	0.726	0.242	0.995	0.00411	0.00132

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static stainless steel cell of capacity 5×10^5 mm^3 fitted with magnetic stirrer and sampling valves. Cell enclosed in cryostat. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Gases added to cell and equilibrated. Samples of liquid and gas withdrawn and analysed using a gas chromatograph with thermal conductivity detector. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.99 mole per cent.
2. Purity 99.5 mole per cent.
3. Purity 99.7 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.01$; δx_{H_2}, $\delta x_{C_3H_6}$, $\delta x_{C_3H_8}$, δy_{H_2}, $\delta y_{C_3H_6}$, $\delta y_{C_3H_8} = \pm 1\%$.

REFERENCES:

1. Sagara, H.; Arai, Y.; Saito, S. *J. Chem. Engng. Japan* 1972, *5*, 339.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Propene (Propylene); C_3H_6; [115-07-1]

3. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Sagara, H.; Mihara, S.; Arai, Y.; Saito, S.

J. Chem. Engng. Japan 1975, *8*, 98-104.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid x_{H_2}	$x_{C_3H_6}$	$x_{C_3H_8}$	Mole fractions in vapor y_{H_2}	$y_{C_3H_6}$	$y_{C_3H_8}$
223.2	2.03	0.0108	0.280	0.709	0.964	0.0128	0.0230
		0.0106	0.480	0.509	0.958	0.0229	0.0186
		0.00976	0.697	0.293	0.958	0.0307	0.0109
	4.05	0.0206	0.281	0.699	0.978	0.00742	0.0141
		0.0210	0.465	0.514	0.976	0.0125	0.0110
		0.0198	0.686	0.294	0.976	0.0173	0.00626
	6.08	0.0319	0.272	0.696	0.984	0.00527	0.0103
		0.0307	0.466	0.504	0.981	0.0101	0.00877
		0.0295	0.683	0.288	0.982	0.0133	0.00480
	8.11	0.0414	0.265	0.694	0.985	0.00494	0.00966
		0.0386	0.459	0.503	0.984	0.00833	0.00736
		0.0396	0.668	0.293	0.984	0.0115	0.00434
248.2	2.03	0.0115	0.323	0.665	0.876	0.0478	0.0761
		0.0119	0.479	0.509	0.871	0.0701	0.0590
		0.0109	0.642	0.347	0.864	0.0931	0.0426
	4.05	0.0250	0.320	0.655	0.930	0.0269	0.0430
		0.0256	0.465	0.509	0.930	0.0369	0.0328
		0.0247	0.631	0.345	0.928	0.0495	0.0229
	6.08	0.0403	0.317	0.642	0.950	0.0189	0.0309
		0.0392	0.465	0.496	0.946	0.0284	0.0255
		0.0399	0.624	0.336	0.946	0.0366	0.0174
	8.11	0.0536	0.304	0.642	0.957	0.0160	0.0270
		0.0549	0.457	0.488	0.957	0.0220	0.0210
		0.0537	0.612	0.335	0.953	0.0318	0.0150

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Propene (Propylene); C_3H_6; [115-07-1]

ORIGINAL MEASUREMENTS:

Sagara, H.; Mihara, S.; Arai, Y.; Saito, S.

J. Chem. Engng. Japan 1975, *8*, 98-104.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid			Mole fractions in vapor		
		x_{H_2}	x_{CH_4}	$x_{C_3H_6}$	y_{H_2}	y_{CH_4}	$y_{C_3H_6}$*
173.2	2.03	0.0	0.848	0.152	0.0	1.0	--
		0.00360	0.500	0.497	0.236	0.764	--
		0.00493	0.246	0.749	0.504	0.496	--
		0.00375	0.155	0.841	0.662	0.338	--
		0.00427	0.116	0.880	0.734	0.266	--
		0.00436	0.0	0.996	1.0	0.0	--
	4.05	0.0154	0.690	0.294	0.459	0.541	--
		0.0145	0.524	0.462	0.528	0.472	--
		0.0109	0.309	0.680	0.679	0.321	--
		0.0108	0.107	0.882	0.861	0.139	--
		0.00944	0.0	0.991	1.0	0.0	--
	6.08	0.0303	0.633	0.337	0.585	0.415	--
		0.0253	0.500	0.475	0.640	0.360	--
		0.0201	0.291	0.689	0.765	0.235	--
		0.0163	0.0994	0.884	0.906	0.0935	--
		0.0143	0.0	0.986	1.0	0.0	--
	8.11	0.0770	0.842	0.0805	0.518	0.482	--
		0.0622	0.788	0.150	0.566	0.434	--
		0.0622	0.772	0.165	0.574	0.426	--
		0.0352	0.566	0.399	0.660	0.340	--
		0.0251	0.234	0.741	0.823	0.177	--

(cont.)

* The mole fraction of propylene in the gas phase at 173.15 K was too small for accurate estimation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static stainless steel cell of capacity 5 × 10^5 mm^3 fitted with magnetic stirrer and sampling valves. Cell enclosed in cryostat. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Gases added to cell and equilibrated. Samples of liquid and gas withdrawn and analysed using a gas chromatograph with thermal conductivity detector. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.99 mole per cent.
2. Purity 99.9 mole per cent.
3. Purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.01$; δx_{H_2}, δx_{CH_4}, $\delta x_{C_3H_6}$, δy_{H_2}, δy_{CH_4}, $\delta y_{C_3H_6} = \pm 1\%$.

REFERENCES:

1. Sagara, H.; Arai, Y.; Saito, S. *J. Chem. Engng. Japan* 1972, *5*, 339.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. Propene (Propylene); C_3H_6; [115-07-1]

ORIGINAL MEASUREMENTS:

Sagara, H.; Mihara, S.; Arai, Y.; Saito, S.

J. Chem. Engng. Japan 1975, *8*, 98-104.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid x_{H_2}	x_{CH_4}	$x_{C_3H_6}$	Mole fractions in vapor y_{H_2}	y_{CH_4}	$y_{C_3H_6}$*
173.2	8.11	0.0229	0.126	0.851	0.897	0.103	--
		0.0200	0.0	0.980	1.0	0.0	--
198.2	2.03	0.0	0.384	0.616	0.0	0.991	0.00942
		0.00244	0.259	0.739	0.197	0.794	0.00854
		0.00355	0.178	0.818	0.389	0.601	0.00969
		0.00475	0.116	0.879	0.573	0.418	0.00858
		0.00600	0.0672	0.927	0.754	0.238	0.00808
		0.00599	0.0	0.994	0.992	0.0	0.00768
	4.05	0.0	0.851	0.149	0.0	0.993	0.00707
		0.00984	0.516	0.474	0.257	0.735	0.00776
		0.0101	0.386	0.604	0.386	0.610	0.00457
		0.0104	0.245	0.744	0.558	0.435	0.00678
		0.0108	0.124	0.866	0.758	0.238	0.00421
		0.0108	0.0	0.989	0.996	0.0	0.00423
	6.08	0.0230	0.622	0.355	0.335	0.660	0.00434
		0.0199	0.381	0.600	0.533	0.462	0.00521
		0.0197	0.219	0.761	0.694	0.301	0.00458
		0.0209	0.163	0.816	0.775	0.219	0.00521
		0.0166	0.0	0.983	0.996	0.0	0.00388
	8.11	0.0359	0.587	0.377	0.453	0.543	0.00304
		0.0329	0.438	0.529	0.563	0.433	0.00385
		0.0286	0.227	0.744	0.743	0.253	0.00374
		0.0263	0.161	0.813	0.811	0.185	0.00449
		0.0239	0.0	0.976	0.997	0.0	0.00327
223.2	2.03	0.0	0.226	0.774	0.0	0.960	0.0401
		0.00162	0.180	0.818	0.123	0.828	0.0488
		0.00424	0.110	0.885	0.389	0.567	0.0439
		0.00589	0.0693	0.925	0.597	0.364	0.0392
		0.00741	0.0348	0.958	0.768	0.192	0.0397
		0.00857	0.0	0.991	0.958	0.0	0.0422
	4.05	0.0	0.441	0.559	0.0	0.974	0.0256
		0.00868	0.289	0.703	0.280	0.692	0.0284
		0.0112	0.196	0.793	0.472	0.504	0.0240
		0.0132	0.103	0.884	0.694	0.283	0.0233
		0.0126	0.0382	0.949	0.863	0.115	0.0211
		0.0146	0.0	0.985	0.977	0.0	0.0228
	6.08	0.0	0.751	0.249	0.0	0.977	0.0233
		0.0160	0.450	0.534	0.261	0.716	0.0238
		0.0211	0.314	0.664	0.437	0.543	0.0203
		0.0229	0.210	0.767	0.607	0.377	0.0166
		0.0216	0.112	0.866	0.765	0.220	0.0151
		0.0216	0.0	0.978	0.986	0.0	0.0136
	8.11	0.0286	0.507	0.465	0.315	0.662	0.0222
		0.0283	0.448	0.523	0.365	0.615	0.0200
		0.0319	0.343	0.625	0.496	0.486	0.0174
		0.0349	0.164	0.801	0.741	0.245	0.0143
		0.0275	0.0	0.972	0.988	0.0	0.0119
248.2	2.03	0.0	0.149	0.851	0.0	0.858	0.142
		0.00326	0.100	0.896	0.231	0.634	0.134
		0.00545	0.0679	0.927	0.403	0.459	0.137
		0.00687	0.0371	0.956	0.593	0.268	0.139
		0.00802	0.0179	0.974	0.726	0.135	0.139
		0.00977	0.0	0.990	0.863	0.0	0.137

(cont.)

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* The mole fraction of propylene in the gas phase at 173.15 K was too small for accurate estimation.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Methane; CH_4; [74-82-8] 3. Propene (Propylene); C_3H_6; [115-07-1]	Sagara, H.; Mihara, S.; Arai, Y.; Saito, S. *J. Chem. Engng. Japan* 1975, *8*, 98-104.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid			Mole fractions in vapor		
		x_{H_2}	x_{CH_4}	$x_{C_3H_6}$	y_{H_2}	y_{CH_4}	$y_{C_3H_6}$
248.2	4.05	0.0	0.334	0.666	0.0	0.913	0.0872
		0.00436	0.273	0.723	0.100	0.812	0.0877
		0.0119	0.174	0.814	0.350	0.567	0.0829
		0.0159	0.0994	0.885	0.586	0.334	0.0800
		0.0175	0.0468	0.936	0.753	0.170	0.0768
		0.0183	0.0	0.982	0.914	0.0	0.0857
	6.08	0.0	0.505	0.495	0.0	0.927	0.0733
		0.0147	0.330	0.655	0.245	0.690	0.0646
		0.0226	0.232	0.745	0.422	0.516	0.0616
		0.0306	0.0969	0.873	0.705	0.236	0.0580
		0.0295	0.0864	0.884	0.728	0.212	0.0598
		0.0292	0.0	0.971	0.949	0.0	0.0512
	8.11	0.0	0.712	0.288	0.0	0.921	0.0790
		0.0216	0.445	0.533	0.207	0.726	0.0661
		0.0331	0.248	0.719	0.496	0.452	0.0516
		0.0365	0.229	0.734	0.542	0.407	0.0507
		0.0416	0.0931	0.865	0.775	0.181	0.0446
		0.0409	0.0	0.959	0.956	0.0	0.0438

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]
3. Methane; CH_4; [74-82-8]
4. 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:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Mole fractions in liquid				Mole fractions in gas			
x_{H_2}	x_{N_2}	x_{CH_4}	$x_{C_2H_6}$	y_{H_2}	y_{N_2}	y_{CH_4}	$y_{C_2H_6}$
	T/K = 199.8		P/psia = 1000		P/MPa = 6.89		
0.00296	0.1880	0.0852	0.7239	0.0410	0.6196	0.0866	0.2528
0.0146	0.1410	0.0791	0.7653	0.2073	0.6282	0.0814	0.0831
	T/K = 144.3		P/psia = 500		P/MPa = 3.45		
0.00462	0.1215	0.0880	0.7859	0.2454	0.7087	0.0398	0.00606
0.00626	0.0973	0.0873	0.8091	0.3448	0.6101	0.0391	0.00608
0.00698	0.0795	0.0841	0.8295	0.4476	0.5096	0.0374	0.00549
0.00743	0.0705	0.0844	0.8377	0.5044	0.4532	0.0371	0.00525
0.00882	0.0633	0.0848	0.8431	0.5676	0.3932	0.0346	0.00456

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 and 2. No details given.

3 and 4. 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:

1. Hydrogen; H_2; [1333-74-0]
2. Methane;CH_4; [74-82-8]
3. Ethene; C_2H_4; [74-85-1]
4. Ethane; C_2H_6; [74-84-0]
5. Propene; C_3H_6; [115-07-1]
6. Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Benham, A.L.; Katz. D.L.;
Am. Inst. Chem. Engnrs. J. 1957, *3*, 33-36.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K		255.37	199.82	199.82	255.37	199.82
P/bar		34.47	34.47	34.47	68.95	68.95
Liquid composition Mole fractions	x_{H_2}	0.0104	0.0134	0.0148	0.0236	0.0197
	x_{CH_4}	0.0767	0.1484	0.1277	0.1645	0.1782
	$x_{C_2H_4}$	0.0942	0.0906	0.1823	0.1732	0.1797
	$x_{C_2H_6}$	0.0507	0.0466	0.0421	0.0402	0.0374
	$x_{C_3H_6}$	0.0839	0.0777	0.0707	0.0667	0.0600
	$x_{C_3H_8}$	0.6841	0.6233	0.5624	0.5318	0.5250
Vapor compositions Mole fractions	y_{H_2}	0.3828	0.6579	0.6860	0.4693	0.7726
	y_{CH_4}	0.3137	0.3045	0.2545	0.3518	0.1966
	$y_{C_2H_4}$	0.0856	0.0200	0.0406	0.0964	0.0209
	$y_{C_2H_6}$	0.0344	0.0065	0.0060	0.0173	0.0038
	$y_{C_3H_6}$	0.0263	0.0026	0.0024	0.0086	0.0010
	$y_{C_3H_8}$	0.1572	0.0085	0.0105	0.0566	0.0051

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Recirculating vapor flow system. described in ref. 1. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Vapor recirculated by high pressure magnetic pump. Cell charged under pressure. Samples of each phase expanded to room pressure and analysed by mass spectrometer.

SOURCE AND PURITY OF MATERIALS:

1. Purity better than 99.5 mole per cent; further purified to remove water

2,3,4,5 and 6. Purity better than 99.0 mole per cent; further purified to remove water and higher hydrocarbons.

ESTIMATED ERROR:

$\delta T/K = \pm 0.6$; $\delta P/\text{bar} = \pm 0.5\%$;

δx, $\delta y = \pm 0.5\%$.

REFERENCES:

1. Aroyan, H.J.; Katz, D.L.
Ind. Eng. Chem. 1951, *43*, 185.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Benzene; C_6H_6; [71-43-2]
3. Cyclohexane; C_6H_{12}; [110-82-7]
4. Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Brainard, A.J. Williams, G.B.

Am. Inst. Chem. Engnrs.J. 1967, *13*, 60-69.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

		Liquid composition Mole fraction				*K*-values			
T/K	*P*/bar	x_{H_2}	$x_{C_6H_6}$	$x_{C_6H_{12}}$	$x_{C_6H_{14}}$	K_{H_2}	$K_{C_6H_6}$	$K_{C_6H_{12}}$	$K_{C_6H_{14}}$
366.48	36.3	0.0235	0.3935	0.3298	0.2532	40.00	0.0582	0.0546	0.0794
	71.2	0.0450	0.3859	0.3225	0.2476	21.46	0.0329	0.0309	0.0448
	105.9	0.0655	0.3766	0.3156	0.2423	14.84	0.0287	0.0269	0.0390
	137.7	0.0849	0.3688	0.3090	0.2373	11.52	0.0226	0.0212	0.0307
	35.0	0.0204	0.4738	0.3786	0.1272	46.13	0.0593	0.0590	0.0856
	70.5	0.0401	0.4608	0.3754	0.1237	24.17	0.0311	0.0308	0.0473
	101.9	0.0580	0.4515	0.3671	0.1234	16.82	0.0240	0.0247	0.0379
	136.9	0.0756	0.4440	0.3619	0.1185	12.94	0.0213	0.0215	0.0335
	35.9	0.0245	0.2341	0.5558	0.1856	38.16	0.0684	0.0609	0.0825
	69.8	0.0455	0.2277	0.5441	0.1827	21.25	0.0356	0.0308	0.0442
	102.2	0.0651	0.2243	0.5327	0.1779	14.98	0.0270	0.0232	0.0342
	137.0	0.0854	0.2193	0.5234	0.1719	11.46	0.0239	0.0209	0.0308
394.26	35.2	0.0255	0.3935	0.3287	0.2523	34.66	0.1080	0.1010	0.1530
	70.6	0.0511	0.3834	0.3202	0.2453	18.30	0.0636	0.0590	0.0888
	105.8	0.0741	0.3742	0.3124	0.2393	12.85	0.0470	0.0433	0.0688
	137.4	0.0976	0.3646	0.3045	0.2333	9.80	0.0450	0.0397	0.0639
	38.3	0.0255	0.4662	0.3830	0.1253	35.52	0.0917	0.0890	0.1417
	72.2	0.0464	0.4562	0.3748	0.1226	20.34	0.0544	0.0530	0.0862
	102.9	0.0682	0.4458	0.3662	0.1198	14.04	0.0430	0.0425	0.0663
	137.6	0.0897	0.4334	0.3580	0.1189	10.75	0.0377	0.0370	0.0571
	35.8	0.0258	0.2266	0.5660	0.1816	34.98	0.1069	0.0895	0.1344
	70.1	0.0509	0.2237	0.5487	0.1767	18.52	0.0623	0.0556	0.0780
	102.2	0.0752	0.2170	0.5357	0.1721	12.72	0.0480	0.0410	0.0626
	134.7	0.0957	0.2178	0.5189	0.1676	10.07	0.0399	0.0350	0.0521

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stirred equilibrium cell. Pressure measured with Bourdon gauge. Analysis of samples carried out by expanding into an expansion cylinder and freezing out the hydrocarbon; hydrogen measured volumetrically and then total hydrocarbon estimated volumetrically. Composition of hydrocarbon residue measured by mass spectrometer. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Matheson ultrapure sample, purity better than 99.998 mole per cent.
2. Phillips Petroleum sample, purity 99.89 mole per cent; major impurity toluene.
3. Phillips Petroleum sample, purity 99.99 mole per cent; major impurity 2,4-dimethyl pentane and 2,2-diethyl pentane.
4. Phillips Petroleum sample, purity 99.97 mole per cent; major impurity methyl cyclopentane.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/\text{bar} = \pm 0.15$; $\delta x, \delta y = \pm 2.0\%$.

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Benzene; C_6H_6; [71-43-2]
3. Cyclohexane; C_6H_{12}; [110-82-7]
4. Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Brainard, A.J. Williams. G.B.

Am. Inst. Chem. Engnrs. J. 1967, *13*, 60-69.

EXPERIMENTAL VALUES:

		Liquid composition Mole fraction				K-Values			
T/K	P/bar	x_{H_2}	$x_{C_6H_6}$	$x_{C_6H_{12}}$	$x_{C_6H_{14}}$	K_{H_2}	$K_{C_6H_6}$	$K_{C_6H_{12}}$	$K_{C_6H_{12}}$
422.04	34.8	0.0272	0.4022	0.3127	0.2579	29.32	0.1980	0.1810	0.2590
	71.8	0.0578	0.3896	0.3028	0.2498	15.38	0.1073	0.1050	0.1496
	103.1	0.0844	0.3786	0.2943	0.2427	10.82	0.0859	0.0854	0.1205
	139.5	0.1105	0.3678	0.2859	0.2358	8.41	0.0715	0.0719	0.1008
	37.9	0.0277	0.4670	0.3818	0.1235	29.58	0.1769	0.1716	0.2510
	70.4	0.0530	0.4511	0.3714	0.1245	16.75	0.1148	0.1126	0.1538
	105.7	0.0793	0.4405	0.3623	0.1179	11.63	0.0806	0.0791	0.1142
	138.8	0.1018	0.4333	0.3492	0.1157	9.20	0.0673	0.0673	0.0978
	35.3	0.0278	0.2261	0.5649	0.1812	29.52	0.1827	0.1685	0.2380
	70.3	0.0561	0.2195	0.5485	0.1759	16.01	0.1060	0.0985	0.1351
	103.6	0.0829	0.2133	0.5329	0.1709	11.12	0.0847	0.0775	0.1098
	132.4	0.1062	0.2079	0.5193	0.1666	8.81	0.0750	0.0640	0.0923

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methane; CH_4; [74-82-8]
3. 1,2,3,4-Tetrahydronaphthalene (Tetralin); $C_{10}H_{12}$; [119-64-2]

ORIGINAL MEASUREMENTS:

Simnick, J. J.; Sebastian, H. M.; Lin, H.-M.; Chao, K.-C.

J. Chem. Eng. Data 1980, *25*, 147-149.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Phase		Mole fractions	
				x_{H_2}	x_{CH_4}	$x_{C_{10}H_{12}}$
462.3	49.7	5.04	liquid	0.0256	0.00834	0.9661
			vapor	0.8825	0.1033	0.01417
462.2	101.0	10.23	liquid	0.0508	0.01513	0.9341
			vapor	0.8892	0.1031	0.00769
462.2	150.3	15.23	liquid	0.0742	0.0204	0.9054
			vapor	0.8934	0.1014	0.00519
462.4	249.4	25.27	liquid	0.1194	0.0309	0.8497
			vapor	0.8929	0.1031	0.00398
462.2	49.9	5.06	liquid	0.0232	0.01525	0.9616
			vapor	0.7780	0.2068	0.01518
462.2	100.5	10.18	liquid	0.0459	0.0289	0.9252
			vapor	0.7899	0.2009	0.00920
462.2	150.1	15.21	liquid	0.0695	0.0403	0.8902
			vapor	0.7921	0.2007	0.00714
462.3	252.8	25.61	liquid	0.1105	0.0556	0.8338
			vapor	0.8154	0.1785	0.00621
462.3	50.0	5.07	liquid	0.0171	0.0339	0.9490
			vapor	0.5489	0.4344	0.01677
462.2	100.4	10.17	liquid	0.0333	0.0639	0.9029
			vapor	0.5514	0.4377	0.01090
462.2	150.5	15.25	liquid	0.0506	0.0922	0.8573
			vapor	0.5501	0.4403	0.00961
462.3	249.1	25.24	liquid	0.0863	0.1301	0.7836
			vapor	0.5830	0.4076	0.00938

(cont.)

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Details in ref. (1). Composition of liquid and vapor determined by stripping out hydrogen and methane and analysing by gas chromatography. Amount of gas determined volumetrically and amount of liquid determined gravimetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.95 mole per cent.
2. Purity better than 99 mole per cent.
3. Purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.02$; δx_{H_2}, δx_{CH_4}, $\delta x_{C_4H_{10}} = \pm 2\%$.

REFERENCES:

1. Simnick, J. J.; Lawson, C. C.; Lin, H. M.; Chao, K. C. *Am. Inst. Chem. Engnrs. J.* 1977, *23*, 469.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Methane; CH_4; [74-82-8] 3. 1,2,3,4-Tetrahydronaphthalene (Tetralin); $C_{10}H_{12}$; [119-64-2]	Simnick, J. J.; Sebastian, H. M.; Lin, H.-M.; Chao, K.-C. *J. Chem. Eng. Data* 1980, *25*, 147-149.

EXPERIMENTAL VALUES:

				Mole fractions		
T/K	P/atm	P/MPa	Phase	x_{H_2}	x_{CH_4}	$x_{C_{10}H_{12}}$
663.4	50.0	5.07	liquid	0.0435	0.0065	0.9491
			vapor	0.4608	0.0428	0.4965
663.3	101.5	10.28	liquid	0.1080	0.0156	0.8762
			vapor	0.6471	0.0609	0.2920
663.3	151.3	15.33	liquid	0.1666	0.0211	0.8119
			vapor	0.7182	0.0595	0.2223
663.5	250.2	25.35	liquid	0.2762	0.0315	0.6920
			vapor	0.7631	0.0601	0.1768
663.4	50.0	5.07	liquid	0.0393	0.0124	0.9483
			vapor	0.4135	0.0854	0.5012
663.3	99.9	10.12	liquid	0.0981	0.0303	0.8717
			vapor	0.5741	0.1179	0.3080
663.4	146.3	14.82	liquid	0.1387	0.0450	0.8163
			vapor	0.6105	0.1356	0.2539
663.4	252.1	25.54	liquid	0.2604	0.0732	0.6664
			vapor	0.6754	0.1368	0.1879
663.3	50.1	5.08	liquid	0.0284	0.0308	0.9408
			vapor	0.2865	0.2081	0.5054
663.3	100.9	10.22	liquid	0.0722	0.0764	0.8514
			vapor	0.3931	0.2819	0.3250
663.3	150.5	15.25	liquid	0.1129	0.1114	0.7745
			vapor	0.4227	0.3055	0.2718

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,2,3,4-Tetrahydronaphthalene, (Tetralin); $C_{10}H_{12}$; [119-64-2]
3. 1,3-Dimethylbenzene, (*m*-xylene); C_8H_{10}; [108-58-3]

ORIGINAL MEASUREMENTS:

Oliphant, J.L.; Lin, H.-M.; Chao, K.-C.

Fluid Phase Equil. 1979, *3*, 35-46

VARIABLES:

Temperature, pressure, liquid composition.

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$P/10^5$Pa	Mole fraction in liquid x_{H_2}	$x_{C_{10}H_{12}}$	$x_{C_8H_{10}}$	Mole fraction in vapor, y_{H_2}	$y_{C_{10}H_{12}}$	$y_{C_8H_{10}}$
462.15	19.8	0.0130	0.497	0.486	0.892	0.0204	0.0872
462.15	19.8	0.0130	0.498	0.486	0.894	0.01923	0.0868
462.45	50.7	0.0327	0.488	0.479	0.952	0.00823	0.0394
462.45	50.7	0.0336	0.486	0.480	0.955	0.00785	0.0370
462.35	151.7	0.0919	0.461	0.447	0.978	0.00348	0.0184
462.35	151.8	0.0927	0.455	0.453	0.978	0.00345	0.01832
462.35	253.5	0.1461	0.432	0.422	0.983	0.00257	0.01489
462.35	253.5	0.1463	0.434	0.420	0.982	0.00289	0.01522
502.65	20.3	0.01342	0.599	0.388	0.796	0.0594	0.1445
502.65	20.3	0.01337	0.598	0.389	0.797	0.0598	0.1437
502.85	51.2	0.0368	0.551	0.412	0.907	0.0237	0.0688
502.85	51.2	0.0369	0.544	0.419	0.909	0.0232	0.0674
502.65	151.4	0.1076	0.495	0.397	0.958	0.01021	0.0316
502.65	151.4	0.1079	0.498	0.394	0.959	0.00986	0.0309
502.55	253.0	0.1665	0.467	0.366	0.869	0.00749	0.0239
502.55	253.0	0.1689	0.468	0.364	0.968	0.00750	0.0240
542.75	19.8	0.01255	0.604	0.384	0.589	0.1394	0.272
542.75	19.8	0.01247	0.603	0.384	0.598	0.1391	0.263
542.65	50.7	0.0407	0.522	0.437	0.813	0.0541	0.1327
542.65	50.7	0.0412	0.521	0.438	0.813	0.0538	0.1332
542.65	151.1	0.1265	0.453	0.420	0.922	0.0211	0.0570
542.65	151.1	0.1253	0.448	0.427	0.920	0.0215	0.0587
542.65	253.0	0.1987	0.419	0.382	0.940	0.01642	0.0433
542.65	253.0	0.1993	0.423	0.378	0.941	0.01605	0.0425

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which the phases separated under gravity. Liquid sample removed from the bottom of cell and vapor sample from top. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Composition of solvent determined by GC. Temperature measured with thermocouple and pressure with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. Air Products sample, minimum purity 99.95 mole per cent.
2. and 3. Aldrich Chemical Company samples, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/MPa = \pm 0.02$; δx_{H_2}, $\delta y_{H_2} = \pm 1\%$

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,2,3,4-Tetrahydronaphthalene, [Tetralin); $C_{10}H_{12}$; [119-64-2]
3. 1,3-Dimethylbenzene, (*m*-xylene); C_8H_{10}; [108-58-3]

ORIGINAL MEASUREMENTS:

Oliphant, J.L.; Lin, H.-M.; Chao, K.-C.

Fluid Phase Equil. 1979, *3*, 35-46.

EXPERIMENTAL VALUES: Mole fraction in liquid, Mole fraction in vapor,

T/K	$P/10^5$Pa	x_{H_2}	$x_{C_{10}H_{12}}$	$x_{C_8H_{10}}$	y_{H_2}	$y_{C_{10}H_{12}}$	$y_{C_8H_{10}}$
582.45	20.2	0.00986	0.645	0.345	0.352	0.283	0.363
582.45	20.2	0.00989	0.640	0.350	0.357	0.275	0.368
582.35	50.6	0.0432	0.581	0.376	0.691	0.1201	0.189
582.35	50.6	0.0430	0.582	0.375	0.687	0.1224	0.1907
582.65	151.6	0.1459	0.484	0.370	0.859	0.0500	0.0911
582.65	151.6	0.1459	0.484	0.370	0.860	0.0493	0.0903
582.35	252.9	0.232	0.434	0.325	0.900	0.0356	0.0644
582.35	252.9	0.231	0.434	0.335	0.899	0.0361	0.0649

HAD - KK

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,2,3,4-Tetrahydronaphthalene, (Tetralin); $C_{10}H_{12}$; [119-64-2]
3. 1,1'-Methylenebisbenzene, (Diphenylmethane); $C_{13}H_{12}$; [101-81-5]

ORIGINAL MEASUREMENTS:

Oliphant, J.L.; Lin, H.-M.; Chao, K.C

Fluid Phase Equil. 1979, *3*, 35-46.

VARIABLES:

Temperature, pressure, liquid composition.

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$P/10^5$Pa	Mole fraction in liquid			Mole fraction in vapor,		
		x_{H_2}	$x_{C_{10}H_{12}}$	$x_{C_{13}H_{12}}$	y_{H_2}	$y_{C_{10}H_{12}}$	$y_{C_{13}H_{12}}$
462.45	20.6	0.01188	0.4866	0.5016	0.9815	0.01532	0.00320
461.15	20.7	0.01171	0.4684	0.5198	0.9818	0.01462	0.00355
461.15	20.7	0.01168	0.4688	0.5195	0.9820	0.01436	0.00363
461.35	50.7	0.0294	0.4768	0.4938	0.9919	0.00642	0.00162
461.25	152.7	0.0828	0.4546	0.4626	0.9966	0.00265	0.00078
461.05	252.3	0.1292	0.4352	0.4356	0.9974	0.00204	0.00060
541.55	20.0	0.01457	0.3729	0.6125	0.8981	0.0652	0.0366
541.55	51.1	0.0398	0.4396	0.5205	0.9531	0.0334	0.01345
541.55	51.1	0.0388	0.4441	0.5172	0.9533	0.0336	0.01313
541.45	152.3	0.1195	0.4184	0.4621	0.9816	0.01336	0.00505
541.45	152.3	0.1147	0.4203	0.4649	0.9801	0.01438	0.00551
541.45	152.3	0.1186	0.4208	0.4605	0.9806	0.01404	0.00537
541.55	252.3	0.1790	0.3885	0.4325	0.9865	0.00964	0.00383
541.55	252.3	0.1688	0.3910	0.4402	0.9860	0.00995	0.00403
621.65	20.6	0.01515	0.448	0.537	0.598	0.255	0.1469
621.65	20.6	0.01513	0.445	0.540	0.597	0.255	0.1480
621.55	51.1	0.0486	0.445	0.506	0.822	0.1139	0.0642
621.55	51.1	0.0486	0.439	0.512	0.819	0.1160	0.0650
621.45	152.0	0.1444	0.417	0.439	0.927	0.0476	0.0253
621.45	152.0	0.1432	0.417	0.440	0.925	0.0489	0.0261
621.45	253.0	0.229	0.372	0.399	0.949	0.0329	0.01818
621.45	253.0	0.225	0.373	0.402	0.951	0.0316	0.01740
621.45	253.0	0.228	0.366	0.406	0.949	0.0326	0.01842

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which the phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Composition of solvent determined by GC. Temperature measured with thermocouple and pressure with Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

1. Air Products sample, minimum purity 99.95 mole per cent.

2. and 3. Aldrich Chemical Company samples, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/MPa = \pm 0.02$;
$\delta x_{H_2}, \delta y_{H_2} = \pm 1\%$.

(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. 1,2,3,4-Tetrahydronaphthalene, [Tetralin); $C_{10}H_{12}$; [119-64-2]
3. 1,1'-Methylenebisbenzene, (Diphenylmethane); $C_{13}H_{12}$; [101-81-5]

ORIGINAL MEASUREMENTS:

Oliphant, J.L.; Lin, H.-M.; Chao, K.-C.

Fluid Phase Equil. 1979, *3*, 35-46.

EXPERIMENTAL VALUES:

		Mole fraction in liquid			Mole fraction in vapor		
T/K	$P/10^5$Pa	x_{H_2}	$x_{C_{10}H_{12}}$	$x_{C_{13}H_{12}}$	y_{H_2}	$y_{C_{10}H_{12}}$	$y_{C_{13}H_{12}}$
701.05	30.2	0.01920	0.446	0.534	0.251	0.421	0.328
701.05	30.2	0.01912	0.446	0.535	0.252	0.429	0.328
701.15	30.9	0.0212	0.409	0.570	0.274	0.376	0.349
700.75	50.4	0.0539	0.428	0.518	0.497	0.282	0.221
700.75	50.4	0.0538	0.428	0.518	0.495	0.283	0.223
701.05	151.0	0.202	0.392	0.406	0.761	0.1397	0.0993
701.05	151.0	0.203	0.398	0.405	0.760	0.1405	0.0993
701.05	253.0	0.328	0.311	0.361	0.828	0.0947	0.0773
701.05	253.0	0.316	0.316	0.368	0.835	0.0908	0.0742
701.05	253.0	0.321	0.313	0.365	0.835	0.0909	0.0745

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hydrogen sulfide; H_2S; [7783-06-4]
3. Nonane; C_9H_{20}; [111-84-2]

ORIGINAL MEASUREMENTS:

Eakin, B.E.; DeVaney, W.E.

Am. Inst. Chem. Eng. Symp. Ser., 1974, *70*, 80-90.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

		Mole fractions					
			in liquid			in vapor	
T/K	*p*/MPa	x_{H_2}	x_{H_2S}	$x_{C_9H_{20}}$	y_{H_2}	y_{H_2S}	$y_{C_9H_{20}}$
310.9	3.45	0.0265	0.0207	0.9528	0.9829	0.0167	0.00041
	6.89	0.0506	0.0212	0.9282	0.9902	0.0095	0.00029
	13.79	0.0927	0.0231	0.8842	0.9943	0.0056	0.00019
366.5	3.45	0.0348	0.0227	0.9425	0.9602	0.0348	0.00502
	6.89	0.0624	0.0237	0.9139	0.9773	0.0197	0.00302
	13.79	0.1188	0.0269	0.8543	0.9853	0.0129	0.00187
477.6	3.45	0.0490	0.0213	0.9297	0.8244	0.0680	0.1075
	6.89	0.0991	0.0227	0.8782	0.8880	0.0387	0.0733
	13.79	0.1859	0.0243	0.7898	0.9270	0.0218	0.0512
310.9	3.45	0.0202	0.1563	0.8235	0.8499	0.1498	0.00036
	6.89	0.0392	0.1541	0.8067	0.9225	0.0772	0.00025
	13.79	0.0846	0.1518	0.7636	0.9530	0.0468	0.00017
366.5	3.45	0.0212	0.1540	0.8248	0.7314	0.2647	0.00396
	6.89	0.0495	0.1462	0.8042	0.8534	0.1430	0.00365
	13.79	0.1042	0.1461	0.7497	0.9166	0.0819	0.00158
477.6	3.45	0.0232	0.1427	0.8341	0.3729	0.4866	0.1405
	6.89	0.0635	0.1627	0.7738	0.6400	0.2822	0.0778
	13.79	0.1570	0.1459	0.6971	0.8083	0.1603	0.0314

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stainless steel rocking equilibrium cell fitted with liquid and gas sampling ports. Pressure measured with Bourdon gauge. Components charged into cell under pressure, equilibrated and samples withdrawn. Samples analysed by GC using a termal conductivity detector and Porapak P column.

SOURCE AND PURITY OF MATERIALS:

1. Liquid Carbonic sample, purity 99.999 mole per cent.
2. Matheson sample, purity better than 99 mole per cent.
3. Phillips Petroleum sample, purity better than 99.6 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.05$;

$\delta x, \delta y = \pm 0.001$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hydrogen sulfide; H_2S; [7783-06-4]
3. 1,3,5-Trimethylbenzene, (Mesitylene); C_9H_{12}; [108-67-8]

ORIGINAL MEASUREMENTS:

Eakin, B.E.; DeVaney, W.E.,

Am. Inst. Chem. Eng. Symp. Ser., 1974, *70*, 80-90.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	p/MPa	x_{H_2}	x_{H_2S}	$x_{C_9H_{12}}$	y_{H_2}	y_{H_2S}	$y_{C_9H_{12}}$
		Mole fractions					
			in liquid			in vapor	
310.9	3.45	0.0124	0.0202	0.9674	0.9811	0.0187	0.00013
	6.89	0.0271	0.0203	0.9526	0.9889	0.0110	0.00014
	13.79	0.0525	0.0253	0.9224	0.9926	0.0073	0.00008
366.5	3.45	0.0174	0.0235	0.9590	0.9520	0.0465	0.00156
	6.89	0.0349	0.0273	0.9378	0.9719	0.0264	0.00171
	13.79	0.0702	0.0234	0.9064	0.9865	0.0123	0.00113
477.6	3.45	0.0274	0.0188	0.9538	0.8103	0.1008	0.0889
	6.89	0.0575	0.0192	0.9233	0.9013	0.0455	0.0532
	13.79	0.1135	0.0218	0.8647	0.9384	0.0279	0.0338
310.9	3.45	0.0121	0.1547	0.8332	0.8632	0.1367	0.00015
	6.89	0.0266	0.1523	0.8211	0.9265	0.0733	0.00016
	13.79	0.0521	0.1400	0.8079	0.9596	0.0403	0.00008
366.5	3.45	0.0156	0.1418	0.8426	0.7154	0.2808	0.00379
	6.89	0.0288	0.1624	0.8089	0.8238	0.1739	0.00226
	13.79	0.0615	0.1656	0.7729	0.9091	0.0897	0.00118
477.6	3.45	0.0104	0.1468	0.8428	0.2707	0.6308	0.0985
	6.89	0.0414	0.1465	0.8121	0.6147	0.3378	0.0475
	13.79	0.0965	0.1518	0.7518	0.8071	0.1905	0.0241

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stainless steel rocking equilibrium cell fitted with liquid and gas sampling ports. Pressure measured with Bourdon gauge. Components charged into cell under pressure, equilibriated and samples withdrawn. Samples analysed by GC using thermal conductivity detector and Porapak P column.

SOURCE AND PURITY OF MATERIALS:

1. Liquid Carbonic sample, purity 99.999 mole per cent.
2. Matheson sample, purity better than 99 mole per cent.
3. Eastman Kodak sample, normal boiling point 160-163°C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.05$;

$\delta x, \delta y = \pm 0.001$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hydrogen sulfide; H_2S; [7783-06-4]
3. 1-Methylethylcyclohexane, (isopropylcyclohexane); C_9H_{18}; [696-29-7]

ORIGINAL MEASUREMENTS:

Eakin, B.E.; DeVaney, W.E.

Am. Inst. Chem. Eng. Symp. Ser., 1974, *70*, 80-90.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

		Mole fractions					
		in liquid			in vapor		
T/K	p/MPa	x_{H_2}	x_{H_2S}	$x_{C_9H_{18}}$	y_{H_2}	y_{H_2S}	$y_{C_9H_{18}}$
310.9	3.45	0.0171	0.0210	0.9619	0.9809	0.0188	0.00027
	6.89	0.0350	0.0194	0.9456	0.9901	0.0097	0.00016
	13.79	0.0662	0.0216	0.9122	0.9933	0.0066	0.00019
366.5	3.45	0.0211	0.0210	0.9579	0.9533	0.0431	0.00364
	6.89	0.0455	0.0189	0.9356	0.9802	0.0181	0.00164
	13.79	0.0872	0.0251	0.8877	0.9839	0.0140	0.00213
477.6	3.45	0.0322	0.0166	0.9512	0.8419	0.0643	0.0937
	6.89	0.0683	0.0223	0.9094	0.9031	0.0477	0.0492
	13.79	0.1344	0.0225	0.8431	0.9240	0.0265	0.0495
310.9	3.45	0.0154	0.1403	0.8443	0.8575	0.1421	0.00031
	6.89	0.0323	0.1446	0.8231	0.9226	0.0772	0.00019
	13.79	0.0617	0.1448	0.7935	0.9552	0.0447	0.00017
366.5	3.45	0.0171	0.1478	0.8351	0.7057	0.2887	0.00563
	6.89	0.0396	0.1485	0.8119	0.8375	0.1589	0.00364
	13.79	0.0801	0.1493	0.7705	0.9047	0.0931	0.00220
477.6	3.45	0.0138	0.1424	0.8438	0.3303	0.5525	0.1172
	6.89	0.0483	0.1549	0.7968	0.6114	0.3202	0.0684
	13.79	0.1160	0.1560	0.7280	0.7696	0.1912	0.0392

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stainless steel rocking equilibrium cell fitted with liquid and gas sampling ports. Pressure measured with Bourdon gauge. Components charged into cell under pressure, equilibriated and samples withdrawn. Samples analysed by GC using a thermal conductivity detector and Porapak P column.

SOURCE AND PURITY OF MATERIALS:

1. Liquid Carbonic sample, purity 99.999 mole per cent.
2. Matheson sample, purity better than 99 mole per cent.
3. Phillips Petroleum sample, purity better than 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.05$;

$\delta x, \delta y = \pm 0.001$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hydrogen sulfide; H_2S; [7783-06-4]
3. Methane; CH_4; [74-82-8]
4. 1-Methylethylcyclohexane, (isopropylcyclohexane); C_9H_{18}; [696-29-7]

ORIGINAL MEASUREMENTS:

Eakin, B.E.; DeVaney, W.E.

Am. Inst. Chem. Eng. Symp. Ser., 1974, *70*, 80-90.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K = 310.9

p/MPa		3.45	6.89	13.79
Mole fraction in liquid	x_{H_2}	0.0110	0.0284	0.0613
	x_{H_2S}	0.1408	0.1451	0.1362
	x_{CH_4}	0.0301	0.0314	0.0339
	$x_{C_9H_{18}}$	0.8181	0.7951	0.7686
Mole fraction in vapor	y_{H_2}	0.5870	0.7740	0.8664
	y_{H_2S}	0.1451	0.0809	0.0444
	y_{CH_4}	0.2676	0.1449	0.0890
	$y_{C_9H_{18}}$	0.00035	0.00028	0.000230

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stainless steel rocking equilibrium cell fitted with liquid and gas sampling ports. Pressure measured with Bourdon gauge. Components charged into cell under pressure, equilibriated and samples withdrawn. Samples analysed by GC using thermal conductivity detector and Porapak P column.

SOURCE AND PURITY OF MATERIALS:

1. Liquid Carbonic sample, purity 99.999 mole per cent.
2. Matheson sample, purity better than 99 mole per cent.
3. No details given.
4. Phillips Petroleum sample, purity better than 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/MPa = \pm 0.05$;

$\delta x, \delta y = \pm 0.001$ (estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Hydrogen sulfide; H_2S; [7783-06-4] 3. Methane; CH_4; [74-82-8] 4. 1-Methylethylcyclohexane, (isopropylcyclohexane); C_9H_{18}; [696-29-7]	Eakin, B. E.; DeVaney, W. E. *Am. Inst. Chem. Eng. Symp. Ser.*, 1974, *70*, 80-90.

T/K = 366.5

p/MPa		3.45	6.89	13.79
Mole fraction in liquid	x_{H_2}	0.0100	0.0235	0.0754
	x_{H_2S}	0.1408	0.1405	0.1412
	x_{CH_4}	0.0313	0.0317	0.0332
	$x_{C_9H_{18}}$	0.8180	0.7953	0.7503
Mole fraction in vapor	y_{H_2}	0.3996	0.6824	0.8104
	y_{H_2S}	0.2592	0.1445	0.0878
	y_{CH_4}	0.3347	0.1696	0.0993
	$y_{C_9H_{18}}$	0.0065	0.0035	0.0025

T/K = 477.6

p/MPa		3.45	6.89	13.79
Mole fraction in liquid	x_{H_2}	0.0014	0.0381	0.1027
	x_{H_2S}	0.1437	0.1476	0.1514
	x_{CH_4}	0.0281	0.0308	0.0309
	$x_{C_9H_{18}}$	0.8268	0.7835	0.7150
Mole fraction in vapor	y_{H_2}	0.0325	0.4444	0.6700
	y_{H_2S}	0.5395	0.3164	0.1876
	y_{CH_4}	0.3103	0.1685	0.0976
	$y_{C_9H_{18}}$	0.1178	0.0707	0.0448

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hydrogen sulfide; H_2S; [7783-06-4]
3. Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Sadamoto, S.; Masuoka, H.; Eto, Y.
Kogyo Kagaku Zasshi 1969, *72*, 2174-7.

VARIABLES:

Temperature, pressure, gas composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid		Mole fractions in gas	
		x_{H_2}	x_{H_2S}	y_{H_2}	y_{H_2S}
273.15	1.01	0.003	0.043	0.925	0.075
		0.006	0.107	0.813	0.187
		0.002	0.205	0.702	0.298
		0.003	0.379	0.400	0.600
		0.002	0.617	0.237	0.763
		0.002	0.688	0.163	0.837
	3.04	0.007	0.043	0.974	0.026
		0.007	0.161	0.928	0.072
		0.007	0.195	0.924	0.076
		0.009	0.197	0.904	0.096
		0.007	0.327	0.781	0.219
		0.009	0.409	0.760	0.240
		0.010	0.685	0.672	0.327
	5.07	0.012	0.050	0.988	0.012
		0.014	0.149	0.962	0.038
		0.014	0.194	0.945	0.055
		0.010	0.221	0.945	0.055
		0.013	0.353	0.868	0.132
		0.015	0.401	0.854	0.146
		0.018	0.675	0.796	0.204
243.15	1.01	0.003	0.397	0.813	0.187
		0.010	0.668	0.692	0.308

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Vapor-liquid equilibrium cell. Diagram given in source. (Original in Japanese.)

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole per cent.

2. Purity 99.0 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; δx_{H_2}, $\delta x_{H_2S} = \pm 0.001$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Hydrogen sulfide; H_2S; [7783-06-4]
3. Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Sadamoto, S.; Masuoka, H.; Eto, Y. *Kogyo Kagaku Zasshi* 1969, *72*, 2174-7.

EXPERIMENTAL VALUES:

T/K	*P*/MPa	Mole fractions in liquid x_{H_2}	x_{H_2S}	Mole fractions in gas y_{H_2}	y_{H_2S}
243.15	1.01	0.004	0.721	0.702	0.298
		0.006	0.776	0.655	0.345
	3.04	0.006	0.397	0.813	0.187
		0.005	0.652	0.896	0.104
		0.006	0.704	0.971	0.030
	3.07	0.010	0.333	0.977	0.023
		0.013	0.621	0.941	0.059
		0.012	0.813	0.929	0.071

COMPONENTS:

1. Hydrogen, H_2; [1333-74-0]
2. Methylbenzene, (toluene); C_7H_8; [108-88-3]
3. Hexacarbonylbis (tributylphosphine) dicobalt; $C_{30}H_{54}Co_2O_6P_2$; [12101-96-1]

ORIGINAL MEASUREMENTS:

Kharchenko, A.A.; Legtyareva, L.V.; Zhesko, T.E. Barinov, N.S.

Zhur. Fiz. Khim. 1975, *49*, 2405-6

VARIABLES:

Pressure, composition

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

$T/K = 328.15$

P_{H_2}/atm	Conc. of (3)	H_2 Solubility, *M*	Mol (1) /mol (3)
40	0.0	0.12	-
60		0.18	-
80		0.23	-
100		0.29	-
120		0.34	-
140		0.40	-
160		0.46	-
180		0.52	-
40	1.5 mass%	0.16	2.1
60	(0.0192 M)	0.24	3.6
80		0.32	4.3
100		0.38	5.1
120		0.46	6.1
140		0.53	6.6
160		0.59	7.0
180		0.66	7.5
40	4 mass%	0.19	1.3
60	(0.0512 M)	0.29	2.3
80		0.39	4.1
100		0.50	4.2
120		0.60	5.0

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Method stated as an analytical high pressure method and ref. (1) given as reference.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.82 mole per cent.
2. Analytical reagent quality
3. No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta M = \pm 8\%$.

(estimated by compiler)

REFERENCES:

1. Tsiklis, D.S. *Technique of Physicochemical Investigations at High and Ultra-High Pressures.* Khimiya,Moscow, 1965.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Methylbenzene, (toluene); C_7H_8; [108-88-3]
3. Hexacarbonylbis (tributylphosphine) dicobalt; $C_{30}H_{54}Co_2O_6P_2$; [12101-96-1]

ORIGINAL MEASUREMENTS:

Kharchenko, A.A. Legtyareva, L.V.; Zhesko, T.E.; Barinov, N.S.

Zhur. Fiz. Khim. 1975, *49*, 2405-6.

EXPERIMENTAL VALUES:

T/K = 328.15

P_{H_2}/atm	Conc. of (3)	H_2 solubility, *M*	Mol (1)/mol (3)
140	4 mass %	0.74	6.6
160	(0.0512 M)	0.84	7.4
180		0.98	9.0
40	8 mass %	0.19	0.7
60	(0,1025 M)	0.29	1.2
80		0.41	1.8
100		0.54	2.5
120		0.68	3.3
140		0.83	4.2
160		1.00	5.7

M appears to be moles per litre and column headed mol (1)/mol (3) appears to be deduced by subtracting the amount of hydrogen dissolved in the toluene from the total amount of hydrogen dissolved.

NOTE: Table taken from *Russ J. Phys. Chem.* 1975, *49*, 1409-10.

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Argon; Ar; [7440-37-1]	Colin L. Young, Department of Chemistry, University of Melbourne, Parkville, Victoria 3052, AUSTRALIA. May, 1980

CRITICAL EVALUATION:

Although this system has been studied by five different groups (1-5) there is a surprising lack of agreement between the various workers. The most extensive study is that of Calado and Streett (1), who studied coexisting vapor and liquid compositions at temperatures from 83 K to 141 K and pressures up to 52 MPa. Volk and Halsey (2) determined liquid phase compositions only, in the temperature range 87 to 140 K and pressures to 10 MPa. Mullins and Zeigler (3) studied coexisting vapor and liquid compositions in the temperature range 68 to 108 K and pressures to 12 MPa. Augood (4) made measurements at 87.4 K at two pressures of 18.4 and 11.6 MPa. Ostronov et al. (5) made measurements from 86 to 113 K at pressures between 1 and 4 MPa.

The very limited data of Augood (4) are consistent with those of Calado and Streett (1). The vapor composition given by Calado and Streett (1) are about 0.03 to 0.05 mole fraction higher than those of Mullins and Zeigler (3) but are sometimes higher and sometimes lower than those given by Ostronov et al. (5). There is reasonable agreement between the data of Volk and Halsey (2), and Calado and Streett (1) for the liquid compositions at 2 MPa but considerable differences at the higher pressures above 100 K. The liquid composition values of Calado and Streett (1) are smaller by about 0.005 than those of Mullins and Zeigler (3). There is fair agreement between the liquid phase compositions of Mullins and Zeigler (3) and Ostronov et al. (5).

The measurements of Calado and Streett (1) were made on ultra high purity samples using a well tried apparatus design and are probably the most accurate. However, in view of the differences between the various workers, the data of Volk and Halsey (2), Mullins and Zeigler (3), Ostronov et al. (5) and Calado and Streett (1) are all classified as tentative. Further measurements with carefully purified samples are needed.

References

1. Calado, J. C. G.; Streett, W. B. *Fluid Phase Equilibria* 1979, *2*, 275.
2. Volk, H.; Halsey, G. D. *J. Chem. Phys.* 1960, *33*, 1132.
3. Mullins, J. C.; Zeigler, W. T. *Intern. Adv. Cryog. Engng.* 1960, *10*, 171.
4. Augood, D. R. *Trans. Instn. Chem. Engnrs.* 1957, *35*, 394.
5. Ostronov, M. G.; Shatskaya, L. V.; Finyagina, R. A.; Brodskaya, L. F.; Zhironova, N. A. *Zhur. Fiz. Khim.* 1977, *51*, 2396.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Argon; Ar; [7440-37-1]

ORIGINAL MEASUREMENTS:

Augood, D. R.

Trans. Instn. Chem. Engnrs.

1957, *35*, 394-408.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig⁺	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
87.4	2650	18.37	0.187	0.941
	2650	18.37	0.181	-
	1670	11.62	0.103	0.948
	1670	11.62	0.091	0.912

⁺ psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The argon was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. British Oxygen Company sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = 4% (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0];

2. Argon; Ar; [7440-37-1]

ORIGINAL MEASUREMENTS:

Volk, H.; Halsey, G. D.

J. Chem. Phys. 1960, *33*, 1132-1139.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	$P^{\dagger}$/bar	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	P/bar	$P^{\dagger}$/bar	Mole fraction of hydrogen in liquid, x_{H_2}
87.0	22.51	24.54	0.0253	87.0	91.26	97.74	0.0860
	24.91	26.96	0.0278	94.2	14.39	16.74	0.0189
	28.01	30.24	0.0308		16.04	18.43	0.0210
	31.97	34.44	0.0349		18.25	20.69	0.0233
	37.39	40.23	0.0402		21.01	23.87	0.0268
	37.75	40.58	0.0408		24.83	27.93	0.0314
	41.91	45.02	0.0451		28.80	32.20	0.0365
	45.22	48.61	0.0481		30.39	33.89	0.0384
	47.22	50.69	0.0499		31.99	35.42	0.0405
	54.22	58.22	0.0565		35.90	39.58	0.0450
	57.87	62.19	0.0595		40.80	44.94	0.0504
	64.27	69.19	0.0652		42.29	46.46	0.0525
	66.53	71.48	0.0671		46.62	51.00	0.0578
	68.87	73.98	0.0691		52.31	57.00	0.0642
	71.38	76.67	0.0712		55.07	59.98	0.0672
	74.16	79.63	0.0733		59.29	64.46	0.0711
	77.04	82.70	0.0758		61.05	66.40	0.0735
	80.22	86.09	0.0780		69.19	74.88	0.0810
	83.67	89.74	0.0804		69.37	75.05	0.0820
	87.23	93.49	0.0829				(cont.)

P = fugacity of hydrogen. $P^{\dagger}$ = total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell. Temperature measured with thermocouple and pressure measured with Bourdon gauge calibrated against a dead weight tester. Composition of liquid calculated from number of moles in gas phase and total number of moles.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.05$;

$\delta x_{H_2} < \pm 2\%$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0];	Volk, H.; Halsey, G. D.
2. Argon; Ar; [7440-37-1]	*J. Chem. Phys.* 1960, *33*, 1132-1139.

EXPERIMENTAL VALUES:

T/K	*P*/bar	$P^{\dagger}$/bar	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	*P*/bar	$P^{\dagger}$/bar	Mole fraction of hydrogen in liquid, x_{H_2}
94.2	80.00	86.32	0.0915	120.0	22.42	36.82	0.0418
	82.95	89.36	0.0945		24.60	39.21	0.0455
	95.51	102.39	0.1056		27.34	42.13	0.0499
100.0	13.68	17.69	0.0197		30.65	45.71	0.0552
	15.10	19.16	0.0214		34.88	50.27	0.0639
	16.79	20.92	0.0236		36.07	51.57	0.0660
	18.89	23.15	0.0264		37.33	53.54	0.0680
	21.68	26.11	0.0306		40.82	56.61	0.0740
	25.53	30.10	0.0360		44.91	61.07	0.0814
	30.72	35.42	0.0428		49.98	66.30	0.0902
	31.17	35.76	0.0435		56.19	73.05	0.1000
	34.08	38.82	0.0475		64.12	81.64	0.1129
	38.06	42.88	0.0530		76.41	95.83	0.1299
	43.49	48.47	0.0600	130.0	25.99	50.20	0.0558
	45.63	50.65	0.0632		28.59	53.16	0.0613
	50.02	55.33	0.0676		31.71	56.67	0.0670
	50.14	55.43	0.0684		36.64	62.24	0.0771
	56.02	61.57	0.0760		40.32	66.36	0.0845
	59.43	65.09	0.0801		44.83	71.43	0.0932
	63.47	69.26	0.0848		45.64	72.33	0.0952
	66.11	71.98	0.0878		45.68	72.40	0.0952
	73.68	79.77	0.0975		46.83	73.63	0.0975
	74.53	80.53	0.0978		52.06	79.08	0.1078
	85.64	91.97	0.1095		52.23	79.44	0.1080
	87.28	93.63	0.1115		57.09	85.01	0.1169
110.0	23.25	31.76	0.0372		62.85	91.35	0.1275
	25.66	34.34	0.0410	140.0	24.96	61.29	0.0615
	28.73	37.52	0.0458		27.54	63.95	0.0670
	32.65	41.64	0.0515		29.30	66.67	0.0723
	38.06	47.22	0.0596		32.21	69.77	0.0779
	38.24	47.40	0.0602		32.77	70.39	0.0796
	42.48	51.97	0.0662		34.20	71.70	0.0824
	47.74	57.52	0.0742		34.57	72.40	0.0833
	54.51	64.81	0.0834		35.90	73.85	0.0863
	63.67	74.61	0.0961		39.22	77.71	0.0943
	63.74	74.68	0.0960		39.92	78.53	0.0953
	65.71	76.74	0.0986		41.46	80.26	0.0990
	67.87	78.91	0.1010		43.76	82.94	0.1044
	70.25	81.47	0.1042		44.36	83.63	0.1060
	81.42	93.22	0.1178		50.78	91.01	0.1199
	85.51	97.58	0.1229		52.92	93.35	0.1245
					55.18	95.90	0.1295

P = fugacity of hydrogen. $P^{\dagger}$ = total pressure.

COMPONENTS:

1. Deuterium; D_2; [7782-39-0];

2. Argon; Ar; [7440-37-1]

ORIGINAL MEASUREMENTS:

Volk, H.; Halsey, G. D.

J. Chem. Phys. 1960, *33*, 1132-1139.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	$P^\dagger$/bar	Mole fraction of deuterium in liquid, x_{D_2}	T/K	P/bar	$P^\dagger$/bar	Mole fraction of deuterium in liquid, x_{D_2}
87.0	22.42	24.34	0.0317	100.0	44.71	50.44	0.0734
	24.52	25.57	0.0348		48.87	54.82	0.0782
	27.12	29.34	0.0381		53.95	60.16	0.0860
	30.42	32.85	0.0424		60.39	66.92	0.0970
	34.73	37.15	0.0480		68.94	75.84	0.1088
	40.31	43.44	0.0557		80.90	88.25	0.1236
	48.75	52.54	0.0669		83.31	90.74	0.1270
	51.26	55.16	0.0693	120.0	18.66	32.86	0.0409
	53.65	57.85	0.0721		26.26	41.25	0.0574
100.0	17.54	21.75	0.0298		32.90	48.19	0.0720
	19.10	23.38	0.0322		35.64	51.16	0.0771
	20.90	25.30	0.0353		39.01	55.02	0.0840
	23.10	27.63	0.0388		43.15	59.50	0.0920
	25.89	30.58	0.0432		48.32	65.08	0.1021
	29.46	34.34	0.0489		53.54	70.69	0.1119
	34.15	39.30	0.0564				

P = fugacity of deuterium.

$P^\dagger$ = total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell. Temperature measured with thermocouple and pressure measured with Bourdon gauge calibrated against a dead weight tester. Composition of liquid calculated from number of moles in gas phase and total number of moles.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.05$;

$\delta x_{D_2} < \pm 2\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Argon; Ar; [7440-73-1]

ORIGINAL MEASUREMENTS:

Mullins, J. C.; Ziegler, W. T.
Internat. Adv. Cryogen. Eng.
1964, *10*, 171-181.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
86.95	60.87	-	0.9395	105.01	80.99	-	0.8347
86.97	121.89	-	0.9316	86.95	60.87	0.0636	-
86.94	101.53	-	0.9397		101.60	0.1024	-
	81.06	-	0.9459		81.06	0.0847	-
	40.87	-	0.9479	86.94	40.87	0.0432	-
	20.25	-	0.9290		20.25	0.02143	-
94.21	121.93	-	0.8955	94.21	121.93	0.1458	-
94.20	101.67	-	0.9054	94.20	101.67	0.1207	-
94.21	81.06	-	0.9119	94.21	81.06	0.0962	-
	60.80	-	0.9143		60.80	0.0720	-
	40.33	-	0.9056		40.33	0.0471	-
	20.40	-	0.8648	94.20	20.40	0.02301	-
99.95	61.21	-	0.8746	99.95	40.53	0.0506	-
	40.53	-	0.8585	99.97	20.29	0.02311	-
99.96	20.29	-	0.7888	99.94	121.32	0.1644	-
99.94	121.32	-	0.8582		101.67	0.1351	-
	101.67	-	0.8688	99.96	81.06	0.1058	-
99.95	81.06	-	0.8754	99.94	61.48	0.0789	-
	61.48	-	0.8749	105.01	61.00	0.0827	-
105.01	61.00	-	0.8306	105.00	40.95	0.0529	-
105.00	40.95	-	0.8046	105.01	20.53	0.02292	-
105.01	20.53	-	0.7065		121.17	0.1801	-
105.00	121.17	-	0.8168	105.02	101.60	0.1473	-
105.02	101.60	-	0.8291	105.01	80.99	0.1138	-

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Single pass flow apparatus with two compartment equilibrium cell. Temperature measured with platinum resistance thermometer; pressure measured with Bourdon gauge. Pure hydrogen bubbled through liquid argon. Samples analysed by gas chromatography. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. and 2. Commercial samples with stated purities better than 99.995 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$; $\delta P/\text{bar} = \pm 0.5\%$; $\delta x_{H_2} < \pm 2\%$; $\delta(1-y_{H_2}) < \pm 3\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Argon; Ar; [7440-37-1]

ORIGINAL MEASUREMENTS:

Ostronov, M.G. Shatskaya, L.V.; Finyagina, R.A.; Brodskaya, L.F.; Zhironova, N.A.

Zhur. Fiz. Khim. 1977, *51*, 2396-2398

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
112.8	10	1.01	0.0041	0.224
	12	1.22	0.0084	0.350
	14	1.42	0.0128	0.434
	16	1.62	0.0171	0.493
	18	1.82	0.0225	0.538
	20	2.03	0.0258	0.574
	25	2.53	0.0367	0.639
	30	3.04	0.0475	0.683
	35	3.55	0.0584	0.720
	40	4.05	0.0692	0.746
102	5	0.51	0.0022	0.300
	6	0.61	0.0030	0.412
	7	0.71	0.0047	0.477
	8	0.81	0.0064	0.524
	9	0.91	0.0080	0.561
	10	1.01	0.0098	0.591
	12	1.22	0.0132	0.638
	14	1.42	0.0165	0.675
	16	1.62	0.0198	0.706
	18	1.82	0.0232	0.730
	20	2.03	0.0266	0.754
	25	2.53	0.0350	0.800
	30	3.04	0.0434	0.826
	35	3.55	0.0518	0.830
	40	4.05	0.0600	0.834

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating flow method with magnetic recirculating pump. The liquid and gaseous samples were analysed by GC using a 5A Molecular sieve. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic grade oil vapor and oxygen removed, dried
2. Grade A purity 99.987 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P = \pm 0.3\%$;
$\delta(1-x_{H_2})$, $\delta(1-y_{H_2}) = \pm 1\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Argon; Ar; [7440-37-1]

ORIGINAL MEASUREMENTS:

Ostronov, M.G.; Shatskaya, L.V.; Finyagina, R.A.; Brodskaya, L.F.; Zhironova, N.A.

Zhur. Fiz. Khim. 1977, *51*, 2396-2398

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
93	5	0.51	0.0042	0.636
	6	0.61	0.0055	0.667
	7	0.71	0.0068	0.694
	8	0.81	0.0088	0.718
	9	0.91	0.0096	0.739
	10	1.01	0.0107	0.758
	12	1.22	0.0135	0.789
	14	1.42	0.0162	0.815
	16	1.62	0.0188	0.835
	18	1.82	0.0215	0.851
	20	2.03	0.0242	0.865
	25	2.53	0.0310	0.887
	30	3.04	0.0376	0.899
	35	3.55	0.0443	0.906
	40	4.05	0.0510	0.916
85.93	5	0.51	0.0051	0.828
	6	0.61	0.0062	0.845
	7	0.71	0.0074	0 858
	8	0.81	0.0086	0.871
	9	0.91	0.0096	0.881
	10	1.01	0.0107	0.892
	12	1.22	0.0130	0.908
	14	1.42	0.0152	0.920
	16	1.62	0.0174	0.930
	18	1.82	0.0196	0.936
	20	2.03	0.0218	0.940
	25	2.53	0.0274	0.948
	30	3.04	0.0327	0.952
	35	3.55	0.0384	0.953
	40	4.05	0.0440	0.953

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Argon; Ar; [7440-37-1]

ORIGINAL MEASUREMENTS:

Calado, J. C. G.; Streett, W. B.

Fluid Phase Equilibria

1979, *2*, 275-282.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen		T/K	P/MPa	Mole fraction of hydrogen	
		in liquid, x_{H_2}	in gas, y_{H_2}			in liquid, x_{H_2}	in gas, y_{H_2}
83.09	10.34	0.0865	0.9820	84.50	35.30	0.3022	-
	13.93	0.1131	0.9764		39.64	0.3476	0.8170
	17.24	0.1378	0.9698		43.09	0.3934	0.7770
	21.03	0.1630	0.9527		46.54	0.4508	0.7260
	28.48	0.2212	0.9366		48.40	0.4902	0.6968
	31.03	0.2404	0.9180		49.23	0.5142	0.6835
	33.09	0.2549	0.9065		49.92	0.5495	0.6584
83.40	4.83	0.0403	0.9836	85.65	1.38	0.0026	0.9427
	8.27	0.0706	0.9820		2.21	0.0130	0.9688
	10.34	0.0876	0.9798		3.65	0.0354	0.9828
	13.79	0.1152	0.9740		4.20	0.0404	0.9800
	17.44	0.1426	0.9670		4.83	0.0466	0.9764
	20.68	0.1676	0.9585		5.79	0.0563	0.9802
	24.34	0.1922	0.9467		6.89	0.0674	0.9800
	27.78	0.2144	0.9333		8.38	0.0806	0.9808
	31.03	0.2393	0.9200		9.44	0.0908	0.9745
	34.47	0.2722	0.8970		10.89	0.1036	0.9722
	39.30	0.3166	0.8590		13.10	0.1226	0.9760
83.74	45.30	0.4005	0.7623		17.37	0.1577	0.9652
	46.54	0.4158	0.7680		20.75	0.1852	0.9502
84.05	49.71	0.4992	0.6890		23.86	0.2128	0.9393
	50.68	0.5190	0.6762		28.37	0.2540	0.9057
	51.43	0.6246	0.6532				

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetically operated pump. Pressure measured with manganin pressure gauge. Temperature measured with platinum resistance thermometer. Samples of liquid and gas analysed using thermal conductivity gas analyser. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. and 2. Linde Division of Union Carbide Co. samples, ultra high purity grade with minimum purity of 99.999 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.05$;
δx_{H_2}, δy_{H_2} = ±0.005 (may be larger near critical point).

REFERENCES:

1. Streett, W. B.; Calado, J. C. G. *J. Chem. Thermodynamics* 1978, *10*, 1089.

1. Hydrogen; H_2; [1333-74-0] 2. Argon; Ar; [7440-37-1]	Calado, J. C. G.; Streett, W. B. *Fluid Phase Equilibria* 1979, *2*, 275-282.

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}	T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
85.65	31.03	0.2796	0.8765	104.11	22.82	0.4340	0.6930
	35.58	0.3284	0.8375		23.59	-	0.6582
	40.95	0.4004	0.7765	111.46	1.72	0.0157	0.0544
	41.78	0.4066	0.7620		2.83	0.0311	0.6648
	43.16	0.4278	0.7507		4.41	0.0565	0.7490
	44.82	0.4590	0.7260		6.41	0.0884	0.7870
	46.47	0.4917	0.6740		9.03	0.1352	0.7990
	47.57	-	0.6333		11.03	0.1744	0.7890
90.16	24.27	0.2492	0.9056		14.13	0.2440	0.7533
	27.85	0.2973	0.8605		16.06	0.3071	0.7138
	33.30	0.3884	0.7863		17.58	0.3664	0.6762
	36.54	0.4311	0.7270		18.75	0.4427	0.6020
	37.58	0.4714	0.7068	122.73	3.45	0.0375	0.4406
	38.26	-	0.6795		4.20	0.0480	0.4986
95.77	1.38	0.0132	0.7877		5.93	0.0802	0.5768
	2.07	0.0213	0.8735		6.45	0.0933	0.5875
	3.45	0.0397	0.9383		7.72	0.1235	0.6089
	5.38	0.0621	0.9513		8.93	0.1501	0.6118
	7.58	0.0891	0.9613		10.34	0.1891	0.6050
	9.17	0.1025	0.9497		11.03	0.2158	0.5900
	10.27	0.1142	0.9503		12.06	0.2449	0.5811
	13.10	0.1495	0.9407		12.55	0.2655	0.5654
	14.96	0.1734	0.9243		13.41	0.2854	0.5383
	18.48	0.2223	0.8965		14.27	0.3487	-
	20.41	0.2514	0.8645	134.91	4.83	0.0520	0.3110
	21.99	0.2774	0.8550		5.27	0.0682	0.3309
	24.48	0.3245	0.8060		5.65	0.0744	0.3425
	25.79	0.3459	0.7703		6.27	0.0804	0.3579
	27.44	0.3914	0.7553		6.55	0.0930	0.3751
	28.96	0.4458	0.7070		6.89	0.1099	0.3768
	29.54	0.4486	0.6910		7.31	0.1147	0.3889
	30.40	0.5375	0.6442		7.86	0.1332	0.3963
104.11	1.10	-	0.6002		8.34	0.1510	0.3961
	1.52	0.0172	0.6892		8.93	0.1692	0.3947
	1.72	0.0177	0.7028		9.24	0.1929	0.3895
	2.07	0.0226	0.7367		9.65	0.2177	0.3667
	2.90	0.0336	0.7990		10.14	0.2577	0.2606
	4.07	0.0482	0.8495	141.42	5.10	0.0442	0.1769
	6.20	0.0787	0.8925		5.51	0.0532	0.2003
	8.69	0.1142	0.9053		6.03	0.0680	0.2202
	11.44	0.1572	0.8900		6.48	0.0838	0.2357
	14.00	0.1965	0.8590		7.03	0.1129	0.2441
	17.44	0.2664	0.8170		7.41	0.1247	0.2481
	20.96	0.3600	0.7397		7.86	0.1445	-

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] or Deuterium; D_2; [7782-39-0] 2. Neon; Ne; [7440-01-9]	Colin L. Young, Department of Chemistry, University of Melbourne, Parksville, 3052: Vic. AUSTRALIA: June, 1980

The deuterium and neon system has been studied by Simon (1,2) at the triple point of neon. The limited nature of the measurements make evaluation difficult but the same worker's data on the neon and hydrogen system (3) are not consistent with data thought to be reliable (see below). Therefore the data are classified as doubtful. Brouwer *et al.* (4) have studied the liquid-liquid and solid-liquid phase boundaries of the neon-deuterium system.

The hydrogen and neon system has been studied by Simon (3), Streett and Jones (5), Heck and Barrick (6) and by Van't Zelfde and Dokoupil (7).

The data of Heck and Barrick (6) cover vapor-liquid equilibrium from 26 to 42.5 K whereas those of Streett and Jones (5) cover the temperature range 24.6 to 33.7 K. These two sets of data are in good agreement and are classified as tentative.

The data of Simon (3) were presented in graphical form and are not consistent with the data Streett and Jones (5) and are not considered further here. There are considerable inconsistencies between the data of Van't Zelfde and Dokoupil (7) and those of Streett and Jones (5). The former worker's data are claimed to be more accurate but are restricted to a much smaller pressure range. The experimental method of Van't Zelfde and Dokoupil (7) is generally less reliable than that of Streett and Jones (5) or of Heck and Barrick (6) and the evaluator suggests that the more recent data of Van't Zelfde and Dokoupil are in error. The error may be partly due to impurities in the gases (to which the method is very sensitive) or may be due to a systematic error in the volume of the apparatus.

REFERENCES:

1. Simon, M. *Physica*, 1963, *29*, 1079
2. Simon, M. *Phys.Lett* 1962 *2*, 234
3. Simon, M. *Phys.Lett* 1963, *5*, 319
4. Brouwer, J.P.; Hermans, L.J.F.; Knapp, H.F.P.; Beennakker, J.J.M. *Physica*, 1964, *30*, 1409.
5. Streett, W.B.; Jones, C.H. *J.Chem.Phys.* 1965, *42*, 3989
6. Heck, C.H.; Barrick, P.L. *Advan.Crogenic. Eng.* 1965, *11*, 349
7. Van't Zelfde, P.; Dokoupil, Z. *Physica*, 1974, *74*, 423.

COMPONENTS:

1. Deuterium; nD_2; [7782-39-0]
2. Neon; Ne; [7440-01-9]

ORIGINAL MEASUREMENTS:

Simon, M.

Physica 1963, *29*, 1079-1086.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/cmHg	P/kPa	Mole fraction of neon in liquid, x_{Ne}	Mole fraction of neon in vapor, y_{Ne}
24.56	98.2	130.92	0.0000	-
	108.33	144.43	0.0645	-
	111.62	148.81	0.1015	-
	114.16	152.20	0.1480	-
	115.78	154.36	0.2118	-
	116.13	154.83	0.2641	-
	116.15	154.85	0.3110	-
	116.10	154.79	0.4897	-
	116.15	154.85	0.6104	-
	116.15	154.85	0.8208	-
	110.87	147.81	0.8724	-
	84.15	112.19	0.9337	-
	32.51	43.34	1.0000	-
	98.1	130.79	-	0.0000
	105.7	140.92	-	0.1019
	112.5	149.99	-	0.1947
	115.75	154.32	-	0.2501
	115.7	154.3	-	0.2781
	99.8	133.1	-	0.3264
	67.5	90.0	-	0.4802
	50.5	67.3	-	0.6339
	32.51	43.34	-	1.0000

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Temperature measured with Platinum resistance thermometer. Composition at dew and bubble points estimated from a knowledge of total volume and amount of substance in systems. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Prepared by electrolysis of heavy water. Mass spectrometry indicated about 1% of HD.
2. At least 99.99 mole per cent pure.

ESTIMATED ERROR:

$\delta T/K = \pm 0.003$; $\delta P/\text{cmHg} = \pm 0.05$; δx_{Ne}, $\delta y_{Ne} = \pm 1\%$.

REFERENCES:

1. Mathot, V.; Staveley, L. A.; Young, J. A.; Parsonage, N. G. *Trans. Faraday Soc.* 1956, *52*, 1488.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Neon; Ne; [7440-01-9]

ORIGINAL MEASUREMENTS:

Heck, C. K.; Barrick, P. L.
Adv. Cryogen. Engng.
1965, *11*, 349-355.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

		Mole fraction of hydrogen				Mole fraction of hydrogen	
T/K	*P*/bar	in liquid, x_{H_2}	in vapor, y_{H_2}	T/K	*P*/bar	in liquid, x_{H_2}	in vapor, y_{H_2}
26.00	0.72	0.0000	0.0000	28.00	5.43	0.0691	-
	2.15	-	0.6370		5.84	-	0.7180
	2.28	-	0.6580		5.89	0.6010	0.7350
	2.87	-	0.7190		5.93	0.6510	0.7400
	3.07	0.0224	-		5.96	0.6740	0.7490
	3.41	-	0.7580		6.01	0.7980	0.8050
	3.68	0.0409	-		6.03	0.8400	0.8340
	3.84	0.0413	-		5.88	-	0.9274
	3.88	0.0412	-		5.81	0.9578	0.9428
	3.92	0.0469	-		5.76	1.0000	1.0000
	4.03	-	0.7950	30.00	2.24	0.0000	0.0000
	4.05	0.7680	0.8010		2.26	-	0.0307
	4.11	0.8120	0.8270		3.26	-	0.3160
	4.13	0.8220	0.8210		4.12	-	0.4150
	4.11	0.8420	0.8400		5.12	0.0283	0.5070
	4.11	0.8630	0.8550		6.09	0.0550	0.5880
	4.09	0.9115	0.9035		6.79	-	0.6140
	3.92	1.0000	1.0000		6.93	0.0893	-
28.00	1.32	0.0000	0.0000		6.99	-	0.6310
	2.89	-	0.5030		7.02	0.0937	-
	3.57	-	0.5910		7.68	-	0.6630
	3.78	0.0137	-		7.80	0.2360	-
	4.44	-	0.6650		7.84	-	0.6740
	4.57	0.0311	-				

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Vapor recirculated through cell. Liquid and vapor samples analysed by gas chromatography. Pressure measured by Bourdon gauge and temperature measured with platinum resistance thermometer. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

1. Maximum impurity 10 parts per million.
2. Matheson research grade. maximum impurity 80 parts per million.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.01$ below 10 bar; ± 0.1 above 10 bar; $\delta x_{H_2} = \pm 2\%$.

REFERENCES:

1. Herring, R. N.; Barrick, R. L. *Adv. Cryogen. Engng.* 1965, *10*, 151.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0]	Heck, C. K.; Barrick, P. L.
	Adv. Cryogen. Engng.
2. Neon; Ne; [7440-01-9]	1965, *11*, 349-355.

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
30.00	7.98	0.4400	-	34.66	16.0	0.5220	0.5600
	8.24	0.6270	0.6960	37.64	10.1	0.0000	0.0000
	8.49	0.7160	0.7430		11.6	0.0182	0.1060
	8.55	0.7890	0.7880		13.3	0.0439	0.1900
	8.56	0.8310	0.8200		14.0	-	0.2230
	8.54	0.8540	0.8400		15.4	-	0.2740
	8.50	0.8720	0.8550		16.2	0.1110	0.3060
	8.38	0.9137	-		18.0	0.1780	0.3500
	8.36	-	0.8980		19.0	0.2040	0.3640
	8.31	0.9372	-		21.1	0.3500	0.3980
	8.29	-	0.9218	39.57	13.7	0.0000	0.0000
	8.11	1.0000	1.0000		16.5	0.0428	0.1390
34.66	6.04	0.0000	0.0000		17.0	0.0503	0.1510
	7.45	0.0178	0.1780		19.0	0.0896	0.2100
	8.00	0.0243	0.2120		21.3	0.1590	0.2550
	9.84	-	0.3410		21.7	0.1690	0.2620
	9.84	0.0560	0.3480	42.50	20.8	0.0000	0.0000
	10.23	-	0.3630		21.9	0.0176	0.0369
	11.8	0.1100	0.4180		23.9	-	0.0817
	13.1	0.1980	0.4600		24.1	0.0511	-
	14.5	0.3070	0.5070		24.6	0.0627	0.0920
	14.9	-	0.5160		25.1	0.0693	0.0933
	15.6	0.4330	0.5410				

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Neon; Ne; [7440-01-9]	Streett, W. B.; Jones, C. H. *J. Chem. Phys.* 1965, *42*, 3989-3994.

VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
24.59	1.74	0.0133	0.7364	27.15	4.57	0.0488	0.7439
	2.15	0.0171	0.7840		4.88	0.0630	0.7600
	2.15	-	0.7843		5.13	0.0762	0.7698
	2.46	0.0213	0.8085		5.17[a]	0.0804	0.7714
	2.77	0.0257	0.8265		5.17[a]	0.0803	0.7715
	3.03	0.0298	0.8410		5.17[a]	0.0803	0.7724
	3.04	0.0312	0.8424	28.12	2.23	0.0083	0.3598
	3.05[a]	0.0315	0.8416		3.35	0.0234	0.5693
	3.05[a]	0.0314	-		4.97	0.0574	0.6982
26.33	2.14	0.0134	0.6232		6.00[a]	0.1232	0.7440
	2.14	0.0151	-		6.00[a]	0.1236	0.7447
	3.55	0.0329	0.7485	29.0	2.60	0.0099	0.3225
	4.03	0.0442	0.7748		3.39	0.0203	0.4668
	4.38	0.0536	0.7899		4.61	0.0403	0.5946
	4.49[a]	0.0589	0.7950		5.87	0.0772	0.6726
	4.49[a]	0.0600	0.7972		6.61	0.1322	0.7049
	4.48[a]	0.0584	-		6.67	0.1457	0.7078
	4.48[a]	0.0579	-		6.72	0.1640	0.7130
	4.48[a]	0.0580	-		6.76	0.1729	0.7133
27.15	2.31	0.0156	0.5422		6.77	0.2246	0.7100
	3.14	0.0243	0.6444		6.77	0.2260	0.7102
	3.83	0.0346	0.7020				

(cont.)

[a] Indicates pressure at which 3 phases are present.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Recirculating vapor flow apparatus with magnetic pump at ambient temperature. Samples analysed by thermal conductivity. Temperature measured with platinum resistance thermometer. Pressure measured using Bourdon gauge. Details in source.	No details given.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.01$ (up to 10 bar); ± 0.1 (above 10 bar); δx_{H_2}, $\delta y_{H_2} = \pm 0.001$.
	REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Neon; Ne; [7440-01-9]

ORIGINAL MEASUREMENTS:

Streett, W. B.; Jones, C. H.

J. Chem. Phys. 1965, *42*, 3989-3994.

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
29.00	6.77	0.2243	-	31.51	10.87	0.6971	0.7307
	6.78	0.3248	0.7135		10.98	0.7681	0.7740
	6.78	0.4093	0.7154		10.98	0.8505	0.8396
	6.78	0.5018	0.7211		10.64	0.9441	0.9334
	6.83	0.5552	0.7255		10.65	0.9436	0.9325
	6.88	0.6000	0.7319		10.43	0.9719	0.9645
	6.94	0.6375	0.7402	33.73	7.27	0.0308	0.2793
	6.98	0.6940	0.7586		9.34	0.0723	0.4109
	7.10	0.7318	0.7733		11.03	0.1254	0.4830
	7.14	0.7640	0.7873		12.58	0.2486	0.5370
	7.15	0.7933	0.8027		13.65	0.4203	0.5782
	7.16	0.8168	0.8184		13.82	0.4735	0.5899
	7.12	0.8509	0.8423		13.84	0.4766	0.5914
	7.06	0.9183	0.9008		13.89	0.4847	0.5938
	6.92	0.9620	0.9495		13.88	0.4860	0.5941
31.51	4.14	0.0099	0.1908	28.65	6.51[a]	0.1708	0.7265
	5.48	0.0291	0.3784		6.51	0.1695	-
	7.75	0.0803	0.5428		6.51	0.4682	-
	9.20	0.1814	0.6054	28.80	6.67[a]	0.1955	0.7175
	9.83	0.3254	0.6295		6.67	0.1968	-
	10.20	0.4693	0.6504		6.67	0.4282	-
	10.24	0.4827	0.6560		6.67	0.4282	-
	10.48	0.5605	0.6721	28.91	6.76[a]	0.2323	-
	10.58	0.5970	0.6976		6.76	0.3771	-
	10.70	0.6304	0.6847				

[a] Indicates pressure at which 3 phases are present.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Neon; Ne; [7440-01-9]	Van't Zelfde, P.; Dokoupil, Z. *Physica* 1974, *74*, 423-434.
VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/mmHg	P/kPa	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	P/mmHg	P/kPa	Mole fraction of hydrogen in liquid, x_{H_2}
20.38	40	5.3	0	24.54	392	52.3	0.0010
20.44	40	5.3	0	24.88	421	56.1	0.0010
20.68	47	6.3	0	25.00	434	57.9	0.0010
21.46	72	9.6	0	25.00	438	58.4	0.0010
22.06	101	13.5	0	25.18	464	61.9	0.0010
22.71	143	19.1	0	25.19	465	62.0	0.0010
23.19	178	23.7	0	25.36	474	63.2	0.0010
24.00	255	34.0	0	25.67	541	72.1	0.0010
24.24	278	37.1	0	25.94	576	76.8	0.0010
24.66	342	45.6	0	20.41	106	14.1	0.0020
24.93	377	50.3	0	21.49	149	19.9	0.0020
25.76	499	66.5	0	22.23	191	25.5	0.0020
25.82	511	68.1	0	23.06	254	33.9	0.0020
25.88	520	69.3	0	23.84	335	44.7	0.0020
25.90	529	70.5	0	24.56	410	54.7	0.0020
25.95	537	71.6	0	24.81	420	56.0	0.0020
26.64	672	89.6	0	24.94	445	59.3	0.0020
27.05	758	101.1	0	24.96	446	59.5	0.0020
23.83	305	40.7	0.0010	25.07	462	61.6	0.0020
24.10	336	44.8	0.0010	25.42	513	68.4	0.0020
24.37	368	49.1	0.0010	25.86	581	77.5	0.0020
24.60	384	51.2	0.0010	26.55	712	94.9	0.0020
24.59	388	51.7	0.0010				(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static vapor equilibrium cell fitted with a bellows pressure transducer. Cell filled with known amount of components. Bubble points determined from change in slope of pressure-temperature curves. Details of apparatus in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole per cent.
2. Purity 99.99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P/kPa = \pm 0.4$.

REFERENCES:

1. Van't Zelfde, P.; Omar, M. H.; Le Pair-Schroten, H. G. M.; Dokoupil, Z. *Physica* 1968, *38*, 241.

1. Hydrogen; H_2; [1333-74-0] 2. Neon; Ne; [7440-01-9]	Van't Zelfde, P.; Dokoupil, Z. *Physica* 1974, *74*, 423-434.

EXPERIMENTAL VALUES:

T/K	*P*/mmHg	*P*/kPa	Mole fraction of hydrogen in liquid, x_{H_2}	T/K	*P*/mmHg	*P*/kPa	Mole fraction of hydrogen in liquid, x_{H_2}
20.38	225	30.0	0.0043	25.85	694	92.5	0.0043
20.42	228	30.4	0.0043	25.85	696	92.8	0.0043
20.42	249	33.2	0.0043	25.88	688	91.7	0.0043
20.86	249	33.2	0.0043	25.96	710	94.7	0.0043
20.98	261	34.8	0.0043	20.46	289	38.5	0.0074
21.62	283	37.7	0.0043	21.61	350	46.7	0.0074
22.30	338	45.1	0.0043	22.30	392	52.3	0.0074
22.33	331	44.1	0.0043	23.23	459	61.2	0.0074
23.0	401	53.5	0.0043	23.71	467	62.3	0.0074
23.06	391	52.1	0.0043	23.71	474	63.2	0.0074
23.77	472	62.9	0.0043	24.32	624	83.2	0.0074
24.39	551	73.5	0.0043	24.55	561	74.8	0.0074
24.46	524	69.9	0.0043	24.55	567	75.6	0.0074
24.51	557	74.3	0.0043	25.15	640	85.3	0.0074
24.53	556	74.1	0.0043	25.36	686	91.5	0.0074
24.53	555	74.0	0.0043	25.56	702	93.6	0.0074
24.53	552	73.6	0.0043	25.83	730	97.3	0.0074
24.53	547	72.9	0.0043	20.58	352	46.9	0.0087
24.54	536	71.5	0.0043	21.67	471	62.8	0.0087
24.54	530	70.7	0.0043	22.32	547	72.9	0.0087
24.54	527	70.3	0.0043	23.03	616	82.1	0.0087
24.54	525	70.0	0.0043	23.92	725	96.7	0.0087
24.54(5)	522	69.6	0.0043	24.29	756	100.8	0.0087
24.54(5)	518	69.1	0.0043	24.42	774	103.2	0.0087
24.54(5)	515	68.7	0.0043	24.46	624	83.2	0.0087
24.54(5)	508	67.7	0.0043	24.48	779	103.8	0.0087
24.54(5)	506	67.5	0.0043	24.48	775	103.3	0.0087
24.67	514	68.5	0.0043	24.48	761	101.5	0.0087
24.69	526	70.1	0.0043	24.48	754	100.5	0.0087
24.86	540	72.0	0.0043	24.74	691	92.1	0.0087
24.88	551	73.5	0.0043	24.77	702	93.6	0.0087
25.02	567	75.6	0.0043	25.00	742	98.9	0.0087
25.07	570	76.0	0.0043	25.01	751	100.1	0.0087
25.53	648	86.4	0.0043	25.04	759	101.2	0.0087
25.66	652	86.9	0.0043	25.31	795	106.0	0.0087
25.66	654	87.2	0.0043	25.84	835	111.3	0.0087

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Nitrogen; N_2; [7727-37-9]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980.

CRITICAL EVALUATION:

This system has been studied by several groups but apart from the work of Streett and Calado (1) there has been no work over a wide range of temperature and pressure. Streett and Calado (1) studied the system from 63 to 110 K and at pressures up to 57 MPa. The first reported measurements on this system were those of Verschoyle (2) who studied four isotherms between 63 and 88 K in the pressure range 0.012 to 22.8 MPa. Although the results are less precise than those of Streett and Calado (1) they are in fair agreement. The measurements of Tsin and coworkers (3), (4) between 78 and 117 K were presented in graphical form and are not considered further. Gonikberg *et al.* (5) studied this system between 79 and 109 K up to pressures of 18 MPa. Their results are in fair agreement with the measurements of Streett and Calado (1). The liquid phase data of Akers and Eubanks (6) for the three isotherms they studied (83, 100, 122 K) are in good agreement with the data of Streett and Calado (1) but their vapor phase data are in fairly poor agreement. Streett and Calado (1) suggested this was partly due to the relatively low purity of Akers and Eubanks (6) samples. The evaluator is inclined to agree as impurities in the samples would be expected to have widely different physical properties from those of the major components (except for argon as an impurity in the nitrogen). There are considerable discrepancies between the data of Augood (7) and Streett and Calado (1) at 67 and 78 K. This is not entirely unexpected in view of the scatter and low precision of Augood's data which are classified as doubtful. Dokoupil and coworker (8), (9) studied the solid-gas equilibrium in the temperature range 35 to 60 K and some vapor compositions up to 75 K. This work is not considered further here as it falls outside the scope of solubility. Yorizane *et al.* (11) studied this system at 77.35 K and the data are in reasonable agreement with those of Streett and Calado (1). However, their results show considerable scatter. Maimoni (12) studied this system at 90 and 95 K. The data are limited and show considerable scatter and are therefore classified as doubtful.

The data of Streett and Calado (1) are classified as tentative. Their measurements were carried out in a well-tried apparatus design with ultra pure samples. However their technique does not allow very accurate measurements to be made in the lower pressure region (below 1 MPa).

(cont.)

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Nitrogen; N_2; [7727-37-9]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

References:

1. Streett, W. B.; Calado, J. C. G. *J. Chem. Thermodynamics* 1978, *10*, 1089.
2. Verschoyle, T. T. H. *Phil. Trans. Roy. Soc. London A* 1931, *230*, 189.
3. Ruhemann, M.; Tsin, N. M. *Phys. Z. USSR* 1937, *12*, 389.
4. Steckel, F. A.; Tsin, N. M. *Zhur. Khim. Prom.* 1939, *16*, 24.
5. Gonikberg, M. G.; Fastowsky, W. G.; Gurwitsch, J. G. *Acta Physiochim. URSS* 1939, *11*, 865.
6. Akers, W. W.; Eubanks, L. S. *Adv. Cryogenic Engng.* 1960, *3*, 275.
7. Augood, D. R. *Trans. Instn. Chem. Engnrs.* 1957, *35*, 394.
8. Dokoupil, Z.; Van Soest, G.; Swenker, M. D. P. *Appl. Sci. Res.* 1955, *A5*, 182.
9. Omar, M. H.; Dokoupil, Z. *Physica* 1962, *28*, 33.
10. Dokoupil, Z. *Adv. Cryogenic Engng.* 1961, *6*, 446.
11. Yorizane, M.; Yoshimura, S.; Masuoka, H. Proc. 1st Inst. Cryogenic Eng. Conf., Heywood Temple Industrial Publ. Ltd., London, 1968, p.57.
12. Maimoni, A. *Am. Inst. Chem. Eng. J.* 1961, *7*, 371.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Nitrogen; N_2; [7727-37-9]	Verschoyle, T. T. H. *Phil. Trans. A* 1931, *230*, 189-220.
VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_H	Mole fraction of hydrogen in vapor, y_H	T/K	*P*/bar	Mole fraction of hydrogen in liquid, x_H	Mole fraction of hydrogen in vapor, y_H
88.16	17.24	0.024	0.770	68.14	225.79	0.307	0.881
88.14	27.11	0.053	0.833	68.12	227.79	0.311	0.854
88.13	41.58	0.092	0.853	63.15	12.31	0.020	0.987
88.14	56.83	-	0.862	63.17	12.35	0.019	-
88.14	81.06	0.207	0.866	63.16	12.37	0.025	0.984
88.15	105.38	0.283	0.821	63.15	17.32	0.027	0.980
78.13	17.42	0.023	0.905	63.16	27.05	0.041	0.981
78.14	37.07	0.073	0.930	63.17	36.78	0.057	0.984
78.13	56.30	0.119	0.937	63.17	46.72	0.075	0.982
78.13	80.96	0.175	0.922	63.15	56.24	0.083	0.984
76.13	115.11	0.248	0.895	63.15	56.33	0.085	0.974
78.14	149.32	0.334	0.840	63.15	56.77	0.078	-
68.12	17.42	0.033	0.973	63.16	90.74	0.121	-
68.14	26.93	0.046	0.976	63.14	90.77	0.120	0.963
68.12	36.46	0.066	0.976	63.16	199.98	0.143	0.948·
68.15	46.50	0.076	0.979	63.15	120.01	0.147	0.957
68.10	56.62	0.094	0.973	63.16	120.02	0.152	-
68.10	90.74	0.154	0.955	63.15	120.05	0.146	0.968
68.12	90.86	0.147	0.953	63.16	149.30	0.163	-
68.10	120.04	0.181	0.944	63.17	149.35	0.172	0.957
68.12	149.36	0.219	0.922	63.16	149.36	0.173	-
68.14	149.39	0.220	0.908	63.15	149.39	0.168	-
68.14	178.74	0.252	0.903				
68.11	206.54	0.296	0.870				
68.12	213.07	0.296	0.883				

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static equilibrium cell fitted with liquid and vapor sampling ports and magnetically operated stirrer. Pressure measured on pressure balance (dead weight gauge). Temperature measured with platinum resistance thermometer. Gas analysed by combustion and absorption. Some details in source.

SOURCE AND PURITY OF MATERIALS:

1. Commercial sample passed over hot copper and through silica gel at liquid air temperature.
2. Prepared by action of sodium nitrite on ammonium sulfate, chemically purified by passing through chromic acid and hot copper.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/bar = \pm 0.05$; δx_{H_2}, $\delta y_{H_2} = \pm 0.005$.

REFERENCES:

HAD - MM

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS:

Gonikberg, M.; Fastowsky, W.;
Gurwitsch, J.
Acta Physicochimica URSS 1939, *11*,
865-881.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/kg cm^{-2}	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
79.0	1.2	0.12	0.0	0.0
79.0	18.9	1.85	0.042	0.910
79.0	34.4	3.37	0.069	-
79.0	53	5.2	0.107	0.936
79.0	69	6.7	0.158	0.922
79.0	81	7.9	0.173	0.913
79.0	98	9.6	0.199	0.915
79.0	103	10.1	0.213	0.902
79.0	111	10.9	0.224	0.889
78.95	124	12.2	0.266	-
78.9	126	12.4	0.271	-
79.0	148	14.5	0.337	0.820
79.0	158	15.5	0.364	0.805
79.0	181	17.8	0.457	0.697
86.1	2.5	0.25	0.000	0.000
86.1	24.1	2.36	0.052	0.830
86.1	45.0	4.41	0.098	0.865
86.0	69	6.8	0.160	-
86.1	80	7.8	-	0.870
86.05	106	10.4	0.255	0.841
86.05	113	11.1	0.269	-
86.1	126	12.4	0.337	0.801
86.1	134	13.1	0.375	0.770
86.1	141	13.8	0.430	0.566

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. Gas analysed by method of Stock and Ritter (1) using a gas density balance. Details of apparatus in source reference.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.07$; $\delta P/\mathrm{MPa} = \pm 0.02$ up to 5 MPa, ± 0.1 above 5 MPa;
δx_{H_2}, $\delta y_{H_2} = \pm 2.0\%$.

REFERENCES:

1. Stock, A.; Ritter, G.
Z. Phys. Chem. 1926, *119*, 333.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Nitrogen; N_2; [7727-37-9]	Gonikberg, M.; Fastowsky, W.; Gurwitsch, J. *Acta Physicochimica URSS* 1939, *11*, 865-881.

EXPERIMENTAL VALUES:

T/K	P/kg cm^{-2}	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
95.4	5.5	0.54	0.000	0.000
95.35	13.5	1.32	0.027	0.516
95.35	25.7	2.52	0.042	0.692
95.4	43.8	4.30	0.102	0.730
95.4	63	6.2	0.162	0.733
95.45	79	7.7	0.221	0.727
95.35	94	9.2	0.277	0.722
95.4	113	11.1	0.394	0.691
95.35	119	11.7	0.417	0.635
95.35	120	11.8	0.432	0.473
109.0	13.3	1.30	0.000	0.000
109.0	19.6	1.92	0.018	0.207
109.0	35.0	3.43	-	0.423
109.0	46.4	4.55	0.103	0.489
108.95	59	5.8	0.156	0.500
109.05	80	7.8	0.284	0.457

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS:

Augood, D. R.

Trans. Instn. Chem. Engnrs., 1957, *35*, 394-408

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig$^+$	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
77.7	2580	17.89	0.451	0.882
	2430	16.86	0.407	0.835
	2250	15.62	0.473	-
	2225	15.44	0.411	0.870
	1660	11.55	0.307	0.920
	1260	8.79	0.217	-
	400	2.86	0.071	0.923
	380	2.72	0.063	0.942
67.0	1270	8.86	0.035	0.971
	1250	8.72	0.039	-

$^+$ psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The nitrogen was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. British Oxygen Company sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = 4% (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS:

Akers, W. W.; Eubanks, L. S.

Adv. Cryogenic Engng. 1960, *3*, 275-293.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
83.15	315	2.17	0.0487	0.8655
	500	3.45	0.0763	0.8948
	1400	9.65	0.2300	0.8700
	2000	13.79	0.3446	0.7977
99.82	315	2.17	0.0377	0.5509
	500	3.45	0.0741	0.6686
	800	5.52	0.1384	0.72795
	1100	7.58	0.2116	0.7175
	1400	9.65	0.3030	0.6530
122.04	500	3.45	0.0261	0.0821

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetic pump at ambient temperature. Cell made of type 303 stainless steel. Pressure measured with Bourdon gauge and temperature measured with copper-constantan thermocouples. Samples of both phases analysed by gas chromatography using a thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

1 and 2. Purity 99.7 mole per cent. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.06$; $\delta P/MPa = \pm 0.02$; δx_{H_2}, δy_{H_2} = ±2%.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS:

Maimoni, A.

Am. Inst. Chem. Engnrs. J. 1961, *3*, 371-375.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/lbs in^{-2}	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
90.00	52.14	0.3595	0	0
90.02	259.0	1.7857	-	0.7324
90.02	196.76	1.3566	0.0248	0.6732
90.01	188.20	1.2976	0.0232	0.6619
90.03	171.91	1.1853	0.0207	0.6367
90.02	164.42	1.1336	-	0.6247
90.03	142.74	0.9842	-	0.5791
90.04	148.07	1.0209	0.0164	0.5903
89.99	122.35	0.8436	0.0119	0.5217
90.01	88.96	0.6134	-	0.3753
90.01	146.00	1.0066	0.0159	0.5855
90.06	354.19	2.4421	0.0534	0.7800
90.04	666.51	4.5954	0.1115	0.8304
95.00	78.43	5.4076	0	0
95.02	160.87	1.1092	0.0149	0.4492
95.00	380.24	2.6217	0.0566	0.7005
94.99	657.44	4.5329	0.1121	0.7643

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. The vapor was recirculated by a double acting mercury piston pump situated outside the low temperature cryostat. Liquid and gas samples analysed by optical interferometry. Temperature measured with thermocouples and pressure with dead weight piston gauge.

SOURCE AND PURITY OF MATERIALS:

1. Purified by passing over activated charcoal at liquid nitrogen temperature. Purity 99.970 mole per cent by mass spectrometry.
2. Purified by passing over activated charcoal at dry ice temperature. Purity 99.974 mole per cent by mass spectrometry.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/MPa = \pm 0.002$;

δx_{H_2}, $\delta y_{H_2} = \pm 0.001$.

REFERENCES:

COMPONENTS:

1. Deuterium; D_2; [7752-39-0]
2. Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS:

Maimoni, A.

Am. Inst. Chem. Engnrs. J.

1961, *3*, 371-375.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/lbs in^{-2}	P/MPa	Mole fraction of deuterium in liquid, x_{D_2}	Mole fraction of deuterium in gas, y_{D_2}
90.00	52.14	0.3595	0	0
89.99	172.86	1.1918	0.0250	0.6403
90.05	112.29	0.7742	0.0122	0.4910
89.99	351.57	2.4240	0.0639	0.7819
90.05	613.40	4.2292	0.1214	0.8268
90.00	1011.59	0.6975	0.2169	0.8264
95.00	78.43	0.5408	0	0
95.01	987.71	6.8100	0.2160	0.7678
95.00	517.83	3.5703	0.9077	0.7446

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. The vapor was recirculated by a double acting mercury piston pump situated outside the low temperature cryostat. Liquid and gas samples analysed by optical interferometry. Temperature measured with thermocouples and pressure with dead weight piston gauge.

SOURCE AND PURITY OF MATERIALS:

1. Purified by passing over activated charcoal at liquid nitrogen temperature. Purity 99.61 mole per cent by mass spectrometry.
2. Purified by passing over activated charcoal at dry ice temperature. Purity 99.974 mole per cent by mass spectrometry.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/\mathrm{MPa} = \pm 0.002$;

δx_{D_2}, $\delta y_{D_2} = \pm 0.001$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Yoshimura, S.; Masuoko, H.; Toyama, A.

Proc. ICECI, 1968, *p.59. Heywood Temple, London.*

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid x_{H_2}	Mole fraction of hydrogen in vapor x_{H_2}
77.35	5	0.51	-	0.749
	10	1.01	0.018	0.858
	20	2.03	0.036	0.913
	30	3.04	0.042	0.926
	50	5.07	0.107	0.933
	70	7.09	0.156	0.925
	90	9.12	0.190	0.911
	100	10.13	0.196	0.903
	110	11.15	0.214	0.889
	130	13.17	0.337	0.876
	150	15.20	0.347	0.843
	150	15.20	0.362	0.831

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:

1. and 2. Purities 99.99 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.03$ up to 7.5 MPa; ± 0.1 above 7.5 MPa; δx_{H_2}, $\delta y_{H_2} = \pm 2\%$. (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS:

Streett, W.B.; Calado, J.C.G.

J. Chem. Thermodynamics, 1978, *10*, 1089-1100.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Pressure /MPa	Mole fraction of hydrogen in liquid x_{H_2}	Mole fraction of hydrogen in gas y_{H_2}
63.19	19.17	0.201	
	20.82	0.214	0.916
	25.30	0.211	0.898
	27.85	0.255	0.890
	30.61	0.276	0.884
	33.57	0.294	0.877
	35.99	0.298	0.869
	39.02	0.325	0.853
	42.33	0.352	0.833
	46.40	0.372	0.815
	49.64	0.407	0.785
	52.05	0.434	0.771
	53.36	0.471	0.735
	57.22	0.536	0.696
70.35	1.45	0.032	0.961
	3.52	0.068	0.967
	5.93	0.105	0.962
	8.27	0.138	0.954
	12.13	0.197	0.936
	15.51	0.242	0.897
	19.37	0.290	0.874
	24.68	0.383	0.808
	26.41	0.414	0.783
	27.44	0.447	0.771

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetically operated pump. Pressure measured with manganin pressure gauge. Temperature measured with platinum resistance thermometer. Samples of liquid gas analysed using a thermal conductivity gas analyser.

SOURCE AND PURITY OF MATERIALS:

Both gases were obtained from the Linde Div. of Union Carbide Corp. and had a stated purity of 99.999 moles per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P/MPa = \pm 0.05$;

$\delta x, \delta y = \pm 0.001$.

REFERENCES:

COMPONENTS

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS

Streett, W.B.; Calado, J.C.G.

J. Chem. Thermodynamics, 1978, *10*, 1089-1100.

EXPERIMENTAL VALUES:

T/K	Pressure /MPa	Mole fraction of hydrogen	
		in liquid, x_{H_2}	in gas, y_{H_2}
70.35	28.68	0.487	0.725
	29.30	0.536	0.690
77.55	1.03	0.026	0.886
	2.07	0.046	0.914
	3.44	0.064	0.931
	4.48	0.086	0.928
	7.03	0.140	0.921
	8.62	0.173	0.919
	10.48	0.214	0.918
	13.79	0.286	0.873
	14.55	0.306	0.862
	15.58	0.335	0.840
	17.10	0.373	0.820
	18.62	0.433	0.762
	19.30	0.474	
	19.44		0.731
83.67	11.27	0.273	0.826
	12.72	0.325	0.798
	13.86	0.360	0.765
	14.34	0.384	0.747
	14.96	9.410	
	15.31	0.429	0.711
	15.68	0.465	0.683
90.79	1.86	0.034	0.685
	2.48	0.047	0.748
	3.45	0.072	0.794
	4.55	0.099	0.816
	6.07	0.144	0.823
	7.31	0.178	0.822
	9.17	0.237	0.803
	10.55	0.289	0.779
	11.86	0.349	0.746
	12.76	0.407	0.698
100.00	1.45	0.018	0.338
	2.07	0.031	0.490
	2.96	0.056	0.587
	4.14	0.090	0.656
	5.34	0.128	0.682
	6.34	0.158	0.688
	7.48	0.207	0.689
	8.55	0.248	0.674
	9.45	0.301	0.645
	10.34	0.361	0.606
110.30	2.38	0.029	0.253
	3.17	0.055	0.361
	3.90	0.080	0.426
	4.69	0.107	0.463
	5.07	0.125	0.477
	5.72	0.153	0.489
	6.17	0.172	0.491
	6.62	0.202	0.486
	7.55	0.260	0.456
	7.79	0.286	0.421

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Carbon monoxide; CO; [630-08-0]	Colin L. Young Department of Chemistry, University of Melbourne, Parkville, 3052, Victoria, AUSTRALIA: September, 1980.

The most extensive study of this system has been undertaken by Tsang and Streett (1) who reported seven isotherms in the temperature range 70 to 125K up to pressures of 53 MPa. They located the mixture critical line over the same temperature range. Verschoyle (2) reported the first work on this system and reported four isotherms, 68.2K, 73.2K, 83.2K and 88.2K in the pressure range 1.7 to 22.8 MPa. He also made some measurements in the vapor-solid region at 58.2 and 63.2K at pressures up to 18 MPa.

Ruhemann and Tsin (3) investigated this system at three temperatures, 78, 83 and 90K at pressures up to 5 MPa. However, their data were presented in graphical form and are not considered further here. Dokoupil *et al* (4) studied the vapor-solid region in the temperature range 32 to 70K and pressures up to 5MPa but did not study liquid-vapor equilibrium in detail and their results are not considered further. Augood (5) studied this system at the isolated temperature of 81.4K at two pressures and his results deviate somewhat from the data of Tsang and Streett (1) and are classified as doubtful.

Akers and Eubanks (6) studied three isotherms at 83, 100 and 122 K up to pressures of 24 MPa and Yorizane *et al* (7) studied three isotherms at 77.2, 103 and 123 K up to pressures of 15 MPa. The latter work was not extensive. The data of Verschoyle (2) Akers and Eubanks (6), Tsang and Streett (1) and Yorizane *et al* (7) are all in fair agreement in the overlapping ranges of temperature and pressure. The data of Tsang and Streett (1) are probably the most reliable and are classified as tentative. Compared with Tsang and Streett's data (1) those of Akers and Eubanks (6) were obtained on gases of lower purity, the data of Yorizane *et al* (7) are limited and of lower precision and the data of Verschoyle were determined fifty years ago with consequent lower precision in analysis.

REFERENCES:

1. Tsang, C.Y.; Streett, W.B. *in press*
2. Verschoyle, T.T.H. *Phil. Trans.* 1931, *A230*, 189.
3. Ruhemann, M.; Tsin, N. *Phys. Z. Sovietunion*, 1937, *12*, 389. C A.1938, *32*, 2416.
4. Dokoupil, Z.; Van Soest, G.; Swenker, M.D.P. *Appl. Sci. Res.* 1955, *A5*, 182.
5. Augood, D.R. *Trans. Instn. Chem. Engnrs.* 1957, *35*, 394.
6. Akers, W.W.; Eubanks, L.S.; *Adv. Cryogenic. Engng.* 1960, *3*, 275.
7. Yorizane, M.; Yoshimura, S.; Masouka, H.; Toyama, A. *Proc. ICECI*, p.57. Heywood Temple Industrial Publ. London, 1968

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon monoxide; CO; [630-08-0]

ORIGINAL MEASUREMENTS:

Verscholye, T. T. H.

Phil. Trans. 1931, *A230*, 189-220.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
88.15	2.18	0.221	0.00	0.00
88.13	17.2	1.74	0.036	0.840
88.15	22.1	2.24	0.052	0.866
88.15	31.4	3.18	0.071	0.888
88.15	55.4	5.61	0.126	-
88.15	55.8	5.65	0.129	0.893
88.14	55.9	5.66	0.134	0.902
88.16	89.3	9.05	0.203	0.888
88.13	89.6	9.08	0.217	0.887
88.15	128.0	12.97	-	0.867
88.16	128.1	12.98	0.304	-
88.12	128.2	12.99	0.303	0.848
83.14	166.7	16.89	0.410	0.771
83.15	181.3	18.37	0.454	0.704
83.15	1.18	0.120	0.00	0.00
83.13	17.2	1.74	0.027	0.899
83.13	51.2	5.19	0.102	0.931
83.14	51.2	5.19	0.125	0.932
83.14	89.5	9.07	0.195	0.918
83.16	89.3	9.05	0.170	0.920
83.13	109.6	11.11	0.206	0.906
83.13	109.8	11.13	0.210	0.907
83.13	109.8	11.13	0.228	0.904

(cont.)

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

Static equilibrium cell fitted with liquid and vapor sampling ports and magnetically operated stirrer. Pressure measured with pressure balance (dead weight gauge). Temperature measured with platinum resistance thermometer. Gas analysed by combustion and absorption. Some details in source.

SOURCE AND PURITY OF MATERIALS:

1. Commercial sample passed over hot copper and through silica gel at liquid air temperature.
2. Prepared by the action of sulfuric acid on sodium formate. Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/MPa = \pm 0.005$;

δx_{H_2}, $\delta y_{H_2} = \pm 0.005$.

REFERENCES:

1. Hydrogen; H_2; [1333-74-0]

2. Carbon monoxide; CO; [630-08-0]

Verscholye, T. T. H.

Phil. Trans. 1931, *A230*, 189-220.

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
83.15	128.1	12.98	0.254	0.888
83.13	128.1	12.98	0.249	0.889
83.18	166.7	16.89	(0.292)	0.840
83.13	166.8	16.90	0.329	0.843
83.15	176.4	17.87	0.344	0.831
83.13	186.1	18.86	0.368	0.808
83.14	190.9	19.34	0.381	0.805
83.15	195.8	19.84	0.401	0.795
83.13	200.6	20.33	0.415	0.777
83.14	200.6	20.33	0.411	0.767
83.15	205.4	20.81	0.435	0.766
83.11	205.4	20.81	0.430	(0.800)
83.13	205.4	20.81	0.422	(0.735)
83.17	210.4	21.32	0.448	0.759
83.11	215.1	21.80	0.470	0.737
83.15	215.2	21.81	(0.389)	0.725
83.12	220.9	22.38	0.486	0.694
83.13	224.8	22.78	0.541	0.663
73.15	0.33	0.033	0.00	0.00
73.17	17.3	1.75	0.033	0.967
73.14	22.2	2.25	-	0.954
73.14	31.5	3.19	-	0.964
73.14	31.8	3.22	0.056	0.975
73.15	50.9	5.16	-	0.970
73.14	51.0	5.17	0.084	0.967
73.17	79.7	8.08	-	0.963
73.14	80.1	8.12	0.120	0.964
73.15	80.2	8.13	0.127	0.959
73.17	113.7	11.52	0.165	0.948
73.15	113.8	11.53	0.154	0.955
73.14	113.9	11.54	0.166	0.951
73.14	128.0	12.97	-	0.942
73.16	142.5	14.44	-	0.935
73.12	152.4	15.44	0.206	0.930
73.15	152.4	15.44	-	0.931
73.19	176.4	17.87	0.218	0.917
73.14	176.4	17.87	0.230	0.920
73.12	186.2	18.87	0.236	0.914
73.15	186.2	18.87	0.229	0.916
73.12	205.4	20.81	0.257	0.902
73.12	205.6	20.82	0.250	0.912
73.15	224.8	22.78	0.265	0.893
73.16	224.9	22.79	0.275	0.890
68.19	17.02	1.725	0.030	0.979
68.17	21.69	2.198	0.033	0.982
68.15	26.61	2.696	0.042	0.976
68.15	31.67	3.209	0.049	0.986
68.11	41.26	4.181	-	0.987
68.15	41.41	4.196	0.062	0.985
68.15	41.45	4.200	0.063	0.975
68.14	79.86	8.092	-	0.977
68.14	79.89	8.095	0.102	0.977
68.16	118.29	11.986	-	0.962
68.15	118.38	11.995	0.138	0.965
68.15	152.17	15.419	0.158	(0.968)
68.15	152.33	15.435	0.163	0.946
68.15	190.97	19.350	0.188	0.939
68.14	215.16	21.801	0.202	0.934

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon monoxide; CO ; [630-08-0]

ORIGINAL MEASUREMENTS:

Augood, D. R.

Trans. Instn. Chem. Engnrs.

1957, *35*, 394-408.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig$^+$	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
81.4	2620	18.17	0.312	0.913
	2600	18.03	0.334	0.941
	1430	9.96	0.184	0.940
	1380	9.62	0.174	0.912

$^+$ psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The carbon monoxide was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. British Oxygen Company sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = 4% (estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Carbon monoxide; CO; [630-08-0]	Akers, W. W.; Eubanks, L. S. *Adv. Cryogenic Engng.* 1960, *3*, 275-293.
VARIABLES:	**PREPARED BY:**
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
83.15	315	2.17	0.0398	0.9084
	500	3.45	0.0609	0.9320
	1400	9.65	0.1745	0.9143
	2000	13.79	0.2490	0.8790
99.82	315	2.17	0.0389	0.6803
	500	3.45	0.0674	0.7619
	800	5.52	0.1163	0.7844
	1100	7.58	0.1727	0.7848
	1400	9.65	0.2399	0.7739
122.04	500	3.45	0.0449	0.2260
	800	5.52	0.1382	0.3349

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetic pump at ambient temperature. Cell made of type 303 stainless steel. Pressure measured with Bourdon gauge and temperature measured with copper-constantan thermocouples. Samples of both phases analysed by gas chromatography using a thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.7 mole per cent. Dried.
2. Prepared from reaction of formic acid and sulfuric acid. Dried. Purity about 97 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.06$; $\delta P/MPa = \pm 0.02$; δx_{H_2}, $\delta y_{H_2} = \pm 2\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon monoxide; CO; [630-08-0]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Yoshimura, S.; Masuoko, H.; Toyama, A.

Proc. ICECI 1968, *p.59. Heywood, Temple, London.*

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of hydrogen in liquid x_{H_2}	in vapor, y_{H_2}
123.15	30	3.04	-	0.140
	40	4.05	0.047	0.235
	50	5.07	0.084	0.288
	60	6.08	0.167	-
	62	6.28	0.200	0.291
	62.7	6.35	0.247	0.293
103.15	10	1.01	-	0.270
	20	2.03	-	0.528
	30	3.04	-	0.637
	40	4.05	-	0.692
	50	5.07	0.136	0.710
	75	7.60	0.192	0.726
	100	10.13	0.267	0.673
	123.5	12.48	0.395	0.563
77.35	6	0.61	-	0.887
	11	1.11	-	0.928
	21	2.13	-	0.954
	31	3.14	-	0.958
	46	4.66	0.075	0.947
	51	5.17	0.083	0.960
	75	7.60	0.113	0.944
	100	10.13	0.160	0.941
	125	12.67	0.200	0.929
	150	15.20	0.250	0.909

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:

1. Purity 99.99 mole per cent or better.
2. Purity 99.67 mole per cent oxygen and nitrogen being principle impurities.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.03$ up to 7.5 MPa;± 0.01 above 7.5MPa; $\delta x_{H_2}, \delta y_{H_2}$ = 2%. (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon monoxide; CO; [630-08-0]

ORIGINAL MEASUREMENTS:

Tsang, C. Y.; Streett, W. B.

in press

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}	T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
70.0	0.49	0.0110	0.9500	70.0	40.44	0.3726	0.8275
	0.79	0.0152	0.9696		42.01	0.3890	0.8173
	1.46	0.0260	0.9804		44.23	0.4130	0.8070
	2.15	0.0349	0.9864		46.91	0.4430	0.7926
	3.49	0.0546	0.9901		49.75	0.4750	0.7600
	4.90	0.0704	0.9878		50.93	0.4975	0.7387
	6.28	0.0871	0.9864		51.64	0.5117	--
	7.59	0.1012	0.9818		52.61	0.5374	0.6951
	9.80	0.1243	0.9654		52.94	0.5561	0.6753
	10.78	0.1327	0.9612	77.3	0.65	0.0136	0.974
	11.86	0.1433	0.9577		1.51	0.0292	0.9437
	13.98	0.1624	0.9491		2.10	0.0369	0.9554
	15.78	0.1764	0.9406		2.86	0.0498	0.9602
	19.18	0.2030	0.9301		3.60	0.0619	0.9615
	22.38	0.2270	0.9155		4.27	0.0732	0.9628
	25.02	0.2468	0.9018		4.95	0.0847	0.9622
	28.09	0.2716	0.8881		5.64	0.0948	0.9647
	30.58	0.2900	0.8798		6.36	0.1058	0.9634
	32.63	0.3053	0.8666		7.03	0.1165	0.9641
	33.44	0.3112	0.8602		7.66	0.1241	0.9570
	34.89	0.3222	0.8547		8.36	0.1355	0.9538
	35.74	0.3314	0.8482		10.47	0.1648	0.9418
	37.94	0.3502	0.8335				

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetically operated pump. Pressure measured with manganin pressure gauge. Temperature measured with platinum resistance thermometer. Samples of liquid gas analysed using a thermal conductivity gas analyser.

SOURCE AND PURITY OF MATERIALS:

1. Matheson ultra high purity sample, purity 99.999 mole per cent or better.
2. Matheson sample, purity 99.99 mole per cent. Passed through cold trap at boiling point of nitrogen.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/MPa = \pm 0.5\%$; $\delta x_{H_2}, \delta y_{H_2} = \pm 0.005$ (but may be as large as ± 0.02 near critical point).

REFERENCES:

1. Streett, W. B.; Calado, J. C. G. *J. Chem. Thermodyn.* 1978, *10*, 1089.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Carbon monoxide; CO; [630-08-0]

ORIGINAL MEASUREMENTS:

Tsang, C. Y.; Streett, W. B.

in press

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
77.3	11.13	0.1743	0.9362
	12.31	0.1914	0.9313
	13.94	0.2155	0.9200
	15.99	0.2410	0.9053
	18.90	0.2851	0.8804
	22.15	0.3334	0.8520
	24.90	0.3814	0.8178
	26.99	0.4270	0.7877
	29.13	0.4916	0.7378
	29.67	0.5176	0.7218
	30.14	0.5458	0.6983
85.0	0.52	0.0090	0.6970
	0.78	0.0142	0.8181
	1.45	0.0266	0.8730
	2.86	0.0543	0.9110
	4.20	0.0814	0.9218
	4.94	0.0957	0.9230
	5.63	0.1084	0.9233
	7.01	0.1364	0.9194
	8.38	0.1640	0.9167
	10.10	0.1977	0.9053
	11.84	0.2321	0.8919
	13.86	0.2760	0.8702
	15.42	0.3122	0.8506
	17.02	0.3537	0.8269
	18.41	0.3936	0.7941
	19.44	0.4312	0.7694
	20.09	0.4610	0.7452
	20.79	0.5103	0.7067
	21.07	0.5358	0.6930
95.0	0.91	0.0120	0.5894
	1.47	0.0240	0.7231
	2.83	0.0543	0.8086
	4.22	0.0881	0.8311
	5.62	0.1221	0.8380
	7.01	0.1560	0.8369
	8.40	0.1933	0.8309
	9.53	0.2255	0.8207
	10.51	0.2522	0.8099
	11.83	0.2972	0.7877
	13.17	0.3464	0.7565
	14.61	0.4264	0.7088
	14.93	0.4635	0.6719
105.0	1.21	0.0121	0.3010
	1.51	0.0197	0.4056
	1.90	0.0291	0.4972
105.0	2.21	0.0364	0.5504
	2.87	0.0541	0.6177
	3.57	0.0731	0.6628
	4.62	0.1034	0.6953
	5.62	0.1322	0.7101
	6.64	0.1644	0.7138
	7.73	0.2015	0.7155
	8.58	0.2329	0.7048
	9.15	0.2556	0.6964
	9.75	0.2813	0.6840
	10.56	0.3248	0.6612
	11.22	0.3698	0.6262
	11.56	0.4026	0.5966
	11.73	0.4314	0.5726
115.0	1.71	0.0084	0.1095
	1.95	0.0159	0.1838
	2.26	0.0249	0.2596
	2.92	0.0444	0.3684
	3.62	0.0663	0.4393
	4.20	0.0859	0.4765
	4.98	0.1142	0.5087
	5.80	0.1447	0.5319
	6.36	0.1680	0.5400
	7.02	0.1964	0.5349
	7.50	0.2227	0.5273
	8.04	0.2553	0.5048
	8.50	0.2945	0.4784
	8.59	0.3068	0.4659
	8.68	0.3195	0.4559
125.0	2.98	0.0217	0.1065
	3.30	0.0330	0.1487
	3.63	0.0461	0.1860
	3.95	0.0594	0.2130
	4.47	0.0820	0.2446
	4.71	0.0953	0.2572
	4.92	0.1050	0.2617
	5.07	0.1131	0.2650
	5.19	0.1219	0.2661
	5.32	0.1303	0.2674
	5.45	0.1402	0.2645
	5.51	0.1457	0.2611
	5.61	0.1550	0.2579
	5.74	0.1680	0.2530

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen oxide, (Nitric oxide); NO; [10102-43-9]

ORIGINAL MEASUREMENTS:

Augood, D. R.

Trans. Instn. Chem. Engnrs.,

1957, *35*, 394-408.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig[+]	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
119.5	2540	17.61	0.017	0.991
	2240	15.55	0.009	0.992
	1620	11.27	0.005	-

[+] psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The nitric oxide was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. Prepared by the method of Johnstone and Giauque (1).

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = ±4% (estimated by compiler)

REFERENCES:

Johnstone, H.L.; Giauque, W.F.

J. Amer. Chem. Soc. 1929, *5*, 3194.

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Carbon dioxide; CO_2; [124-38-9]	Colin Young Department of Chemistry University of Melbourne Parkville, Victoria. 3052 AUSTRALIA September, 1980

This system has been extensively investigated by Tsang and Streett (1) who measured vapor-liquid equilibrium isotherms at ten temperatures between 220K and 290K at pressures up to 172 MPa. Their measurements were carried out with high purity samples in an apparatus of proven reliability. The results of Kaminishi and Toriumi (2), who studied six isotherms between 233.15K and 298.15K at pressures up to 20 MPa, are in good agreement with the more extensive data of Tsang and Streett (1) although the mole fractions of hydrogen in the liquid phase from reference (2) are slightly smaller than those obtained by interpolation of the data of Tsang and Streett (1).

Spano *et al* (3) studied this system at six temperatures ranging from 219.9K to 289.9K at pressures up to 20 MPa. At the three lowest temperatures there is good agreement with the data of Kaminishi and Toriumi (2) and Tsang and Streett (1) but there are significant deviations at the higher temperatures. The hydrogen mole fractions in the liquid phase are smaller in the work of Spano *et al* (3) than in that of the two other groups (1) and (2).

The data of Yorizane *et al* (4), which are restricted to 273.15K and pressure up to 37 MPa give interpolated liquid phase hydrogen compositions which are slightly smaller than those of Tsang and Streett (1) and agree better with the slightly smaller values of Kaminishi and Toriumi (2).

Augood (5) reported data at the single temperature of 239.7K which are in fair agreement with interpolated values from the measurements of Spano *et al* (3) but his data are not considered further in view of their very limited nature.

The earliest reported measurements of vapor-liquid equilibrium for this system are those of Abdullayev (6) who studied the system at 298.2K and pressures between 8 and 20 MPa. The results, which were presented in graphical form, differ widely from any other data on this system and are rejected. Similarly the data of Mills and Miller (7), who reported two isotherms at 288.2K and 281.2K at pressures up to 11 MPa, are rejected. Their data were presented only in graphical form and deviate somewhat from the data given in reference (1), (2), (3) and (4). The results of Greco *et al* (8) were presented in graphical form and appear to agree with the data of Tsang and Streett (1) within a few percent. However in view of the uncertainty in the graphical presentation the data are not considered further here.

The data of Spano *et al* (3), Tsang and Streett (1) Kaminishi and Toriumi (2) and Yorizane *et al* (4) are all classified as tentative. The solubility of hydrogen in carbon dioxide at the highest temperatures varies by several per cent between these workers but there is insufficient evidence to make a definite choice between the four sets of data.

REFERENCES:

1. Tsang, C.Y.; Streett, W.B. *in press*

2. Kaminishi, G.; Toriumi, T.; *J. Chem. Soc. Japan. Ind. Chem. Sec.* 1966, *69*, 175.

3. Spano, J.O.; Heck, C.K.; Barrick, P.L. *J. Chem. Engng. Data*, 1968, *13*, 168.

References (continued).

4. Yorizane, M.; Yoshimura, S.; Masouku, H. *Kagaku Kogaku*, 1970, *34*, 953.

5. Augood, D.R.; *Trans. Instn. Chem. Engnrs.* 1957, *35*, 394.

6. Abdullayev, Y.A. *Zh. Fiz. Khim.* 1939 , *13*, 986.

7. Mills, J.R.; Miller, F.J.L. *Can. Chem. Process. Ind.* 1945, *29*, 651.

8. Greco, G.; Casale, C.; Negri, G. *Comp. rend. Congr. intern. chim. ind.* 27 Congr. Brussels, 1954, 251.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Augood, D. R.

Trans. Instn. Chem. Engnrs.

1957, *35*, 394-408.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig[+]	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
239.7	2780	19.27	0.064	0.910
	2720	18.86	0.071	0.871
	2680	18.58	0.062	0.873

[+] psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrers. After equilibrium had been established samples of gas and liquid phases taken.

The carbon dioxide was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. British Oxygen Company sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = 4% (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Kaminishi, G.; Toriumi, T.

Kogyo Kagaku Zasshi, 1966, *69*, 175-172.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	 in vapor y_{H_2}
298.15	9.64	0.044	0.041
	12.41	0.099	0.191
293.15	9.64	0.044	0.213
	14.57	0.109	0.321
	19.50	0.179	0.260
283.15	7.45	-	0.246
	9.64	0.044	-
	14.57	0.086	0.439
	19.51	0.134	0.469
273.15	5.08	0.011	0.212
	9.64	0.043	0.478
	10.18	0.045	0.483
	14.53	0.081	0.568
	19.51	0.118	0.606
	19.99	-	0.603
253.15	5.27	0.016	0.522
	10.18	0.038	0.696
	15.09	0.061	0.753
	20.00	0.084	0.775
233.15	5.27	0.014	0.746
	10.18	0.029	0.835
	15.09	0.046	0.864
	20.00	0.061	0.875

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_{H_2}, $\delta y_{H_2} = \pm 0.003$.

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon Dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Spano, J.O.; Heck, C.K.; Barrick, P.L.

J. Chem. Engng. Data, 1968, *13*, 168-171

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$p/10^5$Pa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, x_{H_2}
219.9	10.8	0.0013	0.428
	21.6	0.0044	0.693
	35.9	0.0081	0.800
	52.8	0.0128	0.852
	70.6	0.0175	-
	73.2	-	0.885
	102.8	0.0258	0.9090
	154.4	0.0385	0.9267
	198.3	0.0487	0.9335
229.9	16.6	-	0.420
	25.8	0.0056	0.6140
	31.8	0.0077	-
	36.5	0.0092	-
	45.7	0.0121	-
	46.5	-	0.765
	66.6	-	0.822
	73.3	0.0216	0.832
	87.1	-	0.850
	106.9	-	0.864
	121.6	0.0365	0.878
	161.6	0.0477	0.896
	203.0	0.0586	0.9046

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow cell described in detail in ref. (1). Temperature measured with platinum resistance thermometer and pressure measured with Bourdon gauge. Details of apparatus in source and ref. (1). Cell charged with components. Vapor recirculated and vapor and liquid samples withdrawn and analysed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

1. Minimum purity 99.999 mole per cent.
2. Minimum purity 99.99 mole per cent.

ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$ (up to 10.0 MPa), ± 0.3 (up to 30.0 MPa); δx_{H_2}, $\delta y_{H_2} = \pm 1\%$ or 0.0002 whichever is greater.

REFERENCES:

1. Herring, R.N.; Barrick, P.L.
Int. Adv. Cryogenic Engng. 1965, *10*, 151.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon Dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Spano, J.O.; Heck, C.K.; Barrick, P.L.

J. Chem. Engng. Data. 1968, *13*, 168-171.

EXPERIMENTAL VALUES:

T/K	$p/10^5$Pa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
244.9	20.8	0.0027	-
	21.8	-	0.265
	38.0	0.0100	0.523
	52.6	0.0159	0.634
	80.5	0.0276	0.733
	113.0	0.0407	0.789
	161.0	0.0589	0.826
	165.2	0.0605	0.828
	201.1	0.0727	0.839
	203.2	0.0732	0.841
259.9	31.0	-	0.174
	32.7	0.0047	0.206
	50.7	0.0146	0.420
	73.9	0.0269	0.550
	92.6	0.0363	0.618
	123.2	-	0.675
	135.0	0.0598	0.695
	153.5	0.0688	0.711
	156.7	0.0700	0.712
	203.2	0.0927	0.745
274.9	49.9	0.0097	0.180
	66.1	0.0213	0.300
	95.0	0.0405	0.442
	123.1	0.0588	0.518
	160.5	0.0860	-
	166.0	-	0.588
	177.3	0.1000	-
	192.0	-	0.610
	200.6	0.115	-
289.9	65.8	0.0130	0.102
	90.0	0.0258	0.176
	102.3	0.0490	0.280
	153.7	0.110	0.391
	162.1	0.121	0.400
	175.3	0.139	0.422
	182.9	-	0.425

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Yoshimura, S.; Masuoka, H.

Kagaku Kogaku 1970, *34*, 953-7.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P_{total}/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor y_{H_2}
273.15	6.08	-	0.283
	10.44	0.047	0.474
	13.88	0.0789	0.563
	18.34	0.104	0.596
	23.30	0.156	0.625
	27.76	0.180	0.649
	30.30	0.214	0.651
	31.31	0.223	-
	33.94	0.286	0.604
	35.46	0.317	0.580
	36.27	0.321	0.534
	37.49	0.472	0.478

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_{H_2}, δy_{H_2} = ±1-2%.
(estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Carbon dioxide; CO_2; [124-38-9]	Tsang, C. Y.; Streett, W. B. *in press*
VARIABLES:	**PREPARED BY:**
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
220.0	0.93	0.0015	0.2898	225.0	1.47	0.0039	0.4372
	1.00	--	0.3445		2.16	0.0068	0.5997
	1.07	0.0028	0.3871		2.78	0.0089	0.6757
	1.18	--	0.4309		3.56	0.0117	0.7409
	1.27	0.0032	0.4642		4.85	0.0159	0.7965
	1.35	0.0035	0.5025		7.00	0.0218	0.8507
	2.23	0.0067	0.6755		10.65	0.0312	0.8890
	3.51	0.0112	0.7810		14.22	0.0393	0.9036
	5.13	0.0159	0.8369		21.15	0.0567	0.9178
	7.13	0.0218	0.8737		27.88	0.0740	0.9225
	11.01	0.0297	0.9055		34.69	0.0914	0.9232
	14.00	0.0361	0.9162		41.44	0.1073	0.9240
	15.46	0.0394	0.9189		48.37	0.1235	0.9228
	16.93	0.0427	0.9213		55.35	0.1390	0.9209
	18.79	0.0463	0.9209		69.99	0.1690	0.9131
	20.99	0.0514	0.9260		79.48	0.1877	0.9070
	24.34	0.0593	0.9299		91.26	0.2112	0.9036
	26.44	0.0647	0.9307	235.0	1.49	0.0039	0.2127
	27.59	0.0663	0.9303		2.14	0.0069	0.4228
	31.50	0.0721	0.9307		3.38	0.0121	0.6088
	35.40	0.0838	0.9315		5.22	0.0185	0.7286
225.0	1.18	0.0023	0.3102				

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetically operated pump. Pressure measured with manganin pressure gauge. Temperature measured with platinum resistance thermometer. Samples of liquid gas analysed using a thermal conductivity gas analyser.

SOURCE AND PURITY OF MATERIALS:

1. Matheson ultra high purity sample, purity 99.999 mole per cent or better.
2. Matheson sample, purity 99.99 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/MPa = \pm 0.5\%$; δx_{H_2}, δy_{H_2} = ±0.005 (but may be as large as ±0.02 near critical).

REFERENCES:

1. Streett, W. B.; Calado, J. C. G. *J. Chem. Thermodyn.* 1978, *10*, 1089.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0]	Tsang, C. Y.; Streett, W. B.
2. Carbon dioxide; CO_2; [124-38-9]	*in press*

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}	T/K	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in vapor, y_{H_2}
235.0	7.06	0.0243	0.7806	250.0	88.39	0.4317	0.7030
	10.46	0.0342	0.8322		91.61	0.4680	--
	14.03	0.0450	0.8562	260.0	3.37	0.0081	0.2083
	20.73	0.0659	0.8755		5.58	0.0208	0.4511
	27.71	0.0881	0.8828		7.23	0.0284	0.5382
	35.22	0.1123	0.8868		10.53	0.0450	0.6348
	41.38	0.1307	0.8864		13.49	0.0596	0.6787
	55.17	0.1707	0.8813		21.62	0.1044	0.7342
	73.10	0.2184	0.8704		28.15	0.1414	0.7483
	93.03	0.2728	0.8562		34.70	0.1777	0.7483
	117.61	0.3371	0.8343		41.71	0.2197	0.7370
	137.35	0.3928	0.8102		48.44	0.2640	0.7217
	152.00	0.4365	0.7877		55.59	0.3199	0.6965
	165.58	0.4884	0.7556		62.04	0.3908	0.6471
	168.96	0.5062	0.7455		65.64	0.4768	0.5773
	171.79	0.5264	0.7328	270.0	4.38	0.0118	0.1768
237.0	132.08	0.4067	0.7949		5.31	0.0191	0.2749
	138.00	0.4281	0.7837		7.08	0.0301	0.3971
	144.90	0.4530	0.7698		10.62	0.0564	0.5282
	148.35	0.4731	0.7524		13.86	0.0817	0.5852
	150.28	0.4789	0.7486		17.44	0.1095	0.6201
	152.07	0.4908	0.7390		21.93	0.1388	0.6440
	154.90	0.5049	0.7300		25.26	0.1706	0.6496
	156.97	0.5238	0.7190		27.97	0.1956	0.6475
	158.83	0.5401	0.7046		34.76	0.2457	0.6399
	160.41	0.5566	0.6921		39.99	0.2950	0.6157
245.0	83.68	0.3251	0.7918		44.14	0.3560	0.5751
	89.58	0.3521	0.7776		45.69	0.3967	0.5332
	96.65	0.3882	0.7600	280.0	7.44	--	0.2891
	101.54	0.4155	0.7441		9.15	--	0.3612
	105.06	0.4379	0.7303		11.27	--	0.4251
	108.51	0.4657	0.7094		13.80	0.1100	0.4731
	111.83	0.5010	0.6789		18.35	0.1580	0.5166
	113.23	0.5262	0.6603		20.30	0.1791	0.5255
250.0	2.31	0.0044	0.1589		22.62	0.2000	0.5264
	3.04	0.0086	0.3196		24.56	0.2195	--
	3.63	0.0124	0.4090		26.01	0.2358	0.5194
	5.20	0.0186	0.5501		27.45	0.2536	0.5133
	6.98	0.0262	0.6371		29.25	0.2745	0.5039
	10.29	0.0396	0.7179		31.19	0.3043	0.4740
	13.85	0.0545	0.7585		31.96	0.3270	0.4472
	17.28	0.0695	0.7822	290.0	8.53	0.0405	0.1988
	25.44	0.1058	0.8044		9.49	0.0528	0.2342
	31.54	0.1332	0.8105		11.29	0.0804	0.2867
	35.34	0.1488	0.8116		11.72	--	0.2969
	49.66	0.2121	0.8060		13.88	0.1226	0.3296
	62.81	0.2724	0.7834		15.65	0.1449	0.3460
	75.88	0.3412	0.7541		17.27	0.1670	0.3525
	83.22	0.3887	0.7300		18.95	0.1920	0.3327
	86.54	0.4147	0.7126		19.71	0.2065	0.3241

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Hydrogen sulfide; H_2S; [7783-06-4]	Augood, D. R. *Trans. Instn. Chem. Engnrs.*, 1957, *35*, 394-408.
VARIABLES:	PREPARED BY:
Pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig$^+$	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	Mole fraction of hydrogen in gas, y_{H_2}
213.6	1500	10.44	0.015	0.990
	1500	10.44	0.011	0.990

$^+$ psig - pounds per square inch gauge pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The hydrogen sulfide was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. Prepared in Kipp's apparatus liquefied in carbon dioxide/ acetone bath. Non-condensible impurities removed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = ±4% (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Hydrogen sulfide; H_2S; [7783-06-4]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Sadamoto, S.; Masuoka, H.; Eto, Y.

Kogyo Kagaku Zasshi 1969, *72*, 2174-7.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/MPa	Mole fraction of hydrogen in liquid, x_{H_2}
273.15	3.04	0.012
	5.07	0.020
258.15	1.01	0.003
	2.03	0.006
	3.04	0.008
	5.07	0.016
243.15	1.01	0.002
	2.03	0.003
	3.04	0.005
	4.05	0.008
	5.07	0.010

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Vapor-liquid equilibrium cell. Diagram given in source. (Original in Japanese.)

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole per cent.

2. Purity 99.0 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 0.001$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Sulfur dioxide; SO_2; [7446-09-5]

ORIGINAL MEASUREMENTS:

Augood, D.R.

Trans. Instn. Chem. Engnrs.,

1957, *35*, 394-408.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig$^+$	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
293.2	2775	19.24	0.028	0.985
	2760	19.13	0.030	0.988
	1500	10.44	0.017	0.982
263.2	2770	19.20	0.019	0.981
	1860	12.93	0.015	0.979
	1500	10.44	0.016	0.969

$^+$ psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The sulfur dioxide was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample containing 0.09 mole per cent HD.
2. Brotherton sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.1$;

δx_{H_2}, δy_{H_2} = 4% (estimated by compiler)

REFERENCES:

COMPONENTS:	EVALUATOR:
1. Hydrogen; H_2; [1333-74-0] 2. Ammonia; NH_3; [7664-41-7]	Colin L. Young, Department of Physical Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. October 1980

CRITICAL EVALUATION:

The most extensive data on this system are those of Wiebe and coworkers (1), (2) who studied the system over the temperature range 273 K to 373 K and at pressures up to 101 MPa. Their data are thought to be reliable and are classified as tentative. Ipat'ev and Theodorovich (3) studied this system at 298.15 K up to pressures of 25 MPa and from 258 K to 298 K at a pressure of 10.1 MPa. Their mole fraction data at 298 K are significantly lower than those of Wiebe and coworkers (1), (2) and are rejected from further consideration. The data of Zeininger (4) were presented in small graphical form and are rejected for the present purpose.

Reamer and Sage (5) studied the phase behaviour of this system but only made measurements on the composition of the gas phase. They presented a table of coexisting liquid and gas phase compositions but the liquid phase compositions were based on the data of Wiebe and Tremearne (1). Krichevskii and Khazanova (6) and Krichevskii and Efremova (7) also studied the gas phase compositions in this system. Their results are not considered further.

The limited data of Augood (8) at 293.2 K and 239.7 K are consistent with the data of Wiebe and coworkers (1), (2) but of lower precision. The data of Hiese (9) at 298.15 K at pressures up to 20.2 MPa are consistent with those of Wiebe and Tremearne (1).

Lawson and Black (10) have determined the solubility of a mixture of three volumes of hydrogen and one of nitrogen in liquid ammonia at pressures up to 15 MPa over the temperature range of 243 K to 295 K. Their results indicate that the two gases behave independently and that the mole fraction in the liquid phase of either gas is proportional to its partial pressure. Their results are consistent with those of Wiebe and coworkers (1) and (2). The low pressure measurements of Gelperin *et al.* (11) over the temperature range 203 K to 273 K, and of Moore and Otto (12), over the temperature range 203 K to 303 K are also consistent with the results of Wiebe and coworkers (1), (2) if it is assumed that the mole fraction of hydrogen in the liquid phase is a linear function of pressure.

References:

1. Wiebe, R.; Tremearne, T. H. *J. Am. Chem. Soc.* 1934, *56*, 2357.
2. Wiebe, R.; Gaddy, V. L. *J. Am. Chem. Soc.* 1937, *59*, 1984.
3. Ipat'ev, V. V.; Theodorovich, V. P. *Zh. Obshch. Khim.* 1932, *2*, 305.
4. Zeininger, H. *Chem.-Ing.-Tech.* 1973, *45*, 1067.
5. Reamer, H. H.; Sage, B. H. *J. Chem. Engng. Data* 1959, *4*, 152.
6. Krichevskii, I. R.; Khazanova, N. E. *Zh. Fiz. Khim.* 1939, *13*, 1690.
7. Krichevskii, I. R.; Efremova, G. D. *Zh. Fiz. Khim.* 1952, *26*, 1117.
8. Augood, D. R. *Trans. Instn. Chem. Engnrs.* 1957, *35*, 394.
9. Hiese, F. *Ber. Bunsenges. Phys. Chem.* 1972, *76*, 938.
10. Larson, A. T.; Black, C. A. *J. Am. Chem. Soc.* 1925, *47*, 1015 and *Ind. Eng. Chem.* 1925, *17*, 715.
11. Gel'perin, I. I.; Trubitsyn, B. A.; Kalinina, S. Ye.; Bezyulev, V. V. *Khim. Prom.* 1974, *8*, 619.
12. Moore, R. G.; Otto, F. D. *Can. J. Chem. Engng.* 1972, *50*, 355.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Wiebe, R.; Tremearne, T. H.

J. Am. Chem. Soc. 1934, *56*, 2357-60.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^2 Mole fraction of hydrogen in liquid, $10^2x_{H_2}$	T/K	P/bar	10^2 Mole fraction of hydrogen in liquid, $10^2x_{H_2}$
298.15	50.7	0.338	348.15	101.3	1.227
	101.3	0.745		202.7	3.050
	202.7	1.503		405.3	6.290
	405.3	2.816		608.0	9.052
	608.0	3.921		810.6	11.391
	810.6	4.887		1013.3	13.380
	1013.3	5.679	373.15	101.3	1.177
323.15	50.7	0.386		202.7	4.158
	101.3	1.015		405.3	9.652
	182.4	1.963		608.0	14.544
	202.7	2.184		810.6	18.824
	405.3	4.244		1013.3	22.777
	608.0	5.965			
	810.6	7.415			
	1013.3	8.667			

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Mixtures equilibrated in rocking autoclave. Pressures measured with piston gauges. Liquid phase analysed by condensing sample in liquid air and removing nitrogen by Toepler pump and then estimating amount volumetrically.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole per cent, major impurity nitrogen.

2. Contained 0.02 mole per cent of water.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$ or less;

$\delta x_{H_2} = \pm 0.2-0.3\%$.

REFERENCES:

1. Wiebe, R.; Tremearne, T. H.
   J. Am. Chem. Soc. 1933, *55*, 975.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Ammonia; NH_3; [7664-41-7]	Weibe, R.; Gaddy, V.L. *J. Am. Chem. Soc.* 1937, *59*, 1984-7
VARIABLES:	**PREPARED BY:**
Pressure	C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	10^2 x mole fraction of hydrogen in liquid, $10^2 x_{H_2}$
273.15	101.32	0.506
	202.65	0.986
	405.30	1.815
	607.95	2.518
	810.60	3.116
	1013.25	3.644

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:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{H_2} = \pm 0.5\%$ (estimated by compiler).

REFERENCES:

1. Wiebe, R.; Tremearne, T.H. *J. Amer. Chem. Soc.* 1933, *55*, 975.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Ammonia; NH_3; [7664-41-7]	Augood, D. R. *Trans. Instn. Chem. Engnrs.*, 1957, *35*, 394-408.
VARIABLES:	**PREPARED BY:**
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psig$^+$	P/MPa	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
293.2	2750	19.06	0.014	0.900
	2750	19.06	0.015	0.921
	2250	15.61	0.013	0.954
239.7	2760	19.13	0.005	0.973
	2250	15.61	0.004	0.987
	2090	14.51	0.003	0.972

$^+$ psig - pounds per square inch gauge pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Static equilibrium cell fitted with magnetically operated stirrer. After equilibrium had been established samples of gas and liquid phases taken. The ammonia was condensed out and both components estimated volumetrically. Ratio of H_2/HD in liquid estimated by mass spectrometry.	1. Electrolytic sample containing 0.09 mole per cent HD. 2. Imperial Chemical Industries sample.
	ESTIMATED ERROR:
	$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.1$; δx_{H_2}, δy_{H_2} = ±4% (estimated by compiler)
	REFERENCES:

COMPONENTS:

1. Hydrogen, H_2; [1333-74-0]
2. Ammonia, NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Heise, F.,

Ber. Bunsenges, Phys. Chem. 1972, *76*, 938-943.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in vapor, y_{H_2}
298.15	28.90	0.00166	0.6145
	53.45	0.00370	-
	100.2	-	0.8751
	100.7	0.00769	-
	202.15	0.01555	0.9304

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, 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_{H_2}, $\delta y_{H_2} = \pm 2\%$ (estimated by compiler).

REFERENCES:

1. Heise, F. *Dissertation*, Gottengen, 1971.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Ammonia; NH_3; [7664-41-7]	Moore, R.G.; Otto, F.D. *Can. J. Chem. Engng.* 1972, *50*, 355-60.
VARIABLES:	PREPARED BY:
Temperature	C.L. Young

EXPERIMENTAL VALUES:

T/K	10^4x Mole fraction of hydrogen in liquid, $10^4 x_{H_2}$ *
203.2	0.1185
213.2	0.1573
223.2	0.2018
233.2	0.2528
243.2	0.3119
253.2	0.3808
263.2	0.4616
273.2	0.5565
283.2	0.6685
293.2	0.8007
303.2	0.9567

*at a partial pressure of 101.3 kPa

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating flow apparatus fitted with magnetic pump. Amine saturated with hydrogen for a minimum of 8 hr. Samples of liquid withdrawn and amine frozen out, hydrogen released collected in calibrated gas buret. Amount of amine determined gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.999 mole per cent. Dried.
2. Matheson sample, purity 99.95 mole per cent. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{H_2} = \pm 4\%$.

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Moore, R.G., Otto, F.D.

Can. J. Chem. Engng. 1972, *50*, 355-60.

DATA taken from deposited document

		Total pressure	Partial pressure of hydrogen		Solubility +	Mole fraction of hydrogen
T/°C	T/K	P/atm	P/atm	P /MPa		x_{H_2}
-25.01	248.14	7.55	6.06	0.614	0.2837	0.002155
-24.50	248.65	7.54	6.01	0.609	0.2843	0.002159
-24.53	248.62	7.59	6.06	0.614	0.2756	0.002094
-24.31	248.84	16.36	14.81	1.501	0.6669	0.005064
-24.95	248.20	16.35	14.86	1.506	0.6935	0.005266
-24.67	248.48	14.42	12.90	1.307	0.5907	0.004486
-24.39	248.76	14.64	13.10	1.327	0.5996	0.004553
-24.11	249.04	14.57	13.01	1.318	0.5977	0.004539
-23.83	249.32	14.51	12.93	1.310	0.5857	0.004448
-24.39	248.76	16.60	15.06	1.526	0.7101	0.005393
-24.39	248.76	16.58	15.04	1.524	0.6885	0.005228
-35.61	237.54	13.99	13.10	1.327	0.4820	0.003660
-35.61	237.54	13.99	13.10	1.327	0.4777	0.003628
-38.07	235.08	18.07	17.29	1.752	0.5904	0.004484
-38.07	235.08	18.07	17.29	1.752	0.6053	0.004597
19.89	293.04	15.66	7.23	0.733	0.7634	0.005797
19.89	293.04	15.66	7.23	0.733	0.7621	0.005787
-59.83	213.32	17.02	16.80	1.702	0.3472	0.002637
-60.46	212.69	19.17	18.96	1.921	0.3828	0.002908
-62.16	210.99	17.19	17.01	1.724	0.3338	0.002535
-62.16	210.99	17.19	17.01	1.724	0.3303	0.002509
-62.29	210.86	17.37	17.18	1.741	0.3332	0.002531
-62.04	211.11	18.62	18.44	1.362	0.3696	0.002808
-61.09	212.06	15.70	15.50	1.571	0.3098	0.002353
0.19	273.34	15.76	11.50	1.165	0.8378	0.006361
0.19	273.34	21.52	17.25	1.748	1.2692	0.009634
0.19	273.34	21.52	17.25	1.748	1.2625	0.009583
0.13	273.28	18.93	14.67	1.486	1.0732	0.008147
0.11	273.26	18.93	14.68	1.487	1.0725	0.008142
21.96	295.11	17.74	8.74	0.886	0.9450	0.007175
21.96	295.11	17.74	8.74	0.886	0.9595	0.007285

\+ Volume of hydrogen (cm^3) reduced to 101.3 kPa and 273.15K dissolved by 1 gram of ammonia

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Gel'perin, I. I.; Trubitsyn, B. A.; Kalinina. S. Ye.; Bezyulev, V. V.

Khim. Prom. 1974, *8*, 619-20.

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$K^{\S}$/atm g cm^{-3}	10^4 × Mole fraction of hydrogen * at 1 atmosphere partial pressure $10^4 x_{H_2}$
273.15	14.8	0.514
248.15	22.5	0.338
243.15	25.8	0.295
233.15	30.9	0.246
223.15	42.3	0.179
203.15	68.0	0.112

* calculated by compiler assuming molar volume of hydrogen at 101.325 kPa and 273.15 K is 22.4 dm^3.

§ solubility coefficient in equation

$$p = K \times C$$

where p is the partial pressure of hydrogen and C is concentration in cm^3 (reduced to NTP) per gram.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Measurements made in high pressure cell up to 17.0 MPa. Results only given in terms of K but it was stated Henry's law was obeyed up to a mole fraction of 0.005 of hydrogen. Samples analysed by freezing ammonia in liquid nitrogen and estimating hydrogen volumetrically. Hydrogen removed and ammonia estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta x_{H_2} = \pm 2\%$.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]

2. Diborane; B_2H_6; [19287-45-7]

ORIGINAL MEASUREMENTS:

Hu, J.-H.; MacWood, G. R.

J. Phys. Chem. 1956, *60*, 1483-6.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}	T/K	P/bar	Mole fraction of hydrogen in liquid, x_{H_2}	in gas, y_{H_2}
115.49	8.89	0.02590	0.9994	146.19	20.93	0.09307	0.9948
112.34	10.27	0.02969	0.9996	146.55	25.78	0.11338	0.9953
112.43	11.60	0.03365	0.9998	146.75	32.87	0.14406	0.9954
113.82	15.34	0.04435	0.9998	146.01	42.47	0.18326	0.9960
114.51	21.28	0.06182	0.9998	158.43	4.09	0.01954	0.9295
113.46	21.69	0.06285	0.9998	158.32	10.07	0.05106	0.9755
112.66	26.96	0.07501	0.9998	158.30	15.15	0.07634	0.9823
112.85	34.58	0.08694	0.9998	158.15	21.51	0.10854	0.9862
112.08	42.54	0.09667	0.9999	158.33	28.58	0.14541	0.9895
123.83	6.83	0.02330	0.9986	158.35	34.58	0.17622	0.9900
123.95	14.61	0.04842	0.9992	159.26	42.04	0.21377	0.9915
123.92	20.24	0.06841	0.9994	169.55	7.89	0.04337	0.9279
124.24	25.92	0.08469	0.9994	169.86	14.79	0.08427	0.9650
124.46	34.51	0.11180	0.9994	169.88	21.69	0.12433	0.9719
124.23	42.68	0.13554	0.9994	169.97	29.12	0.17083	0.9780
134.94	7.12	0.02834	0.9976	169.69	36.29	0.21139	0.9805
134.93	13.74	0.05381	0.9980	169.71	42.54	0.24527	0.9816
135.13	20.86	0.08230	0.9985	181.56	8.42	0.04900	0.8527
134.80	27.52	0.10757	0.9984	181.68	14.28	0.08921	0.9137
134.95	34.19	0.13073	0.9987	181.42	20.39	0.13143	0.9435
134.95	43.02	0.16129	0.9988	181.55	27.24	0.17661	0.9540
145.91	5.55	0.02458	0.9834	181.55	36.29	0.23562	0.9610
145.66	9.25	0.04152	0.9886	181.73	42.24	0.27194	0.9630

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

High pressure cell connected to vapor recirculating pump. Pressure measured with Bourdon gauge calibrated against dead weight balance. Temperature measured with thermocouple. Hydrogen analysed volumetrically by stripping the liquid phase mixture. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Electrolytic sample.
2. Purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/\text{bar} = \pm 0.03$; $\delta x_{H_2} = \pm 0.0001$; $\delta y_{H_2} = \pm 0.0001$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]
3. Carbon monoxide; CO; [630-08-0]

ORIGINAL MEASUREMENTS:

Akers, W.W.; Eubanks, L.S.
Adv. Cryogenic Engng. 1960, *3*,
275-293.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

			Mole fractions in liquid,			Mole fractions in vapor,		
T/K	*P*/psia	*P*/MPa	x_{H_2}	x_{N_2}	x_{CO}	y_{H_2}	y_{N_2}	y_{CO}
80.37	315	2.17	0.0398	0	0.9602	0.9084	0	0.0916
			0.0404	0.2186	0.7410	0.8865	0.0416	0.0719
			0.0447	0.7483	0.2070	0.8671	0.0181	0.0242
			0.0460	0.8270	0.1270	0.8662	0.1169	0.0169
			0.0469	0.8776	0.0805	0.8658	0.1234	0.0108
			0.0487	0.9513	0	8655	0.1345	0
	500	3.45	0.0609	0	0.0301	0.9320	0	0.0680
			0.0658	0.1165	0.8177	0.9250	0.0158	0.0592
			0.0672	0.2170	0.7158	0.9198	0.0285	0.0517
			0.0694	0.3120	0.6186	0.9050	0.0401	0.0449
			0.0706	0.4030	0.5264	0.9020	0.0495	0.0385
			0.0726	0.4784	0.4490	0.9073	0.0583	0.0344
			0.0745	0.6195	0.3060	0.9018	0.0710	0.0272
			0.0755	0.7185	0.2060	0.8987	0.0819	0.0194
			0.0761	0.8176	0.1063	0.8964	0.0932	0.0104
			0.0763	0.9237	0	0.8948	0.1052	0
	1400	9.65	0.1745	0	0.8255	0.9143	0	0.0857
			0.1815	0.0940	0.7245	0.9080	0.0168	0.0752
			0.1828	0.1122	0.7050	0.9067	0.0201	0.0732
			0.1943	0.2265	0.5292	0.8956	0.0470	0.0574
			0.1950	0.2860	0.5190	0.8950	0.0483	0.0567
			0.2094	0.4796	0.3110	0.8831	0.0810	0.0359
			0.2190	0.6212	0.1598	0.8765	0.1049	0.0186

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetic pump at ambient temperature. Cell made of type 303 stainless steel. Pressure measured with Bourdon gauge and temperature measured with copper-constantan thermocouples. Samples of both phases analysed by gas chromatography using a thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. and 2. Purity 99.7 mole per cent.

3. Prepared from reaction of formic acid and sulfuric acid. Dried. Purity about 97 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.06$; $\delta P/MPa = \pm 0.02$;
δx, δy = ±2%.

REFERENCES:

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]
3. Carbon monoxide; CO; [630-08-0]

ORIGINAL MEASUREMENTS:

Akers, W.W.; Eubanks, L.S.

Adv. Cryogenic Engng. 1960, *3*, 275-293.

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fractions in liquid			Mole fractions in vapor,		
			x_{H_2}	x_{N_2}	x_{CO}	y_{H_2}	y_{N_2}	y_{CO}
80.37	1400	9.65	0.2231	0.6864	0.0905	0.8731	0.1159	0.0110
			0.2300	0.7700	0	0.8700	0.1300	0
	2000	13.79	0.2490	0	0.7510	0.8790	0	0.1210
			0.2815	0.2270	0.4915	0.8508	0.0440	0.1052
			0.3000	0.3500	0.3500	0.8356	0.0743	0.0901
			0.3317	0.5644	0.1039	0.8090	0.1550	0.0360
			0.3446	0.0654	0	0.7977	0.2023	0
99.82	315	2.17	0.0389	0	0.9611	0.6803	0	0.3197
			0.0393	0.0811	0.8796	0.6682	0.0392	0.2925
			0.0398	0.1970	0.7632	0.6504	0.0958	0.2538
			0.0400	0.2980	0.6620	0.6357	0.1390	0.2253
			0.0397	0.5493	0.4110	0.5919	0.2563	0.1518
			0.0392	0.7102	0.2506	0.5680	0.3315	0.1005
			0.0385	0.8651	0.0964	0.5563	0.4037	0.0400
			0.0380	0.9413	0.0207	0.5519	0.4393	0.0088
			0.0377	0.9623	0	0.5509	0.4491	0
	500	3.45	0.0674	0	0.9326	0.7619	0	0.2381
			0.0689	0.0766	0.8545	0.7483	0.0335	0.2182
			0.0707	0.1908	0.7385	0.7318	0.0797	0.1885
			0.0720	0.2968	0.6312	0.7190	0.1133	0.1677
			0.0739	0.5201	0.4050	0.6974	0.1886	0.1140
			0.0744	0.6576	0.2680	0.6868	0.2352	0.0780
			0.0745	0.6761	0.2494	0.6851	0.2422	0.0727
			0.0744	0.8342	0.0914	0.6740	0.2985	0.0275
			0.0744	0.8455	0.0801	0.6732	0.3023	0.0245
			0.0741	0.9259	0	0.6686	0.3314	0
99.82	800	5.52	0.1163	0	0.8837	0.7844	0	0.2156
			0.1281	0.1342	0.7377	0.7708	0.0492	0.1800
			0.1342	0.3074	0.5584	0.7539	0.1099	0.1362
			0.1366	0.4826	0.3808	0.7398	0.1627	0.0975
			0.1378	0.6556	0.2066	0.7290	0.2120	0.0590
			0.1381	0.7230	0.1389	0.7256	0.2340	0.0404
			0.1383	0.8313	0.0304	0.7213	0.2693	0.0094
			0.1384	0.8616	0	0.72795	0.2721	0
	1100	7.58	0.1727	0	0.8273	0.7848	0	0.2152
			0.1860	0.0717	0.7423	0.7760	0.0257	0.1983
			0.2030	0.3452	0.4518	0.7448	0.1237	0.1315
			0.2074	0.4995	0.2931	0.7317	0.1790	0.0893
			0.2102	0.6817	0.1081	0.7208	0.2443	0.0349
			0.2114	0.7611	0.0275	0.7181	0.2727	0.0092
			0.2116	0.7884	0	0.7175	0.2825	0
	1400	9.65	0.2399	0	0.7601	0.7739	0	0.2261
			0.2527	0.0663	0.6810	0.7578	0.0330	0.2092
			0.2662	0.1634	0.5704	0.7357	0.0813	0.1830
			0.2792	0.2965	0.4243	0.7090	0.1476	0.1434
			0.3001	0.6522	0.0477	0.6565	0.3247	0.0188
			0.3030	0.6970	0	0.6530	0.3470	0
122.04	500	3.45	0.0449	0	0.9551	0.2260	0	0.7740
			0.0426	0.1486	0.8094	0.1974	0.1395	0.6631
			0.0395	0.3279	0.6326	0.1660	0.3090	0.5250
			0.0356	0.5083	0.4561	0.1357	0.4791	0.3852
			0.0332	0.6088	0.3580	0.1204	0.5738	0.3058
			0.0288	0.8242	0.1470	0.0945	0.7768	0.1287
			0.0261	0.9739	0	0.0821	0.9179	0

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Hydrogen; H_2; [1333-74-0] 2. Nitrogen; N_2; [7727-37-9] 3. Carbon monoxide; CO ; [630-08-0]	Akers, W.W.; Eubanks, L.S. *Adv. Cryogenic Engng.* 1960, *3*, 275-293.

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fractions in liquid x_{H_2}	x_{N_2}	x_{CO}	Mole fractions in vapor y_{H_2}	y_{N_2}	y_{CO}
122.05	500	5.52	0.1382	0	0.8618	0.3349	0	0.6651
			0.1387	0.1330	0.7283	0.3095	0.1120	0.5785
			0.2256	0.3550	0.4214**			

** Critical point.

COMPONENTS:

1. Hydrogen; H_2; [1333-74-0]
2. Nitrogen; N_2; [7727-37-9]
3. Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Larson, A. T.; Black, C. A.

Ind. Eng. Chem. 1925, *17*, 715-6.

VARIABLES:

Temperature, pressure, composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P_{total}/MPa	P_{H_2}/P_{N_2}	Absorption Coefficients#		Mole fractions*	
			H_2	N_2	x_{H_2}	x_{N_2}
248.0	5.07	3.0	1.62	0.73	0.00123	0.00055
254.7			1.90	0.84	0.00144	0.00064
263.2			2.07	0.94	0.00157	0.00071
270.2			2.35	1.08	0.00178	0.00082
273.2			2.61	1.15	0.00198	0.00087
275.7			2.70	1.19	0.00205	0.00090
292.2			3.19	1.46	0.00242	0.00111
248.2	10.13		3.30	1.35	0.00250	0.00102
253.2			3.66	1.46	0.00277	0.00111
258.7			3.85	1.63	0.00292	0.00124
263.2			4.43	1.83	0.00335	0.00139
268.0			4.84	2.02	0.00366	0.00153
273.2			5.28	2.28	0.00400	0.00173
295.2			7.54	3.21	0.00570	0.00243
251.2	15.20		4.70	1.89	0.00356	0.00143
256.0			5.12	2.09	0.00388	0.00159
263.7			6.20	2.44	0.00469	0.00185
266.0			6.30	2.58	0.00476	0.00196
278.2			8.22	3.33	0.00621	0.00252
286.5			9.42	3.61	0.00711	0.00274

\# cm^3 of gas (measured at 101.325 kPa and 273.15 K) dissolved per gram of ammonia.

* calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Pressure measured with Bourdon gauge. Liquid samples taken and added to excess acid. Hydrogen and nitrogen estimated by volumetric method and combustion of hydrogen.

SOURCE AND PURITY OF MATERIALS:

No details given except that nitrogen contained a trace of argon.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P_{total}/MPa = \pm 0.05$; $\delta x_{H_2} \simeq \delta y_{N_2} = \pm 1\%$ (estimated by compiler).

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- and dimethylsulfoxide is listed as methane, sulfinylbis-. Since hydrogen is usually one of the components it is omitted in the listing.

REGISTRY NUMBER INDEX

Underlined page numbers refer to evaluation text and those not underlined to compiled tables.