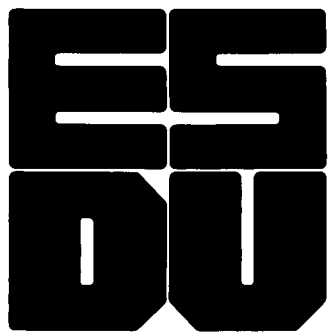




Engineering Sciences Data

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Vapour pressures and critical points of liquids

**Introduction to Data Items
issued after September 1984**

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ENGINEERING SCIENCES DATA ITEM No.84021

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The work of the permanent professional staff of the Engineering Sciences Data Unit on this particular Item was monitored and guided by the Physical Data and Reaction Kinetics Committee which has the following constitution:

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The work on this Item was carried out in the Internal Flow and Physical Properties Group of the Engineering Sciences Data Unit. The member of staff who undertook the construction and subsequent development of the Item was

Mr J.Walton — Senior Engineer,

with special help and advice from Dr D.Ambrose.

The Physical Data and Reaction Kinetics Committee, which first met in May 1966, has the co-operation of many engineers and scientists in industry, research establishments and universities from whom much assistance and information are being received.

In order to assist the preparation of new work, and particularly to assist the periodic review and revision of work already issued, users are encouraged to make known their experience in using the information and procedures and to notify the Unit of any additional information which they can provide or to which reference can be made. Prepaid reply service cards are available for this purpose. Whenever an Item is revised, users who are Associates of ESDU (i.e. have a standing order for one or more Sub-series) automatically receive any material required to up-date Items in the Sub-series held. While it is always advisable to check by use of the current edition of the Engineering Sciences Data Index that Items held are the latest issue and incorporate the latest amendments, those who are not Associates are particularly advised to take this action at reasonable intervals since the Unit

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VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS
INTRODUCTION TO DATA ITEMS ISSUED AFTER SEPTEMBER 1984

1. INTRODUCTION

This Data Item provides explanatory notes and additional information to supplement that given in each Item in the series of Data Items on the vapour pressures and critical points of liquids issued from 1984 onward. These Items update and extend those previously issued from 1972 onward.

The earlier Data Items used a Chebyshev equation to represent vapour pressures but this was replaced by a form of Wagner equation in later Items because the latter, with fewer coefficients, gives a better representation of the vapour pressure behaviour particularly in the high pressure region. For uniformity with the more recent Items the same form of Wagner equation will continue to be used in the revised Data Items.

The experimental vapour pressure work reported since 1972 is mainly in the high pressure range and many new values of critical temperatures and critical pressures have also been reported.

In the low pressure range, vapour pressures estimated from low temperature thermal and volumetric data using appropriate thermodynamic relationships, have been derived for a small number of compounds. These data are thought to be much more reliable than any direct measurements of vapour pressure in this range but the lack of the required thermal and volumetric data has prevented more work in this area.

In the medium pressure range very precise measurements on several compounds have been reported.

Complementing this experimental work, Ambrose and coworkers have published a number of papers giving new methods of correlation and estimation of vapour pressures and critical properties. Among these is a new procedure for the constrained fitting of vapour pressure data which ensures that the derived vapour pressure curve has certain well established characteristics.

All the above developments are taken into account in the revision of the earlier Data Items. In addition the number of compounds in each related group is increased and the extrapolation of the data to low pressures is both extended and improved.

The data on which the values in the Tables of the Data Items are based are the most reliable available and have been fitted and correlated by equations that are valid from the freezing temperature (or triple point where it is known) upwards over the whole liquid range. Tabular values derived from these equations thus considerably extend the range of values obtainable from Antoine equations, available in the literature for most of the compounds, which, of course, should not be extrapolated outside the range within which they were fitted.

Tabulated data are provided in both SI and engineering units, but for users who require them in other units conversion factors are provided in Table 1. Section 2 shows the notation and units adopted and Section 3 outlines the procedure used to derive the values of vapour pressure. Section 4 gives an explanation of the Tables in the Data Items and Section 5 contains general References.

The sources of vapour pressure data used or consulted in the preparation of the Data Items and a discussion of the uncertainties in the tabulated values are given in each Item.

2. NOTATION AND UNITS

All temperatures are based on the International Practical Temperature Scale of 1968 (IPTS-68), which for practical purposes is interchangeable with the Thermodynamic Scale, see Reference 3.

The SI unit of pressure is the newton per square metre, which has the special name of pascal (Pa). A convenient multiple SI unit for the range of vapour pressures covered in the Data Items is the kilopascal (kPa) hence that is the unit adopted here.

b_1, b_2, b_3, b_4	non-dimensional constants for each compound in the Wagner Equation (see Section 3)	
p	vapour pressure	kPa, atm, mmHg or psia
p_c	critical pressure	kPa, atm, or psia
T	temperature	K, deg.C or deg.F
T_c	critical temperature	K, deg.C or deg.F
T_f	freezing point	K, deg.C or deg.F
T_r	reduced temperature	
ω	acentric factor, $-\log p_r - 1$ at $T_r = 0.7$	

3. DERIVATION OF VAPOUR PRESSURES

3.1 Source of Data

Experimental vapour pressure data are, according to the apparatus and technique applied, usually reported for different pressure ranges which may loosely be defined as:-

- low pressure, below say 1 kPa (approximately 7.5 mmHg),
- medium pressure, say 1 kPa to 200 kPa (approximately 2 atm),
- high pressure, say 200 kPa to the critical point,
- critical point region.

The experimental data reported for the low and high pressure ranges are usually less precise than, and not always compatible with, data for the medium pressure range, which may be of a very high degree of precision. The most reliable medium pressure range data have uncertainties of less than 0.005 K in temperature corresponding, typically, to less