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Arthur A. Maryott and Edgar R. Smith

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Contents

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Table of Dielectric Constants of Pure Liquids

Arthur A. Maryott and Edgar R. Smith

The "static" dielectric constants of more than 800 substances in the liquid state were critically examined and tabulated in concise form. The table consists of three sections: A, Standard Liquids; B, Inorganic Liquids; and C, Organic Liquids. An indication of the probable accuracy of the data is given. Wherever feasible, a simple analytical function is employed to express the variation of dielectric constant with temperature.

1. Introduction

This tabulation of the dielectric constants of pure liquids is part of a program for a critical examination of the data of physics and chemistry, sponsored by the National Bureau of Standards in cooperation with the Committee on Tables of Constants and Numerical Data of the National Research Council and the Commission on Tables of Constants of the International Union of Chemistry. The preparation of additional tables of the dielectric constants of gases, solids, aqueous and nonaqueous solutions and mixtures, and of dipole moments is in progress.

The assemblage and evaluation of the data have been made entirely at the National Bureau of Standards with the assistance of M. Eden during the preliminary stages. However, helpful suggestions from M. E. Hobbs of Duke University, C. P. Smyth of Princeton University, and the Committees of the National Research Council and International Union of Chemistry are gratefully acknowledged. The compilations of P. Debye and H. Sack (Tables de Constantes et Données Numériques XI, Fasicule 2, 1931–34; XII, Fasicule 32, 1935–36 and earlier volumes of Tables Annuelles), International Critical Tables, and Landolt-Börnstein Tabellen have been useful in checking the tables for accuracy and completeness. In several instances data have been obtained from the Tables of Dielectric Materials, volume III, prepared by the Laboratory of Insulation Research, Massachusetts Institute of Technology, Cambridge, Mass., 1948.

2. Description of the Table

The table consists of three sections: A, Standard Liquids, B, Inorganic Liquids, C, Organic Liquids. The dielectric constants are intended to be the limiting values at low frequencies, the so-called "static" values. Data obtained at such high frequencies that anomalous dispersion was evident are not included. In questionable cases the frequency is given in a footnote. Temperature is the only variable considered explicitly. Usually the pressure is atmospheric or insignificantly different with respect to its effect on dielectric constant. However, where data are listed at temperatures above the normal boiling point, the pressure corresponds to the vapor pressure of the liquid unless indicated otherwise in a footnote.

2.1. List of Symbols

ϵ = dielectric constant ($\epsilon_{\text{vacuum}} = 1$)
t = temperature, Celsius (°C)
T = temperature, absolute (°K)
$a = -d\epsilon/dt$
$\alpha = -d\text{Log}_{10}\,\epsilon/dt$
f = frequency of alternating current in cycles per second
t_1, t_2 = the limits of temperature between which a or α is considered applicable
mp = melting point
bp = boiling point

2.2. Standard Liquids

Section A contains values of the dielectric constant at selected temperatures for 10 substances that are recommended as reference liquids because of their chemical stability, availability, and the reliability of the data. The probable accuracy is estimated to be about 0.2 percent for methanol and nitrobenzene and about 0.1 percent in the remaining cases. Values of a or α are included for interpolating or for extrapolating over a limited range of temperature without materially altering the accuracy. Additional data for these substances are contained in sections B or C.

2.3. Chemical Formulas and the Order of Listing Substances

Formulas for the inorganic substances are written in the usual manner. The order of listing compounds in section B is alphabetical according to the symbols for the elements in these formulas with consideration also given to the number of atoms of each kind.

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