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VISCOSITY OF LIQUID BENZENE

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ENGINEERING SCIENCES DATA

(Mechanical Engineering Series)

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Mr. A. J. Ward Smith - Head of Fluid Mechanics and Thermodynamics Group

The Fluid Mechanics and Thermodynamics Committee, which first met in May 1964, has the co-operation of many engineers and scientists in industry, research establishments and universities from whom much assistance and unpublished information is being received. Particular assistance was received for the preparation of this Item from Mr. D. T. Jamieson of the National Engineering Laboratory.

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VISCOSITY OF LIQUID BENZENE

1. NOTATION

p	absolute pressure
t	temperature
η	dynamic viscosity
ν	kinematic viscosity
ρ	density

2. GENERAL INFORMATION

Chemical Formula	C_6H_6
Synonyms*	Benzol, Benzole
Critical Temperature	289°C (552°F)
Critical Pressure	$49 \times 10^5 \text{ N/m}^2$ (710 lbf/in ²)
Normal Freezing Point	5.5°C (42°F)
Normal Boiling Point	80°C (176°F)

Benzene is the accepted name of the pure liquid. The synonyms* benzol and benzole are often used, and all three names may refer to the pure liquid or to commercial grades. The latter may contain impurities, which are generally in such small quantities that the viscosity is unaffected.

3. DYNAMIC VISCOSITY

Data are given in Figure 1 for the dynamic viscosity of benzene over a range of temperatures and pressures. The data at atmospheric pressure between boiling point and freezing point (shown by the full line) are based on Reference 1. Benzene is one of the few substances for which viscosity data are available in the supercooled state. Based on Reference 2, these apply down to -10°C and are given by an extrapolation of the straight line at atmospheric pressure. This curve also applies to benzene which has its freezing point depressed due to the presence of impurities, providing the viscosity-temperature relationship does not depart appreciably from that of the pure substance at atmospheric pressure.

The line for saturated vapour pressures is based on the results of Reference 5 and is thought to be accurate to 1-2 per cent up to 180°C, above which the accuracy deteriorates.

The data for high pressures are based on the results from References 3 and 4. For pressures up to 50 times atmospheric, data at atmospheric pressure may be used within an accuracy of 5 per cent.

At atmospheric pressure the dynamic viscosity, η , in centipoise ($1 \text{ cP} = 10^{-3} \text{ N s/m}^2$) is related to temperature, t , according to the formulae

$$\log_{10} \eta = -1.636 + \frac{289.9}{(t + 273.2)} + \frac{3.94 \times 10^4}{(t + 273.2)^2} \quad (t^\circ\text{C}), \quad (1a)$$

$$\log_{10} \eta = -1.636 + \frac{521.8}{(t + 459.7)} + \frac{1.277 \times 10^5}{(t + 459.7)^2} \quad (t^\circ\text{F}). \quad (1b)$$

* Benzine is one of the light distillates from petroleum and is not a synonym for benzene.