

U.S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS

CERTIFICATE  
FOR  
STANDARD SAMPLE NO. 211a  
TOLUENE

MATERIAL

This lot of toluene was prepared at this Bureau by purification<sup>a</sup> of commercial material of original high purity. The amount of impurity in the final product was determined from measurements of freezing points to be  $0.04 \pm 0.02$  mole percent.

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<sup>a</sup> The purification and determination of purity were performed by the NBS Section on Thermochemistry and Hydrocarbons.  
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DENSITY

The density of a sample of this material was measured in a picnometer of special design having a volume of 108 ml. The temperature of the bath was maintained constant to  $\pm 0.01^\circ\text{C}$ . It is believed that the uncertainties in the values of density, which are given in the following table, are less than  $\pm 0.00002$  g/ml.

Temperature	20°C	25°C	30°C
Density <sup>a</sup> , in g/ml (For air-saturated material)	0.86696	0.86231	0.85764

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<sup>a</sup> These measurements were made by the NBS Section on Capacity and Density.  
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These values of density are on the basis of weights in vacuum, with the sample at a pressure of 1 atmosphere and saturated with air. The density of air-free material is greater than that of air-saturated material by about 0.01 percent. Near 1 atmosphere, the change of density with pressure is of the order of 0.01 percent per atmosphere. For a description of the method and apparatus used, reference is made to the following publications: NBS Technological Paper No. 77 (1916); Bulletin NBS 9, 405 (1913).

REFRACTIVE INDEX

The indices of refraction of a sample of this material were measured with a spectrometer by the minimum-deviation method, by use of a water-jacketed hollow prism mounted in a stirred air bath on the

spectrometer table. A platinum resistance thermometer was immersed in the liquid during the measurements. The values of refractive index are corrected to refer to air at the listed temperatures and at a pressure of 76 cm Hg. It is believed that the uncertainties in the values of refractive index, which are given in the following table, are less than  $\pm 0.00002$ . As measured on a spectrometer, in air, values

Wavelength in Angstrom units	Designation of line	Index of Refraction <sup>a</sup>		
		20°C	25°C	30°C
6678.1	helium	1.49180	1.48903	1.48619
6562.8	hydrogen, C	1.49243	1.48966	1.48682
5892.6 <sup>b</sup>	sodium, D <sub>1</sub> , D <sub>2</sub>	1.49693	1.49413	1.49126
5460.7	mercury, e	1.50086	1.49803	1.49514
5015.7	helium	1.50620	1.50334	1.50041
4861.3	hydrogen, F	1.50847	1.50559	1.50265
4358.3	mercury, g	1.51800	1.51506	1.51206

<sup>a</sup> These measurements were made by the NBS Section on Optical Instruments.

<sup>b</sup> Intensity-weighted mean of doublet, D<sub>1</sub>, D<sub>2</sub>.

of refractive index decrease by 0.000005 for each 1 cm Hg increase in pressure of the air. See J. Research NBS 14, 400 (1935) RP 776. When determined by the use of refractometers, such as those of the Abbe and Pulfrich types, the refractive index is, in general, largely independent of the condition of the air at the emergence face of the refractometer block. This is especially true when a strictly comparison procedure is followed. Consequently, the refractive indices of "unknown" samples thus observed are referred to conditions essentially the same as those for the standard samples with which the instrument is adjusted. See J. Research NBS 30, 320 (1943) RP 1535. For a description of the apparatus and method of measurement, reference is made to the following publications: J. Research NBS 20, 419 (1938) RP 1085; J. Optical Soc. Am. 32, 371 (1942).

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