Brookhaven Instruments

BI-870

Dielectric Constant Meter

With Brookhaven's **BI-870**, measurement of dielectric constants has never been so easy. Simply insert the probe in the liquid to be measured, adjust the two controls on the front panel and read the dielectric constant from the display. The **BI-870** can accurately measure in low and high dielectric solvents, including mixtures.

Mixtures

While literature values of dielectric constants are suitable when using pure liquids, for mixtures of liquids, values are not readily available. Also no simple equation describes mixtures using pure component values. Good zeta potential determinations of suspended colloidal particles depend on the accuracy of the dielectric constant of the liquid. Depending on the particle of interest, a number of different liquids may be used, including mixtures of various proportions creating the need for an accurate measurement of dielectric constant.

Features at a Glance

- Absolute accuracy to ± 2%
- Fast & easy to use
- Compact size
- Rugged & reliable
- Easy to clean

Theory of Operation

The **BI-870** has two ranges: 1 – 20 and 1 - 200. Absolute accuracy is ± 2%; repeatability and linearity are better than 0.2%. The measurement signal applied to the outer cylinder of the probe is a low-distortion sine wave a a frequency of 10 kHz.

The amplitude is approximately 7 volts rms on the 1 - 20 range and 0.7 volts on the 1 - 200 range. The frequency is crystal-controlled and is, therefore, stable to approximately 1 part in 10^5. The dielectric constant of the liquid sample is determined by measuring the current between the outer and inner cylinders of the probe. With a stable voltage source and precisely known probe parameters, it is possible to display the dielectric constant directly. Calibration is simple using the back panel adjustment with a liquid of known dielectric constant.

Probe

The probe has an open structure and is easy to clean. It is constructed from two precision cylinders, machined from type 316 stainless steel. Six Teflon balls maintain the cylinder spacing. If the probe is used primarily with low-dielectric constant hydrocarbon fluids, we recommend cleaning by agitation in acetone or ethyl alcohol, followed by gentle drying with clean compressed air. It is important that the probe be cleaned before any residue dries on the cylinders. Since the probe is made of stainless steel and Teflon, it may be cleaned in almost any solvent.

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Dielectric Constant Meter

Material	Measured Dielectric Constant	Temperature	Published[1] Dielectric Constant	% Difference[2]
Cyclohexane	2.03	25 ℃	2.015	0.7
Ethyl Acetate	6.05	25 ℃	6.02	0.6
Dichloromethane	8.92	25 ℃	9.07[3]	-1.6
Methanol	33.2	25 ℃	32.63	1.7
De-ionized Water	79.3 79.9 80.2	25 ℃ 24 ℃ 23 ℃	78.54 78.90 79.27	1.0 1.3 1.2
		Mixtures		
Dichloromethane + Cyclohexane (1:1)	5.35	25 ℃	N/A	--
Methanol + Water (1:1)	61.2	25 ℃	N/A	--

1. *CRC Handbook of Chemistry and Physics*
2. % Difference = [(Measured-Published)/ Published] x 100
3. Corrected for temperature to match 25 ℃ measurements

The measured values are within 2.0 % of the literature values. Notice the -0.6 %/℃ temperature coefficient for water. The temperature coefficient for cyclohexane is –0.08 %/℃.

There are no generally acceptable methods of calculating values for mixtures from pure component values. For example, weighting by mole fractions leads to errors of 17 % and 6 % for the two mixtures. Weighting by volume leads to errors of –8 % for MeOH/H_2O and 2.4 % for CH_2Cl_2/C_6H_6

Specifications

Full Scale Sensitivity	Dielectric constants of 1-20 and 1-200
Maximum Conductivity of Sample	Range 1-20: 1 µS/cm Range 1-200: 10 µS/cm (< 0.05 mM 1:1 electrolyte)
Accuracy	2% Absolute: Repeatability and Linearity 0.2%
Probe Materials	Stainless Steel and Teflon
Minimum Liquid Required	~25 mL standard probe
Power Requirements	100/115 and 200/240 VAC; 50/60 Hz; 10 Watts
Dimensions	190 mm x 240 mm x 70 mm
Operating Temperature	22 ℃ - 58 ℃
Measurement Signal	Low-distortion 10 kHz sine wave
Display	Backlight LCD
Output	Analog Recorder, Full Scale Reading 1.999 V
Calibration	Back Panel Adjustment with Reference Liquid

A policy of continual improvements may lead to specification changes

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