

## 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, values are not readily available for mixtures of liquids. 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.

### Theory of Operation

The **BI-870** has two ranges: 1–20 and 1–200. Absolutely accuracy is  $\pm 2\%$ ; 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 at 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<sup>5</sup>. 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.



#### Features at a Glance

- » Absolute accuracy to  $\pm 2\%$
- » Fast & easy to use
- » Compact size
- » Rugged & reliable
- » Easy to clean

Material	Measured Dielectric Constant	Temperature	Published <sup>1</sup> Dielectric Constant	% Difference <sup>2</sup>
Cyclohexane	2.03	25° C	2.02	0.7
Ethyl Acetate	6.05	25° C	6.02	0.6
Dichloromethane	8.92	25° C	9.07 <sup>3</sup>	-1.6
Methanol	33.2	25° C	32.63	1.7
De-ionized water	79.3	25° C	78.54	1.0
	79.9	24° C	78.90	1.3
	80.2	23° C	79.27	1.2
		Mixtures		
Dichloromethane + Cyclohexane (1:1)	5.35	25° C	N/A	—
Methanol + Water (1:1)	61.2	25° C	N/A	—

1. CRC Handbook of Chemistry and Physics

2. % Difference = [(Measured-Published)/Published] x 100

3. Corrected for temperature to match 25 °C measurements

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

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<sub>2</sub>O and 2.4% for CH<sub>2</sub>Cl<sub>2</sub>/C<sub>6</sub>H<sub>6</sub>.

## Key Features & Specifications

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

## About Brookhaven Instruments

Our talented team of scientists and engineers is dedicated to delivering the most accurate, reliable, and easy-to-use particle characterization instruments on the market. Our modular instrument design allows us to fully customize every aspect of our products, ensuring that our customers receive precisely what they need to meet their research goals. We are continuously improving our products based on feedback from customers, building on our legacy of innovation in particle science.

We strive to act as partners with our customers to ensure they get the most benefit and maximum value from their Brookhaven equipment. We offer extensive post-sale support to educate and empower customers. Whether you have questions about a specific function or are trying to set up a new experiment, our experts will be there to help you every step of the way.



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