Quality Assessment of Dielectric Liquids

Conductivity Meter For Liquids LCM-8716

The **Conductivity Meter For Liquids LCM-8716** is an instrument for measuring of the relative permittivity, the volume conductivity and the dissipation factor of liquid insulation. The instrument is developed according to the new **IEC 61620** standard by using the alternate square wave method. This method permits an accurate determination of above quantities at ambient temperature. The **Conductivity Meter For Liquids LCM-8716** is an easy to use instrument composed of a portable measuring device and a compact low loss test cell.

Features

- Accurate and fast measurements of the volume conductivity from 10^{-14} to10^{-8} S/m and the relative permittivity ε_r up to 5
- Determination of the dissipation factor tanδ at power frequencies down to values of 10^{-6}
- Determination of the discharge time constant of electric volume charges as produced by triboelectric effects
- Optional analogue outputs for continuous recording of the measured values
- Portable instrument, light and self-contained
- Compact test cell, easy to use, easy to clean

Applications

- Test and documentation of the conductivity (or resistivity) of highly insulating liquids used in electrical equipment as transformers, bushings, cables, capacitors and other high voltage apparatus
- Control of the dielectric quality of liquid insulation during the manufacturing of electrical equipment
- Control of the liquid insulation quality for maintenance decisions
- Monitoring of the liquid insulation quality for failure alert purposes
- Detection of the ionic purity of high resistance liquids: tests during the synthesis of liquids, purity checking on chemicals and mineral or organic oils, ageing and degradation studies

phone: +41 44 77 66 77 6
fax: +41 44 77 66 77 7
e-mail: info@alff-engineering.ch
web: www.alff-engineering.ch

ALFF ENGINEERING
Gomweg 7 8915 Hausen am Albis Switzerland

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According to Ohm's law, the volume conductivity σ is a scalar quantity, which relates an applied electric field strength to a material with the generated conduction current density through it. For an homogeneous material and particularly for a liquid subjected to a low electric field, the volume conductivity is constant throughout its volume and it depends on the properties of the liquid material itself and on those of the contained ionisable substances (ionic impurities).Therefore a liquid can well be characterised by its volume conductivity.
The alternate square wave method (low voltage low frequency) according to IEC 61620 standard is an adequate method to determine the volume conductivity σ and the relative permittivity ε_r of insulating liquids at low temperature without disturbing their thermodynamic equilibrium.

For insulating liquids used in electrical power apparatus, the conduction is the sole cause of loss at power frequencies (50/60 Hz), which are low frequencies indeed. Therefore, the dissipation factor $\tan\delta$ calculated from the measured σ and ε_r with the alternate square wave method is equal to the value of $\tan\delta$ measured with the classic bridge method.
The **Conductivity Meter For Liquids LCM-8716** works with the low voltage alternate square wave method and satisfies all the recommendations of IEC 61620 standard:
"Insulating liquids
- Determination of the dielectric dissipation factor by measurement of the conductance and capacitance
- Test method"
first edition, dated 1998-11.

Specifications: Conductivity Meter For Liquids LCM-8716

Electronic measuring instrument LCM-8716	
conductivity measurement range	10^{-14} ... 2 x10^{-8} S/m on four ranges
resolution of conductivity measurements	10^{-14} S/m for conductivities up to 19.99 pS/m 10^{-13} S/m for conductivities up to 199.9 pS/m 10^{-12} S/m for conductivities up to 1.999 nS/m 10^{-11} S/m for conductivities up to 19.99 nS/m
uncertainty of conductivity measurements	±1 digit ±1 % of indicated value
relative permittivity measurement range	up to 5.00
resolution of permittivity measurements	0.001 for relative permittivities up to 1.999 0.01 for relative permittivities from 2.00 to 5.00
uncertainty of permittivity measurements	± 1 digit ± 0.2 % of indicated value
calibration of the test cell	simple on-site adjustment for test cells from 50 to 70 pF
frequency of the measurement voltage	0.5 Hz
amplitude of the measurement voltage	±30 V square wave with no dc part
optional analogue outputs	one for conductivity, one for relative permittivity
analogue outputs voltage span	0 ... 2 V for 0 to 100% of chosen range, short circuit proof
weight	2.6 kg
size	290 x 255 x 115 (width x depth x height in mm)
power supply in the field	six batteries type AA alcaline for several hours of operation
power supply in the lab	universal mains adapter 100 ... 240 Vac 50/60 Hz delivering 6 V DC
temperature (use)	0 ... 35°C
temperature (stock)	-10 ... 50°C
pressure	70 ... 106 kPa
humidity	5 ... 80 % non condensing
acceleration	< 2 g
Test Cell LCM-8716-CS	
required amount of liquid	210 ml
vacuum capacitance	≈ 60 pF
capacitance drift with temperature	< 50 ppm/°C
electrode gap	1.5 mm
material	stainless steel
electrical connection	two standard 50 Ω BNC plugs
temperature measurement	glass thermometer or electronic thermometer
weight	1.2 kg
size	122 x 82 (height x diameter in mm)
cables	one BNC-BNC cable, 1 m, red, for application of the excitation one BNC-BNC cable, 1 m, black, ultra low noise for current measurement

specifications subject to change without notice

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