

# TECHNICAL SPECIFICATION

# IEC TS 62073

First edition  
2003-06

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## Guidance on the measurement of wettability of insulator surfaces

*Mesure de l'hydrophobicité  
de la surface des isolateurs*

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

GUIDANCE ON THE MEASUREMENT OF WETTABILITY OF INSULATOR SURFACES

FOREWORD

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62073, which is a technical specification, has been prepared by IEC technical committee 36: Insulators.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
36/185/DTS	36/197A/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- transformed into an International standard;
- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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## INTRODUCTION

The wetting properties of a surface by water are commonly described by the terms hydrophobic (or hydrophobicity) and hydrophilic (or hydrophilicity). A hydrophobic surface is water-repellent, while a surface that is easily wetted by water is hydrophilic.

The wetting phenomenon of a surface is complex and many different parameters can influence its apparent wettability. Some important parameters include: type of insulator material, surface roughness, heterogeneities of the surface, chemical composition (e.g. due to ageing) and presence of pollution. For some of the insulator materials in common use, the wetting properties can change over time, due to the influence of the ambient conditions. This change can be either reversible or irreversible. Thus, the result of the measurement of the wettability may be influenced by the ambient conditions and the HV corona or dry-band arcing to which the insulator has been previously exposed. This dynamic wetting behaviour is more or less specific to different insulator materials.

The dynamic wetting behaviour exhibited by insulator materials is due to their chemical composition. Different processes such as oxidation, hydrolysis, migration of low molecular weight compounds, formation of complex compounds between e.g. siloxanes and water, rotation of flexible polymer chains, inter- and intra-molecular rearrangements, microbial growth, deposition of contaminants, adhesion and encapsulation of contaminant particles, may take place at different rates, depending on material and ambient conditions. Thus, wettability along and around an insulator can vary, due to differences in the exposure to solar radiation, rain, corona discharges, deposited pollution, etc. Therefore, wettability measurement of insulators should be performed on several separate areas of the insulator.

Measurement of the wettability of a surface is readily performed in the laboratory on well defined, homogeneous, smooth and planar surfaces of prepared specimens. In the case of insulators, for which non-destructive measurements are usually required (and where cut-out of material samples is usually not desired), these conditions do not exist and measurement with high precision is a difficult task. This is especially true when the measurement has to be performed on an insulator installed in an overhead line, substation or even in a high voltage test set-up in the laboratory.



## GUIDANCE ON THE MEASUREMENT OF WETTABILITY OF INSULATOR SURFACES

### 1 Scope and object

The methods described in this technical specification can be used for the measurement of the wettability of the shed and housing material of composite insulators for overhead lines, substations and equipment or ceramic insulators covered or not covered by a coating. The obtained value represents the wettability at the time of the measurement.

The object of this standard is to describe three methods that can be used to determine the wettability of insulators. The determination of the ability of water to wet the surface of insulators may be useful to evaluate the condition of the surface of insulators in service, or as part of the insulator testing in the laboratory.

### 2 Terms and definitions

For the purposes of this document, the following definitions apply.

#### 2.1

##### **wettability**

ability of a surface to be wetted by a liquid (e.g. water)

#### 2.2

##### **hydrophobicity and hydrophilicity**

##### 2.2.1

##### **hydrophobicity**

low level of wettability by water of a surface. A hydrophobic surface has a low surface tension and thus is water-repellent

##### 2.2.2

##### **hydrophilicity**

high level of wettability by water of a surface. A hydrophilic surface has a high surface tension and thus is wetted by water (in the form of a film)

### 2.3

#### surface tension

##### interface tension

region of finite thickness (usually less than 0,1 μm) in which the composition and energy vary continuously from one bulk phase to the other. The pressure (force field) in the interfacial zone has a gradient perpendicular to the interfacial boundary. A net energy is required to create an interface (surface) by transporting the matter from the bulk phase to the interfacial (surface) zone. The reversible work required to create a unit interfacial (surface) area is the surface tension and is defined thermodynamically as follows:

$$\gamma = \left( \frac{\partial G}{\partial A} \right)_{T,P,n}$$

where

$\gamma$  is the surface (interfacial) tension or surface energy;

$G$  is the Gibbs free energy of the total system;

$A$  is the surface (interfacial) area;

$T$  is the temperature;

$P$  is the pressure;

$n$  is the total number of moles of matter in the system.

The surface tension ( $\gamma$ ) is usually expressed in mN/m (1 mN/m = 1 dyn/cm).

### 2.4

#### static contact angle

when a drop of liquid rests on the surface of a solid, and a gas is in contact with both, the forces acting at the interfaces must be in balance. These forces are due to surface tensions acting in the direction of the respective surfaces. From Figure 1 it follows that:

$$\gamma_{GL} \cos \theta_s = \gamma_{GS} - \gamma_{SL}$$

where

$\theta_s$  is the static contact angle of the edge of the drop with the solid surface,

$\gamma_{GL}$  is the surface tension of the gas-liquid interface,

$\gamma_{GS}$  is the surface tension of the gas-solid interface, and

$\gamma_{SL}$  is the surface tension of the solid-liquid interface.

NOTE The above equation (Young's equation) is only valid for ideal and smooth surfaces.

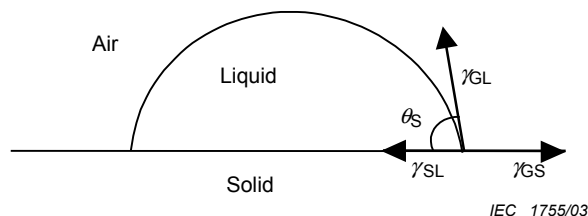


Figure 1 – Definition of the static contact angle

The right side of the above equation (the difference between the surface tensions of the gas-solid and the solid-liquid interfaces) is defined as the surface tension of the solid surface. It is not a fundamental property of the surface but depends on the interaction between the solid and a particular environment.