



BSI Standards Publication

Nanotechnologies — Textiles containing nanomaterials and nanostructures — Superhydrophobic characteristics and durability assessment

National foreword

This Published Document is the UK implementation of ISO/TS 10818:2023.

The UK participation in its preparation was entrusted to Technical Committee NTI/1, Nanotechnologies.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 22481 8

ICS 07.120; 59.080.01

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 August 2023.

Amendments/corrigenda issued since publication

Date	Text affected
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**Nanotechnologies — Textiles
containing nanomaterials and
nanostructures — Superhydrophobic
characteristics and durability
assessment**

*Nanotechnologies — Textiles contenant des nanomatériaux et
des nanostructures — Caractéristiques superhydrophobiques et
évaluation de la durabilité*



Reference number
ISO/TS 10818:2023(E)

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Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and abbreviated terms	1
3.1 Terms and definitions	1
3.2 Abbreviated terms	3
4 Mandatory and recommended measurement characteristics and their measurement methods	3
4.1 General.....	3
4.2 Ageing for superhydrophobic durability assessment.....	4
4.2.1 General.....	4
4.2.2 Washing and dry cleaning.....	4
4.2.3 Ironing.....	4
4.2.4 Mechanical abrasion.....	4
4.2.5 Light exposure.....	5
4.3 Nanomaterial and nanostructure evaluation.....	5
4.3.1 General.....	5
4.3.2 Size and size distribution	5
4.3.3 Nano-roughness (recommended characteristics).....	6
4.3.4 Morphology.....	6
4.3.5 Chemical composition.....	7
4.4 Superhydrophobicity	8
4.4.1 General.....	8
4.4.2 Contact angle.....	9
4.4.3 Dynamic contact angle.....	9
4.5 Superhydrophobic durability assessment.....	9
4.5.1 General.....	9
4.5.2 Grade of superhydrophobic durability.....	9
4.5.3 Index of durability performance.....	11
5 Reporting	12
5.1 General.....	12
5.1.1 Introduction	12
5.1.2 General information.....	12
5.1.3 Measurement results.....	12
5.2 Table format example for reporting.....	13
Annex A (informative) Safety, health and environmental issues	14
Annex B (informative) Superhydrophobicity	16
Bibliography	17

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 229, *Nanotechnologies*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Recently superhydrophobic textiles (woven and nonwoven) have gained significant scientific and industrial interest for its potential applications in outdoor wear and protective clothing. The superhydrophobic textile surfaces refer to superior water repellency with a water contact angle exceeding 150° and low contact angle hysteresis of less than 10° (see [Annex A](#)). For this superhydrophobic textile, dirt and soils are loosely attached, and a rolling water drop can easily attach and remove them from the surface, giving self-cleaning properties. According to Young's, Wenzel and Cassie-Baxter Models superhydrophobicity of textile surface can be made by both the surface treatment with very low surface free energy materials and making nano-roughness (see [Annex B](#)).

Nanotechnology is employed to artificially change the surface free energy and/or cause nano-roughness on the surface. The following methods are normally utilized in this respect:

- using nano-objects such as silica, TiO_2 , CNT, ZnO, etc., in various ways;
- surface etching, i.e. nano roughening (UV-laser or plasma), followed by grafting or physically/chemically attaching compounds with low surface energy;
- using nanofibres.

The establishment of superhydrophobic relies on

- a) superhydrophobic (non-polar) surface chemistry, and
- b) nanostructured surface texture (nano-roughness).

One of the most important obstacles affecting the market growth of textiles containing nanomaterials and nanostructures (TCNNs) showing superhydrophobic response is their relevant durability under different utilization and working conditions. This includes, laundering (washing), ironing, mechanical abrasion (rubbing) and light radiation exposure. If superhydrophobic properties are not durable, the TCNNs are useless in long term applications. Therefore, durability of superhydrophobic TCNNs over repeated use and wash are necessary.

In this regard, the durability and persistence of superhydrophobic behaviour of TCNNs needs to be assessed under above mentioned condition based on standard methods. Generally, from the consumer's perspective, the superhydrophobic durability of TCNNs is very important. However, there is no specific measurement method to evaluate the superhydrophobic durability. In fact, there is a lack of grading procedure for this characteristic.

This document both specifies the characteristics, performance and durability of the TCNNs subjected to laundry (washing), ironing, mechanical abrasion (rubbing) and light exposure. The superhydrophobic durability of such textiles are assessed and reported based on contact angle and hysteresis measurement of the samples before and after subjected to mentioned conditions. In fact, a specific grading method is established in this document. Further, this document also recommends relevant measurement methods to promote communication and mutual understanding of TCNNs for superhydrophobic application between buyers and sellers.

This document supports less water consumption and less waste water production. In addition, this document supports responsible production in terms of superhydrophobic durability of textile. Furthermore, this document can provide a potential for the economic growth for small and medium size enterprises. These items conform with several Sustainability Development Goals (SDGs) defined by United Nations.

Nanotechnologies — Textiles containing nanomaterials and nanostructures — Superhydrophobic characteristics and durability assessment

1 Scope

This document specifies the characteristics and performance(s) of the superhydrophobic textiles containing nanomaterials and nanostructures (TCNNs) based on contact angle measurement before and after being subjected to washing/drying (laundry), ironing processes, light sources and abrasion, that are to be determined by agreement between customer and supplier. This document solely covers woven and nonwoven fabrics.

This document does not address safety and health related issues.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1.1

contact angle

θ

angle to the base line within the drop, formed by means of a tangent on the drop counter through one of the three-phase points

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: The contact angle is preferably indicated in degrees (°). $1^\circ = (\pi/180)$ rad. If the system is in thermodynamic equilibrium, this contact angle is also referred to as thermodynamic equilibrium contact angle.