

ICS 87.040

English Version

**Paints and varnishes - Overview of test methods on
hardness and wear resistance of coatings (ISO/TR
21555:2019)**

Beschichtungsstoffe - Überblick zu Verfahren zur
Bestimmung von Härte und Verschleißfestigkeit von
Beschichtungen (ISO/TR 21555:2019)

This Technical Report was approved by CEN on 4 October 2020. It has been drawn up by the Technical Committee CEN/TC 139.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of ISO/TR 21555:2019 has been prepared by Technical Committee ISO/TC 35 "Paints and varnishes" of the International Organization for Standardization (ISO) and has been taken over as CEN ISO/TR 21555:2020 by Technical Committee CEN/TC 139 "Paints and varnishes" the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of ISO/TR 21555:2019 has been approved by CEN as CEN ISO/TR 21555:2020 without any modification.

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Hardness tests	2
4.1 Indentation tests with resting indenter	2
4.1.1 Indentation test with Buchholz indenter	2
4.1.2 Indentation test with Knoop indenter	5
4.1.3 Indentation test with Pfund indenter	6
4.1.4 Indentation test with Vickers indenter	8
4.2 Indentation tests with oscillating indenter	10
4.2.1 Oscillation damping test with König pendulum	10
4.2.2 Oscillation damping test with Persoz pendulum	11
4.2.3 Oscillation damping test with rocker	13
5 Wear resistance tests	14
5.1 Single-scratch tests	14
5.1.1 Scratch test with pencils	14
5.1.2 Scratch test with ball stylus 1	17
5.1.3 Scratch test with ball stylus 2	20
5.1.4 Scratch test with conical stylus 3	22
5.1.5 Scratch test with conical stylus 4	25
5.1.6 Scratch test with conical stylus 5	28
5.1.7 Scratch test with conical stylus 6	31
5.1.8 Scratch test with disc-shaped stylus	33
5.1.9 Scratch test with U-shaped stylus	37
5.2 Multiple scratch tests	39
5.2.1 Multiple scratch test with locked abrasive wheel	39
5.2.2 Multiple scratch test with abrasive cylinder	40
5.2.3 Multiple scratch test with rotating abrasive wheels	42
5.2.4 Multiple scratch test with rotating brush	43
5.3 Dry abrasion tests	45
5.3.1 Abrasion test with locked abrasive wheel	45
5.3.2 Abrasion test with rotating abrasive wheels 1	47
5.3.3 Abrasion test with abrasive wheels 2	48
5.3.4 Abrasion test with rotating abrasive wheels 3	50
5.3.5 Abrasion test with rotating abrasive wheels 4	51
5.4 Wet abrasion tests	53
5.4.1 Scrub test with brush	53
5.4.2 Scrub test with non-woven web 1	55
5.4.3 Scrub test with non-woven web 2	57
5.5 Falling-sand tests	60
5.5.1 Falling-sand test with corundum granulate	60
5.5.2 Falling-sand test with quartz sand	62
Annex A (informative) Overview on test methods on hardness and wear resistance of coatings	64
Bibliography	69

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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

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

The determination of the hardness and of the wear resistance is one of the most important preconditions for evaluating the resistance of coatings to mechanical stress.

The procedures and numerical data given in this document provide a rough overview; detailed information is found in the applicable standards.

For all of the methods for the evaluation of the hardness and of the wear resistance the visco-elastic properties have a wide influence on the test result. Consequently, the time between testing and evaluation are agreed and observed.

Mechanical properties of coatings depend on, among others, temperature and moisture content. Consequently, the tests should be carried out immediately after the conditioning phase.

The tests are preferably carried out in the climatic chamber.

Each method has its specific application. An unsuitable method may lead to false conclusions. All of the test methods require a certain expertise of the test person. For most of the test methods the test results depend on, among others, the film thickness of the coating to be tested.

Paints and varnishes - Overview of test methods on hardness and wear resistance of coatings

1 Scope

This document provides an overview for selecting the most suitable test method regarding the evaluation of the hardness and the wear resistance of coatings.

[Annex A](#) gives a summarized list of test methods for the evaluation of the hardness and of the wear resistance of coatings for different stresses.

Methods for testing cross-linking (wear test in connection with solvents) and abrasion tests with multiple impacts are not covered by this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4618, *Paints and varnishes — Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 and the following apply.

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

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

3.1

hardness

ability of a dry film or coat to resist indentation or penetration by a solid object

[SOURCE: ISO 4618:2014, 2.136]

3.2

wear

irreversible change of a coating which is caused by the mechanical impact of moved objects

3.3

stylus

scratching tool with specified geometry

[SOURCE: ISO 22557:2019, 3.1]

3.4

scratch

line-shaped damage of a coating which is caused by the impact of a loaded object being moved over the coating