



SLOVENSKI STANDARD
SIST-TP CEN ISO/TR 21555:2020

01-december-2020

Barve in laki - Pregled preskusnih metod za določanje trdote premazov in njihove odpornosti proti obrabi (ISO/TR 21555:2019)

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)

ITEN STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/21555-2020/02beced4836b/sist-tp-cen-iso-tr-21555-2020)

Ta slovenski standard je istoveten z: CEN ISO/TR 21555:2020

<https://standards.iteh.ai/catalog/standards/sist/21555-2020/02beced4836b/sist-tp-cen-iso-tr-21555-2020>

ICS:

87.040

Barve in laki

Paints and varnishes

SIST-TP CEN ISO/TR 21555:2020

en,fr,de

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)

<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>

TECHNICAL REPORT

CEN ISO/TR 21555

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

October 2020

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.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)

<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>



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

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

Contents	Page
European foreword.....	3

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)
<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>

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.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)
<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)

<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>

TECHNICAL REPORT

ISO/TR 21555

First edition
2019-08

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)

<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>



Reference number
ISO/TR 21555:2019(E)

© ISO 2019

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)

<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

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

ISO/TR 21555:2019(E)

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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)

<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST-TP CEN ISO/TR 21555:2020](https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020)

<https://standards.iteh.ai/catalog/standards/sist/0dae5d2e-147b-4882-820b-02beced4836b/sist-tp-cen-iso-tr-21555-2020>

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

ISO/TR 21555:2019(E)

3.5

mar

blemish on the surface of a coating, extending over a particular area of the coating and visible due to the difference in the light-reflection properties of the area affected compared with the light-reflection properties of adjacent areas

[SOURCE: ISO 4618:2014, 1.152]

3.6

abrasion

wear (3.2) which is caused by removal of coating material on a surface

3.7

repeatability conditions

conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time

[SOURCE: ISO 5725-1:1994, 3.14]

3.8

repeatability limit***r***

the value less than or equal to which the absolute difference between two test results obtained under *repeatability conditions* (3.7) may be expected to be with a probability of 95 %

[SOURCE: ISO 5725-1:1994, 3.16]

3.9

reproducibility conditions

conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment

[SOURCE: ISO 5725-1:1994, 3.18]

3.10

reproducibility limit***R***

the value less than or equal to which the absolute difference between two test results obtained under *reproducibility conditions* (3.8) may be expected to be with a probability of 95 %

[SOURCE: ISO 5725-1:1994, 3.20]

4 Hardness tests

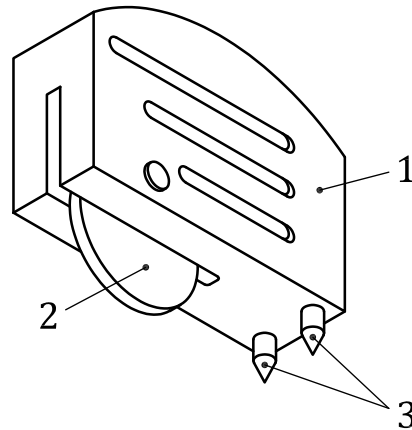
4.1 Indentation tests with resting indenter

4.1.1 Indentation test with Buchholz indenter

— Description

An indenter made of hardened steel, the shape and dimensions of which are specified in accordance with Buchholz, impacts the coating under a load (500 g, corresponding to 4,96 N) for 30 s and produces an indentation. After a resting time of 35 s the indentation length (mm) is determined under specified lighting conditions using a measuring microscope ($\times 20$ magnification).

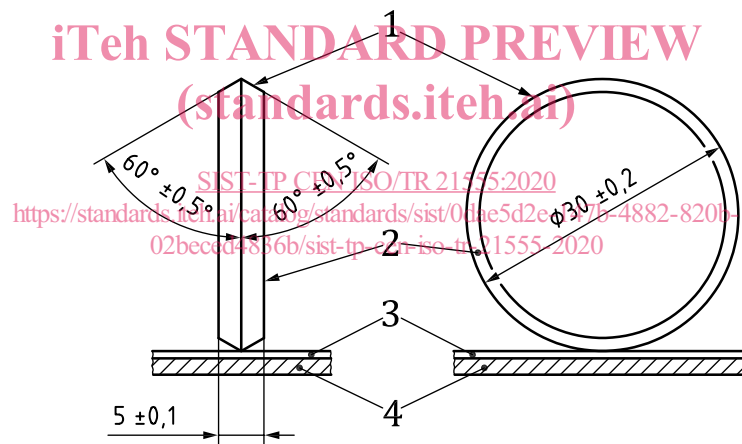
[Figure 1](#) shows the test device and [Figure 2](#) shows the Buchholz indenter. [Figure 3](#) illustrates the microscopic measurement of the indentation.

**Key**

- 1 steel block
- 2 indenter
- 3 tip

Figure 1 — Indentation tester in accordance with Buchholz

Dimensions in millimetres

**Key**

- 1 indentation edge
- 2 indenter
- 3 coating
- 4 substrate

Figure 2 — Buchholz indenter