INTERNATIONAL STANDARD

ISO 8503-5

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Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates —

Part 5: Replica tape method for the determination of the surface profile

Préparation des subjectiles d'acier avant application de peintures et de produits assimilés — Caractéristiques de rugosité des subjectiles d'acier décapés —

Partie 5: Méthode de l'empreinte sur ruban adhésif pour la détermination du profil de surface

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Contents

Page

Annexes

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 8503-5 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 12, *Preparation of steel substrates before application of paints and related products*.

ISO 8503 consists of the following parts, under the general title *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates*:

— *Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces*

— *Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel — Comparator procedure*

— *Part 3: Method for the calibration of ISO surface profile comparators and for the determination of surface profile — Focusing microscope procedure*

— *Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile — Stylus instrument procedure*

— *Part 5: Replica tape method for the determination of the surface profile*

Introduction

The performance of protective coatings of paint and related products applied to steel is significantly affected by the state of the steel surface immediately prior to painting. The principal factors that are known to influence this performance are:

a) the presence of rust and mill scale;

b) the presence of surface contaminants, including salts, dust, oils and greases;

c) the surface profile.

International standards ISO 8501, ISO 8502 and ISO 8503 have been prepared to provide methods of assessing these factors, while ISO 8504 provides guidance on the preparation methods that are available for cleaning steel substrates, indicating the capabilities of each in attaining specified levels of cleanliness.

These International Standards do not contain recommendations for the protective coating systems to be applied to the steel surface. Neither do they contain recommendations for the surface quality requirements for specific situations, even though surface quality can have a direct influence on the choice of protective coating to be applied and on its performance. Such recommendations are found in other documents, such as national standards and codes of practice. It will be necessary for users of these International Standards to ensure that the qualities specified are

— compatible and appropriate both for the environmental conditions to which the steel will be exposed and for the protective coating system to be used;

— within the capability of the cleaning procedure specified.

The four International Standards referred to above deal with the following aspects of preparation of steel substrates:

ISO 8501 — *Visual assessment of surface cleanliness*;

ISO 8502 — *Tests for the assessment of surface cleanliness*;

ISO 8503 — *Surface roughness characteristics of blast-cleaned steel substrates*;

ISO 8504 — *Surface preparation methods*.

Each of these International Standards is in turn divided into separate parts.

It is important to note that numerical characterization of a surface profile is meaningful only when accompanied by an understanding of the errors of measurement and by the realization that different techniques may yield somewhat different numerical values for the profile. Estimates of measurement error associated with different techniques can be obtained from national or international standards or from the equipment manufacturers. As shown in Annex B, values given by the replica tape method align well with those obtained using other parts of ISO 8503.

Information regarding the magnitude of errors associated with use of replica tape is given in Annex A.

NOTE Advantages of the replica tape method include the fact that it affords numerical characterization, yields a permanent record, works well on curved surfaces and benefits from a geographically broad base of user experience over a period of several decades.

Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates —

Part 5:

Replica tape method for the determination of the surface profile

1 Scope

This part of ISO 8503 describes a field method for measuring the surface profile produced by any of the abrasive blast-cleaning procedures given in ISO 8504-2. The method uses replica tape and a suitable gauge for measuring, on site, the roughness of a surface before the application of paint or another protective coating.

The method is applicable within the range of profiles cited for a given grade (or thickness) of replica tape. The commercial grades currently available permit measurement of average peak-to-valley profiles of 20 μm to 115 μm. The method is valid for surfaces that have been cleaned with either metallic or non-metallic abrasives.

2 Normative references

The following referenced documents are indispensable for the application 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 (all parts), *Paints and varnishes — Terms and definitions for coating materials*

ISO 8503-1, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces*

ISO 8503-3, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 3: Method for the calibration of ISO surface profile comparators and for the determination of surface profile — Focusing microscope procedure*

ISO 8503-4, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile — Stylus instrument procedure*

ISO 8504-2, *Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 2: Abrasive blast-cleaning*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 and ISO 8503-1 apply.

4 Principle

The replica film in replica tape consists of a layer of crushable plastic microfoam coated onto a polyester substrate of highly uniform thickness (50 μm ± 2 μm). When compressed against a hard surface, the microfoam collapses to about 25 % of its original thickness.

NOTE 1 When the replica film is coated with a thin (80 nm) layer of a ductile and optically reflective metal, such as indium, the replicated surface can be studied with an optical interferometric profiler. When the film is coated with a similarly thin layer of a ductile and electron-emissive metal, such as gold, platinum or palladium, the replica may be studied with an electron microscope.

NOTE 2 This method measures an “average maximum peak-to-valley profile” because the anvils of the micrometer gauge flatten the replica profile slightly so that the reading equates to an average maximum value, though this is not the same as a mathematical average.

5 Apparatus

5.1 Replica tape, consisting of a square piece of replica film (measuring approximately 10 mm along each side) attached to adhesive-backed paper tape. The film shall be mounted over a hole (approximately 10 mm in diameter) in the centre of a section of the paper tape (approximately 53 mm × 19 mm in size), which is printed with the grade of tape and the corresponding range of profiles.

NOTE 1 Grades of replica tape are available for measurement of profiles between 20 μm and 50 μm, between 33 μm and 85 μm, and between 40 μm and 115 μm.

The tape's adhesive backing prevents movement of the replica film during the test and allows the sample identification and measured profile to be recorded.

NOTE 2 The microfoam can be compressed and should therefore be handled with care, especially when measuring its thickness.

5.2 Micrometer gauge: Use a spring-loaded instrument specifically designed for use with replica tape, having a closing force of 1,5 N and an accuracy of ± 5 μm or better. The anvils shall be circular with the upper anvil having a diameter of 6,3 mm and the lower face being the same size or larger.

5.3 Compression tool, consisting of a moulded plastic rod with a spherical head (nominal diameter 9 mm) that is used to compress the replica film against the surface to be measured.

6 Maintenance and assurance of calibration for the replica tape method

Each component of the replica tape has its own storage life and effective operating temperature, with the replica film being much more durable than the adhesive-backed paper tape.

Testing has shown that replica film is able to produce accurate replicas on surfaces with temperatures over at least the range between − 10 °C and + 65 °C. At typical room temperatures, it is believed that replicas will store well for years, whilst uncompressed film may be stored for decades. In addition, the uncompressed film has never been seen to fail, despite prolonged storage, at temperatures over the range between − 10 °C and + 65 °C. However, the adhesive backing on the paper tape can deteriorate.

Replica tape should be stored at room temperature; prolonged storage of replica tape outside the range 5 °C to 30 °C for more than two years is not recommended.

The measuring gauge, whilst rugged, should be treated with the usual level of care associated with a precision instrument. The gauge shall be calibrated against appropriate standards at regular intervals in accordance with the manufacturer's instructions. The calibration shall then be checked by measuring a known thickness.

Information on the correlation of ISO comparator measurements with those obtained by replica tape is given in Annex B.

7 Procedure

Select a representative area of the surface for measurement.

Select the appropriate grade (thickness) of replica tape.

Prepare the micrometer gauge by cleaning the anvils and adjusting the zero point to read −50 μm, the thickness of the incompressible polyester substrate. This initial adjustment automatically subtracts the thickness of the substrate from all subsequent readings. Before use, the calibration of the gauge shall be checked with a calibrated shim of thickness comparable to that to be measured and, if the results fall outside the limits of accuracy specified by the manufacturer, the instrument shall not be used.

Remove a single piece of replica tape from its release paper. Apply it to the blast-cleaned surface and rub the compression tool (5.3) over the replica film in the centre of the tape, using firm pressure. The replica film will become darker as the surface is replicated and the entire circular area should be darkened uniformly.

Remove the tape from the surface and place the replica between the anvils of the measuring gauge, making sure that it is centred properly. Release the measuring gauge gently onto the replica and measure the profile. The gauge reading is the average maximum peak-to-valley distance on the blast-cleaned surface.

The number of measurements shall be agreed between the interested parties.

Attach the properly annotated tape to the test report and record the measurements as appropriate.

NOTE 1 Before the surface under test is measured, the accuracy of this method may be checked by measuring a known profile, such as an ISO comparator.

NOTE 2 The same procedure is used for measuring gauges that read in non-SI units, such as mils or thous (thousandths of an inch; 1 mil or thou ≈ 25,4 μm). Gauges calibrated in non-SI units are supplied with instructions appropriate to those units.

8 Specification of acceptable error

An essential part of any specification relating to surface profile is an explicit statement of how the surface profile was determined. Implicit in this specification is an understanding of both the precision and the accuracy associated with a given method of measuring the profile. A discussion of error associated with replica tape measurements is given in Annex A.

The number of readings to be taken and the range of acceptable profiles shall be agreed between the interested parties before measurement starts.

9 Test report

The test report shall contain at least the following information:

a) all the information needed for the identification of the sample tested;

b) a reference to this part of ISO 8503 (ISO 8503-5), including its year of publication;

c) the individual sections of tape bearing the surface replicas (the designation of the test area and the measured profile shall be recorded on each section and the replicas shall be grouped in the test report by measurement location);

d) the result(s) of the test;

e) the work site identification and project name (if applicable);

f) the date of the test;

g) the name of the operator;

h) any deviations from the procedure;

i) any unusual features observed.

Annex A
(informative)

Measurement errors associated with replica tape determination of profile

In 1987, a panel of experts convened by NACE International (National Association of Corrosion Engineers) investigated the measurement properties of replica tape. NACE Standard RP 0287 addressed the issue of repeatability and accuracy of measurement and reported the results of round-robin tests in which 14 blasted panels were measured by seven observers. Replica tape and focusing microscope measurements agreed within their 95 % confidence limits (two standard deviations) in 11 of 14 cases. The average difference between the two types of measurement technique was 4,5 μm. It should be noted that some difference is to be expected, based on the fact that the techniques have differing maximum peak-to-valley evaluation distances, evaluation areas and approaches to averaging. This is further discussed in Annex B.

The standard deviation for measurements made by the seven observers, averaged over all fourteen panels, was 5,4 μm. The standard deviation for the corresponding focusing microscope profile determinations, averaged over all fourteen panels, was 8,1 μm.

Confidence intervals comprising two standard deviations (95 % confidence) are commonly specified. A standard deviation of 5,4 μm implies that a single replica tape measurement, by an arbitrary observer, has a 95 % probability of lying within 10,8 μm (two standard deviations) of the nominal replica tape profile.

Independent tests show the standard deviation for measurements performed by a single observer to be 3,6 μm.

Annex B
(informative)

Guidance on the correspondence between replica tape and ISO comparator determinations of profile

B.1 Replica tape

A single replica tape measurement samples a circular patch 6,3 mm in diameter and 31 mm^2 in area. Flexing of the polyester substrate and the curvature of the compression ball cause the film to conform to the surface over distances greater than 0,4 mm. Within patches smaller than approximately 0,4 mm, the portion of the ball pressing the film against the surface is effectively flat. These patches constitute the sampling area for individual maximum peak-to-valley determinations. (In fact, the evaluation areas overlap so there is multi-patch correlation and the sampling process is somewhat more complex.) A measurement using the micrometer gauge approximates the average maximum peak-to-valley heights over all the sampling areas in the 31 mm^2 area evaluated.

B.2 Focusing microscope

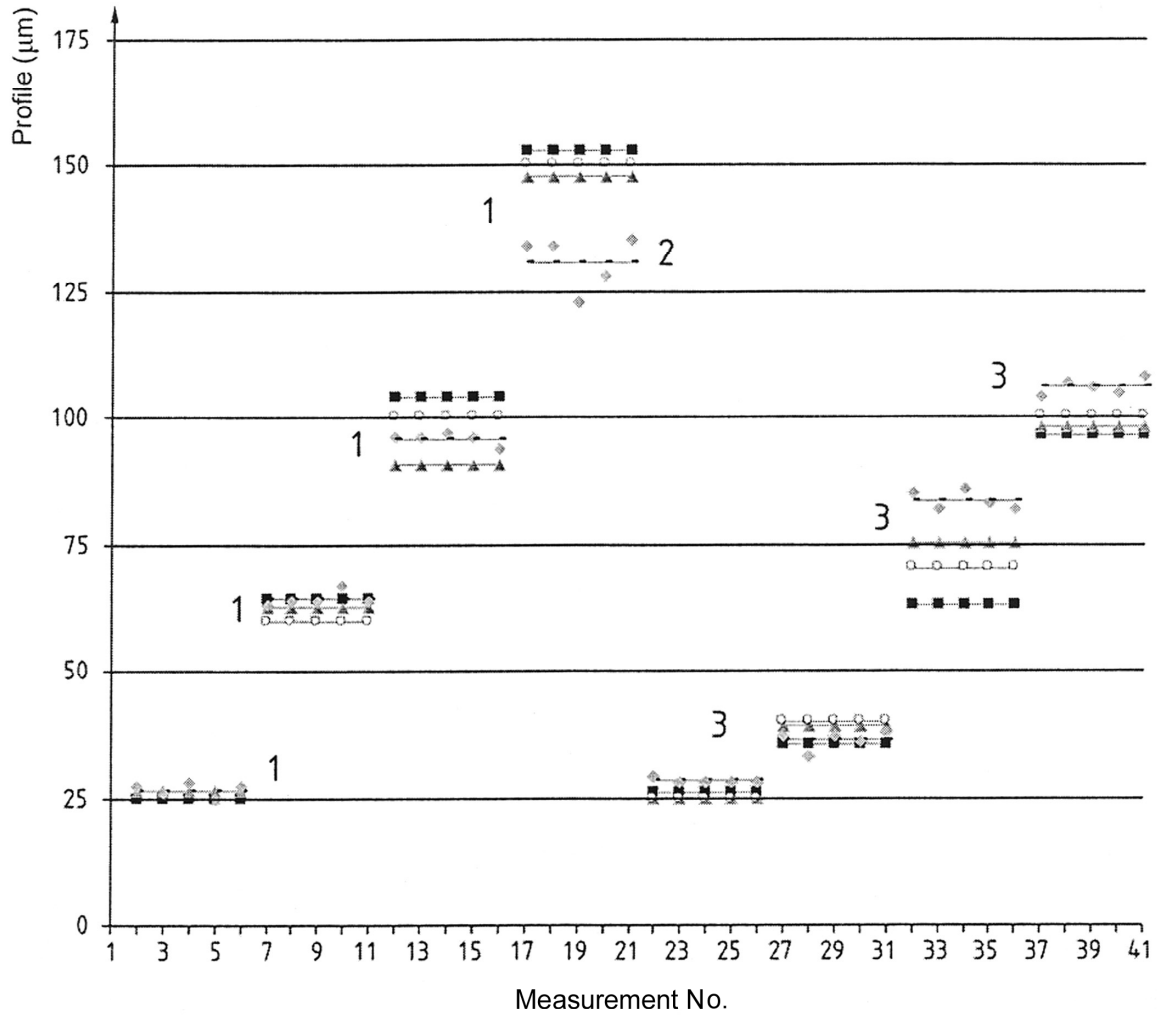
A single maximum peak-to-valley measurement using a focusing microscope covers a sampling region with a diameter of 0,5 mm and an area of approximately 0,2 mm^2. Taking the average of the maximum peak-to-valley distances from twenty of these regions, as specified in ISO 8503-3, gives a total evaluation area of approximately 4 mm^2.

B.3 Stylus device

The sampling length for this method, i.e. the distance over which individual maximum peak-to-valley distances are measured, is 2,5 mm and there are five such lengths in a single traverse of the stylus. For a stylus point with a diameter of 10 μm, the area evaluated on each traverse will be 0,125 mm^2. Taking the average of the maximum peak-to-valley distances from (a minimum of) ten traverses, as specified in ISO 8503-4, gives 50 sampling lengths with a total area of 1,25 mm^2.

B.4 Comparison of different methods

A comparison of profile readings obtained using various ISO methods is given in Figure B.1.



Key

◆	replica tape measurements
—▪—	replica tape averages
○	comparator (nominal spec)
—■—	comparator (microscope)
—▲—	comparator (stylus)
1	grit-blasted surfaces
2	upper limit for XC replica tape
3	shot-blasted surfaces

Figure B.1 — Comparison of profile readings using various ISO methods

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