INTERNATIONAL STANDARD

ISO 8503-4

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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

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

Partie 4: Méthode d'étalonnage des comparateurs viso-tactiles ISO et de classification d'un profil de surface — Utilisation d'un appareil à palpeur

Reference number
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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 8503-4 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*.

This second edition cancels and replaces the first edition (ISO 8503-4:1988), which has been editorially revised to improve the clarity.

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

These International Standards do not contain provisions for the protective coating systems to be applied to the steel surface or for the surface quality provisions 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 provisions are found in other documents, such as national standards and codes of practice.

It is necessary for the users of these International Standards to ensure that the qualities specified are:

— compatible and appropriate both for the environmental conditions to which the steel is 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.

The stylus instrument is commonly used in the precision measurement of surface textures resulting from machining and abrading procedures. The method is highly reproducible and totally independent of the operator and, if required, some instruments can provide a graphical representation of the surface. This procedure can also be used to determine the profile of a substrate after abrasive blast-cleaning, either directly or from a replica.

ISO 8503-3 describes the procedure using an optical microscope. ISO 8503-1 specifies the requirements for ISO surface profile comparators, and ISO 8503-2 describes the procedure for their use. The many abrasive blast-cleaning procedures in common use are described in ISO 8504-2.

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

1 Scope

This part of ISO 8503 specifies the stylus instrument and describes the procedure for calibrating ISO surface profile comparators conforming to the requirements of ISO 8503-1.

This part of ISO 8503 is also applicable to the determination of the surface profile, within the range $\overline{R_{y5}}$ = 20 µm to $\overline{R_{y5}}$ = 200 µm, of essentially planar blast-cleaned steel. The determination can be carried out on a representative section of the blast-cleaned surface or, if direct observation of the surface is not feasible, on a replica of the surface (see Annex C).

NOTE Where appropriate, this procedure can be used to assess the roughness profile of other abrasive blast-cleaned substrates.

An alternative procedure is described in ISO 8503-3.

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 3274, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*

ISO 4287:1997, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 5436-1, *Geometrical Product Specifications (GPS) — Surface texture: Profile method; Measurement standards — Part 1: Material measures*

ISO 5436-2, *Geometrical Product Specifications (GPS) — Surface texture: Profile method; Measurement standards — Part 2: Software measurement standards*

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*

3 Terms and definitions

For the purposes of this document, the definitions given in ISO 8503-1 and the following apply. Attention is also drawn to the terms used and/or defined in ISO 3274, ISO 4287, ISO 5436-1 and ISO 5436-2 prepared by ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

3.1
evaluation length
l_n
length in the direction of the X-axis used for assessing the profile under evaluation

NOTE 1 The evaluation length may contain one or more sampling lengths (see Figure 1).

NOTE 2 For default evaluations lengths, see ISO 4288:1996, 4.4. ISO 4288 does not give default evaluation length for W-parameters.

[ISO 4287:1997]

3.2
traversed length
l_t
sum of the start-up length, the evaluation length and the run-out length

NOTE The traversed length is shown in Figure 1.

4 Principle

The peaks and valleys are measured by vertical displacement of a stylus traversing the test surface in the direction of travel over the specified traversed length and the mean maximum peak-to-valley height, R_{y5}, is determined. The procedure is repeated to obtain values at not less than 10 different locations on the test surface and the grand mean maximum peak-to-valley height $\overline{R_{y5}}$ is calculated.

5 Apparatus

5.1 Stylus instrument, conforming to the description in ISO 3274 and equipped with a diamond stylus in good condition, assessed as described in ISO 5436-1. The tip radius shall be 5 µm ± 1 µm. The stylus shall traverse an evaluation length, l_n, of 12,5 mm and the corresponding sampling length, l, shall be 2,5 mm. The rate of traverse of the stylus shall be not greater than 1,0 mm/s.

6 Test surfaces

6.1 ISO surface profile comparator

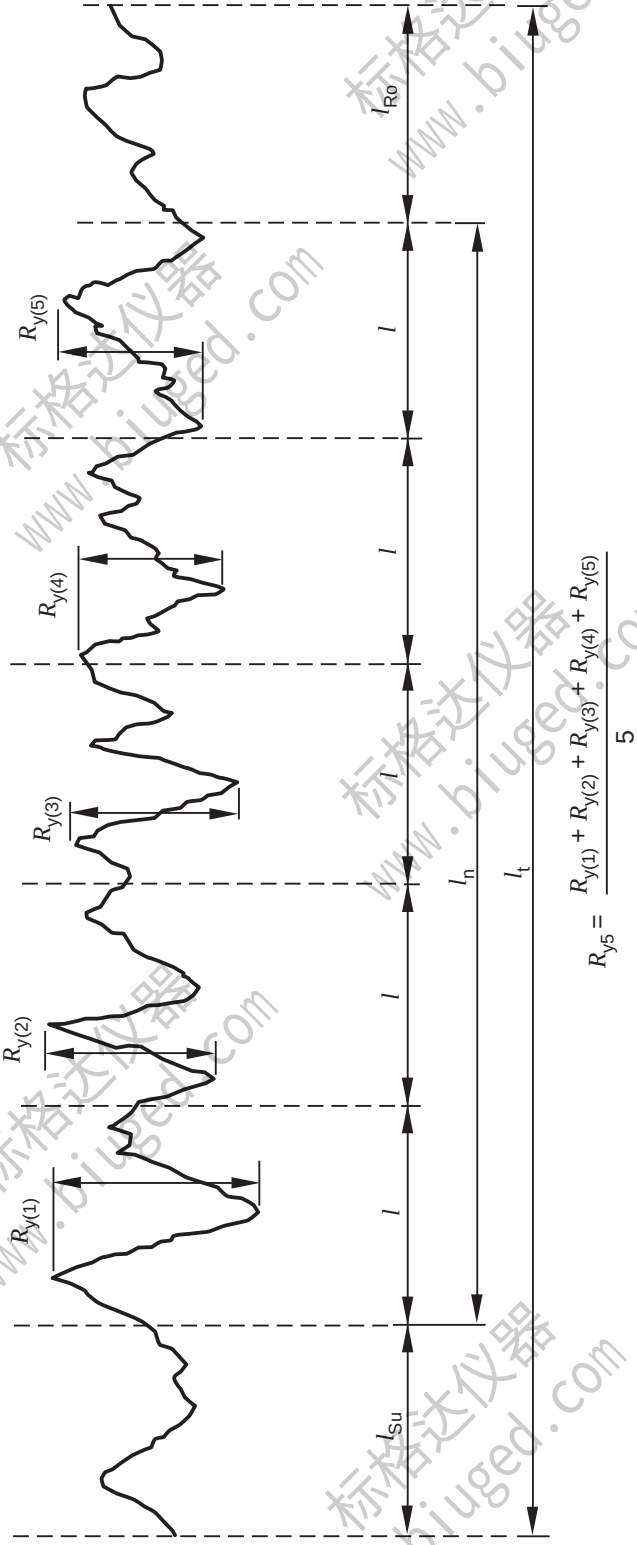
Visually check that each segment of the ISO surface profile comparator (see ISO 8503-1) which is to be calibrated is undamaged. Lightly clean the surface with a dry, fine-bristle brush to remove any particles of dust and then, using a similar brush, wash the surface with petroleum spirit, 40/60 (commercial grade), to remove oil and grease residues. Allow to dry before carrying out the calibration.

Calibrate each segment of the comparator as described in Clause 7.

6.2 Blast-cleaned steel substrates/replica

Visually check that the surface which is to be measured is undamaged. Lightly clean the surface with a dry, fine-bristle brush to remove any particles of dust and then, using a similar brush, wash the surface with petroleum spirit 40/60 (commercial grade) to remove oil and grease residues. Allow to dry before carrying out the procedure. If a replica (see Annex C) is to be measured, clean it only with a dry brush.

Determine the surface profile as described in Clause 7.



Key

l_{Su}	start-up length	l	sampling length	l_{Ro}	run-out length
l_n	evaluation length	l_t	traversed length		

Figure 1 — Components of a stylus profile measurement on a blast-cleaned surface

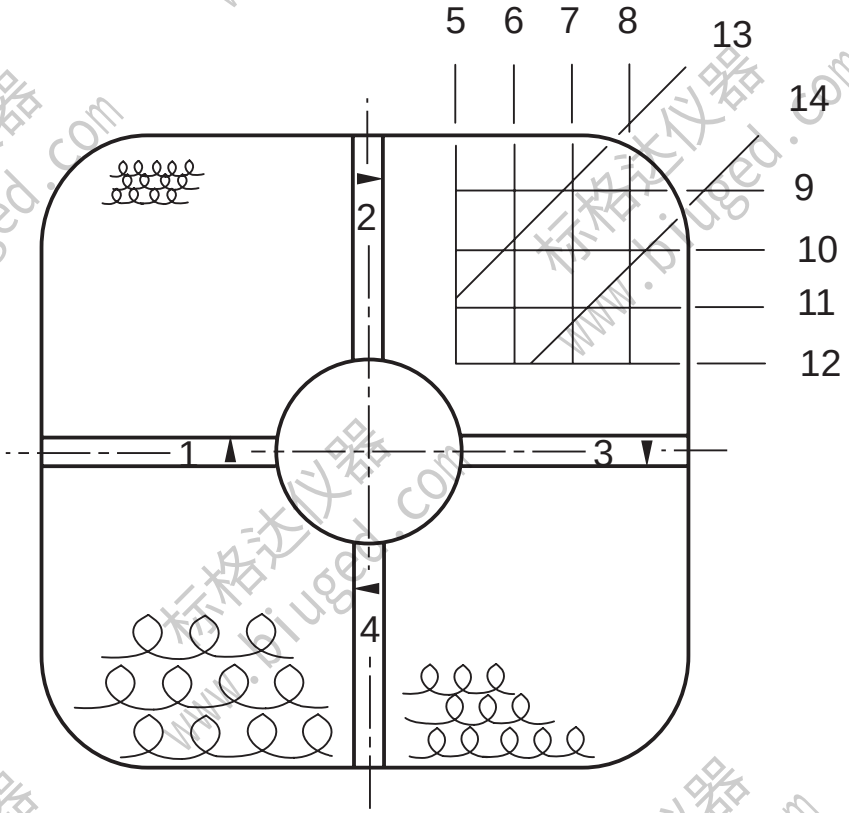
7 Procedure for measurement of maximum peak-to-valley height, R_y

7.1 Locate the test surface (see Clause 6) under the stylus instrument (see Clause 5) so that the measurements are taken on a test area not less than 5 mm from any edge.

7.2 Determine the mean maximum peak-to-valley height, R_{y5}, of the test area in accordance with the manufacturer's instructions for the stylus instrument, using an evaluation length, l_n, of 12,5 mm and corresponding sampling lengths, l, of 2,5 mm. Record R_{y5} on the form given in Annex B.

7.3 Repeat the procedure described in 7.1 and 7.2 until values of R_{y5} have been obtained over at least 10 evaluation lengths uniformly distributed over the surface of the comparator or test area. Carry out the surface measurements with not more than four sets of readings in any one direction (see Figure 2).

7.4 Repeat the procedure described in 7.1, 7.2 and 7.3 for each surface to be calibrated or determined.



Key

1 to 4 measurement segments

5 to 14 readings 1 to 10, respectively

Figure 2 — Suggested traversing pattern to obtain 10 readings of R_{y5}
(shown actual size)

8 Calculation and expression of results

8.1 Calculate the grand mean value, $\overline{R_{y5}}$, and the standard deviation for the 10 readings of R_{y5} for each test surface.

If the standard deviation obtained is less than 20 % of the mean, report the standard deviation and the result as the grand mean maximum peak-to-valley height, $\overline{R_{y5}}$.

8.2 If the method is used to calibrate an ISO surface profile comparator and if the standard deviation obtained is more than 20 % of the mean value, repeat the procedure (see Clause 7) and obtain the mean and standard deviation for the 20 readings. If the standard deviation is still more than 20 % of the mean, reject the comparator as the profile is of inadequate uniformity.

8.3 If the method is used to determine the profile of a blast-cleaned surface, either directly or from a replica, report $\overline{R_{y5}}$ together with the standard deviation and the maximum reading of R_{y5} to indicate the degree of uniformity of the surface roughness.

9 Test report

The test report form is given in Annex A and shall contain at least the following information:

a) all information necessary for the identification of the ISO surface profile comparator and the segments tested or, if the profile of a steel substrate was determined, the identification of the steel substrate and whether a replica of the substrate was used;

b) a reference to this part of ISO 8503 (ISO 8503-4:2012);

c) the evaluation length, l_n, and the number of evaluation lengths measured;

d) the sampling length, l;

e) the result of the test, calculated as specified in Clause 8, and, if the profile of an ISO surface profile comparator was determined, the limits for the comparator (see ISO 8503-1);

f) any deviations from the procedure specified and, if the profile of a steel substrate was determined on a replica, the method of preparation of the replica (see Annex C);

g) any unusual features (anomalies) observed during the test;

h) the name of the operator;

i) the date of the test.

Annex A
(normative)

Test report for the calibration of ISO surface profile comparators and for the determination of surface profiles

1.	Test laboratory and address				
2.	Test surface identification				
a)	ISO surface profile comparator				
b)	steel substrate/ replica[a]				
3.	International Standard reference	ISO 8503-4			
4.	Stylus instrument				
Manufacturer:					
Type:					
Model:					
Tip radius = ...	µm				
Evaluation length, l_n = ...	mm				
Sampling length, l = ...	mm				
5.	Results[b]	Nominal reading	Maximum reading of R_{y5} µm	Grand mean, $\overline{R_{y5}}$ µm	Standard deviation
Segment 1					
Segment 2					
Segment 3					
Segment 4					
Steel substrate/replica[c]					
6.	Any deviations from the standard procedure[d]				
7.	Name and position of person authorizing the deviations (see 6 above)				
8.	Date of present test(s)				
9.	Date(s) of any previous test(s)[d]				
10.	Name of operator				

[a] If profile measurement is of i) a steel substrate or ii) a replica, give details.

[b] See separate form (Annex B) for actual readings.

[c] Delete as appropriate.

[d] If applicable.

Annex B
(normative)

Form for recording surface profile measurements made in accordance with ISO 8503-4

Test laboratory and address					
Stylus instrument Manufacturer: Type: Model:				Tip radius = … µm Evaluation length, l_n = … mm Sampling length, l = … mm	
Item reference[a]	a) ISO surface profile comparator b) Steel substrate/replica[b]				
Reading No.	Segment 1	Segment 2	Segment 3	Segment 4	Steel substrate/ replica[a]
	R_{y5} µm	R_{y5} µm	R_{y5} µm	R_{y5} µm	R_{y5} µm
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Maximum value of R_{y5}					
Grand mean, $\overline{R_{y5}}$					
Standard deviation					

a Delete as appropriate.

b If profile measurement is of i) a steel substrate or ii) a replica, give details.

Annex C
(informative)

Guidance notes for the preparation and measurement of replicas

When the test method is used to verify the profile of a steel substrate, it is usually impractical to obtain a small sample of the actual surface whose profile is to be determined. In this case, it is still possible, by examining a replica of the steel surface, to determine the surface profile.

A replica produces the reverse of the metal surface (that is, the peaks of the steel substrate become the valleys of the replica and the valleys of the steel become the peaks of the replica), but this reversal does not affect the validity of the measurement methods described in ISO 8503-3 and this part of ISO 8503.

A variety of replicating techniques is available, including the use of solventless, two-component organic polymers which crosslink to give a hard solid surface. These polymers can have disadvantages in that they do not penetrate into the deepest, sharpest valleys and that a release agent might be required. They provide, however, a hard enough surface to enable the stylus measurements described in this part of ISO 8503 to be made.

A two-component, pigmented silicone rubber product has also been used with success. Its initial viscosity and flexible nature when crosslinked mean that penetration into re-entrants of grit-blasted profiles, and subsequent removal, is good. Because of its softness, however, measurement is restricted to the microscope method described in ISO 8503-3.

Before any replicating technique is used, it should be examined for accuracy by replicating at least five steel surfaces whose profiles have been determined directly. These steel surfaces should have been prepared by use of abrasive of the same type as that used on the surface to be tested, and they should have profiles which span the test surface profile range. It is preferable that the profile obtained from the replica be within 10 % of that obtained on the steel surfaces.

If a replicating technique is used to determine the surface profile of a substrate, this should be stated when reporting the grand mean maximum peak-to-valley height.

Bibliography

[1] ISO 4288:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

[2] ISO 8503-2, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel — Comparator procedure*

[3] 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*

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

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