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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

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 pour étalonner les échantillons de comparaison viso-tactile ISO et pour caractériser un profil de surface — Utilisation d'un appareil à palpeur

Reference number
ISO 8503-4 : 1988 (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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8503-4 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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INTERNATIONAL STANDARD ISO 8503-4 : 1988 (E)

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

0 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 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 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.

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 may 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 a focusing 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.

1 Scope and field of application

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

1.2 This part of ISO 8503 is also applicable to the determination of the surface profile, within the range $\overline{R_{y5}} = 20$ to 200 µm, of essentially planar blast-cleaned steel. The determination may 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 may be used for assessing the roughness profile of other abrasive blast-cleaned substrates.

An alternative procedure is described in ISO 8503-3.

2 References

ISO 3274, *Instruments for the measurement of surface roughness by the profile method — Contact transformation — Contact profile meters, system M.*

ISO 4287-1, *Surface roughness — Terminology — Part 1 : Surface and its parameters.*

ISO 4618, *Paints and varnishes — Vocabulary.*

ISO 5436, *Calibration specimens — Stylus instruments — Types, calibration and use of specimens.*

ISO 8503, *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.*

ISO 8504, *Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 2 : Abrasive blast-cleaning.* [1)]

3 Definitions

For the purpose of this part of ISO 8503, the definitions given in ISO 4618 and ISO 8503-1, together with the following, apply. Attention is also drawn to the terms used and/or defined in ISO 3274, ISO 4287 and ISO 5436, prepared by ISO/TC 57, *Metrology and properties of surfaces.*

3.1 evaluation length, l_n (as defined in ISO 4287-1) : The length (see figure 1) over which the values of the surface parameters are assessed, and which may contain one or more sampling lengths, l.

3.2 traversed length, l_t : The sum of the start-up length, the evaluation length l_n and the run-out length (see figure 1).

NOTE — This term is defined in ISO 4287-2 as "the complete length of the pick-up movement along the surface being measured". The similar terms "traversing length" and "transversion length" are sometimes used.

4 Principle

Measurement of the peaks and valleys by vertical displacement of a stylus traversing the test surface in the direction of travel over the specified traversing length.

Determination of the mean maximum peak-to-valley height, R_{y5} by the equipment in accordance with the instructions of the instrument manufacturer.

Repetition of the procedure to obtain values at not less than 10 different locations on the test surface and calculation of the grand mean maximum peak-to-valley height $\overline{R_{y5}}$.

5 Apparatus

Stylus instrument, complying with the description in ISO 3274, and equipped with a diamond stylus in good condition assessed as described in ISO 5436. The tip radius shall be 5 ± 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) that 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 that 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.

Determine the surface profile as described in clause 7.

NOTE — If a replica (see annex C) is to be measured, clean it only with a dry brush.

7 Procedure for measurement of the mean maximum peak-to-valley height, R_{y5}

7.1 Locate the test surface (see clause 6) under the stylus instrument (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 the corresponding sampling lengths l of 2,5 mm. Record on the form given in annex B.

1) At present at the stage of draft.

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.

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 (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) 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);

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

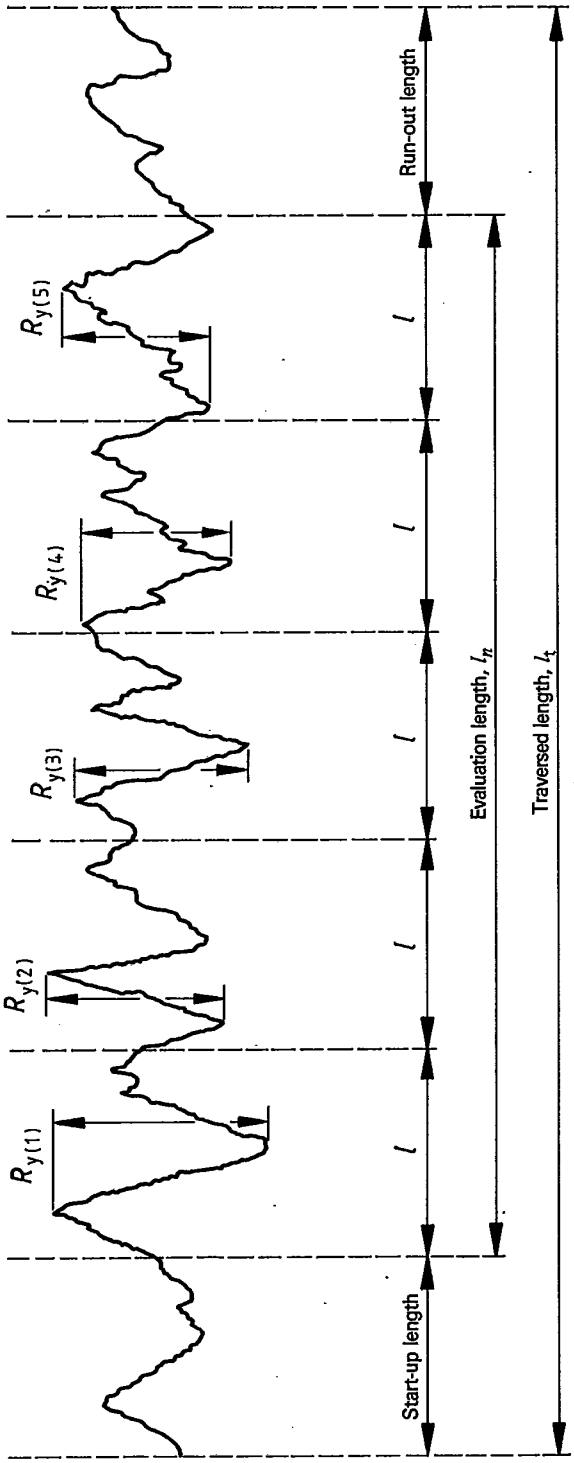
d) the sampling length l;

e) the result of the test as indicated 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 deviation, by agreement or otherwise, from the procedure described and, if the profile of a steel substrate was determined on a replica, the method of preparation of the replica (see annex C);

g) the name of the operator;

h) the date of the test.



$$R_{y5} = \frac{R_{y(1)} + R_{y(2)} + R_{y(3)} + R_{y(4)} + R_{y(5)}}{5}$$

l = Sampling length

Figure 1 — Significant features of a typical blast-cleaned surface profile measurement

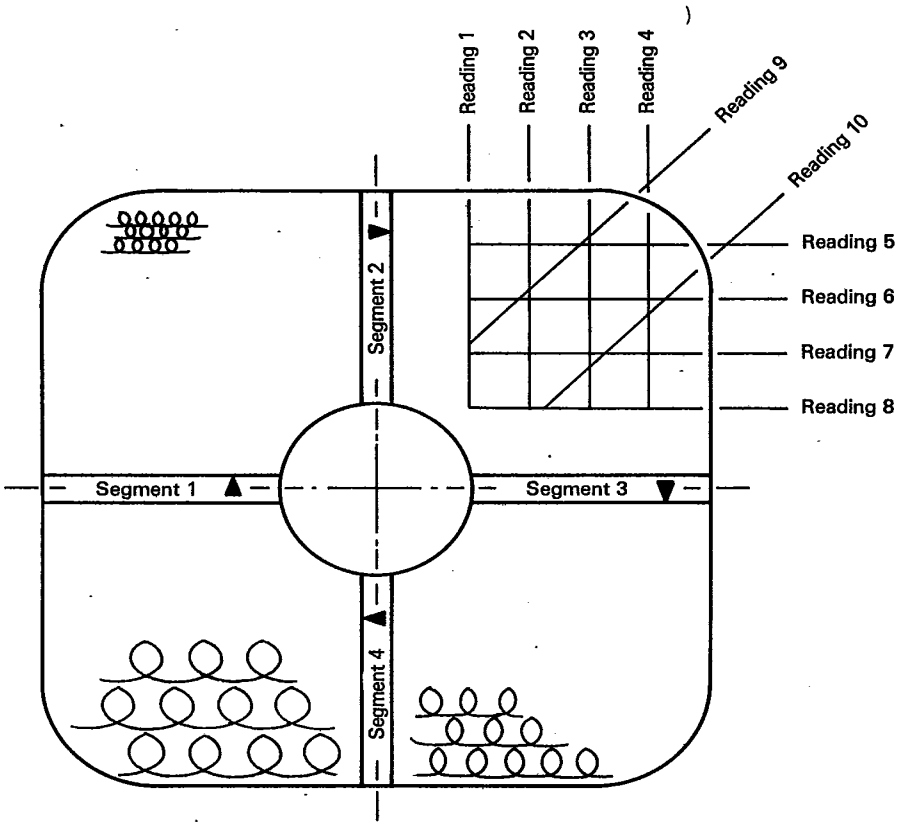


Figure 2 — Suggested traversing pattern to obtain 10 readings of R_{y5}

Annex A

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

(This annex forms an integral part of the Standard.)

1. Test laboratory and address					
2. Test surface identification a) ISO surface profile comparator b) steel substrate/replica[1]					
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[2]	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[3]					
6. Any deviations from the standard procedure[4]					
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)[4]					
10. Name of operator					

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

2) See separate form (annex B) for actual readings.

3) Delete as appropriate.

4) If applicable.

Annex B

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

(This annex forms an integral part of the Standard.)

Test laboratory and address

Stylus instrument
Manufacturer :
Type :
Model :

Tip radius = µm
Evaluation length l_n = mm
Sampling length l = mm

Item reference[1]

a) ISO surface profile comparator
b) Steel substrate/replica[2]

Reading No.	Segment1	Segment 2	Segment 3	Segment 4	Steel substrate/replica[1]
	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					

1) Delete as appropriate.

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

Annex C

Guidance notes for the preparation and measurement of replicas

(This annex does not form an integral part of the Standard.)

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 solventless two-component organic polymers that cross-link to give a hard solid surface. These polymers may have disadvantages in that they do not penetrate into the deepest, sharpest valleys and that a release agent may 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 cross-linked mean that penetration into re-entrants of grit-blasted profiles, and subsequent removal, is good. Due to 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 that span the test surface profile range. It is preferable that the profile obtained from the replica should 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".

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Descriptors : paints, varnishes, substrates, steel products, tests, determination, surface condition, profile criteria, roughness, viso-tactile comparison specimens, profile meters.

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