



SIS - Standardiseringskommissionen i Sverige

Handläggande organ

SIS-STG

## SVENSK STANDARD SS-ISO 8503-3

Fastställd

1992-04-22

Utgåva

1

Sida

1 (9)

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### Behandling av stålytor före beläggning med målningsfärg och liknande produkter – Karakterisering av ytråhet hos blästrade stålunderlag – Del 3: Metod för kalibrering av ISO ytprofilkomparatorer och för bestämning av ytprofil – Förfarande med fokuserande mikroskop

Denna svenska standard utgörs av den engelska versionen av den internationella standarden ISO 8503-3 (Utgåva 1): 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.

I denna standard beskrivs en metod för kalibrering av ISO ytprofilkomparatorer genom användning av ett fokuserande mikroskop. Metoden kan också användas för bestämning av ytprofil hos blästrade stålunderlag antingen direkt eller indirekt genom mätningar på ett avtryck av ytan.

Ytprofilen bestäms genom att beräkna medelvärdet för en serie mätningar av maximala topp-till-dal höjder erhållna genom fokusering med ett specificerat mikroskop – först på den högsta toppen och sedan på den djupaste dalen inom samma synfält i mikroskopet.

Nackdelen med metoden är att den kräver omfattande mätningar. Metoden ger dock precision. God överensstämmelse mellan olika laboratorier och operatörer kan erhållas genom att noggrant specificera synfältet och fältdjupet hos mikroskopet.

### 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

This Swedish standard consists of the English version of the International Standard ISO 8503-3, 1st ed, 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.

This standard describes a method for calibration of ISO surface profile comparators by use of a focusing microscope. The method can also be used to determine the surface profile of blast-cleaned steel substrates either directly or indirectly by measurements on a replica of the surface.

The surface profile is determined by averaging a series of maximum peak-to-valley measurements obtained by focusing a specified microscope – first on the highest peak and then on the lowest valley in the same field of view.

The disadvantage of the method is that it requires tedious measurements. But, the method gives a good precision. A good agreement between different laboratories and operators can be obtained by specifying the field of view and depth of field of the microscope.

UDK 667.6:669.14:620.179.11

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Prisgrupp L

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## 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 optical microscope is one of the most widely used instruments for measuring surface profile. The method can be used by any laboratory equipped with a good microscope that has a calibrated focusing mechanism meeting the requirements of 5.1. This procedure may also be used to determine the profile of a substrate after abrasive blast-cleaning either directly or from a replica.

This method is based on that developed in the USA by the Steel Structures Painting Council. It entails averaging a series of maximum peak-to-valley measurements obtained by focusing a specified microscope — first on the highest peak and then on the lowest valley in the same field of view, noting the distance of movement of the stage (or objective).

This method has the disadvantage of requiring a series of tedious measurements, but good precision and agreement between laboratories and between operators can be obtained by specifying closely the field of view and depth of field of the microscope. To avoid a widespread divergence in measuring profile within and between laboratories, this method requires a significant number of measurements as well as correct calibration, proper focus movement, standardized depth of field and field diameter of the microscope necessary to measure properly both coarse and fine profiles under a single set of conditions.

ISO 8503-4 describes the procedure using a stylus instrument. ISO 8503-1 specifies the requirements for ISO surface profile comparators and ISO 8503-2 describes 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 focusing microscope 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  $\bar{h}_v = 20$  to  $200 \mu\text{m}$ , of essentially planar blast-cleaned steel. The determination may be carried out on a representative section of the blast-cleaned substrate or, if direct observation of the surface is not feasible, on a replica of the surface (see annex E).

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 8503-4.

## 2 References

ISO 4618, *Paints and varnishes — Vocabulary*.

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 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*.<sup>1)</sup>

## 3 Definitions

For the purpose of this part of ISO 8503, the definitions given in ISO 4618 and ISO 8503-1 apply.

## 4 Principle

Observation of the test surface over a specified field of view using a specified microscope. Adjustment of the microscope, by movement of the objective (or the stage), to focus on the highest peak within the field of view. Determination of the distance  $h_v$  moved by the objective (or the stage) in order to focus on the lowest valley within the same field of view.

Repetition of the procedure to obtain values for a further 19 different fields of view and calculation of the arithmetic mean of the distance  $h_v$  between the highest peak and lowest valley in each field of view as the mean maximum peak-to-valley height  $\bar{h}_v$ .

## 5 Apparatus

**5.1 Optical microscope**, having a fine focus adjustment with little or no backlash (play) (see clause A.5 in annex A). The adjustment shall give fine control of the movement of the objective or stage and shall be fitted with a graduated vernier scale having a scale value of not more than  $1 \mu\text{m}$ . The microscope shall have an objective lens with a numerical aperture of not less than 0,5 together with an eyepiece lens to give a field of view greater than 0,5 mm in diameter. The field of view may be reduced by the use of a circular eyepiece reticle or by a stop in the lamphouse.

NOTE — Advice concerning the use of the microscope is given in annexes A and D. Annex A describes a procedure for determining the microscope backlash. Annex D explains the significance of the defined variables for the microscope. (See also the note to 5.2.)

**5.2 Light source**, fitted to the microscope (5.1) to illuminate the test surface perpendicular to its plane. Light filters may be used to minimize glare.

NOTE — These requirements for the apparatus (5.1 and 5.2) are generally met by microscopes for metallurgical purposes.

## 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 E) is to be measured, clean it only with a dry brush.

## 7 Procedure for measurement of maximum peak-to-valley height $h_v$

**7.1** Locate the test surface (clause 6) under the objective of the microscope (5.1) so that the measurements are taken on a test area not less than 5 mm from any edge. Adjust the light

1) At present at the stage of draft.

source (5.2) to illuminate the test area, normal to the plane of the surface. Focus the microscope approximately on the surface.

**7.2** Raise the objective until no part of the test area is in focus (see the notes). Then slowly lower the objective, using the fine adjustment knob, until the first point in the observed area just comes into focus. On the form given in annex C, record the reading  $r_1$  on the vernier scale as the height of the highest peak in that field of view.

#### NOTES

1 On some microscopes, the objective is fixed and the stage is movable. Adjustment of focus is achieved by raising or lowering the stage.

2 It is recommended that focusing should always be carried out in the same direction (see clause D.2).

**7.3** Lower the objective until no part of the test area is in focus (see the notes to 7.2). Then slowly raise the objective until the first point in the observed area just comes into focus. On the form given in annex C, record the reading  $r_2$  on the vernier scale, corrected for any backlash (see annex A), as the depth of the lowest valley in that field of view. If the reading cannot be corrected for backlash in the microscope movement, continue to raise the objective until the lowest valley is no longer in focus. Then slowly lower the objective until the lowest valley is once more in focus. Record the reading  $r_2$  on the vernier scale as the depth of the lowest valley in that field of view.

**7.4** The difference between the readings ( $r_1 - r_2$ ) is the maximum peak-to-valley height  $h_v$  for that field of view.

**7.5** Repeat the procedure described in 7.2, 7.3 and 7.4 until the maximum peak-to-valley height has been determined for 20 completely different fields of view, uniformly distributed over the test surface, but not less than 5 mm from any edge.

## 8 Calculation and expression of results

**8.1** Calculate the mean value  $\overline{h_v}$  and the standard deviation for the 20 maximum peak-to-valley readings  $h_v$  for each test surface.

If the standard deviation obtained is less than one-third of the mean, report the standard deviation and the result as the "mean maximum peak-to-valley height  $\overline{h_v}$ ".

**8.2** If the method is used to calibrate an ISO surface profile comparator and if the standard deviation obtained is more than one-third of the mean result, repeat the procedure (clause 7), and obtain the mean and standard deviation for the 40 readings. If the standard deviation is still more than one-third 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  $\overline{h_v}$ , together with the standard deviation and the maximum reading of  $h_v$  to indicate the degree of uniformity of the surface roughness.

## 9 Test report

The form of the test report is given in annex B 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 8503-3);
- c) the magnification of the objective lens, and its numerical aperture;
- d) the magnification of the eyepiece lens and of any intermediate magnification;
- e) the diameter of the field of view of the test area;
- f) the total magnification of the microscope;
- g) 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 8503-1);
- h) 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 E);
- i) the name of the operator;
- j) the date of the test.

## Annex A

### Determination of backlash (play) in the microscope adjustment mechanism

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

**A.1** Carry out the following procedure using the microscope (5.1) but with the magnification increased to between X 360 to X 450.

**A.2** Place an ISO surface profile comparator (6.1) on the stage of the microscope so that the area to be examined is not less than 5 mm from any edge. Adjust the light source to illuminate the test area normal to the plane of the surface. Focus approximately the microscope on the surface.

**A.3** Raise the objective (see note 1 to 7.2) until no part of the test areas is in focus. Slowly lower the objective using the fine adjustment knob, until the first point (i.e. the highest peak) in the observed area just comes into focus. Record the reading ( $p_1$ ) of the vernier scale.

Repeat this procedure *without moving the comparator* until 20 readings have been obtained, and then calculate their mean ( $\bar{p}_1$ ).

**A.4** Without displacing the comparator, lower the objective until the highest peak is no longer in focus. Slowly raise the objective until the highest peak in the observed area just comes into focus. Record the reading ( $p_2$ ) of the vernier scale.

Repeat this procedure without moving the comparator until 20 readings have been obtained, and then calculate their mean ( $\bar{p}_2$ ).

**A.5** Calculate the backlash as the difference ( $\bar{p}_1 - \bar{p}_2$ ) and provided that the value is not greater than 3  $\mu\text{m}$ , use this value in 7.3. If the value is greater than 3  $\mu\text{m}$ , reject the microscope.