TECHNICAL REPORT

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Preparation of steel substrates before application of paints and related products — Analytical colorimetry method to support visual assessment of surface preparation grades

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Foreword

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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).

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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 12, *Preparation of steel substrates before application of paints and related products*.

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 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, and

c) the surface profile.

The ISO 8501 series, the ISO 8502 series and the ISO 8503 series provide methods for assessing these factors, while the ISO 8504 series 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 provisions on the protective coating systems applied to the steel surface. They do not contain provisions related to the surface quality requirements for specific situations even though surface quality can have a direct influence on the choice of protective coating applied and on its performance. Such provisions are given in other documents such as national standards and codes of practice. It would be useful 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 used, and

— within the capability of the cleaning procedure specified.

While these four series of International Standards deal with specific aspects of the preparation of steel substrates, the ISO 8501 series covers the visual assessment of surface cleanliness.

ISO 8501-1 is intended to be a tool for visual assessment of rust grades and of preparation grades. It identifies four levels (designated as "rust grades") of mill scale and rust that are commonly found on surfaces of uncoated erected steel and steel held in stock. It also identifies certain degrees of visual cleanliness (designated as "preparation grades") after surface preparation of uncoated steel surfaces and of steel surfaces after overall removal of any previous coating. These levels of visual cleanliness are related to the common methods of surface cleaning that are used prior to painting.

Preparation of steel substrates before application of paints and related products — Analytical colorimetry method to support visual assessment of surface preparation grades

1 Scope

This document provides guidance on the usage of analytical colorimetry to support visual assessment of surface preparation grades described in ISO 8501-1:2007, Clause 4.

This document provides examples of applications where the use of a colorimeter or spectrophotometer can enable a quick and objective assessment of the preparation grade of the substrate.

NOTE The data given in this document was obtained using the methodology described in Annex A.

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 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in in ISO 8501-1 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
CIELAB colour space
CIE 1976 $L^* a^* b^*$ colour space
three-dimensional L^*, a^*, b^* colour space

3.2
colour difference
difference between two colour stimuli defined as the Euclidean distance between the points representing them in the $L^* a^* b^*$ space and calculated as follows

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

3.3
illuminant
radiation with a relative spectral power distribution defined over the wavelength range that influences object colour perception

3.4
standard illuminant
illuminants (3.3) by the CIE defined in terms of relative spectral power distributions

Note 1 to entry: These illuminants are intended to represent the following:

a) Planckian radiation at a temperature of about 2 856 K;

b) direct solar radiation (obsolete);

c) average daylight;

d) daylight.

The 2-digit number associated to D illuminant denotes the correlated colour temperature.

3.5
observer
CIE 1931 standard colorimetric observer
ideal observer whose colour-matching properties correspond to the CIE colour-matching functions adopted by the CIE in 1931

Note 1 to entry: This standard colorimetric system is applicable to centrally-viewed fields of angular subtending between about 1° and about 4°.

3.6
supplementary standardized observer
CIE 1964 supplementary standard colorimetric observer
ideal observer whose colour-matching properties correspond to the CIE colour-matching functions adopted by the CIE in 1964

Note 1 to entry: This standard colorimetric system is applicable to centrally-viewed fields of angular subtense greater than about 4°.

Note 2 to entry: When this system is used, all symbols that represent colorimetric measures are distinguished by use of the subscript 10.

4 Symbols

L^*	CIELAB lightness
a^*, b^*	CIELAB a^*, b^* coordinates
ΔL^*	CIELAB lightness difference
Δa^*, Δb^*	CIELAB a^*, b^* difference
ΔE^*	CIELAB colour difference
ΔC^*	CIELAB chroma difference
ΔH^*	CIELAB hue difference

5 Principle

The assessment of preparation grade of the surface is done by calculation of the colour difference components, taking as reference the colour components values of a substrate with the targeted surface preparation grade.

The surface preparation will be considered as acceptable if the colour difference is below a certain value agreed between the parties.

NOTE The tolerance associated for each preparation grade described in words in ISO 8501-1 is associated to a dispersion of the colour components values.

6 Recommendations for instruments

6.1 Instrument handling

Two types of instruments can be used for colour measurement: the spectrophotometer and the tristimulus colorimeter. Both types are available as portable instruments and can be used for obtaining the data given in this document.

It is important to ensure a close contact between the instrument and the surface to be controlled, to avoid any foreign light contamination and to keep a constant distance between the surface to analyze and the instrument detection system, as specified by the instrument manufacturer.

The measurement should not be carried out in excessively dusty environments.

6.2 Instrument specifications

Colour measurements of a surface are influenced by the light source (illuminant), the observer and the geometric conditions of observation.

It is important to know these parameters and to keep them constant.

NOTE If one of these factors is modified during the analytical colorimetry measurement, the colour components and the colour difference components will be affected.

6.2.1 Illuminant and observer

The CIE has defined standard illuminants and standard observers that are commonly used by colorimeter and spectrophotometer manufacturers.

6.2.2 Illuminating and viewing conditions

The measured colour values depend on the geometric relationships between the measuring instrument and the sample. These relationships are called geometric conditions. A complete terminology description of geometric conditions can be found in CIE 15.

Several geometric conditions are standardized, and they need to be fixed during the colour measurement. Mainly, two different geometric conditions are used by colorimeter and spectrometer manufacturers:

— 45/0°

  Measurement systems with this measurement geometry observe the sample under conditions similar to those of natural observation by a human. This means that measurements with the angle geometry (45°/0° or 0°/45°) are always taken with the gloss excluded, and therefore result in closer equivalence to the eye's visual impression. This geometry is predominantly used in colour control for end products.

— d/8°

  Measurement instruments with sphere geometry (d/8°) illuminate the sample diffusely and measure the light reflected by the sample in one direction at an angle of 8° to the vertical position of the sample. When using a sphere instrument, the specular component may be included or excluded from the measurement.