INTERNATIONAL STANDARD

ISO 8502-4

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Preparation of steel substrates before application of paint and related products — Tests for the assessment of surface cleanliness —

Part 4: Guidance on the estimation of the probability of condensation prior to paint application

Préparation des subjectiles d'acier avant application de peintures et de produits assimilés — Essais pour apprécier la propreté d'une surface —

Partie 4: Principes directeurs pour l'estimation de la probabilité de condensation avant application de peinture

Reference number
ISO 8502-4:1993(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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

International Standard ISO 8502-4 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Sub-Committee SC 12, *Preparation of steel substrates before application of paints and related products*.

ISO 8502 consists of the following parts, under the general title *Preparation of steel substrates before application of paint and related products — Tests for the assessment of surface cleanliness*:

— *Part 1: Field test for soluble iron corrosion products* [Technical Report]

— *Part 2: Laboratory determination of chloride on cleaned surfaces*

— *Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)*

— *Part 4: Guidance on the estimation of the probability of condensation prior to paint application*

— *Part 5: Measurement of chloride on steel surfaces prepared for painting — Ion detector tube method*

— *Part 6: Sampling of soluble impurities on surfaces to be painted — Bresle method*

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— *Part 7: Analysis of soluble impurities on surfaces to be painted — Analysis methods for field use for oil and grease*

— *Part 8: Analysis of soluble impurities on surfaces to be painted — Analysis methods for field use for moisture*

Users should note that the titles to future parts 5 to 8 are working titles only and that, while it is at present planned to publish all the parts listed above, one or more may nevertheless be deleted from the work programme before publication, which may, in turn, lead to renumbering of the remaining parts.

Annex A of this part of ISO 8502 is for information only.

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.

Some paints (but not all) require dry surfaces when being applied to steel structures. Thin films of condensed water on steel surfaces are mostly

invisible. It is therefore important to have a method by which the probability of condensation can be estimated prior to the application of paint.

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Preparation of steel substrates before application of paint and related products — Tests for the assessment of surface cleanliness —

Part 4:
Guidance on the estimation of the probability of condensation prior to paint application

1 Scope

This International Standard gives guidance on the estimation of the probability of condensation on a surface to be painted. It may be used to establish whether conditions at the job site are suitable for painting or not.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 8502. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 8502 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4677-1:1985, *Atmospheres for conditioning and testing — Determination of relative humidity — Part 1: Aspirated psychrometer method.*

ISO 4677-2:1985, *Atmospheres for conditioning and testing — Determination of relative humidity — Part 2: Whirling psychrometer method.*

ISO 8601:1988, *Data elements and interchange formats — Information interchange — Representation of dates and times.*

3 Probability of condensation

The relative humidity of the air and the steel surface temperature are the basis for the estimation of the probability of condensation, but there is no simple rule to employ. The situation is complex because there are a multitude of factors which have an influence on the condensation and evaporation of moisture, such as

— heat conductance of the structure;

— solar radiation on the surface;

— flow of ambient air around the structure;

— contamination by hygroscopic substances on the surface.

These factors sometimes provoke wetting or prevent drying locally on the surface, e.g. where the surface temperature remains low or tends to fall due to heat losses or where the air becomes quickly saturated due to reduced ventilation. Naturally, the same factors sometimes have the opposite effect. Therefore any test results should be interpreted with the greatest care.

Unless otherwise agreed, the steel surface temperature generally should be at least 3 °C above the dew-point when paints are used.

NOTE 1 For paints that are tolerant to moisture on the surface, a temperature difference less than 3 °C may be acceptable.

Other temperature differences may be specified by the paint manufacturer, or agreed by the interested parties.

If the difference between the surface temperature and the dew-point is below or will fall below the required and/or agreed minimum, the probability of condensation should be considered as being "high".

If the difference is above and will remain above the required and/or agreed minimum, the probability of condensation should be considered as being "low".

It is important to judge whether a temperature drop, sufficient to cause condensation, is likely to occur during the critical period. Table 1 may be used to help with this determination.

If the relative humidity is 85 % or higher, then painting should be judged critically as the dew-point is a maximum of 2,5 °C away.

If the relative humidity is high (92 % or dew-point 1,3 °C away), painting should only be considered if conditions can be confidently expected to remain static or improve during the application and drying period.

NOTE 2 This period is usually approximately 6 h.

If the relative humidity is apparently satisfactory (for example 80 % or dew-point 3,4 °C away), the environmental conditions over an appropriate time period ahead, often about 6 h, should still be considered in order to ascertain that dew conditions will not occur.

4 Instruments

The following instruments should be used, although instruments other than those described may be used provided they have an equivalent or greater accuracy.

a) For air temperature measurements, mercury thermometers or digital electronic thermometers, accurate to ± 0,5 °C.

b) For air humidity measurements, any of the following instruments:

1) Aspirated psychrometers and whirling (sling) hygrometers, including tables for calculation of humidity (see ISO 4677-1 and ISO 4677-2, respectively), accurate to ± 3 % RH.

NOTE 3 The aspirated psychrometer is the reference instrument type according to the World Meteorological Organization (WMO).

2) Digital electronic hygrometers based on measurement of capacitance change of polymer films, accurate to ± 3 % RH and capable of operating at any relative humidity in the range 0 % RH to 100 % RH and at any temperature in the range – 40 °C to + 80 °C.

3) Digital electronic hygrometers based on measuring the resistance change in a salt bridge, accurate to ± 2 % RH and capable of operating at any relative humidity in the range 0 % RH to 97 % RH and at any temperature in the range 0 °C to 70 °C.

c) For surface temperature measurements, digital electronic thermometers, accurate to ± 0,5 °C.

NOTE 4 Magnetic surface thermometers may be used provided they have the required accuracy and are left on the surface for sufficient time to reach the surface temperature.

5 Procedure

5.1 Using the instruments described in 4 a) and 4 b), measure the air temperature to the nearest 0,5 °C and the relative humidity.

5.2 Calculate the dew-point, which is a logarithmic function of the vapour pressure at the actual temperature. There are tables or charts from which the dew-point can be determined. Their parameters are air temperature and relative humidity. Such a table is given in annex A. Commercial dew-point calculators of sufficient accuracy may also be used.

Table 1 — Temperature drop needed for condensation to occur, as a function of the relative humidity

Relative humidity, %	98	95	92	90	85	80
Temperature drop, °C	0,3	0,8	1,3	1,6	2,5	3,4

NOTE — The figures are mean values for air temperatures from 0 °C to 35 °C. For a given air temperature, more accurate figures can be obtained from annex A.

5.3 Using the instrument described in 4 c), measure the steel surface temperature. Take at least one temperature measurement for every 10 m^2 of the surface and adopt the lowest measured temperature in calculating the dew point.

NOTE 5 When selecting locations for temperature measurements, any variation in the thickness of the steel and the effect of shade should be considered.

5.4 Estimate the minimum surface temperature (above the dew-point) that is needed to avoid condensation under the prevailing environmental conditions.

6 Test report

The test report should include the following:

a) a reference to this part of ISO 8502 (i.e. ISO 8502-4);

b) the date of carrying out the measurements (including the day and hour), expressed in accordance with ISO 8601;

c) a description of the instruments used;

d) the calculated dew-point;

e) the measured steel surface temperature;

f) the difference between the steel surface temperature and the dew-point;

g) the minimum temperature difference needed to avoid condensation;

h) an estimate of the probability of condensation as being "high" or "low".

Annex A
(informative)

Table for determination of dew-point

The following table gives the dew-point temperature t_d as a function of the air temperature t and the relative humidity, ϕ.

The following instructions are given for the use of the table:

— Enter the table at values of relative humidity which straddle the actual (measured) value.

— Enter the table at values of air temperature which straddle the actual (measured) value.

— Identify the corresponding four intersection values of dew-point temperature, make a linear interpolation in two steps and round off to 0,1 °C.

The values given in the table are computed from the following equation which is valid for $t \geqslant 0$ °C.

$$t_d = 234{,}175 \times \frac{(234{,}175 + t)(\ln 0{,}01 + \ln \phi) + 17{,}080\ 85t}{234{,}175 \times 17{,}080\ 85 - (234{,}175 + t)(\ln 0{,}01 + \ln \phi)}$$

NOTE 6 As can be seen from the equation, t_d is a comparatively simple function of two variables, t and ϕ. This function therefore lends itself to calculations by use of an ordinary scientific programmable calculator. Such a calculator, including its programme, can be regarded as being equivalent to the table. It is superior to the table in that it presents without interpolation a direct reading of the dew-point temperature. In addition a small pocket-type calculator is usually easier to manipulate on site than a comprehensive table covering several A4-format pages. To make sure that the calculator is properly programmed, put in any tabulated pair of t- and ϕ-values and compare the result with the corresponding value of t_d in the table.