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Paints and varnishes — Natural weathering of coatings — Exposure and assessment

Peintures et vernis — Vieillissement naturel des revêtements — Exposition et évaluation

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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 2810 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This second edition cancels and replaces the first edition (ISO 2810:1974), which has been technically revised.

Paints and varnishes — Natural weathering of coatings — Exposure and assessment

1 Scope

This International Standard specifies the conditions which need to be taken into consideration in the selection of the type of natural weathering and the natural weathering procedure to be used to determine the resistance of coatings or coating systems (direct weathering or weathering behind window glass).

Natural weathering is used to determine the resistance of coatings or coating systems (denoted in the following text simply by coatings) to the sun's radiation and the atmosphere.

Special atmospheric influences, e.g. industrial pollution, are not taken into account in this International Standard.

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 1514, *Paints and varnishes — Standard panels for testing*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 2813, *Paints and varnishes — Determination of specular gloss of non-metallic paint films at 20°, 60° and 85°*

ISO 3668, *Paints and varnishes — Visual comparison of the colour of paints*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 4628-1, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 1: General introduction and designation system*

ISO 4628-2, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering*

ISO 4628-3, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting*

ISO 4628-4, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 4: Assessment of degree of cracking*

ISO 4628-5, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 5: Assessment of degree of flaking*

ISO 4628-6, *Paints and varnishes — Evaluation of degradation of paint coatings — Designation of intensity, quantity and size of common types of defect — Part 6: Rating of degree of chalking by tape method*

ISO 4628-7, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 7: Assessment of degree of chalking by velvet method*

ISO 4628-8, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 8: Assessment of degree of delamination and corrosion around a scribe*

ISO 4628-10, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 10: Assessment of degree of filiform corrosion*

ISO 7724-1, *Paints and varnishes — Colorimetry — Part 1: Principles*

ISO 7724-2, *Paints and varnishes — Colorimetry — Part 2: Colour measurement*

ISO 7724-3, *Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences*

ISO 8565:1992, *Metals and alloys — Atmospheric corrosion testing — General requirements for field tests*

ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

EN 13523-19, *Coil coated metals — Test methods — Part 19: Panel design and method of atmospheric exposure testing*

SAE J1976:2002, *Outdoor weathering of exterior materials*

WMO, *Guide to meteorological instruments and methods of observation*, WMO Publication No. 8, sixth edition, World Meteorological Organization, Geneva, 1996

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
durability
ability of a coating to resist the deleterious effect of its environment

3.2
time of wetness
period during which an exposed coating has visible water present on it

4 General

The durability of a coating during natural weathering depends on how, where and when the coating is weathered. Therefore, these parameters and the intended use of the coating shall be taken into account when exposures are carried out.

In particular, the following parameters shall be considered:

a) The location of the exposure site, for example industrial, marine, rural. In choosing sites, those which differ markedly in the type or level of pollution from the normal shall be avoided, unless they are appropriate to the intended end use of the coating under test.

b) The height, angle and orientation of the exposure rack. These parameters will govern the extent to which the specimens are affected, for example by dew, frost and atmospheric pollutants.

c) The nature of the terrain on which the rack is constructed (for example concrete, grass, gravel). The terrain may affect the climatic conditions around the specimen under test. It would rarely be feasible to select an

ideal terrain in practice, but the effect of such variations in climatic conditions will be minimized by ensuring that all specimens are situated sufficiently high above the ground (see Clause 5).

d) Whether the performance of the coating on the front and/or the back of the specimen is of interest. Certain types of degradation, for example rust formation and/or mould growth, are frequently more severe on the sheltered parts of the specimen.

e) The intended use of the coating, including its substrate, and whether the coating is to be washed or polished in service.

The results of tests on an exposure rack will apply precisely only to the environment in which they were obtained.

Provided that the test conditions are reasonably appropriate to the intended end use, the relative performance of a number of coatings tested at the same time will enable valid deductions to be drawn. It is recommended that each series of specimens under evaluation include coatings of known performance to act as reference standards.

The results of natural weathering may vary according to the time of year during which the tests are carried out. The influence of these variations will be reduced if the exposure period is sufficiently long. The exposure period should be at least one year, or a multiple of one year. The reproducibility of the results will be improved if the exposure period always starts at the same time of year, preferably in spring.

Natural weathering tests are normally carried out for a fixed period of time. However, in many cases it is preferable to define the test period in terms of a certain degree of degradation or by the radiant exposure (dosage) of solar radiation to which the specimen is to be subjected (see Clause 6). The latter procedure may reduce the influence of seasonal variations but does not eliminate it.

Radiant exposure may be determined by measurement of irradiance, and integration of the measurements over the period of natural weathering.

The climatic conditions shall be monitored and a complete record reported, together with the other conditions of weathering.

Care is required in the selection of test specimens of substrates with variable (anisotropic) properties, for example wood or steel. In these cases, replication of the tests is essential if misleading results are to be avoided.

Washing and polishing during exposure will affect the durability of the coating. It shall therefore be mentioned in the test report.

5 Exposure racks

Unless otherwise specified or agreed, use exposure racks on which the specimens are facing towards the equator. The specimens shall be firmly held on the racks by attachments made of stainless steel or other corrosion-resistant material, in such a manner that they are mechanically stressed as little as possible.

The exposure racks shall be constructed so that the atmosphere has free access to the specimens and that no water drains from one specimen on to another. In addition, the racks may be designed so that a portion of the specimens can be covered to allow evaluation between an exposed and an unexposed area. By using special devices, particular conditions may be simulated, for example by using a “black box” in accordance with SAE J1976[1)] to simulate automotive conditions, or backing the test panel with plywood or other insulation material to simulate building side wall or roof area conditions.

Metal substrates for corrosion tests shall not be in electrical contact with metals during the exposure period or, as far as possible, in direct contact with wood or other porous materials. If specimens are supported in grooves, suitable drainage holes shall be provided to prevent accumulation of water.

1) SAE — Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, USA.

Unless otherwise stated, the racks shall be constructed so that all specimens are supported either at a minimum height of 0,45 m above the ground or at a height sufficient to avoid contact with vegetation and to prevent damage.

The area beneath and in the vicinity of the racks shall be characterized by low reflectance and by ground cover typical of that climatological area. In desert areas, the racks shall be located on gravel, in most temperate areas on low-cut grass.

Usually the panels are supported at an angle of 45° to the horizontal. Depending on the intended end use of the coating, other angles may be agreed, for example 5° for automotive finishes or roof coatings, or vertical exposure for textured wall finishes. When testing corrosion performance, it is appropriate to expose specimens vertically facing away from the equator as well as inclined at 45° and 5° facing towards the equator (see EN 13523-19). Specimens facing away from the equator will remain wet for longer periods since they dry less rapidly than those exposed facing towards the equator. This will lead to a higher tendency to corrode.

The racks shall be situated so that, at a sun height of 20° and more, no shadow falls on to the specimens.

When testing the durability of coatings for interior use which are exposed to radiation which has passed through window glass, racks that are covered by a window pane are used. Since, depending on the quality, the transmission of window glass in the UV range is different, the type of window glass shall be agreed upon between the interested parties for each particular case (see Clause 9).

6 Apparatus for measurement of climatic factors

6.1 Measurement of solar radiation

6.1.1 Pyranometers

Pyranometers are radiometers used to measure the total solar radiant energy incident upon a surface per unit time per unit area.

The energy measured includes direct and diffuse radiant energy as well as radiant energy reflected from the background.

Pyranometers shall meet at least the requirements for a Second Class instrument as defined by the World Meteorological Organization (WMO). In addition, pyranometers shall be calibrated at least annually, and their calibration factor shall be traceable to the World Radiometric Reference (WRR) (see WMO Publication No. 8, Chapter 9).

6.1.2 Pyrheliometers

Pyrheliometers are radiometers used to measure the direct (beam) solar irradiance incident on a surface normal to the sun's rays.

The energy measured excludes diffuse radiant energy as well as radiant energy reflected from the background.

Pyrheliometers shall meet at least the requirements for a First Class instrument as defined by the World Meteorological Organization (WMO). In addition, pyrheliometers shall be calibrated at least annually, and their calibration factor shall be traceable to the World Radiometric Reference (WRR) (see WMO Publication No. 8, Chapter 9).

6.1.3 Total-ultraviolet radiometers

When used to define exposure stages, total-ultraviolet radiometers shall have a passband that maximizes the acceptance of radiation in the 300 nm to 400 nm, 295 nm to 385 nm, or any other commonly used total-ultraviolet wavelength region, and they shall be cosine-corrected to include ultraviolet sky radiation.

Commercially available total-ultraviolet radiometers require annual calibration checks if they are deployed between latitudes 40° north and 40° south. Outside these latitudes, annual calibration is not a requirement, but it is considered satisfactory.

6.1.4 Narrow-band ultraviolet radiometers

When used to define exposure stages, narrow-band ultraviolet radiometers shall be cosine-corrected if used in conjunction with either natural fixed-angle or glass-filtered exposures. They shall be calibrated following the manufacturer's instructions.

6.2 Other climate-measuring instruments

Instrumentation required for the measurement of air temperature, specimen surface temperature, relative humidity, rainfall, time of wetness, and sunshine hours shall be appropriate to the exposure method used, and shall be agreed upon between the interested parties.

7 Test specimens

The simplest and most widely used test specimen is a flat panel of the appropriate substrate, but much useful additional information may be obtained by carrying out exposure tests on structures. This is particularly true of wooden assemblies such as window frames, where coating performance at the joints is of interest. Design features which allow accumulation and entrapment of water may also lead to premature coating degradation. Therefore, test specimens should preferably be included which show the characteristics of such structures.

Unless otherwise agreed, use standard test panels complying with ISO 1514, with the area of the panels at least 0,03 m^2 and no side less than 100 mm long.

Coat the panels with the product(s) under test by the appropriate method and dry (or stove) each coat in the specified manner for the specified time, followed (if appropriate) by conditioning or ageing. Coat both faces and the edges of the panels with the product under test, unless the panel would not be so used in practice. Alternatively, the back and edges may be coated with a good-quality protective paint [see Clause 4, item d)].

If specified or agreed, particularly in the case of corrosion tests, provide uncoated areas on the specimen, preferably by one or more of the following methods:

a) After the specified drying time and immediately before placing the specimens on the exposure rack, make a straight scratch or scribe mark through the coating to the substrate. To make the scratch, use an instrument with a hard tip. The scratch shall have a width of 0,2 mm to 1,0 mm, unless otherwise agreed. As the result of the test depends on e.g. the depth of the scratch and the scratching tool used, the details of how the scratch was made shall be stated in the test report.

   NOTE Normally, vertical and/or horizontal lines are used. By agreement, diagonal criss-cross lines (a St. Andrew's cross) can be employed. However, in this case the coating may flake where the lines cross which makes evaluation, e.g. by image analysis, difficult.

b) Before applying the product(s) under test, attach to the prepared specimen a strip of pressure-sensitive adhesive tape of agreed size at an agreed location. Coat the specimen in the normal way. Either directly after coating or immediately before placing on the exposure rack, carefully remove the tape. Clean off any residues of adhesive with a suitable solvent which does not affect the coating.

Determine the thickness, in micrometres, of the coating by using one of the non-destructive methods specified in ISO 2808. Provide the specimens with a suitable marking which is resistant to natural weathering.

The number of test specimens depends on

— the number of different properties to be investigated and the number of specimens required for each test method;

— the number of times each test method is to be carried out before, during and after weathering.