INTERNATIONAL STANDARD

ISO 11507

First edition
1997-05-15

Paints and varnishes — Exposure of coatings to artificial weathering — Exposure to fluorescent UV and water

Peintures et vernis — Exposition des revêtements au vieillissement artificiel — Exposition au rayonnement UV fluorescent et à l'eau

Reference number
ISO 11507:1997(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 11507 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

Annex A forms an integral part of this International Standard.

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Printed in Switzerland

Introduction

Coatings from paints, varnishes and similar materials are weathered in the laboratory, in order to simulate ageing processes occurring during natural weathering. Generally, valid correlations between ageing during artificial and natural weathering cannot be expected because of the large number of influencing factors. Certain relationships can only be expected if the effect of the important parameters (spectral distribution of the irradiance in their photochemically relevant range, temperature of the specimen, type of wetting, wetting cycle relative humidity) on the coating is known. However, unlike natural weathering, testing in the laboratory is carried out taking into consideration a limited number of variables which can be controlled and therefore the results are more reproducible.

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Paints and varnishes — Exposure of coatings to artificial weathering — Exposure to fluorescent UV and water

1 Scope

This International Standard is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products.

It specifies a test method for determining the resistance of paint coatings to artificial weathering in apparatus including fluorescent UV lamps and condensation or water spray.

NOTE 1 - The ultraviolet light produced by the fluorescent tubes simulates only part of the UV region of the natural sunlight and consequently the test pieces are subjected to a small but destructive portion of the spectrum.

Due to the lack of energy of visible and infra-red radiation compared to sunlight the test piece is not heated above the temperature of the surrounding air which takes place in practical use.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 1512 : 1991, Paints and varnishes - Sampling of products in liquid or paste form.

ISO 1513 : 1992, Paints and varnishes - Examination and preparation of samples for testing.

ISO 1514 : 1983, Paints and varnishes - Standard panels for testing.

ISO 2808 : —[1)] , Paints and varnishes - Determination of film thickness.

ISO 2813 : 1994, Paints and varnishes - Determination of specular gloss of non-metallic paint films at 20°, 60° and 85°.

ISO 3668 : 1976, Paints and varnishes - Visual comparison of the colour of paints.

ISO 3696 : 1987, Water for analytical laboratory use - Specification and test method.

ISO 4628-1 : 1982, Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 1: General principles and rating schemes.

ISO 4628-2 : 1982, Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 2: Designation of degree of blistering.

ISO 4628-3 : 1982, Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 3: Designation of degree of rusting.

ISO 4628-4 : 1982, Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 4: Designation of degree of cracking.

ISO 4628-5 : 1982, Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 5: Designation of degree of flaking.

ISO 4628-6 : 1990, 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 4892-1 : 1994, Plastics - Methods of exposure to laboratory light sources - Part 1: General guidance.

ISO 7724-1 : 1984, Paints and varnishes - Colorimetry - Part 1: Principles.

ISO 7724-2 : 1984, Paints and varnishes - Colorimetry - Part 2: Colour measurement.

ISO 7724-3 : 1984, Paints and varnishes - Colorimetry - Part 3: Calculation of colour differences.

ISO 11341 : 1994, Paints and varnishes - Artificial weathering and exposure to artificial radiation - Exposure to filtered xenon-arc radiation.

1) To be published. (Revision of ISO 2808:1991)

3 Definitions

For the purpose of this International Standard, the following definitions apply:

3.1 ageing criterion: A given degree of ageing, corresponding to a specified or agreed degree of change in a selected property of the coating under test. [ISO 11341]

3.2 ageing behaviour: The change in properties of a coating during artificial weathering or exposure to artificial radiation until a certain ageing criterion (see 3.1) is satisfied.

NOTE 2 - One measure of ageing is the radiant exposure H in the wavelength range below 400 nm or at a specified wavelength, e.g. 340 nm. The ageing behaviour of coatings exposed to artificial weathering, or to artificial radiation, depends on the type of coating, the conditions of exposure of the coating, the property selected for monitoring the progress of the ageing process and the degree of change of this property. [ISO 11341]

3.3 Irradiance, *E*: Radiant flux/area for a specified wavelength range expressed in watts per square metre.

3.4 radiant exposure, *H*: A measure of the radiant energy to which a test panel has been exposed, given by the formula

$$H = \int E \, dt$$

where

E is the irradiance, in watts per square metre;

t is the exposure time, in seconds.

H is therefore expressed in joules per square metre.

If the irradiance E is constant throughout the whole exposure time, the radiant exposure H is given simply by the product of E and t. [ISO 11341]

4 Principle

Artificial weathering of coatings using fluorescent UV lamps and condensation or water spray is carried out in order to produce a certain radiant exposure or mutually agreed total number of operation hours, a given degree of a change in a property or properties. The properties of the exposed coatings are compared with those of unexposed coatings, prepared from the same coating materials under identical conditions, or with coatings whose degradation properties are known. These properties are evaluated by criteria agreed in advance between the interested parties, these criteria usally being of a subjective nature.

Radiation, temperature and humidity all contribute to the ageing process. Therefore, apparatus specified in this standard simulates all three factors.

The results obtained by the use of this method do not necessarily related directly to the results obtained under natural exposure conditions. The relationship between these results needs to be established before the method can be used to predict performance.

5 Required supplementary information

For any particular application, the test method specified in this International Standard needs to be

completed by supplementary information. The items of supplementary information are given in annex A.

6 Apparatus

6.1 Test chamber

The test chamber consists essentially of a conditioned enclosure made from corrosion resistant material in which are housed the lamps, a heated water-tray or spray nozzles and test panel racks.

6.1.1 Lamps

UV lamps emit UV light from a low pressure mercury arc. The required spectral distribution is achieved by a careful selection of the type of phosphor coating on the inner surface of the lamp and the nature of the glass used in the construction of the tubes.

Unless otherwise specified or mutually agreed the lamp shall be one of the three types listed below:

Type 1: This lamp emits a significant amount of radiation at wavelengths below 300 nm which is not present in the sun's radiation. Due to the higher quantum energy of this radiation, photochemical ageing processes may be initiated which do not take place in natural weathering. Therefore this type of fluorescent lamp is suitable for use only for aerospace technology, or when specially agreed between the parties concerned.

This lamp, commonly called UVB (313), has a peak emission at 313 nm and the following relative spectral irradiance:

Wavelength, λ nm	**Relative spectral irradiance** *) %
$270 < \lambda \leq 400$	100
$\lambda \leq 270$	0
$270 < \lambda \leq 280$	0,3 ± 0,03
$280 < \lambda \leq 300$	16,2 ± 1,6
$300 < \lambda \leq 320$	41,6 ± 4,2
$320 < \lambda \leq 340$	29,4 ± 2,9
$340 < \lambda \leq 360$	9,1 ± 0,9
$360 < \lambda \leq 380$	3,0 ± 0,3
$380 < \lambda \leq 400$	0,4 ± 0,04
*) The spectral irradiance between 270 nm and 400 nm is defined as 100 %.	

Type 2: This lamp, commonly called UVA (340), has a peak emission at 340 nm and the following relative spectral irradiance:

Wavelength, λ nm	**Relative spectral irradiance*)** %
$270 < \lambda \leq 400$	100
$\lambda \leq 270$	0
$270 < \lambda \leq 280$	0
$280 < \lambda \leq 300$	0
$300 < \lambda \leq 320$	7,8 ± 0,8
$320 < \lambda \leq 340$	29,6 ± 3,0
$340 < \lambda \leq 360$	34,4 ± 3,4
$360 < \lambda \leq 380$	20,9 ± 2,1
$380 < \lambda \leq 400$	7,3 ± 0,7
*) The spectral irradiance between 270 nm and 400 nm is defined as 100 %.	

Type 3: This lamp, commonly called UVA (351), has a peak emission at 351 nm and the following relative spectral irradiance:

Wavelength, λ nm	**Relative spectral irradiance*)** %
$270 < \lambda \leq 400$	100
$\lambda \leq 270$	0
$270 < \lambda \leq 280$	0
$280 < \lambda \leq 300$	0
$300 < \lambda \leq 320$	2,1 ± 0,2
$320 < \lambda \leq 340$	19,4 ± 1,9
$340 < \lambda \leq 360$	43,4 ± 4,3
$360 < \lambda \leq 380$	28,2 ± 2,8
$380 < \lambda \leq 400$	6,9 ± 0,7
*) The spectral irradiance between 270 nm and 400 nm is defined as 100 %.	

If the lamps are of the same type, they shall be fixed in banks of at least four. It is not recommended, but when combinations of lamps with different spectral emissions are used, provision shall be made to ensure uniformity of the spectral irradiance at the surface of the specimens, e.g., by changing the positions of the specimens at intervals. Since the spectral output deteriorates with age, the lamps shall be renewed or rotated according to the apparatus manufacturers' recommendation.

6.1.2 Device for wetting the test panels

The test panels shall be wetted by condensation from the heated water tray or by spray. Water to ISO 3696 grade 2 shall be used.

6.1.3 Test panel racks

The design of the racks shall be such that when the test panels are mounted in place there will be sufficient free access of air to cool the back of the panel and produce condensation on the front.

6.1.4 Black panel thermometer

Set the apparatus to operate at the specified parameters, and the temperature shall be monitored by a remote sensor attached to the black panel. The black panel thermometer shall be exposed to the same exposure conditions as the specimens.

NOTE 3 - Fluorescent UV lamps emit relatively little infrared radiation when compared to xenon-arc and carbon-arc sources. In fluorescent UV apparatus, the heating of the test panel is primarily by convection of heated air across the panel. Therefore, there is a small difference between the temperature of the black panel thermometer, the test panel surface, and air in the test chamber.

Indicate the type of black panel thermometer used in the test report.

6.1.5 Radiometer

The use of a radiometer to monitor irradiance and radiant exposure is optional. If a radiometer is used, it shall conform to 5.2 of ISO 4892-1 : 1994.

6.2 Control material

The use of control material has been found to be satisfactory.

7 Sampling

Take a representative sample of the product to be tested (or of each product in the case of a multicoat system), as described in ISO 1512.

Examine and prepare each sample for testing, as described in ISO 1513.

8 Test panels

8.1 Substrate

The substrate used for the preparation of the test panels shall be that usually used in practice (e.g. plaster, wood, metal, or plastic material).

Unless otherwise agreed or specified, standard test panels according to ISO 1514 shall be used. The test panels shall be flat and their dimensions shall match those of the test panel racks (see manufacturers' recommendations).

The maximum test-panel thickness shall be such that condensation occurs on the front of the panel.

8.2 Preparation and coating

Unless otherwise specified, prepare each test panel in accordance with ISO 1514 and then coat it by the specified method with the product or system under test.

Unless otherwise agreed, only the front of each test panel shall be coated with the coating material or coating system to be tested. The backs and edges of the test panels are coated, if necessary, with a protective paint.

8.3 Drying and conditioning

Dry (or stove) and age (if applicable) each coated test panel for the specified time and under the specified conditions.

Unless otherwise agreed, immediately prior to the tests condition the coated test panels at a temperature of (23 ± 2) °C and a relative humidity of (50 ± 5) % for at least 16 h.

Mark all the test panels indelibly.

8.4 Thickness of coating

Determine the thickness, in micrometers, of the dried coating by one of the non destructive procedures specified in ISO 2808.

8.5 Number of test panels

Generally, for each coating material, an appropriate number of test panels is tested in one apparatus. In the case of graduated testing the number of test panels for each coating material will have to be increased.

If required, at least one additional test panel for each coating material shall be stored, e.g. at room temperature, avoiding humidity and direct radiation, as a reference specimen. (Caution - The properties of some reference coatings may change during storage.)

9 Procedure

9.1 Mounting the test panels

Secure the test panels in the racks and arrange in the apparatus according with the manufacturer's instructions. All spaces shall be occupied by test panels or blanks.

To ensure uniform exposure of test panels, follow the instructions of the manufacturer of the test apparatus, (it is assumed that these minor interruptions will not adversely affect the end result e.g. the test panels shall be rotated at intervals of not more than 3 days).

9.2 Operation

Method A - Exposure including condensation

Locate the apparatus in a draft free but ventilated environment maintained at a temperature of (23 ± 5) °C.

Maintain the black panel temperature during the irradiation (dry) phase at (60 ± 3) °C for a period of 4 h, unless otherwise agreed or specified.

Maintain the black panel temperature during the condensation phase at (50 ± 3) °C for a period of 4 h, unless otherwise agreed or specified.

Weekly examination of test panels is suggested. Test panels shall be examined towards the end of the dry phase of the test cycle. It is also advisable to remove the test panels for examination towards the end of the dry phase of the test cycle.

The apparatus shall be allowed to equilibrate at the specified conditions when started for the first time or after a period of shut-down.

It is recommended that the apparatus is checked frequently to ensure condensation has occured.

Method B - Exposure including water spray

Instead of condensation phases, periods of water spray may be used. The cycle shall be agreed between the interested parties.

9.3 Duration of test

Continue the test until the agreed or specified ageing criterion or the specified radiant exposure (see 3.1 and 3.4) is reached.

It is not possible to specify a duration of test which would be valid for all the different types of surface coatings. The duration of the test depends on the type of lamps used.

Testing of the test panels is normally carried out without interruption except for servicing, maintenance of the apparatus and examination of the panels.

10 Calibration

10.1 Black panel thermometers shall be calibrated in accordance with the manufacturers' recommendations.

10.2 Apparatus equipped with an irradiance control system shall be calibrated in accordance with the manufacturers' recommendations.

NOTE 4 - It is advisable to expose reference specimens to the required test cycle to verify the reproducibility of the test cycle.

11 Examination of test panels (ageing criteria)

It shall be agreed between the interested parties which properties of the coating shall be tested prior to, during and after ageing, and the appropriate standards shall be used. The methods specified in ISO 2813, ISO 7724-1 to -3, ISO 3668 and ISO 4628-1 to -6 may be used for instance.

Unless otherwise agreed, the test panels shall not be washed or polished during examinations.

12 Precision

Precision data for this International Standard are not yet available.

13 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the product tested;

b) a reference to this International Standard (ISO 11507);

c) the type of lamp used (type 1, 2 or 3 or, if another type was used, details of that type);

d) the type of black panel thermometer used;

e) the items of supplementary information referred to in annex A of this International Standard;

f) a reference to the international or national standard, product specification or other document supplying the information referred to in e);

g) the results of the test, as indicated in clause 11;

h) any deviation from the procedure specified;