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General methods of test for pigments and extenders —

Part 15: Comparison of resistance to light of coloured pigments of similar types

Méthodes générales d'essai des pigments et matières de charge —

Partie 15: Comparaison de la résistance à la lumière des pigments colorés de types semblables

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

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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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 256, *Pigments, dyestuffs and extenders*.

This second edition cancels and replaces the first edition (ISO 787-15:1986), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— Clause 3 on “Terms and definitions”, with a general reference to ISO 18451-1, has been added;

— a bibliography has been added;

— the text has been editorially revised.

A list of all parts in the ISO 787 series can be found on the ISO website.

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 terms “resistance to light” and “light fastness (or colour fastness)” describe the resistance of a material to change in its appearance as a result of exposure to light. The magnitude of the change, if any, is influenced by the quantity and quality of the light to which the material is exposed, and by the nature and composition of the material itself. Two compositions, each consisting of identical components but in different proportions, may not have the same resistance to light. Also, two compositions each consisting of the same proportions of similar, but not identical, components may not have the same resistance to light.

When exposed to natural light, the conditions of the test vary continuously because of the large number of variables (for example intensity and spectral distribution of the light, temperature, relative humidity, and the amount and nature of atmospheric contaminants) and therefore results cannot be related to similar tests carried out on other occasions. Consequently, expressing the results as a function of time alone is not recommended.

These considerations form the basis for the comparison of light fastness of two different samples of a coloured pigment. Each sample is incorporated in the same proportion in otherwise identical compositions and these compositions, in a suitable form, are examined for any difference in their change of appearance after exposure to the same quantity and quality of light. In order to comply with these exposure conditions, it is necessary for the compositions to be exposed side by side at the same time to the same light source for the same period of time.

In addition, the light fastness of a pigment may be affected by the presence of other pigments such as titanium dioxide. This important aspect may be accommodated in document by allowing the agreed binder (medium) to consist of a dispersion of such a pigment. The test procedure is then followed as described.

The extent, to which the change on exposure is allowed to proceed before the comparison is made, may be of importance. It is unrealistic to assess the exposures when the change is only equivalent to the first perceptible change, but it is also inadvisable to wait until the amount of change is large. Thus, it is recommended that comparisons of change of appearance be made when the amount of change of the pigment with known resistance to light (agreed reference pigment) is equal to fastness grade 4 and 3 of the grey scale in accordance with ISO 105-A02.

For any particular application, the method of test described in this document should be completed by the following supplementary information. This information should be derived, in part or totally, from a national or an international standard or other document related to the product under test or, if appropriate, should be agreed between the interested parties.

a) Type and identification of the agreed reference pigment.

b) The binder (medium) for dispersion of the test sample and the agreed reference pigment and details of the composition of the dispersion.

c) The method of dispersion to be used.

d) Whether the test is to be carried out under natural exposure (method A) or artificial light (method B).

e) If method A is to be used, the exposure angle of the test specimens and glass cover.

f) If method B is to be used, the details of the apparatus and of the light source.

General methods of test for pigments and extenders —

Part 15: Comparison of resistance to light of coloured pigments of similar types

1 Scope

This document describes a general method of test for comparing the resistance to light of samples of similar types of coloured pigments (agreed reference pigment and test sample).

Two methods of exposure are described in this document. In method A, the material is exposed under glass to natural light. In method B, the material is exposed to direct artificial light.

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 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

ISO 18451-1, *Pigments, dyestuffs and extenders — Terminology — Part 1: General terms*

CIE Publication No 20 (TC-2.2), *Recommendations for the integrated irradiance and the spectral distribution of simulated solar radiation for testing purposes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18451-1 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/

4 Principle

The test sample and the agreed reference pigment are each dispersed in the same agreed binder (medium). The dispersions are applied to a substrate and dried. They are then exposed to natural daylight with protection from rain (method A) or to artificial light (method B) under specified conditions.

The resistance to light is assessed by comparing the change in colour of the test sample to that of the agreed reference pigment.

5 Apparatus and materials

5.1 Substrate

a) aluminium or rigid cardboard panels of suitable size for the applicator used, and with a white high gloss, light fast, coated and non-absorbent surface for the application of paint or

b) paper used as substrate for mass tone prints.

5.2 Film applicator or other device, suitable for applying, side by side, two films of wet thickness 50 µm to 100 µm, or a **suitable apparatus** for preparing mass tone prints with a thickness of about 1,5 µm.

5.3 Cover sheet, of aluminium foil or other suitable opaque material.

5.4 Grey scale for assessing change in colour, complying with ISO 105-A02.

5.5 Agreed reference pigment, for comparison with the test sample. It shall be agreed between the parties and shall be similar in composition to that of the test sample.

5.6 Binder (medium), to be agreed between the interested parties. Its choice should be made with regard to the field of application of the pigments being tested.

5.7 Cabinet for exposure under glass to natural light (for method A).

The exposure cabinet shall have a glass cover and shall be of a sufficient size to carry out the expected number of tests.

The cabinet shall be constructed of metal, wood or other material capable of protecting the coated test substrates (specimens) from rain and similar climatic effects, and there shall be adequate ventilation to allow free flow of air over the test specimens.

The glass cover shall be a single piece of clear sheet glass, of thickness 2 mm to 3 mm, and free from bubbles or other imperfections. The transmittance of the glass shall be approximately 90 % at 360 nm and throughout the visible region of the spectrum, falling to a transmittance of less than 1 % at 300 nm and shorter wavelengths. To maintain these characteristics, it is usually necessary to clean the glass periodically and to replace the glass at intervals of not more than 2 years.

The cabinet shall be fitted with a means of support that allows the specimens to be placed not less than 50 mm below, and in a plane parallel to, the glass cover. The cabinet shall be placed so as to receive direct sunlight throughout the day without shadows of neighbouring objects falling upon it. If the cabinet is placed over ground, the distance between the bottom of the cabinet and the plane of the cleared area shall be great enough to avoid any undesirable effects of contact with grass or plant growth during the period of exposure. The glass cover and the test specimens shall slope toward the equator at an angle from the horizontal approximately equal to the latitude of the location at which the tests are being made. Other angles of exposure such as 45° may be used, but the angle shall be stated in the test report.

5.8 Apparatus for exposure to artificial light (for method B).

The apparatus may be a conventional artificial weathering machine, containing a suitable light source such as a xenon arc lamp and filter system, or a similar device (see also ISO 4892-2:2013, 4.1 which gives further details of the characteristics of xenon arc lamps.)

The apparatus shall operate under the following conditions:

— the simulated total irradiance incident on the specimens provided by the light source (lamp and filter system) shall be (550 ± 55) W/m^2 in the range 300 nm to 800 nm;

— the irradiance shall be (50 ± 15) W/m^2 in the range 300 nm to 400 nm;

— the irradiance at wavelengths shorter than 320 nm shall not exceed 0,5 W/m^2;

— the spectral distribution of the total radiation at wavelengths above 360 nm corresponding to Table 1 and Figure 1 (taken from CIE Publication No. 20); an approximation within ±10 % of radiation data are sufficient;

— the air drawn into the test chamber shall be at normal ambient conditions of temperature and humidity, the degree of ventilation shall be such that the test specimens are maintained at a black panel temperature of (50 ± 5) °C;

NOTE ISO 4892-1 gives details regarding black panel thermometers.

— no water spray shall be used.

Xenon arc lamps are convenient to use and give a spectrum reasonably close to natural daylight. It is necessary to frequently monitor the output of each lamp because it characteristically decreases (especially within the actinic region) with use. Lamps should be replaced immediately when they fail to comply with the requirements specified in this clause. Typical commercially available lamps have a useful life of about 1 000 h. In some cases, the transmission characteristics of the associated filter system also alter in course of time and a regular replacement of filters is necessary.

Table 1 — Irradiance of the total radiation in spectral bands, in watts per square metre and in percentage of E_T = 1 120 W/m^2

Range	Wavelength nm	Irradiance W/m^2		Percentage of total radiation[a] %	
0	<280	0		0	
1	281 to 320[b]	5	68	0,5	6,1
	321 to 360	27		2,4	
	361 to 400	36		3,2	
2	401 to 440	56	580	5,0	51,8
	441 to 480	73		6,5	
	481 to 520	71		6,3	
	521 to 560	65		5,8	
	561 to 600	60		5,4	
	601 to 640	61		5,5	
	641 to 680	55		4,9	
	681 to 720	52		4,6	
	721 to 760	46		4,1	
	761 to 800	41		3,7	
3	801 to 1 000	156	329	13,9	29,4
	1 001 to 1 200	108		9,7	
	1 201 to 1 400	65		5,8	

[a] Total radiation, E_T = 1 120 W/m^2.

[b] Radiation below 300 nm does not reach the surface of the earth.

[c] Radiation above 3 000 nm is negligible.

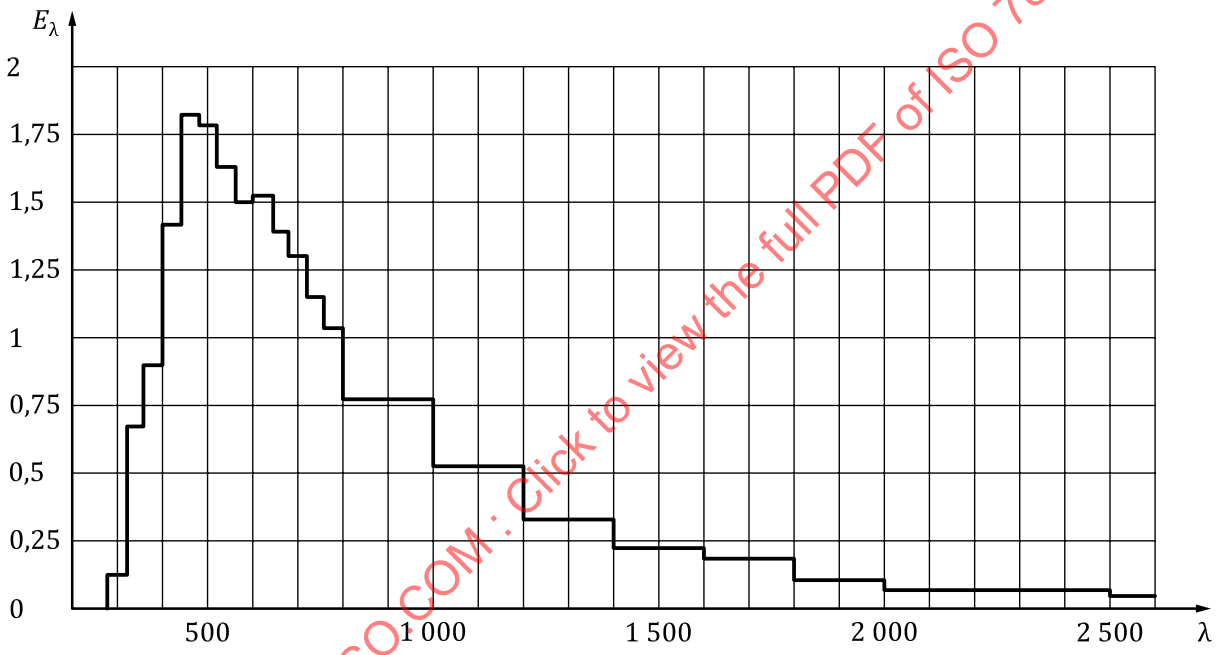
Table 1 *(continued)*

Range	Wavelength nm	Irradiance W/m²		Percentage of total radiation[a] %	
4	1 401 to 1 600	44	143	3,9	12,7
	1 601 to 1 800	29		2,6	
	1 801 to 2 000	20		1,8	
	2 001 to 2 500	35		3,1	
	2 501 to 3 000	15		1,3	
5	>3 000[c]	—		—	
0 to 5	Σ	1 120	1 120	100	100

[a] Total radiation, E_T = 1 120 W/m².

[b] Radiation below 300 nm does not reach the surface of the earth.

[c] Radiation above 3 000 nm is negligible.



Key

λ wavelength, in nm

E_λ spectra radiance, in W/(m²·nm)

NOTE Altitude of the sun, h = 90°, cloudless days, air mass = 1.

Figure 1 — Spectral irradiance of the total radiation in spectral bands

The values of the spectral irradiance shall be multiplied by the spectral bandwidth to obtain the table values.

6 Sampling

Take a representative sample of the product to be tested, as described in ISO 15528.

7 Procedure

7.1 Preparation of the test specimens

Prepare dispersions of the test sample and of the agreed reference pigment (5.5) in the agreed binder (medium) (5.6) by an agreed dispersion method. By means of a film applicator (5.2), apply to the substrate (5.1) continuous films of each dispersion so that both are at least 25 mm wide. Allow to dry in a horizontal position in diffuse daylight for 24 h at ambient temperature. If a stoving medium has been agreed, stove under the specified conditions for the binder (medium).

Cut from the substrate a test specimen to a size, suitable to fit the exposure frame, if used, so that the dividing line between the two dispersion films is central. Cut a second test specimen and retain it in the dark at ambient temperature for later comparison with the tested specimen.

7.2 Exposure of the test specimens

7.2.1 Place the test specimen in the apparatus (5.7 or 5.8). Fasten a cover sheet (5.3) across the middle one-third of the test specimen, but in such a way that the cover cannot distort or buckle and can be removed for examination of the films and replaced in the same position.

7.2.2 Expose the test specimen to the source of light and, at suitable intervals of time, examine it by raising the cover to determine whether there is any change between the exposed and unexposed portions. Replace the cover in the same position immediately after each examination.

Continue to expose the test specimen until the contrast between the exposed and unexposed portions of the film of the agreed reference pigment is equal to grey scale 4. Assess the degree of contrast of the exposed and unexposed portions of the film of the test sample by reference to the grey scale and replace the cover.

7.2.3 Place an additional cover sheet (5.3) over the test specimen so that only one-third of the test specimen remains exposed.

Continue the exposure until the contrast between the fully exposed and the central unexposed portions of the film of the agreed reference pigment are equal to grey scale 3. Assess the degree of contrast of the fully exposed and the central unexposed portions of the film of the test sample by reference to the grey scale.

7.2.4 Compare the unexposed portion of the films of the agreed reference pigment and the test sample with a piece of the second specimen that has not been subjected to the exposure (see 7.1). A difference in appearance between the original material and the unexposed portion of the exposed specimen indicates that the material has been affected by some agent other than light, such as heat, moisture, or a reactive gas in the atmosphere. This change in appearance shall be stated in the test report.

NOTE In the case of light fastness tests carried out in natural daylight, the blue wool scale (see ISO 105-B01 and ISO 105-B02) can be used to assist evaluation.

8 Test report

The test report shall contain at least the following information:

a) the type and identification of the product tested and of the agreed reference pigment;

b) a reference to this document, i.e. ISO 787-15:2019;

c) the agreed binder used, and details of the composition and method of dispersion used;

d) whether method A or method B was used, and if method A was used, the exposure angle from the horizontal of the glass cover and of the test specimens (see 5.7); and if method B was used, details of the apparatus and of the light source (see 5.8);