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Paints and varnishes — Methods of exposure to laboratory light sources —

Part 4: Open-flame carbon-arc lamps

Peintures et vernis — Méthodes d'exposition à des sources lumineuses de laboratoire —

Partie 4: Lampes à arc au carbone

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

ISO 16474 consists of the following parts, under the general title *Paints and varnishes — Methods of exposure to laboratory light sources*:

— *Part 1: General guidance*

— *Part 2: Xenon-arc lamps*

— *Part 3: Fluorescent UV lamps*

— *Part 4: Open-flame carbon-arc lamps*

Introduction

Coatings of paints, varnishes and similar materials (subsequently referred to simply as coatings) are exposed to laboratory light sources, in order to simulate in the laboratory the ageing processes which occur during natural weathering or behind window glass.

Paints and varnishes — Methods of exposure to laboratory light sources —

Part 4: Open-flame carbon-arc lamps

1 Scope

This part of ISO 16474 specifies methods for exposing specimens to open-flame carbon-arc lamps in the presence of moisture to reproduce the weathering effects that occur when materials are exposed in actual end-use environments to daylight or to daylight filtered through window glass.

The specimens are exposed to filtered open-flame carbon-arc light under controlled conditions (temperature, humidity and/or wetting). Different types of filters are used to simulate either direct exposure to the environment or exposure through window glass.

Specimen preparation and evaluation of the results are covered in other International Standards for specific materials.

General guidance is given in ISO 16474-1.

NOTE Open-flame carbon-arc exposures for plastics are described in ISO 4892-4.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4582, *Plastics — Determination of changes in colour and variations in properties after exposure to daylight under glass, natural weathering or laboratory light sources*

ISO 4618, *Paints and varnishes — Terms and definitions*

ISO 9370, *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

ISO 16474-1, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 1: General guidance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 and the following apply.

3.1
radiant exposure
H
amount of radiant energy to which a test panel has been exposed

Note 1 to entry: Radiant exposure is given by the equation $H = \int E \cdot \mathrm{d}t$

where

H is the radiant exposure, in joules per square metre;

E is the irradiance, in watts per square metre;

t is the exposure time, in seconds

Note 2 to entry: 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.

4 Principle

4.1 Specimens of the materials to be tested are exposed to glass-filtered open-flame carbon-arc light, to heat, to relative humidity and to water (see 4.3) under controlled environmental conditions.

4.2 The exposure conditions may be varied by selection of

a) the light filter(s);

b) the temperature during light exposure;

c) the relative humidity of the chamber air during light and dark exposures, when test conditions requiring control of humidity are used;

d) the type of wetting (see 4.3);

e) the water temperature and wetting cycle;

f) the timing of the light/dark cycle.

4.3 Wetting is usually produced by spraying the test specimens with demineralised/ deionized water or by condensation of water vapour onto the surfaces of the specimens.

4.4 The procedure may include measurements of the irradiance and radiant exposure in the plane of the specimens.

4.5 It is recommended that a similar material of known performance (a control) be exposed simultaneously with the test specimens to provide a standard for comparative purposes.

4.6 Intercomparison of results obtained from the test specimens exposed in different types of apparatus should not be made unless an appropriate statistical relationship has been established between the apparatuses for the particular material to be tested.

5 Apparatus

5.1 Laboratory light source

5.1.1 General

Open-flame carbon-arc light sources typically use one, three or four pairs of carbon rods which contain a mixture of rare-earth metal salts and have a surface coating of a metal such as copper. An electric current is passed between the carbon rods which burn, giving off ultraviolet, visible and infrared radiation. The pairs of carbon rods are burned in sequence, with one pair burning at any one time. Use the carbon rods recommended by the manufacturer of the apparatus. The radiation reaching the specimens passes through glass filters. Three types of glass filter are used in practice. Tables 1 and 2

show the typical relative spectral power distribution for open-flame carbon-arc lamps with daylight and window-glass filters, respectively. When extended-UV filters are used, the relative spectral power distribution shall meet the requirements of Table 3.

NOTE Solar spectral irradiance for a number of different atmospheric conditions is described in CIE No. 85. The benchmark daylight used in this part of ISO 16474 is that defined in CIE No. 85:1989, Table 4.

5.1.2 Spectral irradiance of open-flame carbon-arc lamps with daylight filters (Type 1)

The data in Table 1 are typical of an open-flame carbon-arc lamp with glass filters used to simulate daylight (see CIE No. 85:1989, Table 4).

5.1.3 Spectral irradiance of open-flame carbon-arc lamps with window glass filters (Type 2)

The data in Table 2 are typical of an open-flame carbon-arc lamp with window-glass filters.

5.1.4 Spectral irradiance of open-flame carbon-arc lamps with extended-UV filters (Type 3)

The data in Table 3 are typical of an open-flame carbon-arc lamp with extended-UV filters. A typical example of a suitable type 3 filter is that commonly known as Corex 7058[1)].

Table 1 — Typical ultraviolet spectral power distribution for open-flame carbon-arc lamps with daylight filters (type 1)[a,b]

Spectral passband	Typical distribution for open-flame carbon-arc lamp with daylight filters[c]	CIE No. 85:1989, Table 4[d,e]
(λ = wavelength in nm)	%	%
$\lambda < 290$	0,05	
$290 \leq \lambda \leq 320$	2,9	5,4
$320 < \lambda \leq 360$	20,5	38,2
$360 < \lambda \leq 400$	76,6	56,4

[a] This table gives the irradiance in the given passband, expressed as a percentage of the total irradiance between 290 nm and 400 nm. To determine the relative spectral power distribution of an open-flame carbon-arc lamp through a specific daylight filter or set of filters, the spectral power distribution shall be measured from 250 nm to 400 nm. Typically, this is done in 2 nm increments. The total irradiance in each passband is then summed and divided by the total irradiance between 290 nm and 400 nm.

[b] The table gives typical data for an open-flame carbon-arc lamp with borosilicate-glass daylight filters. There is currently not enough data available to develop a specification for the open-flame carbon-arc lamp with a daylight filter.

[c] For any individual spectral power distribution, the calculated percentages for the passbands in this table will sum to 100 %.

[d] The data from CIE No. 85:1989, Table 4, is the global solar irradiance on a horizontal surface for an air mass of 1,0, an ozone column of 0,34 cm at STP, 1,42 cm of precipitable water vapour and a spectral optical depth of aerosol extinction of 0,1 at 500 nm. These data are provided for comparison purposes only.

[e] For the solar spectrum represented by CIE No. 85:1989, Table 4, the UV irradiance (290 nm to 400 nm) is 11 % and the visible irradiance (400 nm to 800 nm) is 89 %, expressed as a percentage of the total irradiance between 290 nm to 800 nm.

1) Corex 7058 is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 16474 and does not constitute an endorsement by ISO of this product.