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Aerospace series - Test methods for transparent materials for aircraft glazing - Part 5: Determination of visible light transmission

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Luft- und Raumfahrt - Prüfverfahren für transparente Werkstoffe zur Verglasung von Luftfahrzeugen - Teil 5: Messung des Lichttransmissionsgrades im sichtbaren Bereich

Série aérospatiale - Méthodes d'essais pour matériaux transparents pour vitrages aéronautiques - Partie 5: Mesure de la transmission originale dans le visible

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English version

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This European Standard was accepted by CEN on 1988-03-17. CEN members are bound to comply with the requirements of CEN Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to CEN Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat : Rue Bréderode 2, B—1000 Bruxelles

Brief history

This European Standard has been prepared by the European Association of Aerospace Manufacturers (AECMA).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has successively received the approval of the National Associations and the Official Services of the member countries of AECMA, prior to its presentation to CEN.

According to the Common CEN/CENELEC Rules, following countries are bound to implement this European Standard : Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope and field of application

This standard specifies the determination of visible light transmission for transparent materials by using a photometer employing a defined light source and a photocell matched to the response of the human eye.

Because the materials under test are basically colourless, certain deviations from ideal conditions, indicated in the test, are allowable.

2 Definitions

Visible light transmission is defined as the intensity of an emerging beam of light compared with that of the incident parallel beam falling upon the specimen under examination.

3 Apparatus

The apparatus shall consist of a hazemeter, constructed essentially as shown in figure 1 or figure 2. It consists of a stabilised light source and associated optical system, specimen holder and photometer all rigidly mounted on a convenient optical bench. The distance of the photometer from the illuminated area of the specimen shall not be less than 250 mm in order to avoid spurious signals from scattered light.

3.1 Light source

3.1.1 The light source is a tungsten filament lamp operated at a colour temperature of (2855 ± 285) K. This will be attained by using a gas filled tungsten filament lamp operating at its rated voltage.

3.1.2 The power supply to this lamp shall be stabilized. The short term change in voltage output shall not be more than ± 0,1%.

3.1.3 The light source is combined with an optical system to produce a parallel light beam of area at least 1 cm^2.

3.2 Photometer

This shall be a suitable photocell fitted with diffusion screen or integrating sphere.

3.2.1 The spectral response of the photocell shall be corrected to approximate that of the human eye. For practical purposes this correction may be limited to ensuring that no substantial response exists beyond the visible band. A selenium/iron photocell with a green filter is satisfactory for this purpose.

3.2.2 The output response of the photocell shall be linear within ± 0,5%.

3.2.3 The output of the photocell shall be read on a suitable measuring instrument of ± 0,5% accuracy.

3.2.4 The photocell shall be fitted with a diffusion screen and both shall be of adequate dimensions to completely cover the parallel light beam produced by the light source.

3.3 Specimen holder

The specimen holder shall be such as to hold the specimen rigidly in a plane normal to the light beam.

3.4 Use of integrating sphere

It may be convenient to use a photometric integrating sphere in place of the photometer described in 3.2. In which case the apparatus may be constructed essentially as shown in figure 1 or figure 2.

3.4.1 Integrating sphere

An integrating sphere is used to collect transmitted flux. The sphere may be of any diameter so long as the total port area does not exceed 4% of the internal reflecting area of the sphere.

The entrance and exit ports shall be centred on the same great circle of the sphere and there shall be at least 170° of arc between centres. The exit port shall subtend an angle of 8° at the centre of the entrance port. The axis of the irradiating beam shall pass through the centres of the entrance and exit ports.

The photocell or photocells shall be positioned on the sphere (90 ± 10)° from the entrance port. In the pivotable model, figure 2, which is designed to use the interior sphere wall adjacent to the exit port as the reflectance standard, the angle of rotation shall not exceed 10°.

3.4.2 Light beam

The specimen shall be illuminated by a substantially unidirectional beam ; the maximum angle which any ray of this beam makes with the direction of its axis shall not exceed 3°. The beam shall not be vignetted at either port of the sphere.

When the beam is unobstructed by a specimen, its cross section at the exit port shall be approximately circular, sharply defined and concentric within the exit port, leaving an annulus of (1,3 ± 0,1)° subtended at the entrance port. When the specimen is placed immediately against the integrating sphere at the entrance port, the angle between the normal to its surface and the axis of the beam shall not exceed 8°.

3.4.3 Reflecting surfaces

The surfaces of the interior of the integrating sphere, baffles and reflectance standards shall be of substantially equal reflectance,matt and highly reflecting throughout the visible wave lenghts (freshly smoked magnesium oxide is excellent for this purpose but highly reflecting matt sphere paints are more durable).

3.4.4 Light trap

For some measurements the standard at the exit port is replaced by a light trap by actual removal of the reflectance standard or by pivoting the sphere (see figure 2). The light trap shall absorb the beam completely when no specimen is present.

Due to the absorbing annulus surrounding the unimpeded beam at the exit port, this trap will absorb slightly more than the undeviated portion of the total flux transmitted by the specimen.

3.4.5 Photoelectric cell

The radiant flux within the sphere shall be measured by a photoelectric cell, the output measurements of which shall be proportional within 1% to the incident flux over the range of intensity used. Spectral conditions for source and receiver shall be constant throughout the test of each specimen.

The design of the instrument shall be such that there shall be a zero reading when the sphere is dark. The spectral response of the photocell shall be corrected to approximate that of the human eye.

3.4.6 Clauses 3.2.1, 3.2.2 and 3.2.3 apply to the photocell used in conjunction with the integrating sphere.

4 Specimens

Specimens shall be cut from sheets with the surfaces substantially flat and parallel.

5 Procedure

5.1 The specimen shall be cleaned with soapy water on both surfaces before measurements are made.

5.2 The apparatus is allowed sufficient time to reach thermal equilibrium before the measurements are made.

5.3 The measurements shall be made with the light beam normal to the surface of the specimen and the average taken from three independent measurements on the one specimen.

5.4 A first reading (a) of the photometer output shall be made with the specimen outside of the beam.

5.5 A second reading (b) shall be made with the specimen interposed between the light source and photometer (specimen-photometer distance at least 250 mm).

5.6 The thickness of the specimen shall be measured in three places to an accuracy of 0,02 mm.

6 Expression of results

The percentage of visible light transmission is calculated from the formula :

$$\% \text{ visible light transmission} = \frac{b}{a} 100$$

7 Test report

The test report shall include the following :

7.1 The percentage of visible light transmission as the average of three calculated results,

7.2 The thickness of the specimen as the arithmetic average of the three measurements.