

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 877

PLASTICS

DETERMINATION OF RESISTANCE OF PLASTICS

TO COLOUR CHANGE

UPON EXPOSURE TO DAYLIGHT

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 877, *Plastics – Determination of resistance of plastics to colour change upon exposure to daylight*, was drawn up by Technical Committee ISO/TC 61, *Plastics*, the Secretariat of which is held by the United States of America Standards Institute (USASI).

Work on this question led, in 1963, to the adoption of a Draft ISO Recommendation.

In August 1964, this Draft ISO Recommendation (No. 757) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Argentina	Hungary	Romania
Austria	India	South Africa, Rep. of
Belgium	Israel	Switzerland
Canada	Japan	Turkey
Czechoslovakia	Korea, Rep. of	U.A.R.
Finland	Netherlands	United Kingdom
France	New Zealand	U.S.A.
Germany	Poland	U.S.S.R.

Two Member Bodies opposed the approval of the Draft :

Italy
Sweden

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in December 1968, to accept it as an ISO RECOMMENDATION.

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PLASTICS

**DETERMINATION OF RESISTANCE OF PLASTICS
TO COLOUR CHANGE
UPON EXPOSURE TO DAYLIGHT**

1. SCOPE

This ISO Recommendation describes a procedure for assessing the resistance of plastics to colour change upon exposure to daylight, under glass.

2. PRINCIPLE OF METHOD

- 2.1 Test specimens of the plastics material to be tested are exposed to light, together with pieces of the dyed wool standards specified in ISO Recommendation R 105/1, *Tests for colour fastness of textiles (First series)*, Part 11 : "Colour fastness to light : Daylight". These standards vary in colour fastness to light, No. 8 being the most stable and No. 1 the least stable.

After specified exposure, the degree of contrast between exposed and unexposed portions of the test specimens is compared with that of the dyed wool standards, and the fastness rating obtained from the rating of the standard which shows a degree of contrast similar to that of the test specimen.

Provision is also made in this ISO Recommendation for the use of other standards and other means of measurement. Related methods are described in the following ISO Recommendations :

ISO Recommendation R 878, *Determination of resistance of plastics to colour change upon exposure to light of the enclosed carbon arc;*

ISO Recommendation R 879, *Determination of resistance of plastics to colour change upon exposure to light of a xenon lamp.*

- 2.2 The quality and intensity of solar radiation at the earth's surface vary with climate, location and time. The use of the dyed wool standards minimizes the effects of these variations on fastness ratings, but when plastics materials are to be compared it is preferable to expose them at the same time and place, under conditions approximating to those expected in service. While radiation may affect other properties of plastics, this method pertains only to its effect on colour.

3. APPARATUS**3.1 Exposure case**

The exposure case consists essentially of an open-bottomed box, covered with a framed lid of glass and containing a removable rectangular rack for carrying the test specimens and the wool standards. The rack rests upon a supporting screen made of wire cloth. Ventilating holes, 20 mm (0.75 in) in diameter, are provided in the upper side of the exposure case, their centres being approximately 75 mm (3 in) apart and 13 mm (0.5 in) above the upper surface of the battens. These holes are covered with wire mesh.

Suitable dimensions for the apparatus are given in Figure 1 (page 10) and Figure 2 (page 11).

The exposure case should be situated in the open and facing south in the northern hemisphere, north in the southern hemisphere. It should be so supported on legs that its lower front edge is 760 mm (30 in) from the ground. The lid, rack and screen should all be inclined at 45° to the horizontal.

The exposure case should be so placed that no obstruction in an easterly, southerly or westerly direction (in the northern hemisphere), or in an easterly, northerly or westerly direction (in the southern hemisphere) subtends an angle of more than 20° with the horizontal at the centre of the case. No obstruction in a northerly direction (in the northern hemisphere) or in a southerly direction (in the southern hemisphere) should subtend an angle of more than 70° with the horizontal at the centre of the case.

3.1.1 Lid. The lid (see Fig. 1) of the exposure case consists of a framed sheet of good-quality flat glass 3 mm thick, uniformly transparent and without defects, and having a transmittance of less than 1 % below 300 nm and at least 90 % from 370 to 380 nm and in the visible region of the spectrum. It has an unobstructed free area with length and width at least 90 mm (3.5 in) greater than the corresponding dimensions of the space occupied by the test specimens. When in position, its lower surface is 75 mm (3 in) from the upper surface of the rack; the lid fits snugly and symmetrically into the case.

3.1.2 Rack. The removable rack consists of horizontal wooden battens attached at each end to side frames, as shown in Figure 1. The battens are so arranged that there is an air-space 50 mm (2 in) wide between them.

A series of 38 mm (1.5 in) wide wooden flaps are so hinged to the battens that the lower 38 mm (1.5 in) strip of each batten may be covered. The hinges are so arranged that

- (a) when each flap is held parallel to the batten, there is a space of 3.0 mm (0.12 in) between flap and batten, and
- (b) when each flap is allowed to fall freely, its lower edge rests upon the batten.

Removable opaque cover strips are provided so that portions of the test specimens can be protected from light at different stages of exposure, in accordance with clause 5.4. Cover strips, when in place, should be in close contact with the test specimens.

The rack fits snugly into the exposure case. When in position, the lower surface of the rack rests immediately on the upper surface of the wire screen.

3.1.3 Wire screen. The screen is made from woven wire cloth with mesh aperture about 0.16 mm (0.0063 in). The wire cloth is supported on a rectangular frame (removable for cleaning), incorporating narrow cross supports if required. The wire cloth is fixed to the upper side of the frame so that an area approximately equal to that of the glass lid is free from obstruction, except for the cross supports. The frame fits snugly into the exposure case.

3.2 Standards

Blue dyed wool standards No. 1 to No. 8, as specified in ISO Recommendation R 105/1, Part 11, clause 3.1.1.* (See Appendix, section Z.1, of this ISO Recommendation).

3.3 Grey scale

Grey scale for assessing change of colour, as specified in ISO Recommendation R 105/1, Part 2.* (See Appendix, section Z.2, of this ISO Recommendation). In this scale, Grade 1 corresponds to the greatest degree of contrast, and Grade 5 to zero contrast (two patterns of identical colour).

* See ISO Recommendation R 105/1, *Tests for colour fastness of textiles (First series)* :
 Part 2 : "Grey scale for assessing change in colour",
 Part 11 : "Colour fastness to light : Daylight".

4. TEST SPECIMEN

- 4.1 The test specimen may conveniently be approximately 115 mm (4.5 in) in length and 20 mm (0.8 in) or more in width.

For film and sheet, the test specimen is cut to size and is of the thickness of the film or sheet.

For moulding materials, a moulded sheet of thickness 3 ± 0.15 mm is prepared and the test specimen cut from this, unless other methods of preparation or other thicknesses are prescribed in the specification for the material.

For materials which may shrink in one direction during the test, the test specimen should be cut with its long dimension at right angles to this direction, since a change in the length of the test specimen may displace the limiting line between exposed and unexposed parts and thus diminish the sharpness of contrast.

- 4.2 One test specimen is used. More may be required for materials which are not of a uniform colour. A further control specimen (or specimens) is required for comparison.

5. PROCEDURE

- 5.1 Test specimens are fixed at the top and bottom on the rack so that the upper 38 mm (1.5 in) are covered by the flap, the next 38 mm (1.5 in) are freely exposed, and the remaining 25 mm (1 in) rest on the next lower batten. Each test specimen is placed neither less than 6 mm (0.25 in) from any other test specimen nor within 6 mm (0.25 in) of the end of the spaces between the battens, to permit free air circulation around the test specimen.

- 5.2 The dyed wool standards are exposed on the same rack, mounted in a similar manner to the test specimens. If desired, the portions of the test specimens and of the dyed wool standards which rest on the lower support may be covered by an opaque cover throughout the test. This gives an unexposed area adjacent to the area of maximum exposure, for comparison.
The glass lid should be kept clean during the test.

- 5.3 **Preliminary assessment of colour fastness.** The test specimens and the dyed wool standards, mounted as described in clauses 5.1 and 5.2, are exposed simultaneously for 24 hours per day. The *standards* are inspected frequently, and when a change in standard 3 can just be perceived, the *test specimens* are inspected and their colour fastness rated by comparing any change in colour (see Note below) with the changes in standards 1, 2 and 3.

The preliminary colour fastness rating is the number of the standard which shows a visual contrast between exposed and unexposed portions similar to that of the test specimen. If the change in colour of the test specimen is less than the change in standard 3, no preliminary assessment for it is recorded.

NOTE. — The term *change in colour* includes not only true fading, i.e. destruction of colouring matter, but also changes in hue, depth, brightness, or any combination of these characteristics.

- 5.4 Exposure is then continued as before, until a change in standard 4 can just be perceived. At this point, the first opaque cover strip is fixed in position as shown in Figure 5 (page 14), so that one-third of the exposed portions of the test specimens and standards is protected from the light.

Exposure is continued until a change in standard 6 can just be perceived. Then a second opaque cover strip is fixed as shown in Figure 5, so that an additional one-third of the originally exposed portions of the test specimens and standards is also protected from the light.

Exposure is continued until either

- (a) a contrast is produced in standard 7 equal to that of Grade 4 of the grey scale, or
- (b) a contrast equal to that of Grade 3 of the grey scale has been produced on the most resistant test specimen,

whichever occurs first.

NOTE. — If desired, when testing very resistant specimens, exposure may be continued until a contrast is produced in standard 8 equal to that of Grade 4 of the grey scale. If this procedure is used, the fact should be stated in the test report.

- 5.5 **Final assessment of colour fastness.** After the prescribed exposure, the test specimens and dyed wool standards are removed. The test specimens are cleaned with soap and cold water if necessary, dried and examined indoors, in a good north light*, against a white background in comparison with the dyed wool standards.

The change in colour of the test specimen (see Note of clause 5.3) is compared with the changes which have occurred in the dyed wool standards. The rating of the colour fastness to daylight of the material under test is the number of the standard which shows a similar visual contrast between exposed and unexposed parts. Test specimens which have not changed in colour when standard 7 shows a change equal to Grade 4 of the grey scale are given a rating of 8.

If the test specimen shows a change approximately half-way between two standards, an appropriate half-rating may be given. For example, a light fastness of 3 to 4 means that the test specimen is not as fast as standard 4, but faster than standard 3.

If different assessments are obtained from the areas which have been given different degrees of exposure, the light fastness is the arithmetic mean of these assessments, to the nearest half-rating.

- 5.6 **Colour fastness rating of test specimen.** If the final assessment of colour fastness, according to clause 5.5, is 4 or higher, and a preliminary assessment in accordance with clause 5.3 has been recorded, the preliminary assessment is reported in brackets. For example, a rating of 6 (3) indicates that the test specimen has changed slightly in the test when standard 3 begins to change, but that on continuing exposure the resistance to light is equal to that of standard 6.

- 5.7 **Evaluation and expression of results if operating at one stage only.** It is more expedient and often sufficient, for commercial transactions, to compare the test specimen and standards at only one stage of colour change of the test specimens.

The buyer and seller may then decide to discontinue the test in accordance with one of the two following criteria :

- (a) when *one of the wool standards 3, 4 or 6, chosen in advance*, shows between the exposed and unexposed portions a contrast equal to Grade 4 of the grey scale; or
- (b) when *the test specimen* shows between the exposed and unexposed portions a contrast equal to that of a grade of the grey scale selected in advance.

In this case, the test is begun as indicated in clauses 5.1 and 5.2. Then the exposure is continued until either of the conditions (a) or (b) occurs, according to agreement.

The assessment of colour fastness is then made as indicated in clause 5.5. The value is given under the name

- colour fastness at contrast 4 of the *chosen standard*, if the test has been discontinued in accordance with criterion (a), or
- colour fastness at the chosen contrast of the *test specimen*, if the test has been discontinued in accordance with criterion (b).

* See ISO Recommendation R 105/1, *Tests for colour fastness of textiles (First series)* :
Part 1 : "General principles of testing", section 12.

- 5.8 **Variation in appearance.** Besides the assessments of colour fastness described in clauses 5.6 and 5.7, note whether there has been any change in depth, hue, gloss or transparency, such as : variation in depth (lighter or darker); variation in hue (e.g. reddening or yellowing); variation in gloss (more matt or more glossy); or, for transparent or translucent bodies, variation in transparency (more transparent or more opaque).

Furthermore, note whether defects have appeared on the surface (e.g. marbled appearance, exudation, efflorescence, cracking, etc.).

- 5.9 Other types of standards and other methods of assessment may be used by agreement between buyer and seller.

6. TEST REPORT

The test report should include the following :

- (a) the complete identification of the material tested;
- (b) the location of the exposure site;
- (c) the dates of exposure;
- (d) the colour fastness to daylight and the assessment procedure used (indicate clause number of the assessment procedure);
- (e) any changes in appearance in accordance with clause 5.8;
- (f) any variation from the specified procedure.

Dimensions in millimetres with inch equivalents in parentheses

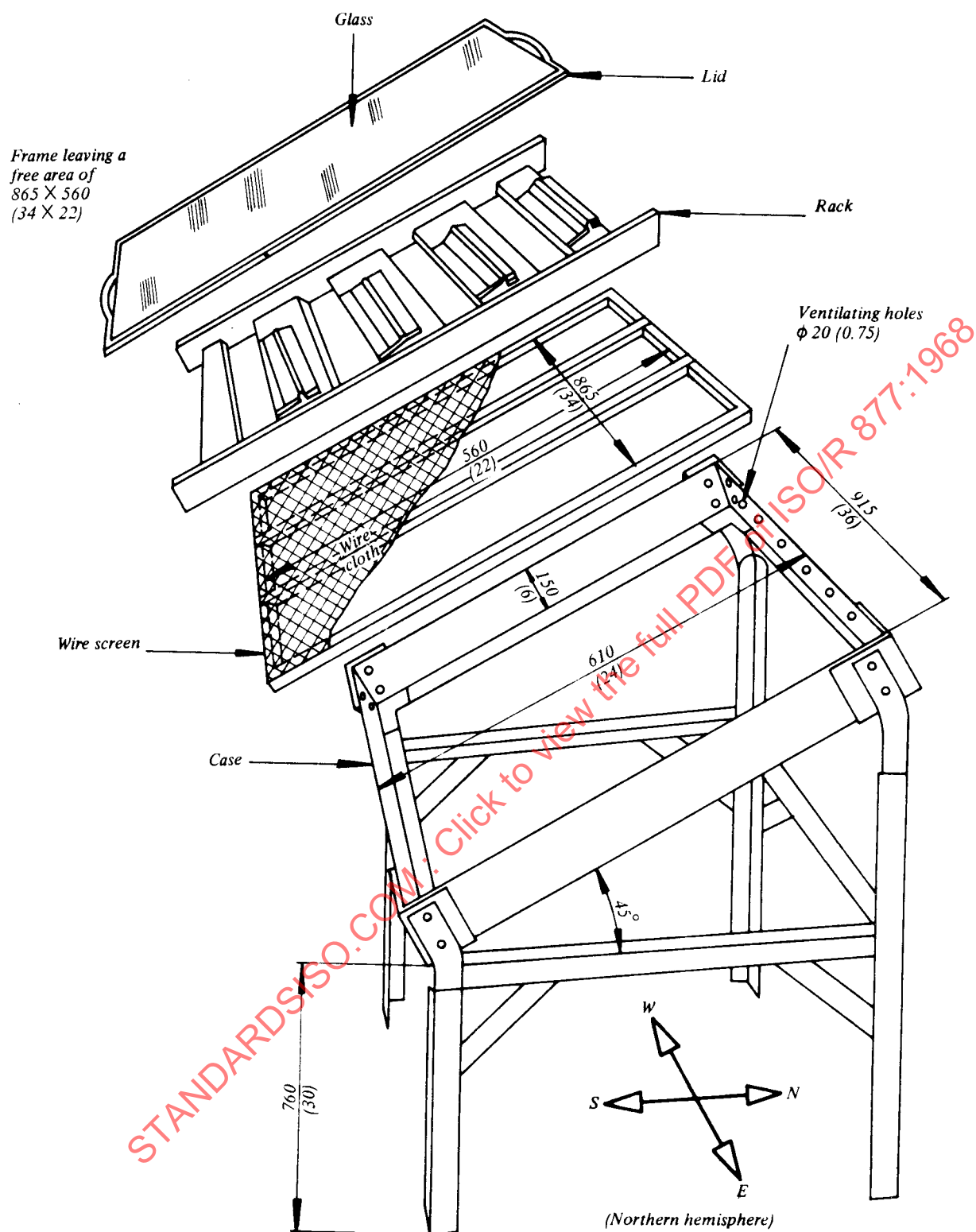
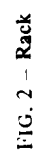


FIG. 1 – Exposure case



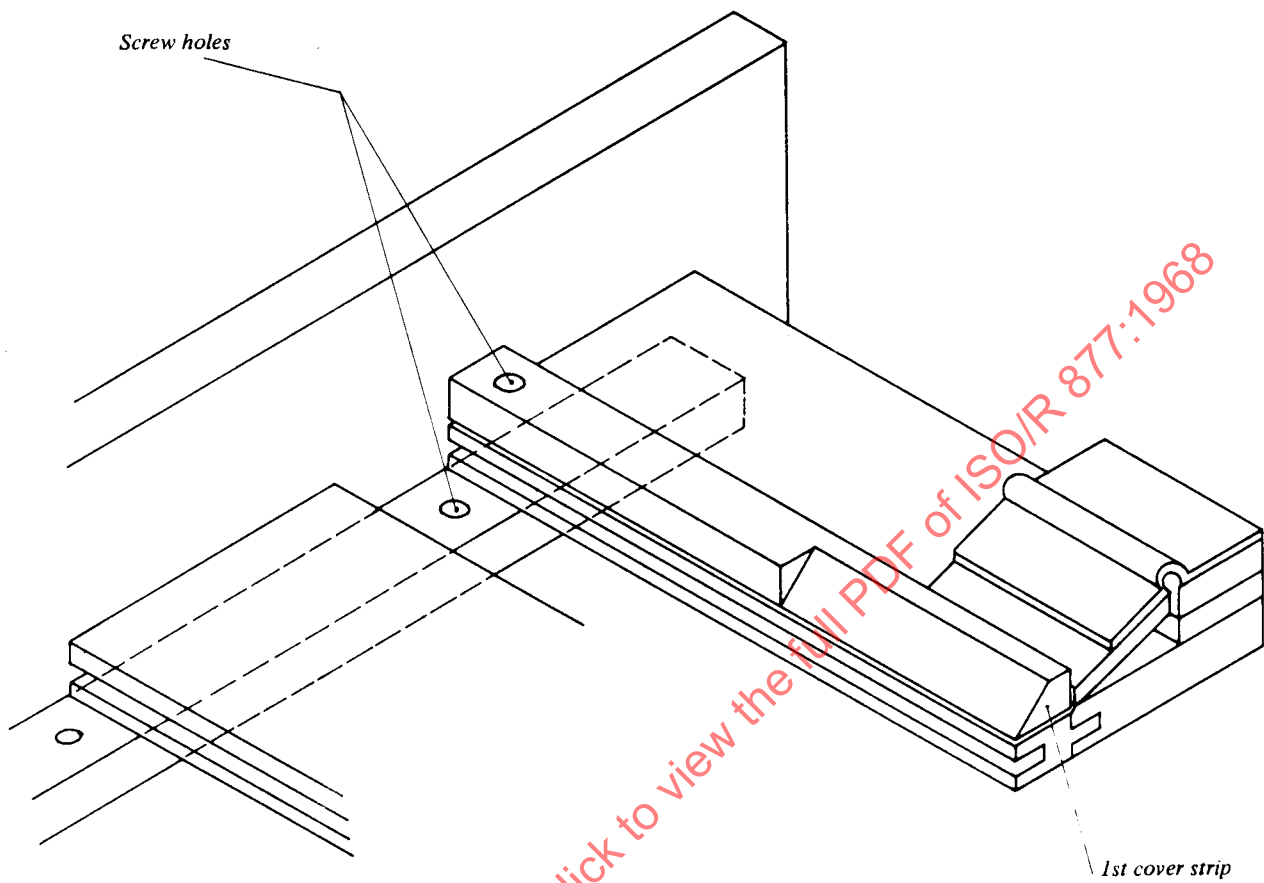


FIG. 3 - Positioning of first cover strip