

Methods of testing vulcanized rubber —

Part A54: Methods for exposure to artificial light, for use in determining resistance to weathering

[ISO title: Rubber, vulcanized — Resistance to weathering —
Part 3: Methods of exposure to artificial light]

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Committees responsible for this British Standard

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- British Railways Board
- British Rubber Manufacturers' Association
- ERA Technology Ltd.
- GAMBICA (BEAMA Ltd.)
- Institution of Mechanical Engineers
- Institution of Water Engineers and Scientists
- Malaysian Rubber Producers' Research Association
- Ministry of Defence
- National College of Rubber Technology
- Rapra Technology
- SATRA Footwear Technology Centre

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National foreword

This Part of BS 903 has been prepared under the direction of the Rubber Standards Committee. It is identical with ISO 4665-3:1987 “*Rubber, vulcanized — Resistance to weathering — Part 3: Methods of exposure to artificial light*”, published by the International Organization for Standardization (ISO).

Terminology and conventions. The text of the International Standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Whenever the words “part of ISO 4665” appear, referring to this Part of this standard, they should be read as “Part of BS 903”.

Cross-references

International Standard	Corresponding British Standard
	BS 1006:1978 <i>Methods of test for colour fastness of textiles and leather</i>
ISO 105-A02:1984	Section A02 <i>Grey scale for assessing change in colour</i> (Technically equivalent)
ISO 105-B01:1984	Section B01 <i>Blue wool standards</i> (Technically equivalent)
	BS 903 <i>Methods of testing vulcanized rubbers</i>
ISO 1826:1981	Part A19:1986 <i>Heat resistance and accelerated ageing tests</i> (National appendix A is technically equivalent)
ISO 4661:1986	Part A36:1988 <i>Preparation of test pieces</i> (Identical)
ISO 4665-1:1985	Part A55:1988 <i>Method for assessment of changes in properties after exposure to natural weathering or artificial light, for use in determining resistance to weathering</i> (Identical)
ISO 4665-2:1985	Part A53:1988 <i>Methods for exposure to natural weathering, for use in determining resistance to weathering</i> (Identical)

Additional information. A suitable physical standard for the determination of radiation dosage (see 4.7.2) uses polysulphone film and is described in BS 2782-5 “*Optical and colour properties, weathering*” Method 540C “*Polysulphone film light exposure dosimeter*”.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

The effects of light on the colour and other properties of rubbers is of considerable technical and commercial importance. Methods of exposing rubbers to natural light are dealt with in part 2 of this International Standard.

Testing with laboratory light sources usually has one of the following purposes:

- a) to obtain results by accelerated testing under controlled conditions to indicate behaviour which would be given by prolonged exposure to natural daylight;
- b) for control tests on a material of known light resistance to establish that the level of quality of different batches does not vary from a known acceptable control.

NOTE Guidance concerning the problems of correlation between the effects of exposure to artificial light sources and those obtained after exposure to natural light is given in Annex A.

For some specific applications, it may be possible to use certain fluorescent lamps as light sources. However, there is at present insufficient information on the reliability and repeatability of the results from such exposures to warrant inclusion of this type of apparatus in this part of ISO 4665. Investigations into these matters are being undertaken and it is hoped that, as a result, fluorescent lamp light sources may be incorporated at a future revision. Notes giving some existing information on fluorescent lamps and their possible use are given in Annex D which may assist interested parties in making their own investigations into the use of such devices.

1 Scope and field of application

This part of ISO 4665 specifies methods of exposing vulcanized rubbers to an artificial light source in order to assess changes produced by such exposure.

Of the different light sources available, the xenon arc is advantageous in that it can, when correctly filtered and maintained, yield a spectrum most closely approximating to that of daylight. Hence, this part of ISO 4665 is confined to this light source.

This part of ISO 4665 also specifies means of determining radiation dosage.

NOTE 1 For the method of determination of changes in properties after exposure, see ISO 4665-1.

NOTE 2 Tests described in this part of ISO 4665 are usually carried out in the absence of any stress applied to the test pieces. A stress or strain may, however, be applied by agreement between the interested parties, provided that its use is fully reported.

2 References

ISO 105, *Textiles — Tests for colour fastness — Section A02: Grey scale for assessing change in colour; — Section B01: Colour fastness to light: Daylight*.

ISO 1826, *Rubber, vulcanized — Time-interval between vulcanization and testing — Specification*.

ISO 4661-1, *Rubber, vulcanized — Preparation of samples and test pieces — Part 1: Physical tests*.

ISO 4665, *Rubber, vulcanized — Resistance to weathering — Part 1: Assessment of changes in properties after exposure to natural weathering or artificial light — Part 2: Methods of exposure to natural weathering*.

3 Principle

Test pieces are exposed to the light source together with means of assessing the light dosage. These means may comprise one or more of the following:

- a) physical standards which change in colour or other well-defined properties upon exposure to light, the degree of change indicating the light dosage;
- b) instrumental means of measuring irradiance and/or integrating this to give the light dosage over a period of time.

For indication of behaviour that might be found under natural daylight, changes in the test pieces are determined at each of a number of light exposure stages, to give a sufficiently full picture of the performance throughout exposure. This method is also used, with interpolation if necessary, to find the amount of exposure needed to produce a specified change in the material.

For control tests, a suitable exposure stage is selected in advance from a knowledge of the expected light resistance of the material and the change in the test piece is evaluated at this stage only. Alternatively, the exposure stage may be determined at which a defined change in the properties of the exposed test pieces occurs.

4 Apparatus

4.1 Laboratory light sources

4.1.1 General

To improve the correlation between results of exposures to laboratory light sources and natural light, it is necessary that the spectrum of the laboratory light source be as near as possible to that of the natural light, particularly in the ultra-violet region, because some rubbers are very sensitive to the spectral distribution of the radiation. However, the intensity of the radiation will generally be higher than that of natural sunlight because of the need to accelerate the degradation processes in laboratory tests, even though correlation with the natural exposure condition may be weakened (see Annex A).

Recommendations for the integrated irradiance and spectral distribution of simulated solar radiation for test purposes in the laboratory are given in CIE Publication No. 20 (TC-22), 1972¹⁾. The recommendation for the integrated irradiance for testing the deterioration resistance of materials and equipment exposed to natural radiation is $1\,000 \pm 100 \text{ W/m}^2$.

The spectral distribution described in CIE Publication No. 20 (TC-22), 1972, is reproduced in Annex C.

NOTE For various reasons it is not practicable to reproduce this radiation level exactly in either spectral distribution or intensity with presently available apparatus.

4.1.2 Xenon arc lamp

The xenon arc lamp emits radiation in a range which extends from below 270 nm in the ultra-violet through the visible spectrum and into the infra-red. For exposure tests, light from the lamp is filtered to reduce shorter wavelength emissions and also to remove as much of the infra-red as possible, so that radiation reaching test pieces exposed to it has a spectral power distribution that closely matches sunlight. The facility may also be available to reduce short wavelength energy further so that an alternative spectrum, similar to that of solar radiation as received behind window glass, may be obtained. These two modes of operation are often available on the same equipment, using different filter systems.

The irradiance at the test piece face in the wavelength range 300 to 890 nm shall normally be $1\,000 \pm 200 \text{ W/m}^2$. If, exceptionally, other intensities are used, these shall be stated in the test report. Irradiance below 300 nm shall not exceed 1 W/m^2 . The irradiance shall not vary by more than $\pm 10 \%$ over the whole test piece area.

The characteristics of xenon arcs and filters are subject to changes in use due to ageing and these items shall be replaced at appropriate intervals. Further, they are subject to changes due to the accumulation of dirt and they shall be cleaned at appropriate intervals.

4.2 Test enclosure

WARNING — Care shall be taken to protect laboratory staff from the effects of ozone.

The enclosure contains a cylindrical frame carrying test piece holders, with provision for passing air over the test pieces for control of temperature. Accumulation of any ozone generated by the lamps shall be prevented either by venting the air to the outside of the building or by other appropriate means.

The lamp shall be so placed that the amount of radiation received by the test pieces does not vary by more than $\pm 10 \%$ over the entire area in which the test pieces are exposed.

To reduce the effect of any eccentricity in the lamp, or when more than one lamp is used in a single enclosure to increase the amount of radiation, the radiation distribution shall be improved by rotating the frame carrying the test pieces around the light source and, if necessary, by periodically changing the position of each test piece vertically.

The test piece holders may rotate on their own axes as well as rotating with the frame, thus exposing to the direct radiation of the light source the side of the test piece holder that was previously in the dark. This method helps to maintain a low black panel temperature on the test piece. Alternatively, dark cycles may be produced by cycling the source on and off. If either of these cycles is used, it shall be fully reported.

4.3 Black panel thermometer, to indicate the test temperature, consisting of a blackened absorbing metal plate that approximates the absorption characteristics of a “black body”. The plate shall be at least 1 mm thick and of a size to fit the test piece holders. The temperature of the plate is indicated by a suitable thermometer or thermocouple making good thermal contact.

¹⁾ Published by the International Commission on Illumination, Bureau Central, 52, boulevard Malesherbes, F-75008 PARIS, France.