

Plastics — Determination of time-temperature limits after prolonged exposure to heat

IMPORTANT NOTE. Before reading this method it is essential to read BS 2782-0, Introduction, issued separately.

The European Standard EN ISO 2578:1998 has the status of a British Standard

ICS 83.080.01

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Plastics and Rubber Standards Policy Committee (PRM/-) to Technical Committee PRM/21, upon which the following bodies were represented:

- British Plastics Federation
- British Textile Confederation
- Department of the Environment (Building Research Establishment)
- Department of Trade and Industry (National Physical Laboratory)
- Electrical and Electronic Insulation Association (BEAMA Ltd.)
- GAMBICA (BEAMA Ltd.)
- Institute of Materials
- Ministry of Defence
- Packaging and Industrial Films Association
- Pira International
- RAPRA Technology Ltd.

This British Standard, having been prepared under the direction of the Plastics and Rubber Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 December 1993

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The following BSI references relate to the work on this standard:
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National foreword

This British Standard is the English language version of EN ISO 2578:1998

Cross-references

International Standard	Corresponding British Standard
ISO 291:1977	BS 2782: <i>Methods of testing plastics</i> Part 0:1992: <i>Introduction</i> (Annex A is identical)

The terms “temperature index” and “relative temperature index” used in this standard should not be confused with temperature indices used in flammability tests.

WARNING NOTE. This British Standard, which is identical with EN ISO 2578, does not necessarily detail all the precautions necessary to meet the requirements of the Health and Safety at Work etc. Act 1974. Attention should be paid to any appropriate safety precautions and the method should be operated only by trained personnel.

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, the EN ISO title page, pages 2 to 18, 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.

English version

Plastics — Determination of time-temperature limits after prolonged exposure to heat

(ISO 2578:1993)

Plastiques — Détermination des limites
temps-températures après exposition à l'action
prolongée de la chaleur
(ISO 2578:1993)

Kunststoffe — Bestimmung der
Temperatur-Zeit-grenzen bei langanhaltender
Wärmeeinwirkung
(ISO 2578:1993)

This European Standard was approved by CEN on 12 June 1998.

CEN members are bound to comply with the CEN/CENELEC 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 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 the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

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

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

The text of the International Standard from Technical Committee ISO/TC 61, Plastics, of the International Organization for Standardization (ISO) has been taken over as a European Standard by Technical Committee CEN/TC 249, Plastics, the secretariat of which is held by IBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 1999, and conflicting national standards shall be withdrawn at the latest by February 1999.

According to CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 2578:1993 has been approved by CEN as a European Standard without any modification.

NOTE Normative references to International Standards are listed in Annex ZA (normative).

Introduction

During the preparation of this International Standard, account was taken of the contents of IEC 216. Accordingly, the terms and definitions in this International Standard, as well as the procedures described, are in line or identical with those specified in IEC 216.

1 Scope

1.1 This International Standard specifies the principles and procedures for evaluating the thermal endurance properties of plastics exposed to elevated temperature for long periods.

1.2 The term thermal endurance is used here to refer to tests made in air, excluding any other influence or stress applied to the test specimens. Thermal endurance properties evaluated in different environments and/or with different stresses applied to the test specimens require different test procedures.

1.3 In this International Standard, the study of the thermal ageing of plastics is based solely on the change in certain properties resulting from a period of exposure to elevated temperature. The properties studied are always measured after the temperature has returned to ambient.

The various properties of plastics change at various rates on thermal ageing. To enable comparisons to be made of the thermal ageing of different plastics, the criteria for judgement depend on the type of property to be studied and its acceptable limiting value.

1.4 In the application of this standard it is assumed that a practically linear relationship exists between the logarithm of the time required to cause the predetermined property change and the reciprocal of the corresponding absolute temperature (Arrhenius Law).

For the plastics tested, no transition, in particular a first-order transition, should occur in the temperature range under study.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing*.

IEC 216-1:1990, *Guide for the determination of thermal endurance properties of electrical insulating materials — Part 1: General guidelines for ageing procedures and evaluation of test results*.

IEC 216-2:1990, *Guide for the determination of thermal endurance properties of electrical insulating materials — Part 2: Choice of the test criteria*.

IEC 216-3-1:1990, *Guide for the determination of thermal endurance properties of electrical insulating materials — Part 3: Instructions for calculating thermal endurance characteristics — Section 1: Calculations using mean values of normally distributed complete data*.

IEC 216-3-3:—, *Guide for the determination of thermal endurance properties of electrical insulating materials — Part 3: Instructions for calculating thermal endurance characteristics — Section 3: Calculations for incomplete data¹⁾*.

IEC 216-4-1:1990, *Guide for the determination of thermal endurance properties of electrical insulating materials — Part 4: Ageing ovens — Section 1: Single-chamber ovens*.

IEC 216-5:1990, *Guide for the determination of thermal endurance properties of electrical insulating materials — Part 5: Guidelines for the application of thermal endurance characteristics*.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1

temperature index (TI)

number corresponding to the temperature, in degrees Celsius, derived from the thermal endurance relationship at a given time (normally 20 000 h)

¹⁾ To be published. [15B (B.C.) 82]

3.2**relative temperature index (RTI)**

temperature index of a test material, obtained at the time which corresponds to the known temperature index of a reference material when both materials are subjected to the same ageing and diagnostic procedures in a comparative test

3.3**halving interval (HIC)**

number corresponding to the temperature interval, in degrees Celsius, which expresses the halving of the time to end-point taken at the temperature of the TI or the RTI

HIC is a measure of the slope of the thermal endurance graph. It is not constant, but varies with temperature even when the thermal endurance relationship is linear. In many practical cases, the error arising from the use of HIC in the temperature range of interest remains within acceptable limits

3.4**thermal endurance graph (Arrhenius graph)**

graph in which the logarithm of time to reach a specified end-point in a thermal endurance test is plotted versus the reciprocal thermodynamic (absolute) test temperature

3.5**threshold value**

value, corresponding to a percentage of the initial value of the property under investigation, at which the ageing test is stopped and the time to failure is calculated

NOTE 1 The level of 50 % is often used to determine the threshold value.

NOTE 2 If a minimum value is required after ageing, it may be agreed between the interested parties to use this minimum value as the threshold value, instead of a percentage of the initial value.

3.6**test-specimen failure time**

time required at the exposure temperature for a specimen to either fail the proof test or reach the threshold value of the characteristic under investigation, whichever is shorter

4 Principle**4.1 Determination of time to failure**

At a chosen temperature, the variations in the numerical value of a chosen characteristic (for example, a mechanical, optical or electrical property) are determined as a function of time.

The procedure is continued until the relevant threshold value of that characteristic has been reached, resulting in the time to failure at that particular temperature.

Further specimens are exposed at least two other temperatures and the variations in the relevant characteristic determined. It is recommended to heat-age test specimens at three to four temperatures, and determine the time to failure for each of the temperatures.

4.2 Determination of TI

The times to failure are plotted versus the reciprocal values of the exposure temperatures. The intersection of this curve with the chosen time limit (in general 20 000 h) gives the temperature index sought.

4.3 Use of correlation coefficient

The reliability of the extrapolation of the graph depends on obtaining an acceptable Arrhenius plot, which may not be possible with materials showing behaviour related to a transition phenomenon in the chosen temperature range.

For this purpose the correlation coefficient r is calculated in accordance with Annex B. If this calculation results in a value smaller than 0,95 (for three test temperatures; see also IEC 216), an additional test at a different test temperature may improve the linearity of data.

4.4 Determination of RTI

For determination of RTI, the chosen reference plastic, its thermal endurance and the method of determination are of central importance.

The reference plastic shall be of the same type as the tested plastic, and have a history of satisfactory service. It shall have a known temperature index for the property and a threshold value which are the same, or at least reasonably similar to, those to be employed in the RTI test. The TI and HIC of the reference material should also be approximately the same as the values expected for the tested plastic.

Since processing conditions may significantly affect the ageing characteristics of some materials, the sampling, cutting of sheet from the supply roll, cutting of anisotropic material in the same direction, moulding, curing, preconditioning, etc. shall be performed in the same manner for both materials, and the specimens shall be tested in the same thickness.