



BSI Standards Publication

Plastics — Determination of dynamic mechanical properties

Part 11: Glass transition temperature

National foreword

This British Standard is the UK implementation of [ISO 6721-11:2019](#). It supersedes [BS ISO 6721-11:2012](#), which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/21, Testing of plastics.

A list of organizations represented on this committee can be obtained on request to its secretary.

Attention is drawn to the fact that during the development of this International Standard, the UK committee voted against its approval.

The UK committee submitted a negative vote due to concerns regarding the introduction in this revision of two alternative definitions for measuring glass transition temperature (T_g) (i.e. [Subclause 3.1](#) ($T_{M''}$) and [Subclause 3.3](#) ($T_{\tan\delta}$) in addition to the original definition given in [Subclause 3.2](#) ($T_{M'}$)).

[Subclause 3.3](#) defines temperature at peak of loss factor curve and notes that 'loss factor' is also called ' $\tan \delta$ '. The UK committee recommends use of ' $\tan \delta$ ' to describe the ratio of loss modulus divided by storage modulus (see below) because it is a more widely adopted terminology by users of this technique and other known standards than 'loss factor'. It also avoids potential confusion between 'loss modulus' and 'loss factor'.

[Clause 4](#) states that T_g is determined using one of the characteristic data points in the measured data as defined in Subclauses 3.1 to 3.3. These options could cause confusion through multiple T_g values being quoted, with the possibility of several degrees ($^{\circ}\text{C}$) difference in the reported values.

In addition, no guidance is given on a default definition in cases of dispute or qualification.

The UK committee recommends that users should determine T_g using the definition provided in Subclause 3.2, which was the only definition of glass transition (T_g) given in the withdrawn standard BS ISO 6721-11:2012. This definition is the same as that used in BS ISO 20144:2019, *Fibre-reinforced plastic composites — Standard qualification plan (SQP) for composite materials, including reduced qualification plan (RQP) and extended qualification plan (EQP) schemes*, where BS ISO 6721-11:2019 is referenced for T_g measurements.

The UK committee also notes that:

- commercial instrument software will often not include loss factor as an option for data plotting, so $\tan \delta$ should be used in these cases; and
- no evidence of validation is given for the calibration specimens in the tensile mode described in Annex B, [Subclause B.1.3](#).

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Plastics — Determination of dynamic mechanical properties —

Part 11: Glass transition temperature

*Plastiques — Détermination des propriétés mécaniques
dynamiques —*

Partie 11: Température de transition vitreuse



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

This second edition cancels and replaces the first edition ([ISO 6721-11:2012](http://www.iso.org/iso/6721-11:2012)), which has been technically revised. The main changes compared to the previous edition are as follows:

- the scope has been revised to specify suitable materials more accurately;
- definitions of specific points in DMA curves have been extended;
- reference to quality assurance purposes have been deleted;
- several methods have been introduced for evaluation of the glass transition temperature;
- the procedure for determination of heat dependent results has been revised;
- curves of storage modulus, loss modulus and loss factor have been added to the test report;
- the temperature calibration procedure has been revised;
- additional temperature reference specimen for different loading modes has been introduced.

A list of all parts in the ISO 6721 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at <https://www.iso.org/members.html>.

Introduction

This document covers the use of dynamic mechanical analysis (DMA) procedures, in the temperature scanning mode, to determine a value for the glass transition temperature of plastics. It provides an alternative procedure to the use of differential scanning calorimetry (DSC) (see [ISO 11357-2](#))^[1] for this measurement.

DMA is used to determine the variation of the storage modulus, loss modulus and loss factor as a function of temperature and frequency. From these data, a value for the glass transition temperature is determined. Many types of commercial equipment are available that use this technique, and, in principle, it applies to all the loading modes described in [ISO 6721-1](#).

The procedures minimize errors due to thermal lag of the specimen, which varies with the heating rate used, through assuming the specimen temperature is given by the measured oven temperature^[2]. This eliminates the need for the temperature of the specimen to be measured directly by, for example, a thermocouple embedded in the specimen.