BRITISH STANDARD

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Building tolerances — Measurement of buildings and building products —

Part 1: Methods and instruments

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Policy Committee (BDB/-) to Technical Committee BDB/4, upon which the following bodies were represented:

Association of County Councils
British Standards Society
Building Employers Confederation
Chartered Institution of Building Services Engineers
Concrete Society
Department of Education and Science
Department of the Environment (Property Services Agency)
Department of the Environment (Building Research Establishment)
Incorporated Association of Architects and Surveyors
Institute of Building Control
Institute of Clerks of Works of Great Britain Inc.
Institution of Civil Engineers
Institution of Structural Engineers
Institution of Water and Environmental Management
Royal Institute of British Architects
Royal Institution of Chartered Surveyors

The following body was also represented in the drafting of the standard, through sub-committees and panels:

Chartered Institute of Building

This British Standard, having been prepared under the direction of the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 28 September 1990

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

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 to vi, pages 1 to 88, 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.

1 Scope and field of application

This International Standard gives some alternative measuring methods for the determination of shape, dimensions and dimensional deviations of buildings and building products which are relevant to fit. The methods can also be applied when accuracy data are being collected in factories or on building sites.

Information is given about deviations of parts of buildings or of building products which can be determined with the equipment described.

The measuring methods concern primarily those objects the faces of which are rectilinear in shape and which have a modulus of elasticity larger than 35 kPa, for example concrete, wood, steel, hard plastic. Building products consisting of glass wool and similar soft materials are not the subject of this International Standard.

Rules for quality control in all stages of measurement such as frequency checks, place, time, etc., are not covered by this International Standard.

Part two of this International Standard gives the position of measuring points to be used in the measurement described in this part.

To facilitate cross-referencing, the same numbering is used in the two parts of this International Standard.

2 References

ISO 4464, *Tolerances for building — Relationship between the different types of deviations and tolerances used for specification.*

ISO 7078, *Building construction — Procedures for setting out, measurement and surveying — Vocabulary and guidance notes.*

ISO 7976-2, *Tolerances for building — Methods of measurement of building and building products — Part 2: Position of measuring points.*

ISO 8322, *Building construction — Measuring instruments — Procedures for determining accuracy in use — Part 1: Theory*[1)] *— Part 2: Measuring tapes*[1)] *— Part 3: Optical levelling instruments*[1)] *— Part 4: Theodolites*[1)] *— Part 5: Optical plumbing instruments*[1)] *— Part 6: Laser instruments*[1)] *— Part 7: Instruments when used for setting out*[1)] *— Part 8: Electronic distance measuring instruments*[1)].

3 General

3.1 Methods of measurement

The methods of measurement refer to the main dimensions of building products, distances between such products and their geometrical deviations. They may, however, also be applied to parts and to subdivisions in building products.

The items to be measured should be supported as they will be supported in use. When this is impractical, the support conditions should be agreed in the measuring schedule. If components are measured whilst they are in a manufacturing jig or mould, this should be noted. Flexible components should always be fully supported on a flat surface.

For both compliance measurements and for the collection of accuracy data, the measurement procedure should be significantly more accurate than the permitted deviation specified for the manufacturing or construction process to be measured.

Arrangements which make it possible to check the accuracy of the measurement procedure are an essential part of the method. (See ISO 8322-1 to ISO 8322-8.)

When recording the result of a measurement the following conditions should be reported where appropriate:

— identification of operator, instrument and time;

— position and attitude of the object being measured;

— temperature and moisture content of the object being measured;

— any other matters pertaining to the measurement.

[1)] At present at the stage of draft.

It is usually possible to measure directly on surfaces cast against a smooth mould. Local defects such as pores, burns and casting blemishes shall be avoided in the measurement. They shall not appear as incorrect sizes, but their presence shall be noted. In the case of a surface with a considerable roughness in relation to the permitted deviations, the measurements can be specified to be made with the aid of sufficiently large position pieces placed on the object of measurement.

At the end of each of clauses **4** to **14**, there is a table that specifies the following items for each of the measuring operations in that clause:

— the measuring operation;

— limits of measuring accuracy, in terms of the permitted deviation of the item to be measured;

— the measuring range;

— the measuring instrument or tool which can be chosen.

3.2 Influence of deviations from reference conditions

Variations in the ambient conditions from the specified reference values can give rise to errors in the measured size of a dimension. Temperature, especially direct sunshine, is normally the most significant of these ambient conditions.

Other reference conditions such as moisture content of timber and age of concrete components shall be taken into account where appropriate.

The actual temperature of either the object to be measured or the measuring equipment may be difficult to determine in practice since it is unlikely that either will be at uniform temperature and because temperature differentials within the object to be measured or in the equipment will exist. The most satisfactory solution is to allow both the object to be measured and the measuring equipment adequate time to achieve a stable ambient temperature. This temperature can then be measured and allowance made for any variation from the specified reference temperature.

So far as the measuring equipment is concerned, the most likely sources of heat input are from the handling of the equipment and from differences between ambient temperature and the reference condition. The object to be measured is also affected by ambient temperature and may also be subjected to considerable heating during manufacture.

The reference temperature in this example is considered to be 20 °C. The following symbols are used:

t_1 is the temperature of object to be measured, in degrees centigrade;

t_2 is the temperature of measuring equipment, in degrees centigrade;

a_1 is the coefficient of expansion of object to be measured;

a_2 is the coefficient of expansion of measuring equipment;

$\% t_1$ is the temperature difference from 20 °C of object to be measured ($\% t_1 = t_1 - 20$);

$\% t_2$ is the temperature difference from 20 °C of measuring equipment ($\% t_2 = t_2 - 20$);

L is the length being measured.

Then the error in measurement $\% L$ caused by the temperature differentials $\% t_1$ and $\% t_2$ is given by:

$$\% L = L\,(a_1\,\% t_1 - a_2\,\% t_2)$$