International Standard ISO 3443/4

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Tolerances for building — Part 4 : Method for predicting deviations of assemblies and for allocation of tolerances

Tolérances pour le bâtiment — Partie 4 : Méthode pour la prévision des écarts d'assemblage et pour la disposition des tolérances

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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0 Introduction

This part of ISO 3443 forms one of a series concerning tolerances for building and building components.

It should be read in conjunction with ISO 3443/1, ISO 3443/2, ISO 1803/1 and ISO 1803/2.

Parts 3 and 4 of ISO 3443 have been produced to meet the need for internationally agreed methods of relating accuracy, tolerances and fit in the determination of sizes for components and construction (and, in ISO 3443/4, joints). Two distinct needs are identified, though both share common ground.

There is thus a need to provide generally applicable expressions relating accuracy, tolerances and fit, that can be drawn upon, either :

a) to identify optimum target sizes for standard components, where each type of component has a variety of applications, or

b) to identify appropriate limits of size for components, whether standard or not, for application in a specific building.

Both needs can be met by expression of substantially the same relationships between the factors affecting fit, and in principle either standard might be pressed into service to meet either aim. In practice, however, each is structured to serve its particular purpose.

Joints in more than one dimension are however only considered in this part of ISO 3443.

Part 3 of ISO 3443 is structured to meet the aims in a) above. It provides procedures for selecting target sizes (formerly "work sizes") for components, or *in situ* works, such that joint clearances will be within their required limits with a known probability of success.[1] The procedures deal with the relationship between the following factors:

1) accuracy of components and *in situ* work;
2) sizes of components and *in situ* work;
3) joint clearances;
4) probability of fit;

and they can be used whether 2), 3) or 4) above is the unknown to be calculated. The procedures assume that values for 1) above have been established by measurement surveys and relate target sizes to co-ordinating sizes using the concepts of "extension" and "deduction"; see 4.4 and 4.5.

The procedures also enable a target size to be calculated for any standard component, such that the component will have an optimal probability of fit in all its applications.

Worked examples are given in annex B.

ISO 3443/4 is structured to meet the needs in b) above. It is therefore concerned primarily with the design of buildings in which components (including standard components) are used, and is aimed primarily at building designers who, as engineers, can be expected to be mathematically and statistically competent. It is to meet these aims that this part of ISO 3443 deals with

— methods for predicting deviations and specifying tolerances to obtain a particular desired total accuracy in an assembly,

— the effect of specified tolerances on expected size variability,

— the basis for optimization of tolerances for each particular assembly and its elements.

ISO 3443/4 presupposes calculations only for assemblies with elements of one dimension, such as beams and columns, for the sake of simplicity. However, tables for common cases with elements of two and three dimensions (panels, etc.) are given in the annex.

1 Scope

This part of ISO 3443 indicates some general principles and one method for predicting deviations in composite systems and specifying tolerances for the constituent elements in order to meet functional requirements and tolerance specifications for the assembly.

2 Field of application

This part of ISO 3443 applies to tolerances and deviations in all kind of assemblies and other systems composed of elements, within the building industry.

1) ISO 3443/3 deals with accuracy in terms of target size and limits of size (e.g. upper and lower limits of component size). Alternatively, accuracy can be defined in terms of permitted deviations in relation to a reference size — usually identical with the target size. See ISO 1803/1.

3 References

ISO 1791, *Modular co-ordination — Vocabulary*.

ISO 1803/1, *Building construction — Tolerances — Vocabulary — Part 1: General terms.*

ISO 1803/2, *Building construction — Tolerances — Vocabulary — Part 2: Derived terms.*[1]

ISO 3443/1, *Tolerances for building — Part 1: Basic principles for evaluation and specification.*

ISO 3443/2, *Tolerances for building — Part 2: Statistical basis for predicting fit between components having a normal distribution of sizes.*

ISO 3443/3, *Tolerances for building — Part 3 : Procedures for selecting target size and predicting fit.*[1]

ISO 3443/7, *Tolerances for building — Part 7 : General principles for approval criteria, control of conformity with dimensional tolerance specifications and statistical control — Method 2.*[1]

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

4 Definitions

For the purpose of this part of ISO 3443, the definitions given in ISO 1791 and ISO 1803/1 apply with the following additions.

4.1 reference size : Size specified in the design, to which deviations and tolerances are related.

NOTES

1 For the purposes of the calculations in this part of ISO 3443, the upper and lower permitted deviations are assumed to be equal. Where this is not so, the mean of the upper and lower limits of size should be taken as the reference size.

2 The term "target size", as defined in ISO 1803/1, is a special case of reference size which normally coincides with the concept of reference sizes as used in this International Standard.

4.2 constituent element in an assembly : Any component, joint, space or set-out distance, etc., which contributes to the observed dimension of the assembly.

NOTE — "Constituent element" is sometimes shortened to "element" in the text.

5 Propagation of deviations in an assembly or other composite system

The reference size B for a given element in an assembly is expressed generally in relation to the other elements in the assembly :

$$B = K_1 B_1 + K_2 B_2 + \dots + K_i B_i + \dots + K_n B_n = \sum_{i=1}^{n} K_i B_i \qquad \dots (1)$$

where

B_i is the reference size of element number i;

K_i is a coefficient determined from the geometry of the assembly and the method of erection.

As seen in the examples below, the normal values for K_i are $+1$, -1, $+\frac{1}{2}$ and $-\frac{1}{2}$.

The actual deviation V from the reference size is then given by :

$$V = \sum_{i=1}^{n} K_i V_i \qquad \dots (2)$$

where

K_i is the same coefficient from equation (1);

V_i is the actual deviation from the reference size B_i.

Example 1 :

Figure 1 shows an assembly of components erected from the set-out line L with given joint widths to a previously erected component C.

$$B = -B_1 - B_2 - B_3 - B_4 - B_5 - B_6 + B_7$$

$$V = -V_1 - V_2 - V_3 - V_4 - V_5 - V_6 + V_7$$

Example 2 :

If the last component is positioned with the intention of being symmetrical in the remaining space, we have the situation in figure 2.

Now element number 5 represents the departure from symmetry and therefore

$B_5 = 0$, but $V_5 \neq 0$.

$$B = -B_1 - B_2 - B_3 - B_4 - B_5 - B - B_6 + B_7$$

or

$$B = -\frac{1}{2}B_1 - \frac{1}{2}B_2 - \frac{1}{2}B_3 - \frac{1}{2}B_4 - \frac{1}{2}0 - \frac{1}{2}B_6 + \frac{1}{2}B_7$$

$$V = -\frac{1}{2}V_1 - \frac{1}{2}V_2 - \frac{1}{2}V_3 - \frac{1}{2}V_4 - \frac{1}{2}V_5 - \frac{1}{2}V_6 + \frac{1}{2}V_7$$

When the actual deviations are not known, either because they are not measured or because the components have not yet been produced, the deviations are treated as probability distributions.

If V_i is distributed with the expected (mean) value μ_i and the standard deviation σ_i, the respective parameters of the distribution of V are given by :

$$\mu = \sum_{i=1}^{n} K_i \mu_i \qquad \dots (3)$$

1) At present at the stage of draft.