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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Façades made of components — Tests for resistance to positive and negative static pressure generated by wind

Façades construites avec des composants — Essais de résistance aux pressions et dépressions statiques engendrées par le vent

Reference number
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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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Façades made of components — Tests for resistance to positive and negative static pressure generated by wind

0 Introduction

0.1 This International Standard is one of a series of standards relating to the performance of building elements.

This series comprises firstly :

— Performance Standards which indicate the type of performance characterizing each family of elements — façades, partitions, roofs, cross-walls, tridimensional units — making up a building with their scales of values, if required, and which also refer to suitable methods for determining performance,

— and, secondly, International Standards applicable to each family of elements, describing the means (measurement, calculation, test method or method of examination) by which a certain performance achieved by the element is to be evaluated or verified, and/or the means of forecasting the life expectancy.

In conjunction with this series of standards, another series will also be established defining the rules pertaining to dimensional coordination and modular coordination for the different families of elements, given that they and performance are so related that some correlation is desirable.

0.2 Wind generates positive and negative pressures on façades.

Where there is insufficient prior knowledge on the behaviour of façades when submitted to positive and negative pressures due to wind, tests simulating these actions may help to procure the necessary information.

This International Standard proposes test methods for measuring the deformations undergone by a façade under positive and negative pressure and for observing any deterioration.

1 Scope

This International Standard specifies the method to be used for testing the resistance to positive and negative static air pressure of complete façades made of components, i.e. of the assembly consisting of glazed components, either opening or fixed, opaque components, their connections and the devices fixing them to the structure.

2 Field of application

This International Standard applies to all types of façades made of components[1], made of any material, set up in compliance with general rules of good practice and with the supplier's recommendations.[2]

However for façades in which no structural openings exhibit frontal displacements in excess of 1 mm[3] at any point when a pressure of 100 Pa is applied, these tests on a façade specimen without its opening and closing part may be dispensed with and the opening parts should be tested in accordance with ISO 6612.

3 Reference

ISO 6612, *Windows and door height windows — Wind resistance tests.*

4 Definitions

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

4.1 permanent residual deformation : Deformation which does not disappear when pressures are no longer applied.

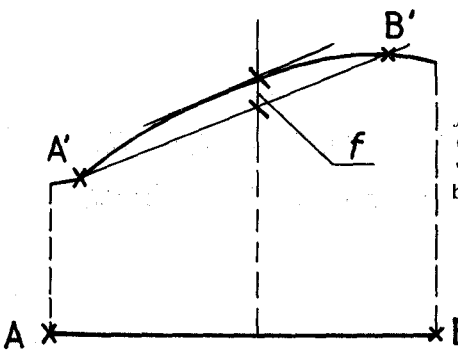
4.2 frontal displacement : Displacement of a point on the facade measured normal to the plane of the façade.

1) Except façades of opening or fixed screens.

2) These may either refer to general or specific rules, for the prevailing conditions of construction and use.

3) These deformations shall be determined using the calculation rules relative to the material under consideration.

4.3 frontal deflection : Maximum frontal displacement of a point on a façade element or on a structure. If displacement of the edges A and B of this element occurs, the deflection is measured with respect to the final position A′ and B′ of these edges (see figure 1).



f is the frontal deflection of the element AB which, when deformed, becomes A′ B′.

Figure 1 — Frontal deflection

4.4 relative frontal deflection : Relationship of the frontal deflection to the initial dimension AB of the façade element under examination; in the case of figure 1, it is the relationship $\frac{f}{AB}$.

5 Test principle

The tests consist in submitting the façade to three successive and distinct sequences of positive and negative pressure as follows.

5.1 Deformation test

Application of positive pressure in stages up to the value P_1 and of negative pressure in stages up to the value P'_1 (P_1 not necessarily being equal to the absolute value of P'_1), with a view to establishing the curve of deformation and observing any damage.

5.2 Repeated positive (and negative) pressure test

Positive pressure P_2 and negative pressure P'_2 (P_2 not necessarily being equal to the absolute value of P'_2) applied n times, the absolute values of P_2 and P'_2 being less than or equal to the absolute values of P_1 and P'_1 respectively, with a view to recording the increase in any deformation and observing any damage.

5.3 Safety test

The single application of positive pressure P_3 higher than P_1 and of negative pressure P'_3, the absolute value of which is higher than P'_1 (P_3 not necessarily being equal to the absolute value of P'_3) with a view to recording :

— the increase in effort needed to operate any opening parts,

— permanent residual deformation,

— material failure or the collapse of parts of it,

— changes in watertightness and air permeability of the façade.[1)]

The values required for P_1, P'_1, P_2, P'_2, P_3, P'_3 and n shall be fixed by the test sponsor.

Depending on the performance requirements, the application of the test may be limited to one sequence of tests, or to several.

6 Test apparatus[2)]

The test apparatus shall comprise the following :

a) Rigid frame, i.e. the frontal displacements of which are at no point more than 0,1 mm at 100 Pa, suitably equipped to allow attachment of the proposed fixings without being subject to deformation, and adaptable to the characteristic dimensions of the specimen. This frame shall be able to reproduce the permitted deviations in the dimensions of the actual structure, both horizontally and vertically.

b) Chamber capable of covering a whole panel and all of its joints, placed against the façade to be tested. A device attached to the chamber ensures that the connection is tight all the way round.

c) Means of providing a controlled differential air pressure across the façade.

d) Means for measuring the pressure differential between the two faces of the façade with an accuracy of 10 Pa.

e) Devices for measuring the frontal displacements of the specimen (frontal displacements in the direction of positive and of negative pressure and any permanent deformation) to the nearest 0,5 mm and means to position these devices and ensure their stability during the test.

7 Preparation of the façade for testing

7.1 Composition of the specimen

The specimen shall comprise the number of components necessary to represent the joints in current use and all the devices in current use for fixing the element onto the structure and onto adjacent components.

1) These changes shall be recorded, which will be the subject of future International Standards on air permeability and watertightness. This International Standard will be duly modified when these International Standards are adopted.

2) The description of this apparatus shall be supplemented with regard to air permeability and watertightness when future International Standards have been adopted.

As an example, since there are numerous possible combinations, and if a panel is a component or an assembly of components constituting one complete functional part of the façade (e.g. a spandrel panel, a window and an overpanel) the specimen might comprise the following :

a) one panel, if it is intended to be inserted on all four sides (see figure 2);

b) three panels, if they are intended to be inserted between floors (see figure 3);

c) one panel and the eight panels (or sections of eight panels) surrounding the centre panel, if these panels are not inserted on any side (see figure 4). The dimensions of the specimen are then such that its height is two storeys high and its width is equal to the width of three panels.

All transparent or opaque filling components shall comply with the supplier's recommendations regarding the type of filling components, their composition and how they are to be fixed.

The way in which the components making up the panels are fixed to each other and the way in which they are attached to the adjacent panels shall reproduce operating conditions, particularly with respect to the nature, type and position of the fixings and the distance between them.

If the façade includes expansion joints or devices to compensate for deviations of the fixings, these joints and devices shall be included in the specimen.

7.2 Fixing of the specimen

The specimen shall be fixed onto the frame so as to reproduce operating conditions, particularly with respect to the nature, type and position of the fixings, and the distance between them. The devices which ensure that the specimen is fixed shall be adjusted so that it is in a vertical plane and its constituent elements are assembled in the appropriate planes.

The devices ensuring that the façade is properly fixed shall be assembled so as to make maximum use of their adjustment capacity, i.e. the deviations on the load-bearing frame shall be the maximum permitted.[1]

7.3 Preparation for the test

In order to bring the specimen into position, three pulses of air pressure, positive before the positive pressure test and negative before the negative pressure test, shall be applied. The time taken to increase the positive or negative pressure shall be not less than 1 s, and the positive or negative pressure shall be held for at least 3 s.

These pulses shall reach the positive pressure P_1 or the negative pressure P'_1 required for the deformation test; however they must be not less than 500 Pa as an absolute value.

With the positive and negative pressure reduced to 0, a check shall be carried out to ensure that any opening parts and their hardware are in good working order. The effort required to operate opening parts shall be measured.

7.4 Points for measuring frontal displacement

The devices for measuring frontal displacement shall be put in position so as to register the maximum deformations.

Figures 2, 3 and 4 give examples of the points of measurement.

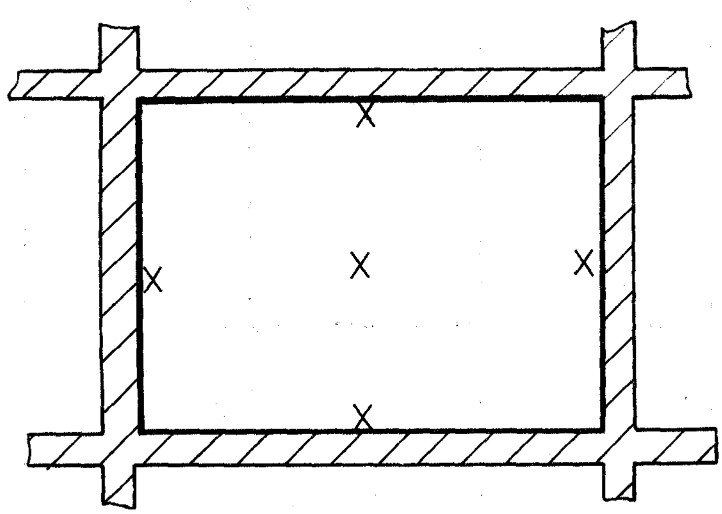


Figure 2 — Panel inserted on four sides

1) Where permitted deviations are fixed in standards, the adjustment capacity of the fixings shall correspond to the values fixed; where there are no relevant standards available, these values shall be fixed in the test instructions.

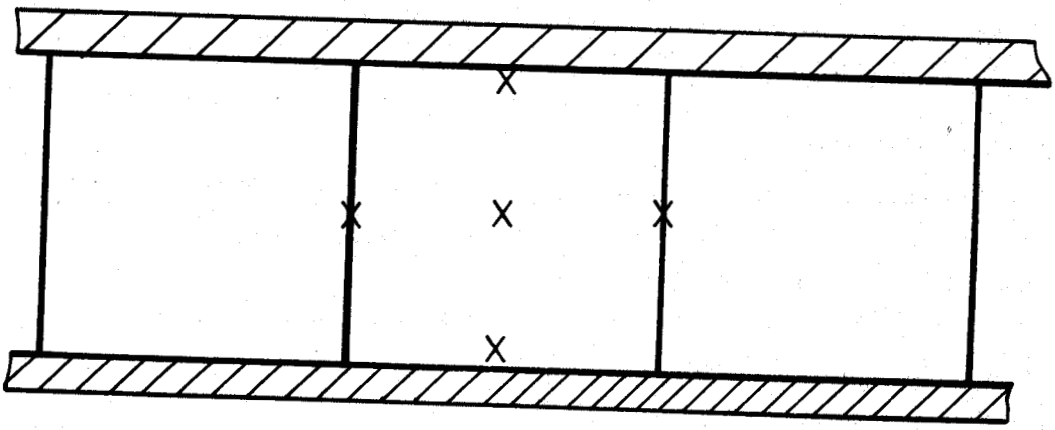


Figure 3 — Three panels inserted between floors

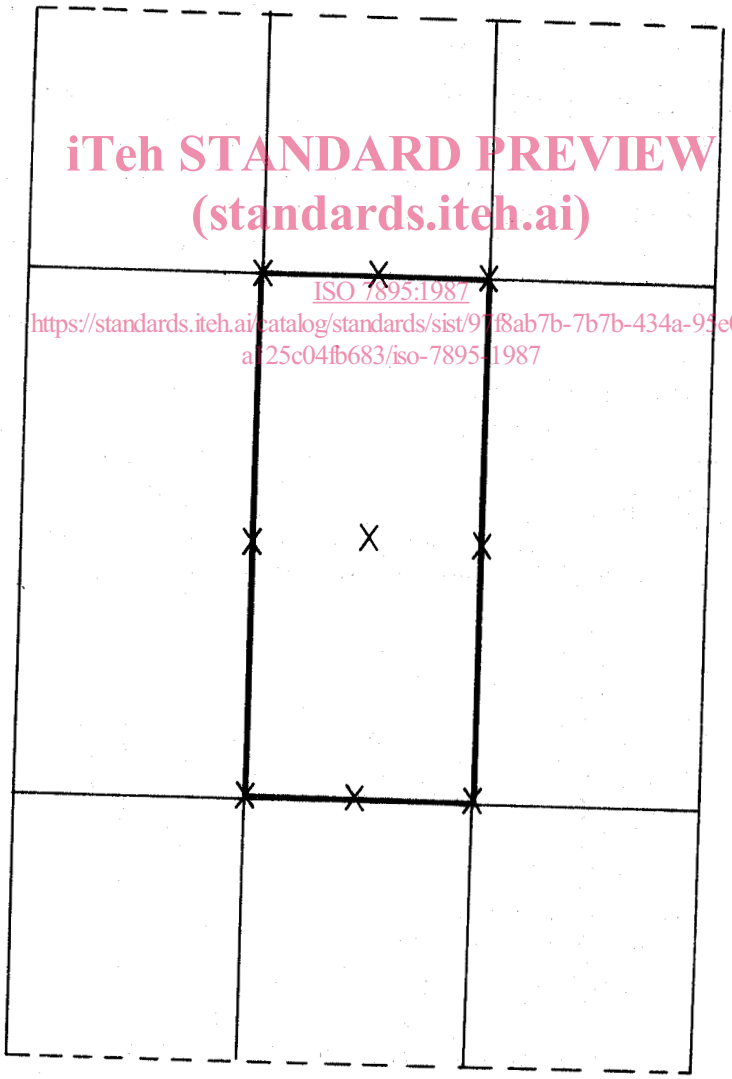


Figure 4 — One panel and the eight panels (or panel sections) surrounding it

8 Test procedure

8.1 General

The specimen shall undergo the following sequences of tests in conformity with clause 5, as represented on the diagram indicating a typical programme of application of positive and negative pressure.

8.2 Deformation test

Submit the façade to pressure, increasing in stages for a minimum period of 10 s at each stage, up to the maximum pressure required (P_1) for this test.

The pressure at these stages shall be 100, 200, 300, 400 and 500 Pa and shall, if necessary, be increased to P_1 in stages of not more than 250 Pa.

At each pressure stage the frontal displacement at the points indicated and described in 7.4 shall be measured.

With the pressure reduced to 0, note the residual permanent frontal displacement at these points after stabilization. Any cracks shall be measured and their development traced.

The test is repeated under the same conditions, but this time negative pressure is applied, the maximum required negative pressure being P'_1.

8.3 Repeated positive (or negative) pressure test

Then submit the façade to the required number of positive pressure impulses between 0 and the value P_2 agreed for this test.

The duration of pressure increase or decrease shall be not less than 1 s. At each impulse the pressure shall be held for at least 3 s.

At the last impulse the frontal displacement shall be recorded.

With the pressure reduced to 0 any observed damage, any difficulties in operating moving parts and any permanent residual frontal displacement shall be recorded.

The same shall be performed for the negative pressure test, the agreed value being P'_2.

8.4 Safety test

Submit the façade to the maximum required pressure P_3.

The pressure P_3 shall be reached as quickly as possible, but not in less than 1 s, and held for 3 s.

Any permanent residual deformation and any damage observed shall be recorded, including any additional effort required in operating opening parts.

The same shall be performed for the negative pressure test, the agreed value being P'_3.

8.5 Supplementary tests

Tests for air permeability and watertightness may be performed on completion of the various sequences, in conditions which will form the subjects of future International Standards.

9 Expression of results

The frontal displacement and permanent deformation are expressed in millimetres. The pressure is expressed in pascals.

9.1 Results of the deformation tests

9.1.1 The results shall be expressed as a graph showing positive pressure/deformation and negative pressure/deformation for each point of measurement.

9.1.2 The frontal displacement calculated shall be expressed in tabular form : the dimensions corresponding to this displacement shall be marked on a diagram.

9.2 Results of repeated positive (or negative) pressure tests

9.2.1 The results shall be expressed as a graph showing positive pressure/deformation and negative pressure/deformation for each point of measurement.

9.2.2 The frontal displacement calculated shall be expressed in tabular form : the dimensions corresponding to this displacement shall be marked on a diagram.

9.3 Results of safety tests

The increased effort needed to operate opening parts, permanent residual deformation (for each point of measurement) and any damage shall be recorded in relevant tables and diagrams.

9.4 Results of supplementary tests

The results of any tests for air permeability and watertightness shall be recorded.

10 Test report

The test report shall contain the following :

a) a diagram of the test apparatus or reference to a document containing relevant information;

b) detailed drawings of the façade system or reference to supplier's documents in which this is described. These drawings shall show the exact position of the fixings and shall be supplemented by information on their adjustment;

c) the position of points of measurement;

d) diagrams showing the sequence of operation with details of the values of positive pressure P_1, P_2 and P_3 and of negative pressure P'_1, P'_2 and P'_3;

e) frontal displacement and any permanent deformation recorded for each test;

f) the damage observed during each of the tests recorded on the sketch of the specimen;

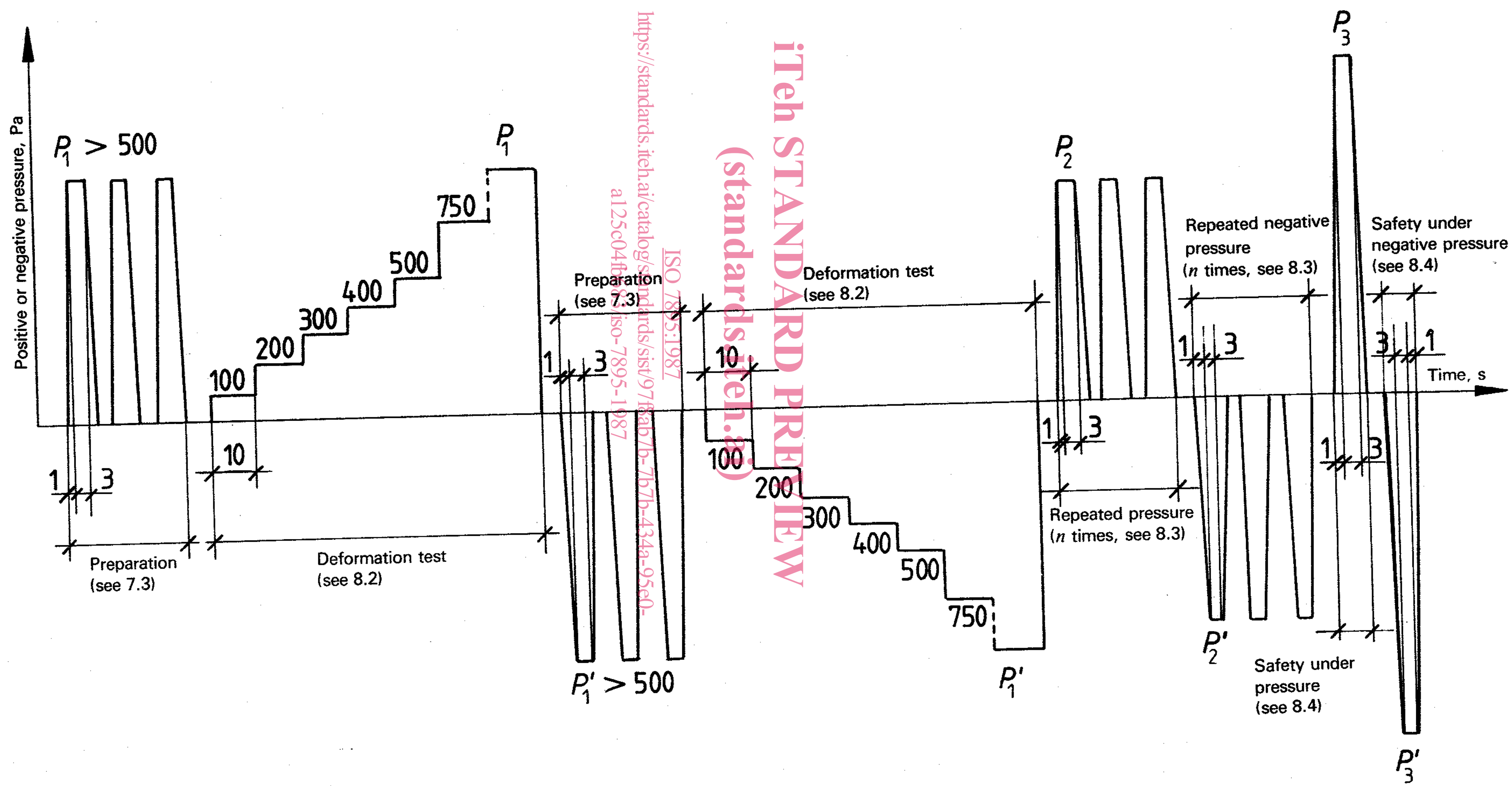
g) any additional effort required in operating opening parts.

The temperature and humidity of the air of the laboratory or box shall be noted and stated in the report.

Annex

Typical programme of application of positive and negative pressure[1)]

(This annex does not form part of the Standard.)



1) This figure is reproduced from ISO 6612.