DRAFT FOR DEVELOPMENT

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15680:2007

Prefabricated timber stairs — Mechanical test methods

ICS 91.060.30

BSI
British Standards

National foreword

This Draft for Development is the UK implementation of CEN/TS 15680:2007.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature. It should be applied on this provisional basis, so that information and experience of its practical application can be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the European organization responsible for its conversion to a European standard. A review of this publication will be initiated not later than 3 years after its publication by the European organization so that a decision can be taken on its status. Notification of the start of the review period will be made in an announcement in the appropriate issue of *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into a European Standard, to extend the life of the Technical Specification or to withdraw it. Comments should be sent to the Secretary of the responsible BSI Technical Committee at British Standards House, 389 Chiswick High Road, London W4 4AL.

The UK participation in its preparation was entrusted to Technical Committee B/543, Round and sawn timber.

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

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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This Technical Specification (CEN/TS) was approved by CEN on 24 September 2007 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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Foreword

This document (CEN/TS 15680:2007) has been prepared by Technical Committee CEN/TC 175 “Round and sawn timber”, the secretariat of which is held by AFNOR.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

There are a number of methods of evaluating the mechanical performance of stairs. These include:

- testing,

- calculation,

- conventional accepted performance.

All methods have equal validity.

This standard identifies a number of possible test methods which can be used.

1 Scope

This Technical Specification gives test methods for prefabricated timber stairs. These stairs are made from timber and/or wood-based materials.

The methods included in this document can also be used for single components used in stairs (e.g. steps, handrails, balusters, …).

This document does not consider the overall structure design of these elements. Stairs that are designed to contribute to the overall stability of the works or to the strength of the structure are not covered by this standard.

The surfaces of the timber elements may be exposed or covered by finishes.

NOTE 1 Where stairs are supplied with a finish or covering, some basic characteristics will not be covered by this standard and references should be made to the appropriate product standard (e.g. colour fastness of carpet finishes)

NOTE 2 Where the term "stair" is used in this document, it may also apply to individual element or component where appropriate

Tests can be carried out on a complete fully assembled system according to manufacturer installation instructions or on individual components.

A fully assembled stair test cannot be used to evaluate individual components.

There is no particular hierarchy of sequences or the need to carry out all the tests.

NOTE The nature of used tests and elements can be given by national regulations.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1991-1-1, *Eurocode 1 : Actions on structures – Part 1-1:General actions – Densities, self-weight, imposed loads for buildings*

EN 14076 : 2004, *Timber stairs – Terminology*

PrEN 15644 : 2007, *Traditionally designed prefabricated stairs made of solid wood – Specifications and requirements.*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14076:2004 and in prEN 15644:2007 apply.

4 Determination of mechanical strength of balusters under static load on prefabricated railing system : handrails or balustrades

4.1 General

This test provides a method to determine mechanical strength under concentrated static load of balusters made also with different materials, being a part of prefabricated railing system, handrails or balustrades.

This test applies to all handrails or balustrades of any material used for their construction, as usually installed and used, according to producer recommendations, in a construction. It does not apply to handrails or balustrades made on site and/or installed with building works.

4.2 Principle

Application of a concentrated load on a standardized conical element put between two balusters, checking deformations and possible breaks of these elements and their anchorages.

NOTE The conical element is the concentrated load application device made with rigid material (for wood > 700 kg/m^3), cone-shaped or frustum of cone, with 30° summit angle and base diameter > 200 mm.

4.3 Equipment

4.3.1 A support structure which is composed by rigid frame to fix the components system of, balustrade or handrail , according to producer instruction : such a frame shall allow the installation of different components in horizontal or vertical position (balustrade or handrail), see Figure 1.

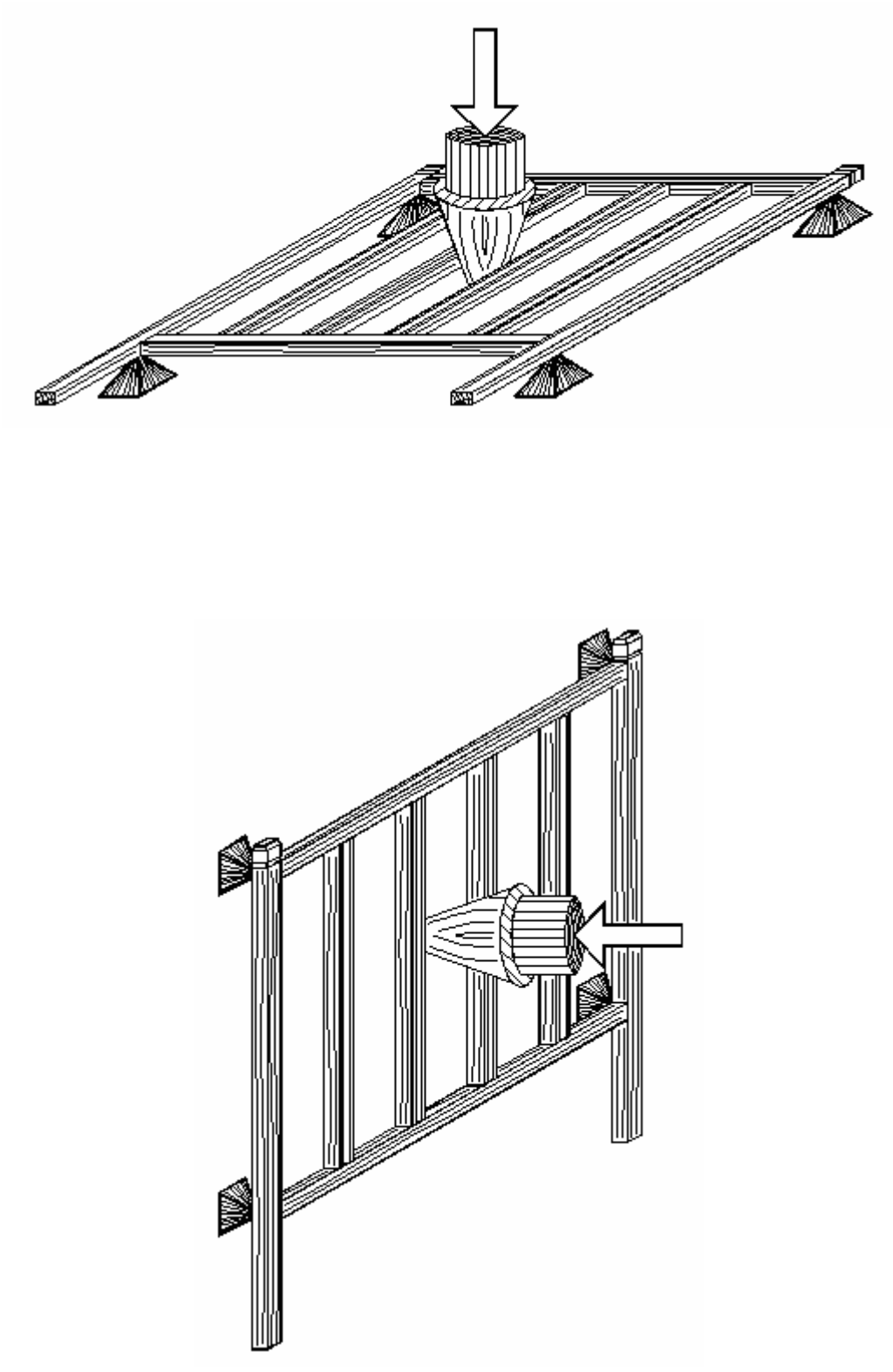

Figure 1 — Example of a support structure

4.3.2 Virtually rigid anchorage system of upper element of handrail or balustrade.

4.3.3 Concentrated load application system including cone-shape or frustum of cone interposed element as above-mentioned

4.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report.

4.5 Sampling

For 3 tests, the sampling is composed at least by 6 balusters.

4.6 Procedure

— For individual components, tested system shall be fixed into the support structure;

— The top of the tested element, next to load application point of the balusters, shall be locked, to avoid deformations during load application;

— Put load application system, so that the interposition cone is placed between two balusters on the worst position, typically closest to the half of their height, measured between the lowest and the upper anchorage;

— Apply the load according to tested element's use (see prEN 15644:2007, Table A.3); load application shall be progressive (not less than 5 s) and in direction towards the external side of the balustrade or handrail (see Figure 2) and maintain for 15 minutes ;

— Measure the largest distance between the two balusters, within 2 minutes of load application and at the end of the test or note the damage, if any, at the level checked or done ;

— The test shall be repeated for each sample (at least 3 pairs of balusters).

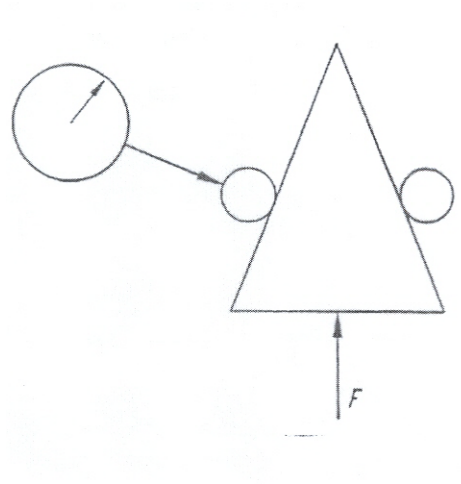

Figure 2 — Example of load application

4.7 Results

At the end of the test, check and record any possible deterioration on tested element which compromise its integrity and it functionality :

— damages of each component of element or relevant anchorage system;

— Specify equipment used;

— Record deformation in each measurement point and the arrow marked under and after loading.

5 Determination of mechanical strength under distributed static load of prefabricated systems : handrails or balustrades

5.1 General

This test provides a method to determine mechanical strength under distributed static loads of prefabricated systems, (handrails or balustrades) as protection for free fall, made by the composition of different components (handrails, balusters, panels and apron linings) made also with different materials.

It applies to all handrails or balustrades of any material used for their construction, as usually installed and used, according to producer recommendations, in a construction. It does not apply to handrails or balustrades made on site and/or installed with building works.

NOTE This test does not apply to the support system (for example newel).

5.2 Principle

Application of a standardized horizontal distributed static load to handrails or balustrades, until rupture or to the minimum load determined in accordance with EN 1991-1-1and its national annexes.

If not specified in national regulation, the material partial safety factor γ_m = 1,5 is to be used for the minimum value of three test. This factor γ_m becomes 1,3 for a 5% fractile (for a confidence level of 75%) of at least 10 tests.

5.3 Equipment

5.3.1 Support structure

This support structure is composed by a rigid frame to fix the component system of the railing, handrail or balustrade, according to producer instructions: such a frame shall allow the installation of different component in horizontal position (handrail or balustrade); the behaviour of tested system with this configuration is comparable to sloping system (railing).

5.3.2 Distributed load application system

Sum of elementary loads applied following the procedure (clause 5.6). Loads system shall be transmitted to handrail and shall not increase the stiffness of tested element.

5.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report.

5.5 Sampling

The sampling is composed at least of 3 systems (handrails or balustrades) of representative length with at least 2 support systems (supports are not tested).

5.6 Procedure

For individual components, tested systems shall be fixed into the support structure.

Determine the minimum total load for use (see EN 1991-1-1 completed by its national annexes for each market supplied and pr EN 15644:2007, Table A.3 and share it into elementary loads).

Apply the loads along the handrail uniformly between 20 cm and 50 cm (minimum 2 per length), in accordance with the following principles:

— Apply a pre-loading, equal to 50% of the minimum service load and keep it on for 5 minutes then remove it. Load application shall be progressive (not less than 5 s) and towards the external side of handrail or balustrade;

— Before starting the test, check the element integrity ;

— Apply loads by loads in fixed points; load application shall be progressive (not less than 5 s) and towards the external side of handrail or balustrade;

— Apply the loads and increase them until rupture or until they reach the minimum total load.

5.7 Calculated value

Calculate the fifth percentile characteristic value of the applied load, X_k. For a normal distribution, this characteristic value is given by:

$$X_k = X_{mean} - k_n X_{stdev}$$

Where X_{mean} : mean value of the load
X_{stdev} : standard deviation

with k_n factor linked to the number of samples. The different values of this factor are given in the table below:

Table 1: values for k_n (ISO 12491)

Number of tests	3	4	6	8	10	20	30	40	50	100
k_n	3,15	2,68	2,34	2,19	2,10	1,93	1,87	1,83	1,81	1,76

For a Log-normal distribution, the characteristic value X_k is given by:

$$X_k = e^{(\ln(Xmean) - k n \ln(Xstdev))}$$

5.8 Test results

Test result shall include following information:

a) All information concerning loads and their position;

b) Measures and characteristic value of the strength ;

c) Length of the samples tested.

6 Determination of mechanical strength under dynamic loads of prefabricated systems : handrails or balustrades

6.1 General

This test provides a method to determine mechanical strength under dynamic loads of prefabricated systems (handrails or balustrades) as protection for free fall, made by the composition of different components (handrails, balusters, panels and apron linings) made also with different materials.

NOTE to classify flat glass under dynamic load, EN 12600 should be used.

It applies to all handrails or balustrades of any material used for their construction, as usually installed and used, according to producer recommendations, in a construction.

6.2 Principle

Application of a standardized dynamic stress to handrails or balustrades, obtained by impact of one hanging body, of determined weight and nature (soft or hard), falling and swinging from fixed height.

NOTE dynamic load is the stress obtained by impact of soft or hard body.

6.3 Equipment

6.3.1 Support structure

This support structure is composed by a rigid frame to fix the system of the handrail or balustrade according to producer instructions : such a frame shall allow the installation of different component (handrail or balustrade).

6.3.2 Hanging impact body system

Following the purpose of this test, it shall be composed either by:

— a sphere cone-shaped element, with a 0,40 m diameter and 0,60 m height, full of hard glass balls with diameter 3 mm, to total weight of 50 kg; hanging system, made of inextensible rope of negligible mass, shall allow the impact body, when running, to touch impact point or,

— a sphere cone-shaped element, with a 0,35 m diameter, full of hard glass balls with diameter 3 mm, to total weight of 30 kg or,

— a steel ball with a 50 mm diameter and 0.5 kg weight or,

— a steel ball with a 62.5 mm diameter and 1.0 kg weight or,

— a steel ball with a 95.5 mm diameter and 3.5 kg weight .

6.3.3 Survey system

Survey of fall height of the impact. It shall be precise to 5 mm.

6.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report.

6.5 Sampling

The sampling is composed by 3 systems (handrails or balustrades) of representative length but not more than 2 m with at least 2 support systems (supports not tested).

6.6 Procedure

— Identify the impact point. This shall occur at the centre of the product to be tested;

— Suspend the impact body as shown in figure 3 so that at rest it makes light contact with the product to be tested and so that its centre of gravity is positioned on a line perpendicular to the product to be tested at its centre ;

— Raise the impact body so that the drop height, *h*, with a tolerance of ± 10 mm, correspond to the required impact energy ;

Release the impact body such that it strikes the product to be tested at the impact point.

NOTE repetition of this operation will necessitate re-shaping of the impact. Body.

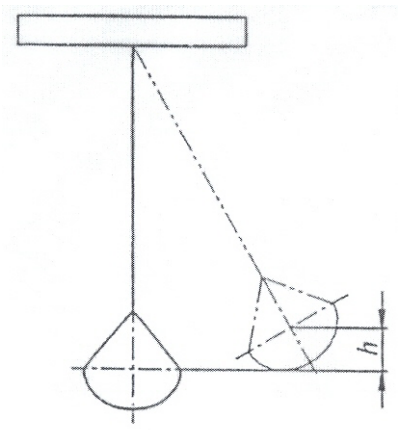

Figure 3 — Drop height of impact body

6.7 Results

— Record and note impact point(s) on test report,

— Record maximum drop height,

— Note all deflections, changes or damage of the product or other fittings at the end of each impact, checking :

  — Dimensions and position of possible damage,

  — Dimensions and position of possible slivers,

  — Movement between handrail or balustrade and support system.

— At the end of the test, note possible damage on the tested component which can compromise integrity and functionality, as :

  — Cracks of each element or relevant support system,

  — Permanent deflection (5 min after the impact).

7 Determination of mechanical strength under vertical static load on handrails

7.1 General

This test provides a method to determine mechanical strength under vertical static load of balustrades without balusters made also with different materials, being a part of prefabricated handrails or balustrades.

It applies to all prefabricated stairs of any material used for their construction, as usually installed and used, according to producer recommendations, in a construction.

7.2 Principle

Application of two concentrated equal loads, with a interval of 300mm between them, on a handrail, checking deflections and possible damages of this element and its relevant supports.

7.3 Equipment

7.3.1 A support structure which is composed by a rigid frame to fix the handrail, according to producer instruction.

7.3.2 **V**irtually rigid anchorage system of upper element of balustrade or handrail.

7.3.3 A survey deflection system which is carried out during the test and after load removal (residual deflections); the accuracy of the measurement system is 1 decimal place.

7.3.4 Concentrated loads application system.

7.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report.

7.5 Sampling

The sampling is composed by 3 straight elements of representative length.

7.6 Procedure

— Tested system shall be fixed on frame, according to producer instructions. In particular, clamping will be done applying strengths checked by suitable equipment, according to producer instructions ;

— Put loads on handrail of tested element, in the middle, with 300 mm between them ;

— Apply a pre-loading, equal to 0,1 kN on each point ;

— Put deflection measurement devices next to the middle of the handrail and set at zero ;

— Apply loads; application shall be progressive (not less than 5 s)

— Maintain the load for 15 min, recording under load deflections ;

— Remove the load and record residual deflections 3 min after the removal.

7.7 Results

At the end of the test, check and record any possible damage on tested element which compromise its integrity and it functionality:

— damages of each component of element or relevant anchorage system ;

— specify equipment and used procedure ;

— record deflection under and after loading.

8 Determination of mechanical strength under concentrated static loads on panels of prefebricated systems: handrails or balustrades

8.1 General

This test provides a method to determine mechanical strength under concentrated static loads on panels, made from different materials, parts of prefabricated handrails or balustrades.

It applies to all handrails or balustrades of any material used for their construction, as usually installed and used, according to producer recommendations, in a construction.

NOTE 1 This test method does not consider handrails or balustrades with glass panels or apron linings, made by using multilayer glass.

NOTE 2 This test method considers panels of any type and materials (except what is mentioned in NOTE 1) a part from their morphology (panels made from full or perforated homogeneous material, panels with horizontal apron linings,

8.2 Principle

Application of a concentrated static load to handrails or balustrades panel or apron linings, checking deflections or possible damage of components and their relevant support system.

8.3 Equipment

8.3.1 Support structure

This support structure is composed by a rigid frame to fix the component system of the handrail or balustrade according to producer instructions : such a frame shall allow the installation of different component (handrail or balustrade).

8.3.2 Virtually rigid anchorage system

This system is applied to the top of balusters to which is anchored the panel; this system shall avoid possible deflection of the whole structure, when the panels is under loading.

8.3.3 Loading application and measurement system

Apply the load by interposition of a rigid circular pad with 120 mm diameter.

8.3.4 Survey system

Survey system of deflections with decimal precision.

8.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report.

8.5 Sampling

The sampling is composed by at least 3 panels elements with at least 2 support elements (balusters). The tested system shall be fixed on frame, according to producer instructions.

8.6 Procedure

— Top of balusters or apron lining on which tested panels is anchored, shall be appropriately blocked to avoid deflections ;

— Apply a pre-loading of 50% of the whole load (See Table A.3 of prEN 15644:2007); loading application shall be progressive (not less than 5 s) ;

— Load shall be applied towards the outside of handrai or balustradel, by interposition of rigid circular pad of 120 mm diameter, next to diagonals crossing the panel ;

— Keep the load for 5 minutes and remove it ;

— Put the deflection device next to loading point and set to zero;

— Apply the load progressively by interposition of rigid circular pad of 120 mm diameter; loading application shall be progressive (not less than 5 s); load to be applied shall be chosen for different stair uses (see Table A.3 of prEN 15644:2007);

— Keep the load for 15 min, record deflections on loading application point (see Figure 4) ;

— Remove the load and record residual deflections 5 min after removal ;

— Carry out the test 3 times on different panel.

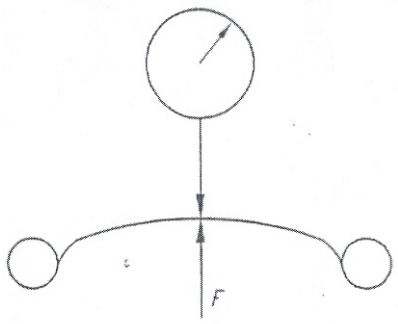

Figure 4 — Example of load application

8.7 Results

At the end of test, record and note possible damage on tested components which compromise the tested system integrity and functionality, as:

— Damage of each component of the element or relevant support system;

— Equipment and used procedure recording deflections or damage under and after load.

9 Determination of load bearing capacity for flights of stairs

9.1 General

This test provides a method to determine mechanical strength in ultimate limit state under distributed static loads of prefabricated flights of stairs, assembled with different elements (load bearing structure, pole, risers, landings and other finished elements, connection and anchorage) and also made from different materials.

9.2 Principle

Application distributed static vertical loads on flights of prefabricated stairs until rupture or to the minimum load determined in accordance with EN 1991-1-1 and its national annexes.

If not specified in national regulation, the material partial safety factor γ_m = 1,5 is to be used for the minimum value of three test. This factor γ_m become 1,3 for a 5% fractile (for a confidence level of 75%) of at least 10 tests.

9.3 Equipment

9.3.1 Support structure

This support structure is composed by a rigid frame to fix the flights, according to producer instructions.

9.3.2 Distributed load application system

This system is the sum of elementary loads applied following the procedure (clause 9.6). Loads system shall be transmitted to flights and shall not increase the stiffness of tested element.

9.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report.

9.5 Sampling

The sampling is composed of at least 3 systems (flights) composed by flight with at least 10 steps without intermediate supports and incorporating all components and fixings.

9.6 Procedure

For individual components, tested systems shall be fixed into the support structure.

Determine the minimum total load for use (see EN 1991-1-1 completed by its national annexes for each market supplied and prEN 15644:2007, Table A.3) and share it into elementary loads.

Apply the loads along the flights uniformly, in accordance with the following principles :

NOTE In the interests of safety a full stair flight may be tested in the horizontal position with simple supports under the ends of each string or carriage. If tested in the position the loading must be adjusted to take account of the change of angle of the imposed load.

— Apply a pre-loading, equal to 50% of the minimum service load and keep it on for 5 minutes then remove it. Load application shall be progressive (not less than 5 s) ;

— Before starting the test, check the element integrity ;

— Apply loads by loads in fixed points; load application shall be progressive (not less than 5 s);

— Apply the loads and increase them until rupture or until they reach the minimum total load.

9.7 Characteristic value

Calculate the fifth percentile characteristic value of the applied load, as described in clause 5.7.

9.8 Results

Test result shall include following information:

a) All information concerning loads and their position;

b) Measures and characteristic value of the strength.

10 Determination of flight deflection under distributed static load

10.1 General

This test provides a method to determine deflection under distributed static loads of prefabricated flights of stairs, assembled with different elements (load bearing structure, pole, risers, landings and other finished elements, connection and anchorage) and also made from different materials.

It applies to all prefabricated stairs of any material in their construction, as usually installed and used, according to producer recommendations, in a building.

10.2 Principle

Application of distributed static vertical loads on flights of prefabricated stairs, determined in accordance with service loads given in EN 1991-1-1 and its national annexes, checking deflections or possible damage of each component and their relevant supports.

10.3 Equipment

10.3.1 Support structure

This support structure is composed of a rigid frame with horizontal and vertical elements t with a support section to allow anchorage to the lower end and an upper support for the tested sample, according to producer instructions.

10.3.2 Load application system

This system is composed of elements of known weight and shape to allow distribution over the surface of the steps, which represent component to be tested.

10.3.3 Survey system

Survey system of deflections during the test and after the removal of load (residual deflections); this system shall allow 3 points for survey of deflections with an accuracy of 0.1mm on the median line of the flight.

10.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report.

10.5 Sampling

Sample is composed by flight with at least 10 steps without intermediate supports.

Tested elements shall be anchored on the frame according to producer instructions.

10.6 Procedure

— Determine total surface of tested component, as projected horizontally - Put deflection measurement devices on supporting structure(s), next to points resulting from dividing into 4 equal parts the length of the flight and set to zero ;

— Determine the minimum total load for use (see EN 1991-1-1 completed by its national annexes for each market supplied and prEN 15644, Table A.3) . Apply the load, for different uses of stairs by a suitable system that ensures even distribution; loading application shall be progressive (not less than 30 s) ;

— Maintain the load for 30 min, then record deflections of the tested component ;

— Remove the load and record residual deflections 5 min after removal.

10.7 Results

At the end of the test, record and note:

— possible damage on tested system which compromise the tested system's integrity and functionality ;

— any possible deflection during and after the test.

11 Determination of mechanical strength under dynamic loads on steps included in flights or on flights of stairs in prefebricated stairs

11.1 General

This test provides a method to determine mechanical strength under dynamic loads on prefabricated steps included in flights or on flights of stairs, assembled with different components (load bearing structure, pole, risers, landings and other finishing elements, connection and anchorage) and also made from different materials.

It applies to all prefabricated stairs of any material used for their construction, as usually installed and used, according to producer recommendations, in a construction.

11.2 Principle

Application of a conventional dynamic stress on steps included in flights or on flights of prefabricated stairs, obtained by impact of a soft or hard body, dropping from a fixed height.

NOTE a dynamic load is the stress obtained by impact of a soft or hard body.

11.3 Equipment

11.3.1 Support structure

This support structure is composed by a rigid frame with horizontal and vertical flat with a right angle to allow anchorage to the lower end (ground anchorage) and upper end (slab anchorage) of the tested sample, according to producer instructions.

11.3.2 Hanging impact body system

This system is composed by a soft body of 50 kg or a hard body of 4.5 kg hanging system, shall allow to apply impact body vertically to impact point.

11.3.3 Survey system

Survey system of fall height of the impact body; it shall allow an accuracy of 5 mm.

11.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report

11.5 Sampling

Sample is composed by flight of representative width, with at least 10 steps without intermediate supports.

Tested components shall be anchored on the frame according to producer instructions.

11.6 Procedure

— Select maximum 2 unfavourable impact points, from a preliminary examination ;

— Determine the stress level (see prEN 15644, Table A.3) for different uses of stairs;

— Drop impact body on to the vertical of chosen impact point. The impact is the result of the impact body falling from a fixed height, *h,* as to the impact point ;

— Drop height changes following to different uses of stairs;

— Carry out test 3 times, at the same height, for each impact point, avoiding the rebound of the impact body.

11.7 Results

Note fixed impact point(s). At the end of the test, note possible on the tested element that can compromise integrity and functionality, as:

— each element or relevant anchorage system ;

— permanent deflection.

12 Determination of bending strength of steps of prefabricated stairs

12.1 General

This test provides a method to determine bending strength of steps for prefabricated stairs.

It applies to all prefabricated stairs of any material used for their construction, as usually installed and used, according to producer recommendations, in a construction.

12.2 Principle

Application of a concentred static load on steps until rupture or to the minimum service load determined in accordance with EN 1991-1-1 and its national annexes.

If not specified in national regulation, the material partial safety factor γ_m = 1,5 is to be used for the minimum value of three test. This factor γ_m become 1,3 for a 5% fractile (for a confidence level of 75%) of at least 10 tests.

12.3 Equipment

12.3.1 Support structure

This support structure is composed by a rigid frame with horizontal and vertical elements with a support section to allow anchorage to the lower end and an upper support for the tested sample, according to producer instructions.

12.3.2 Load application and measurement system

Application of load by the interposition of rigid square pad of 50 mm x 50 mm [1)] on the most unfavourable point.

12.3.3 Survey system

Survey system of deflections, with an accuracy of 1/10 mm.

12.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report.

12.5 Sampling

Sampling is composed of at least 3 steps representative of steps used in the final product, to be fixed according to instructions given above.

12.6 Procedure

Put deflection measurement devices on load point and set to zero.

Determine the minimum total load for use (see EN 1991-1-1 completed by its national annexes for each market supplied and prEN 15644, Table A.3).

Apply the loads on the step, in accordance with the following principles:

— Apply a pre-loading, equal to 50% of the minimum service load and keep it on for 5 min then remove it. Load application shall be progressive (not less than 5 s);

— Before starting the test, check the element integrity ;

— Apply loads choosing the most unfavourable point as regards possible damage of tested component; load application shall be progressive (not less than 5 s);

1) See EN 1991-1-1 (Table 6.2)

NOTE Usually, most unfavourable stressed point is the farthest from anchorage point of the structure.

— Apply the loads and increase them until rupture or until they reach the minimum total load.

12.7 Characteristic value

Calculate the fifth percentile characteristic value of the applied load, as described in clause 5.7.

12.8 Results

— Specify equipment and used procedure, recording in each measured point and arrows, under and after loading ;

— Note any possible deflections (when the rupture is occurring or when the minimum load is obtained) and damage of the tested component ;

— Give the characteristic value.

13 Determination of step deflection under vertical static load

13.1 General

This test applies to all prefabricated stairs or component of any material used for their construction, as usually installed and used, according to producer recommendations.

13.2 Principle

Application of a concentred static loads on steps determined in accordance with EN 1991-1-1 and its national annexes, checking deformations or possible damage of steps.

13.3 Equipment

13.3.1 Support structure

This support structure is composed by a rigid frame with horizontal and vertical elements with a support section to allow anchorage to the lower end and an upper support for the tested sample, according to producer instructions.

13.3.2 Load application and measurement system

Application of load by the interposition of rigid square pad of 50 mm x 50 mm[2)]

2) see EN 1991-1-1 (Table 6.2)

13.3.3 Survey system

Survey system of deflections, with an accuracy of 1/10 mm.

13.4 Conditioning

Temperature and air humidity of the laboratory shall be specified in test report

13.5 Sampling

Sampling is composed of at least 3 steps representative of steps used in the final product, to be fixed according to instructions given above.

13.6 Procedure

— Put deflection measurement devices on load point and set to zero ;

— Determine the minimum load for use (see EN 1991-1-1 completed by its national annexes for each market supplied and prEN 15644, Table A.3). Apply the load, for different uses of stairs; loading application shall be progressive (not less than 5 s) ;

— Maintain the load for 30 min, then record deflections of the tested component;

— Remove the load and record residual deflections 5 min after removal.

13.7 Results

— Specify equipment and used procedure, recording in each measured point and arrows, under and after loading,

— Note any possible deflections (when the rupture is occurring or when the minimum load is obtained) and damage of the tested component.

14 Test laboratory

Test report shall include following information:

c) name, address and the place where the test has been carried out;

b) reference to this standard CEN/TS 15680 and the relevant clause(s);

c) full information concerning sampling, including type, origin and reference numbers of the producer;

d) all information concerning morphology of tested element, its dimensions and anchorage methods of each component;

e) all information concerning loads, drop heights, application points (drawings if necessary) and load application;

f) all measures and all test results, following each relevant clause from 4 to 13;

g) possible deviations from these clauses, which can change the results.

Annex A
(informative)

Examples of calculation on ultimate limit states

A.1 Test until failure

A.1.1 Examples with 3 series

Testing on 3 steps, concentrated load, until failure occurs :

- 1st step : 5200 N
- 2nd step : 5400 N
- 3rd step : 5500 N

The minimum value within these 3 values corresponding to the characteristic value F_k of this « testing »: 5200 kN.

F_{Rd} with γ_M =1,5 :

$$F_{Rd}=\eta_D\frac{k_{mod}\cdot F_k}{\gamma_M}=1,1\frac{0,9\times5200}{1,5}=3432\ \text{N}$$

where

F_{Rd} = *design value of the resistance*

η_D = *conversion factor (dependent on the type of test and the type of material, the recommanded value is 1,0)*

k_{mod} = *Modification factor for duration of load and moisture content*

F_k = *characteristic value determinated from tests*

γ_M = *Partial factor for materials*

Solid wood on service class 1 for short term class of duration : k_{mod} =0,9.

Building category A, concentrated load given by Eurocode 1 : Q_k=2000 N (see national annex). With such a test (until failure occurs), F_{Rd} has to be compared with Q_d given by :

$$Q_d=\gamma_Q\times Q_k=1,5\times2000=3000\ \text{N}$$

where

Q_d = Design applied load

Q_k = Characteristic value of the applied load

$\gamma_{Q:}$ coefficient taking into account uncertainty with the model and dimensional variations :1,5.

Conclusion : $F_{Rd} > Q_d$ then the step is validated for an use in a category A building.

A.1.2 Example with 10 series

10 steps, concentrated load, until rupture :

10 steps, concentrated load, until failure occurs :

$$F_{mean} = \frac{1}{n}\sum(\ln x_i) = 8{,}56$$

$$F_{stdev} = \sqrt{\frac{1}{n-1}\sum(\ln x_i - m_y)^2} = 0{,}039$$

$$F_k = \exp(x_{mean} - k_n \times x_{stdev}) = 4800 \text{ N}$$

with k_n=2,1 for 10 tests

γ_M =1,3 :

$$F_{Rd} = \eta_D \frac{k_{mod} \cdot F_k}{\gamma_M} = 1{,}1 \frac{0{,}9 \times 4800}{1{,}3} = 3655 \text{ N}$$

Same Q_d as above

Conclusion : $F_{Rd} > Q_d$ then the step is validated for an use in an category A building

Table A.1 — Example with 10 tests

F	ln (F)	$(\ln (F)-m_y)^2$
5200	8,56	$4,78x10^{-6}$
5400	8,59	$1,26x10^{-3}$
4900	8,50	$3,80x10^{-3}$
5300	8,58	$2,84x10^{-4}$
5350	8,58	$6,89x10^{-4}$
5100	8,54	$4,67x\ 10^{-4}$
5000	8,52	$1,71x10^{-3}$
5600	8,63	$5,17x10^{-3}$
5100	8,54	$4,67x10^{-4}$
5200	8,56	$4,78x10^{-6}$

A.2 Test without failure

A.2.1 Example with 3 series

Concentrated load, loading without failure, same Q_d

$$Q_d = \gamma_Q \times Q_k = 1,5 \times 2000 = 3000 \text{ N}$$

With $F_{Rd} = Q_d$, the calculation of the test load gives :

With $\gamma_M = 1,5$ for 3 tests :

$$F_k = \frac{\gamma_M \cdot F_{Rd}}{\eta_D \cdot k_{mod}} = \frac{1,5 \times 3000}{1,1 \cdot 0,9} = 4545 \text{ N}$$

Conclusion : When loading 3 steps with F_k ,the step is validated for an use in a category A building if no failure occurs.

A.2.2 Example with 10 series

$$Q_d = \gamma_Q \times Q_k = 1,5 \times 2000 = 3000 \text{ N}$$

With $F_{Rd} = Q_d$, the calculation of the test load gives :

With $\gamma_M = 1,3$ for 10 tests :

$$F_k = \frac{\gamma_M \cdot F_{Rd}}{\eta_D \cdot k_{mod}} = \frac{1,3 \times 3000}{1,1 \cdot 0,9} = 3940 \text{ N}$$

Conclusion : When loading 10 steps with F_k ,the step is validated for an use in a category A building if no failure occurs.

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