TECHNICAL REPORT

Determination of impact resistance of panels and panel assemblies

TR 001
Edition February 2003

EUROPEAN ORGANISATION FOR TECHNICAL APPROVALS

Determination of impact resistance of panels and panel assemblies

Edition February 2003

Foreword

EOTA Technical Reports are developed as supporting reference documents to European Technical Approval Guidelines and can also be applicable to a Common Understanding of Assessment Procedures, an EOTA Comprehension Document or an European Technical Approval, as far as reference is made therein.

EOTA Technical Reports go into detail in some aspects and express the common understanding of existing knowledge and experience of the EOTA bodies at a particular point in time.

Where knowledge and experience is developing, especially through approval work, such reports can be amended and supplemented.

When this happens, the effect of the changes upon the European Technical Approval Guidelines will be laid down in the relevant comprehension documents, unless the European Technical Approval Guideline is revised.

This EOTA Technical Report has been prepared by the EOTA Working Groups 02.05/01 – "Cold storage room kits" and 04.01/04 – "Self-supporting light weight composite panels" and endorsed by EOTA.

1 Introduction

This Technical Report has been developed in the knowledge that ISO/DIS 7893 may be withdrawn and that recent Working Group discussions have lead to improvements to or clarifications of the test procedure, which are considered necessary in the framework of the Construction Products Directive (89/106/EEC).

Although the Technical Report has been developed specifically for the assessment of (composite) panel products and assemblies the test method can also be useful for other products.

Panels, with or out of glass, are not covered by this Technical Report.

In the framework of this Technical Report, panels are considered to be factory-made rigid products of rectangular shape and cross section, in which the thickness is uniform and substantially smaller than the other dimensions. They may be composed of layers of different materials (e.g. one or two faces and a core material), may contain reinforcement (e.g. ribs, studs) and may include finishings (e.g. paints, coatings).

Building elements, depending on their location and use, are subjected to impact.

Impacts have varying characteristics and they occur with varying frequency. They may have an effect on the elements as a whole or may only have a local effect at the place of impact, or both.

The Technical Report distinguishes between "Safety in use" and "Serviceability" assessment.

In Annex A to this Technical Report, recommendations have been given on the impact load and the number of impacts per test.

In the framework of the Construction Products Directive, "Safety in use" is referred to as Essential Requirement 4 (ER4) and is specified in Interpretative Document No 4. Under ER4, impact concerns:

- impacts/collisions, etc. between users and those elements or parts of the work, which are normally subject to contact or manipulation (e.g. doors, windows, automatic garage doors, etc.);
- impacts/collisions, etc. between users and parts of the work as a result of accidents (e.g. such as falling through a brittle element) or particular circumstances (e.g. failure of lighting);
- impacts of falling objects, forming part of the work, upon users.

Apart from the safety aspect, impact should also be looked at from a "serviceability" point of view, i.e. the possible effects of impacts on the serviceability of the element (e.g. watertightness, water-vapour or gas tightness, ...).

No existing EOTA Technical Report is superseded by this Technical Report.

1 Scope

The TR specifies test methods for impact resistance of panel and panel assemblies and recommendations for their use.

The requirements should be incorporated in the appropriate ETA Guideline.

2 Test method for determining soft body impact resistance

2.1 Principle

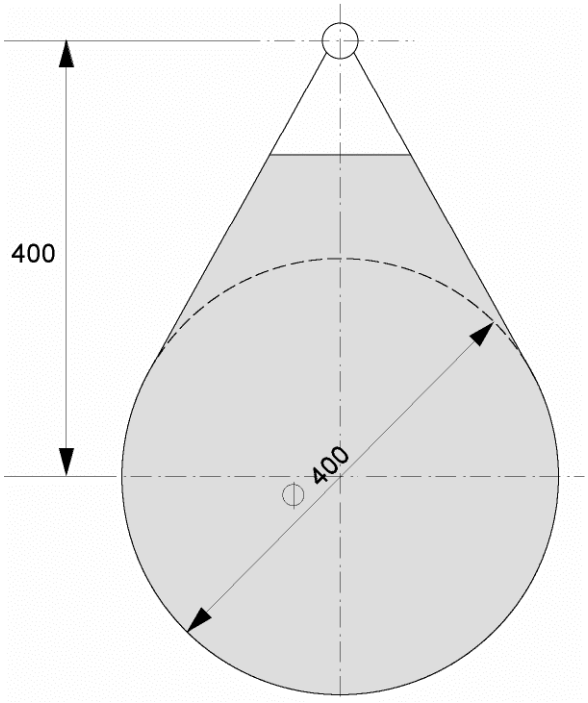
The soft body impact test simulates an impact resulting from a person accidentally falling against the panel.

The soft body is dropped from a height, creating an impact energy, which corresponds with the impact energy released by a person.

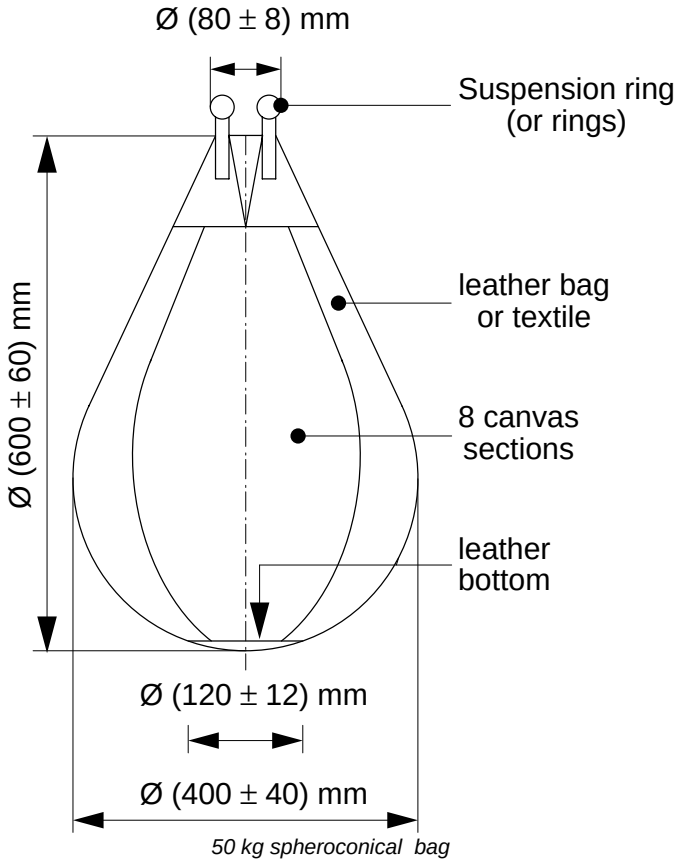
The test is conducted with reference to safety in use, i.e. verification whether the panel or panel assemblies would prevent a person falling through, and to serviceability, i.e. verification whether they would still perform as intended.

2.2 Test apparatus

The soft body impactor should be a spherical canvas bag of diameter 400 mm (± 40) (see Figure 1) filled with 3.0 mm (± 0.3) diameter glass spheres to give a total weight of 50 kg (± 0.5).



Theoretical size of the bag



50 kg spheroconical bag

Figure 1 – Soft body impactor

2.3 Number of tests

2.3.1 Serviceability impact resistance

The test shall be carried out on one test assembly, and generally consists of at least three impacts with the same energy at about the same point of impact. The point of impact should be the one deemed most onerous for the assembly under examination.

If various impact energies are being tested, new assemblies should be tested for each impact energy.

2.3.2 Safety in use impact resistance

The test shall be carried out on one test assembly, and consists of one impact.

The point of impact should be the one deemed most onerous for the assembly under examination.

If various impact energies are being tested, new assemblies should be tested for each level of impact energy.

Note - The serviceability and safety in use impact test should not be carried out on the same assembly, unless the ETA-applicant of the test so wishes.

2.2 Conditioning and test conditions

The panel conditioning shall be recorded, where required.

The conditioning period, if any, shall be agreed between the ETA-applicant and the Approval Body.

The test shall be carried out in normal laboratory circumstances.

2.3 Test assembly

The panels shall be mounted in accordance with the manufacturer's installation specifications, with regard to the intended use (floor, wall or ceiling panel), so that the test assembly corresponds as much as possible with end use conditions.

The manner in which components are fixed to each other shall reproduce actual conditions of use, particularly with respect to the nature, type and position of the fixings and the distance between them.

If the manufacturer's specifications foresee more than one possible end-use assembly, the Approval Body should at least perform the test on the most onerous one.

The manufacturer has the possibility to test additional assemblies, if he claims better performance.

In principle, the most onerous assembly shall be:

- panel: the panel with the highest ratio length (or height) over width in its minimum thickness;
- span: maximum distance between supports.

2.4 Test procedure

In this test, the soft body impactor, with mass (m) is dropped from a height (h), so that the total impact energy (E = g x h x m) corresponds with one of the following energies E in Nm: 60, 100, 120, 130, 200, 240, 300, 400, 500, 600, 700, 900 and 1200.

Note - In most cases g = 9,81 m/s

The height (h) is measured between the designated point of impact and the height of release of the soft body impactor.

For tests conducted on wall assemblies the angle α shall always be smaller or equal to 65° (see Figure 2).

The bag is held vertically when released (not horizontally).

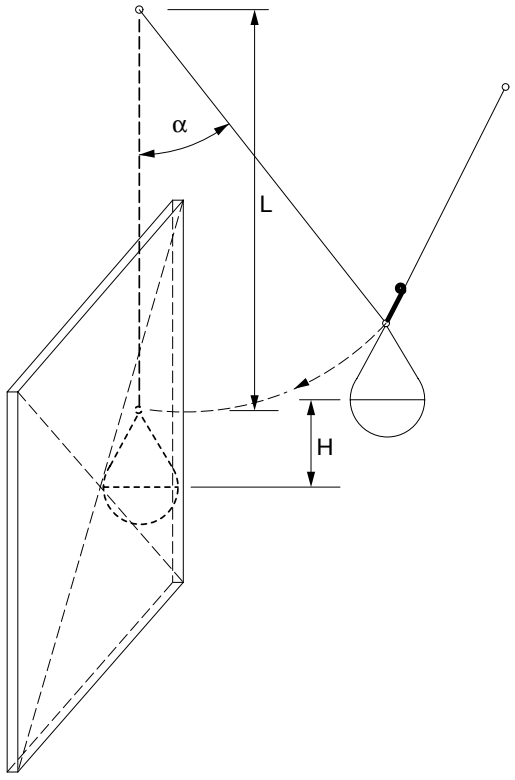


Figure 2 – Impact on vertical assembly
h = drop height; L = lenght rope; a = 65°

For ceiling and floor assemblies, the test is performed on a horizontal assembly (see Figure 3).

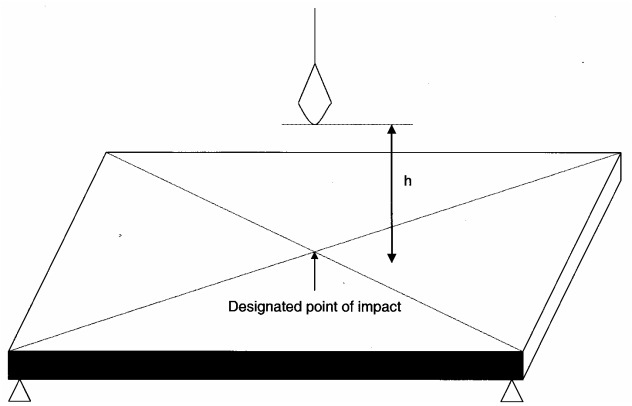


Figure 3 – Vertical impact on horizontal assembly
h = drop height

2.5 Expression of test results

The test result is pass/fail, depending on whether the panel assemblies meet the following combined criteria:

For safety in use:

- no collapse: the test result is favourable when, after the test, the panel or assembly maintains its mechanical integrity and is still capable of carrying its own weight in the tested position;
- no penetration: the test result is favourable when, after the test, the impactor has not passed through the test specimen;
- no projection: the test result is favourable when, after the test, the impactor has not created parts of the panel (e.g. core, face, reinforcement) to project from the face of the panel, on the other side of the specimen than the impact side, creating sharp cutting edges or surfaces likely to cause personal injury by contact.

For serviceability:

- no penetration: the test result is favourable when, after the test, the impactor has not penetrated the face of the test specimen on the impact side of the specimen.
- no degradation: the test result is favourable when, after the test, there are no visible (to the naked eye) cracks, depressions, protuberances or any other defects in the materials, which may influence the fitness for use of the panel or assembly. Deformations, which only affect the appearance, are allowed, but should be mentioned in the test report.

For serviceability, the residual deflection after each impact shall be reported.

The residual deflection shall be reported five minutes after the impact (in mm).

In a favourable test result, the report shall indicate any damage (e.g. localized surface cavities of small dimensions, scratches, wear marks in the form of grooves, etc.).

For extended application of the test results, the general rule is that test results for the most onerous assembly can be used to reflect the behaviour of others.

Note - A list of products that are "deemed-to-satisfy without the need for testing" should be established in an accompanying comprehension document to the ETA Guideline.

2.6 Test report

The test report shall include:

- reference to clause 2 of this Technical Report;
- the name of the testing laboratory;
- the name of the ETA applicant (and manufacturer of the panel);
- date of the test;
- description of the test instruments;
- identification of the product tested (designation, dimensions and any relevant identification characteristic);
- surface structure (e.g. smooth, profiled, structured, ..);
- description of the sample tested, and reference to its marking;
- description of conditioning and preparation of the sample (if any);
- description of test conditions (temperature and RH), where required;
- results of the test, including a description of damage (if any).

3 Test methods for determining hard body impact resistance

3.1 Principle

The hard body impact test simulates the impact, resulting from an object accidentally falling against the panel.

The hard body is dropped from a height, creating an impact energy, which corresponds with the impact energy released when furniture or similar objects with the panel.

The test is conducted with reference to safety in use, i.e. verification whether the panel or panel assemblies would prevent an object falling through, and to serviceability, i.e. verification whether they would still perform as intended (e.g. with reference to water vapour tightness).

3.2 Test apparatus

For safety in use, the hard body impactor should be a steel ball, with a diameter of 63.5 mm (± 1), with a mass of 1030 g (± 40) (1 kg steel ball).

For serviceability, it should be a steel ball, with a diameter of 50 mm (± 0.5), with a mass of 514 g (± 19) (0.5 kg steel ball).

3.3 Number of tests

3.3.1 Serviceability impact resistance

The test shall be carried out on one test panel, and generally consists of at least three impacts at approximately the same point of impact.

The point of impact should be the one deemed most onerous for the assembly under examination.

3.3.2 Safety in use impact resistance

The test shall be carried out on one test panel, and consists of one impact.

The point of impact should be the one deemed most onerous for the assembly under examination.

Note - The serviceability and safety in use impact test should not be carried out on the same panel, unless the ETA-applicant of the test so wishes.

3.4 Conditioning and test conditions

The panel conditioning shall be recorded, where required. The conditioning period, if any, shall be agreed between the ETA applicant and the Approval Body.

The test shall be carried out in normal laboratory circumstances.

3.5 Test assembly

The panel shall be horizontally positioned on supports (see Figure 4), to allow, in case of an unfavourable test result, the possibility of the impactor going completely through the panel.

The most onerous point of impact should be chosen.

In most cases this will be the centre of the panel, but, for panels with reinforcement (studs, stiffening ribs, etc.) behind a relatively weak face, the most onerous impact position is 25 mm (± 2) from the edge of the reinforcement.

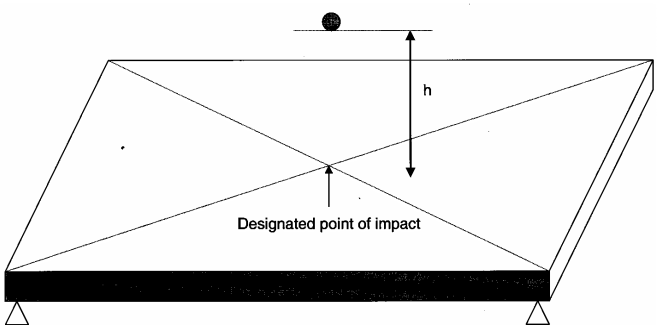


Figure 4 – Assembly for hard body impact test

3.6 Test procedure

In this test, the hard body impactor with mass (m) is dropped from a height (h), so that the total impact energy (E = g x h x m) corresponds with one of:

- hard body impact test (1 kg steel ball): 3 Nm or 10 Nm;
- hard body impact test (0.5 kg steel ball): 1.3 Nm; 2.5 Nm; 3.75 Nm or 6 Nm.

Note - In most cases g = 9,81 m/s.

The height (h) is measured between the designated point of impact and the height of release of the hard body impactor.

3.7 Expression of test results

The test result is pass/fail, depending on whether the panel assemblies meet the following combined criteria:

Safety in use:

- no collapse: the test result is favourable when, after the test, the panel or assembly maintains its mechanical integrity and is still capable of carrying its own weight in the tested position;
- no penetration: the test result is favourable when, after the test, the impactor has not passed the test specimen;
- no projection: the test result is favourable when, after the test, the impactor has not created parts of the panel (e.g. core, face, reinforcement) to project from the face of the panel, on the other side of the specimen than the impact side, creating sharp cutting edges or surfaces likely to cause injury by contact.

Serviceability:

- no penetration: the test result is favourable when, after the test, the impactor has not penetrated the face of the test specimen on the impact side of the specimen;
- no degradation: the test result is favourable when, after the test, there are no visible (to the naked eye) cracks, depressions, protuberances or any other defects in the materials, which may influence the fitness for use of the panel or assembly. Deformations, which only affect the appearance, are allowed, but should be mentioned in the test report.

For serviceability, the diameter and maximum indention after each impact and the residual diameter and indention shall be reported (in mm).

In a favourable test result, the report shall indicate any damage (e.g. localized surface cavities of small dimensions, scratches, wear marks in the form of grooves, etc.).

For extended application of the test results, the general rule is that test results for the most onerous assembly can be used to reflect the behaviour of others.

Note: A list of products that are "deemed-to-satisfy without the need for testing" shall be established in an accompanying comprehension document.

3.8 Test report

The test report shall include:

- reference to the clause 3 of this Technical Report;
- the name of the testing laboratory;
- the name of the ETA Applicant (and manufacturer of the panel);
- date of the test;
- description of the test instruments;
- identification of the product tested (designation, dimensions and any relevant identification characteristic);
- surface structure (e.g. smooth, profiled, structured, …);
- description of the sample tested, and reference to its marking;
- description of conditioning and preparation of the sample (if any);
- description of test conditions (temperature and RH), where required;
- results of the test, including a description of damage (if any).

Annex A

Recommendations on the use of this

Technical Report

This Annex provides information regarding the known energy levels used for impact resistance tests in EEA countries, at the time of writing.

In some cases, several energy levels have been identified, depending on the regulatory requirements in different countries.

A.1 Internal walls

Safety in use

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	1	100 - 200 - 300 - 400 or 500	no collapse and no penetration and no projection
Hard body impact	1	1	10	

Note - For soft body impact, depending on the use of the space the product encloses, the following types may be foreseen:

Type I: Zones accessible primarily to those with high incentive to exercise care. Small risk of accidents occurring and of misuse (100 Nm).

Type II: Zones accessible primarily to those with some incentive to exercise care. Some risk of accidents occurring and of misuse (200 Nm).

Type III: Zones readily accessible to public and others with little incentive to exercise care. Risk of accidents occurring and of misuse (300 Nm).

Type IV: Zones and risk as II and III. In case of failure, risk includes the fall to a floor at a lower level (400 or 500 Nm, depending on regulatory requirements)

Serviceability

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	3	60 or 120	no penetration and no projection
Hard body impact	0.5	3	2,5 * or 6 **	

Note:

* *Zones I and II as indicated in the note above*

** *Zones III and IV as indicated in the note above.*

A.2 External walls

Safety in use

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	1	700 or 900	no collapse and no penetration and no projection
Hard body impact	1	1	10	

Serviceability

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	3	100 - 130 - 300 or 400	no penetration and no degradation
Hard body impact	0.5	3	1 - 3 or 6	

A.3 Roofs/Ceilings

Safety in use

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	1	900 or 1200	no collapse and no penetration and no projection
Hard body impact	1	1	10	

Serviceability

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	1* / 5**	700	no penetration and no degradation
Hard body impact	0.5	1	5* - 10**	

* Roofs, accessible for installation and maintenance only

** Accessible roofs

A.4 Floors

Safety in use

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	1	no recommendation available	no collapse and no penetration and no projection
Hard body impact	1	1		

Serviceability

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	3	no recommendation available	no penetration and no degradation
Hard body impact	0.5	3		

Annex B

References

B.1 References to clause 2

This test method is derived from the following reference documents:

- ISO 7892:1988 Vertical Building Components - Impact Resistance - Impact Bodies and general Test Procedures.
- ISO/DIS 7893:1990 Performance Standards in Building - Partitions made from Components - Impact Resistance Tests.
- M.O.A.T. No 43:1987 UEAtc Directives for Impact Testing - Opaque Vertical Building Components.
- ETA Guideline 003 Internal Partition Kits.
- EN 1195:1998 Timber structure - Test methods - Performance of structural floor decking.
- Nordtest Build 493 Resistance to Impact from a large soft body.

B.2 References to clause 3

This test method is derived from the following reference documents:

- ISO 7892:1988 Vertical Building Components - Impact Resistance - Impact Bodies and general Test Procedures.
- ISO/DIS 7893:1990 Performance Standards in Building - Partitions made from Components - Impact Resistance Tests.
- M.O.A.T. No 43:1987 UEAtc Directives for Impact Testing - Opaque Vertical Building Components.
- ETA Guideline 003 Internal Partition Kits.