
**Razširjena uporaba rezultatov preskusov požarne odpornosti - Nenosilne stene - 7.
del: Stene iz kovinskih sendvič panelov**

Extended application of results from fire resistance tests - Non-loadbearing ceilings —
Part 7: Metal sandwich panel construction

Erweiterter Anwendungsbereich der Ergebnisse von Feuerwiderstandsprüfungen -
Nichttragende Unterdecken - Teil 7: Sandwichelemente in Metallbauweise

Application étendue des résultats d'essais de résistance au feu - Plafonds non porteurs
Panneaux sandwichs métalliques pour la construction - Partie 7 : Panneaux
sandwichs métalliques pour la construction

Ta slovenski standard je istoveten z: EN 15254-7:2012

ICS:

13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements
91.060.10	Stene. Predelne stene. Fasade	Walls. Partitions. Facades

SIST EN 15254-7:2012**en,fr,de**

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 15254-7

June 2012

ICS 13.220.50; 91.060.30

English Version

Extended application of results from fire resistance tests - Non-loadbearing ceilings - Part 7: Metal sandwich panel construction

Application étendue des résultats d'essais de résistance au feu - Plafonds non porteurs - Partie 7: Panneaux sandwichés métalliques pour la construction

Erweiterter Anwendungsbereich der Ergebnisse von Feuerwiderstandsprüfungen - Nichttragende Unterdecken - Teil 7: Sandwichelemente in Metallbauweise

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Contents

Page

Foreword.....	3
1 Scope	4
2 Normative references	4
3 Terms, definitions, symbols and abbreviations	4
3.1 Terms and definitions	4
3.2 Symbols and abbreviations	5
4 Establishing the field of extended application	6
4.1 General.....	6
4.2 Assumptions in the extended application	6
4.3 Assumed structural behaviour of a sandwich panel in fire	7
5 Rules for extended applications of the tested product	7
5.1 General.....	7
5.2 Variations in the materials of the product.....	8
5.2.1 General.....	8
5.2.2 Variations in the metal sheets	8
5.2.3 Variations in the adhesive	9
5.2.4 Variations in the core material	10
5.3 Variations in the construction	11
5.3.1 Variations in span length	11
5.3.2 Variations in the panel thickness.....	11
5.3.3 Variations in the joint construction	12
5.3.4 Variations in the boundary conditions and fixing system	12
5.3.5 Length and width of ceiling construction	12
5.4 Interaction between the factor influences.....	12
5.5 Support structure.....	13
5.6 Heating conditions.....	13
6 Small scale tests and calculation methods	13
6.1 Small scale tests	13
6.2 Calculation methods	14
6.2.1 General.....	14
6.2.2 Calculation of strength properties	14
6.3 Additional measurements to be carried out in the reference test.....	14
7 Report of the extended application analysis	14
Annex A (informative) Typical behaviour of a sandwich panel ceiling when exposed to fire.....	16
Annex B (normative) Typical examples of sandwich panel ceiling end fixings to support structure	18
Annex C (normative) Rules and calculation methods for extending the span length of sandwich panel ceilings	19
Bibliography	22

Foreword

This document (EN 15254-7:2012) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2012, and conflicting national standards shall be withdrawn at the latest by December 2012.

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EN 15254 is divided into the following parts:

- EN 15254-2, *Extended application of results from fire resistance tests — Non-loadbearing walls — Part 2: Masonry and Gypsum Blocks*
- EN 15254-4, *Extended application of results from fire resistance tests — Non-loadbearing walls — Part 4: Glazed constructions*
- EN 15254-5, *Extended application of results from fire resistance tests — Non-loadbearing walls — Part 5: Metal sandwich panel construction*
- prEN 15254-6, *Extended application of results from fire resistance tests — Non-loadbearing walls — Part 6: Curtain walling*
- EN 15254-7, *Extended application of results from fire resistance tests — Non-loadbearing ceilings — Part 7: Metal sandwich panel construction*, [the present document]

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, 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, Turkey and the United Kingdom.

EN 15254-7:2012 (E)**1 Scope**

This European Standard defines rules for extended applications, provides guidance, and, where appropriate, specifies procedures, for variations of certain parameters and factors associated with the design of internal non-loadbearing ceilings constructed of metal sandwich panels that have been tested in accordance with EN 1364-2.

This European Standard applies to self-supporting, double skin metal faced sandwich panels which have an insulating core bonded to both facings.

2 Normative references

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

EN 1363-1:2012, *Fire resistance tests — Part 1: General requirements*

EN 1363-2, *Fire resistance tests — Part 2: Alternative and additional procedures*

EN 1364-2:1999, *Fire resistance tests for non-loadbearing elements — Part 2: Ceilings*

EN 1993-1-2, *Eurocode 3. Design of steel structures — Part 1-2: General rules — Structural fire design*

EN 13501-2, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

EN 14509:2006, *Self-supporting double skin metal faced insulating panels — Factory made products — Specifications*

3 Terms, definitions, symbols and abbreviations**3.1 Terms and definitions**

For the purpose of this document, the terms and definitions given in EN 14509:2006, EN 1364-2:1999, EN 1363-1:2012 and the following apply.

3.1.1**direct field of application of test results**

outcome of a process (involving the application of defined rules) whereby a test result is deemed to be equally valid for variations in one or more of the product properties and/or intended end use applications

3.1.2**extended field of application of test results**

outcome of a process (involving the application of defined rules that may incorporate calculation procedures) that predicts, for a variation of a product property and/or its intended end use application(s), a test result on the basis of one or more test results to the same test standard

3.1.3**factor**

one of the possible variations that may be applied to a parameter

3.1.4**factor influence**

one of the potential causes of a change in the fire resistance due to a factor

3.1.5**fastening, fixing**

device that fastens the panels to a support structure or to the test frame

3.1.6**fixing system**

system consisting of fastenings and other possible means used to fasten the panels to a support structure or to the test frame

3.1.7**length of assembly**

length of the ceiling in the span (or panel length) direction in the reference test or in the end use application

3.1.8**width of assembly**

width of the ceiling in the cross direction of the span (or panel length) in the reference test or in the end use application

3.1.9**reference test**

fire resistance test on which the extended application is based and the results of which are used as the main source of data for the extended application

Note 1 to entry: The fire resistance test is in accordance with EN 1363-1 and EN 1364-2 and where applicable EN 1363-2.

3.1.10**stiching**

device for fixing panels to panels in the longitudinal joint

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3.1.11**span length**

center to center distance between two consecutive supports to which the sandwich panel is fixed

3.1.12**support structure**

construction onto which the panel ceiling is fastened in the end use application

3.1.13**test frame**

frame containing the test construction for the purpose of mounting onto the furnace

3.2 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

F_{Ed} catenary force acting on the fasteners

F_v vertical force due at g acting at the fastener

F_{Ed1} catenary force acting at the fastener at maximum temperature in the test

F_{Ed2} catenary force acting at the fastener at temperature for the increased span

F_{v1} vertical force due at g acting at the fastener at maximum temperature in the test

EN 15254-7:2012 (E)

F_{v2}	vertical force due at g acting at the fastener at temperature for the increased span
L	span length
T	temperature
b	width of panel
g	panel weight per square meter
n	number of fasteners
p	relative end movement in the fastener
w	deflection of the ceiling
α	linear coefficient of thermal expansion

4 Establishing the field of extended application**4.1 General**

An extended application analysis is required when the application differs in one or more parameters from the one tested and described in the test report and/or in the classification document, and which is not covered by the field of direct application of the classification document.

The extended application of the sandwich panels used as a non-loadbearing ceiling shall be based on the reference fire test results performed according to EN 1364-2. It may be complemented by one or more additional small or full-scale tests or by historical data. If historical data are used, they shall comply with the rules given in this document.

4.2 Assumptions in the extended application

The following assumptions are considered when evaluating extended applications for sandwich panels:

- the ceiling is required to possess fire resistance in the end-use condition (relevant classes are given in EN 13501-2);
- the ceiling is assumed to be exposed on the entire face of one side (either from above or below) to the standardised heating conditions given in the EN 1363-1 fire resistance test specification;
- the structure to which the ceiling is fixed does not deflect during the fire exposure period; this simulates the non-deflecting nature of the test frame which forms part of the furnace test apparatus;

NOTE In reality constructions deflect and this fact should be taken into account when designing the building and planning the constructional details.

- after delamination of the fire exposed facing, the dead load of the panels is carried by a support structure to which the ends of the sandwich panels are attached; the forces from the dead load will be distributed to the support structure by the panel fixings from which loadbearing capacity shall be evaluated;
- the support structure has at least the same loadbearing capacity, R, of the resistance to fire performance as the sandwich panel ceiling regarding integrity;
- the self weight of the facing and core is calculated from the volume and density of the materials;

- g) the calculation of the reduction in the strength properties of steel at elevated temperature shall be in accordance with EN 1993-1-2.

4.3 Assumed structural behaviour of a sandwich panel in fire

When one face of a sandwich panel assembly is exposed to fire, the following behaviour may be expected. Delamination of the fire-exposed face will occur after a couple of minutes in a fire. After delamination, the flexural strength of the assembly is lost and, unless both faces are restrained at the ends, the panels can collapse. The fastenings for the ends of the panels need to support the dead load of the whole panel for the entire fire resistance period. The behaviour slightly differs depending on the direction of the fire (from above or below). In both cases, the structure acts as a catenary construction.

NOTE Annex A illustrates typical behaviour of panels.

5 Rules for extended applications of the tested product

5.1 General

When performing extended applications for a tested ceiling, changes can occur either in the materials and/or in the construction. Both are dealt with in this standard. Table 1 and Table 2 list the changes which may or may not be made in an extended application assessment. The rules for the changes are either given in Table 1 or Table 2 or in 5.2 and 5.3.

Table 1 — Material changes relevant to extended application

Parameter	Factors	Factor influence on performance		Rules
		Integrity E	Insulation I	
Changes in metal facings	Chemical composition of coating	influence	no influence ^a	5.2.2.1
	Change from coated to non-coated metal	no influence	influence	5.2.2.1
	Sheet thickness	influence	no influence ^a	Valid up to $\pm 50\%$ of tested nominal thickness but no decrease is allowed for thicknesses below 0.5 mm and fixing capacity shall be checked
	Change from one metal to another	influence	influence	5.2.2.2
	Change in sheet geometry	influence	influence	5.2.2.3
Changes in adhesive	Amount	influence	influence	5.2.3
	Type	influence	no influence ^a	5.2.3
Changes in core material	Type	major influence	major influence	5.2.4
	Change in composition	major influence	major influence	5.2.4.2 - 5.2.4.7

^a It is understood that when a change in a factor can influence the integrity of a joint, there is a possibility that a change in leakage of hot gases or in joint geometry can also influence the temperature rise near the joint and therefore influence the insulation rating.

Table 2 — Constructional changes relevant to extended application

Parameter	Factors	Factor influence on performance		Rules
		Integrity E	Insulation I	
Span length	Decrease	no influence	no influence	Allowed
	Increase	influence	no influence ^a	5.3.1
Panel width	Decrease	no influence	no influence	Allowed
	Increase	influence	no influence ^a	Test results valid up to + 20 %
Panel thickness e.g. core thickness	Decrease/increase	influence	major influence	5.3.2
Joint construction	Type	major influence	major influence	5.3.3
	Stiching decreased	influence	influence	Not allowed
	Stiching increased	influence	influence	5.3.3
	Sealants	influence	influence	5.3.3
Fixing system	Type	major influence	no influence ^a	5.3.4
	Amount decreased	major influence	no influence ^a	5.3.4
	Amount increased	influence	no influence ^a	Allowed
	Protection decreased	major influence	influence	5.3.4
	Protection increased	influence	influence	Allowed
Length of assembly	Decrease	no influence	no influence	5.3.5
	Increase	influence	no influence ^a	5.3.5
Width of assembly	Decrease	no influence	no influence	5.3.5
	Increase	no influence	no influence	5.3.5
Support structure	Changes	influence	no influence ^a	5.5

^a It is understood that when a change in a factor can influence the integrity of a joint, there is a possibility that a change in leakage of hot gases or in joint geometry can also influence the temperature rise near the joint and therefore influence the insulation rating.

5.2 Variations in the materials of the product

5.2.1 General

Sandwich panels consist of three main materials: facing metal sheets, adhesive and core material. In the case of auto-adhesively bonded panels, the foamed core material also forms the adhesive layer during the foaming process.

Changes in the components of a panel can have influences on the fire resistance. The rules in Clause 5 apply to such changes.

5.2.2 Variations in the metal sheets

5.2.2.1 Variations in the coatings

The most essential property of the coating with regard to fire resistance is the emissivity on the non-exposed side. Normally the emissivity for a coated steel sheet is between 0,8 and 0,95. A change in emissivity of -10 % for a new coating compared to the tested one is thus allowed if there is at least a 10 % margin in the insulation

test result compared to the I-classification. Test results are always valid for coatings with higher emissivity values compared to the tested one. When a change in coating is made, the manufacturer of the coated sheet shall provide emissivity properties for the products.

A non-coated metal sheet can have an emissivity as low as 0,1. A change from a coated to a non-coated sheet is therefore not allowed. The same rule specified above for coatings applies also in this case. A decrease in emissivity of 10 % is allowed if the emissivities of the different sheets are known.

For changes in emissivity >10 %, surface temperatures can be estimated from small-scale tests in accordance with 6.1 where the surface temperatures of the new panel are compared to the one tested in the reference scenario. If appropriate calculation methods are available, the surface temperatures can also be calculated and compared, provided that temperature-dependent thermal resistance values for the core material are available.

The energy content of the coating on the exposed side is small and will not affect the fire resistance properties of the sandwich panel. Test results are valid for all coatings.

If modifications in the coatings on the non-exposed side are made, compared to the tested one, the ignitability of the modified coating shall be higher or equal to that tested. This can be checked by conducting small-scale tests according to 6.1. Test results are valid for all colours of the same type of coating.

5.2.2.2 Variations in the metal material

The following rules are valid for extended applications.

- 1) The test results are valid for all grades of tested normal steel, and if once tested as stainless steel for all grades of stainless steel. (A change from mild steel to stainless steel is not possible without conducting further tests.)
- 2) For other types of metals, the test result is valid for tested type only.
- 3) For panels with perforated facings on one or both sides of the panels, a test result achieved with a perforated facing is always valid for non-perforated facings in the same position as in the tested product. Test results for a product tested with non-perforated facings are valid only for a product with perforated facings on the fire exposed side where the perforation area is not greater than 25 % and where the reaction to fire class of the core material is A2-s1, d0 or better. Other changes are not allowed.

5.2.2.3 Changes in profile geometry of facing

The following rules are valid for extended applications.

- 1) For flat or small profiling (between 0 mm and 5 mm): test results are valid for any change.
- 2) For profiles greater than 5 mm: test results are valid for variations + 50 % of profile depth.

5.2.3 Variations in the adhesive

This paragraph is valid only for panels with adhesively bonded cores. The following rules apply for an adhesive with no strength at high temperatures (> 500 °C) which means that the metal sheet on the exposed side will disconnect from the core in the very beginning of a fire and the construction will lose its sandwich capability. For this reason, an organic adhesive cannot be changed to a non-organic one or vice versa.

Normally the energy content of the adhesive is small and will not affect the fire resistance properties of the sandwich panel. The following rules are valid for extended applications.

- 1) For gross calorific potential PCS value 0 MJ/m² to 4 MJ/m²: the results are valid for all adhesives when gross calorific potential PCS value stays between 0 MJ/m² and 4 MJ/m².