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**GYPSUM PLASTERBOARDS
FOR LOAD-BEARING APPLICATIONS**

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1 SCOPE OF THE EAD

1.1 Description of the construction product

Gypsum plasterboards for load-bearing applications are composed of a reinforced gypsum plaster core encased in, and firmly bonded to paper liners to form flat rectangular boards. The nominal thickness of the gypsum plasterboards amounts from 12.5 mm to 20.0 mm.

Board types DEFH1IR or better according to EN 520 are considered within this EAD.

The product is not fully covered by the following harmonised technical specification: EN 520

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

The use considerations for walls according to Annex 2 shall be considered.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document, shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The gypsum plasterboards are used for load bearing applications as system components for drywall constructions (e.g. on wooden based or steel based substructures).

The gypsum plasterboards are intended to be used in service classes 1 and 2 according to EN 1995-1-1.

The substructure is not part of the product.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the gypsum plasterboard for the intended use of 50 years when installed in the works provided that the gypsum plasterboard is subject to appropriate installation (see 1.1). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works¹.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

¹ The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of the gypsum plasterboards for load-bearing applications is assessed in relation to the essential characteristics.

Table 1 Essential characteristics of the product and assessment methods and criteria for the performance of the product in relation to those essential characteristics

No	Essential characteristic	Method of assessment	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability ¹⁾			
1	Bending strength ^{2) 3)}	2.2.1.1	Level
2	Shear strength ³⁾	2.2.1.2	Level
3	Compression strength ^{2) 3)}	2.2.1.3	Level
4	Tensile strength ³⁾	2.2.1.4	Level
5	Racking strength and stiffness ³⁾	2.2.1.5	Description
6	Embedding strength	2.2.1.6	Level
7	Creep and duration of the load	2.2.1.7	Level
8	Structure of the cohesion of the core at high temperature	2.2.1.8	Description
9	Dimensions	2.2.1.9	Description
10	Dimensional stability	2.2.1.10	Description
11	Density	2.2.1.11	Level
12	Surface hardness	2.2.1.12	Description
Basic Works Requirement 2: Safety in case of fire			
13	Reaction to fire	2.2.2.1	Class
Basic Works Requirement 3: Hygiene, health and the environment			
14	Content, emission and/or release of dangerous substances	2.2.3.1	Description
15	Water vapour permeability – Water vapour transmission	2.2.3.2	Level
16	Water absorption	2.2.3.3	Level
Basic Works Requirement 4: Safety and accessibility in use			
17	Hard body impact	2.2.4.1	Description

Basic Works Requirement 6: Energy economy and heat retention			
18	Thermal conductivity	2.2.5.1	Level
1)	This characteristic also relates to BWR 4.		
2)	Load bearing capacity and stiffness regarding mechanical actions perpendicular to the gypsum plasterboard.		
3)	Load bearing capacity and stiffness regarding mechanical actions in plane of the gypsum plasterboard.		

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

Characterisation of products to be assessed shall be done in accordance with available specifications, notably

- Thickness of the gypsum plasterboard
- Density of the gypsum plasterboard

2.2.1 Mechanical resistance and stability

2.2.1.1 Bending strength

Bending strength and the bending modulus of elasticity perpendicular to the plane of the boards and in plane of the boards shall be determined according to Annex 1. Testing shall be performed after storage under climatic conditions of 20°C and 65% humidity.

Tests with vector of momentum in direction of production and perpendicular to direction of production of the gypsum plasterboards shall be performed.

The characteristic values shall be determined in accordance with EN 14358.

The provisions of EN 520 regarding board type R must be met.

The declared value of the bending strength and bending modulus of elasticity perpendicular to and in plane of the gypsum plasterboards shall be given in the ETA.

2.2.1.2 Shear strength

Shear tests shall be performed following EN 789, Clause 10 and Annex B, whereas the dimensions of the specimen shall be $w \times L \times t = 500 \text{ mm} \times 600 \text{ mm} \times t \text{ mm}$. Side bars are fixed on the specimen which is finally fixed into the testing machine under an angle of 14°. Two displacement sensors are placed centric on opposite sides in direction of the compression diagonal with a measuring length of 200 mm. The load F is applied at a constant rate of loading so that the maximum load is achieved within $(300 \pm 120) \text{ s}$.

Tests shall be performed on specimen orientated in direction of production as well as perpendicular to direction of production of the gypsum plasterboards.

Evaluation of the shear strength and the shear modulus of elasticity shall be performed according to EN 789.

The characteristic values shall be determined in accordance with EN 14358.

The declared value of the shear strength and shear modulus of elasticity shall be given in the ETA.

2.2.1.3 Compression strength

Compression tests perpendicular to the plane of the boards and in plane of the boards shall be performed according to EN 789.

Tests shall be performed on specimen orientated in direction of production as well as perpendicular to direction of production of the gypsum plasterboards.

Evaluation of the compressive strength and the compressive modulus of elasticity perpendicular to the plane of the boards and in plane of the boards shall be performed according to EN 789.

The characteristic values shall be determined in accordance with EN 14358.

The declared value of the compressive strength and compressive modulus of elasticity perpendicular to and in plane of the gypsum plasterboards shall be given in the ETA.

2.2.1.4 Tensile strength

Tension tests in plane of the boards shall be performed following EN 789, whereas the dimensions of the specimen shall be $w \times L \times t = 50 \text{ mm} \times 350 \text{ mm} \times t \text{ mm}$ with a sample reduction to 30 mm width in the middle.

Tests shall be performed on specimen orientated in direction of production as well as perpendicular to direction of production of the gypsum plasterboards.

Evaluation of the tensile strength and the tensile modulus of elasticity in plane of the gypsum plasterboards shall be performed according to EN 789.

The characteristic values shall be determined in accordance with EN 14358.

The declared value of the tensile strength and tensile modulus of elasticity in plane of the gypsum plasterboards shall be given in the ETA.

2.2.1.5 Racking strength and stiffness

Shear tests shall be performed according to EN 594. At least two configurations with the minimum and maximum number of fasteners shall be tested.

The load deflection curve shall be recorded. Afterwards the static failure load shall be determined according to EN 594.

The tests shall be carried out under normal conditions of regular application.

The racking resistance and stiffness of timber frame wall panels shall be compared with the results of the calculation method according to EN 1995-1-1, chapter 9.2.4. If no correspondence with the above mentioned design procedure can be proved, the causes are to be ascertained and necessary modifications of the design procedure in the evaluation report are to be explained.

2.2.1.6 Embedding strength

The embedding strength shall be evaluated according to EN 383.

The declared value of the embedding strength shall be given in the ETA.

2.2.1.7 Creep and duration of the load

Design for duration of load and creep can be undertaken in accordance with EN 1995-1-1 by using the following factors:

	k_{mod}					
	Service class	Load duration class				
		Permanent action	Long action	Medium action	Short action	Very short action
Hard gypsum plasterboards	1	0.2	0.4	0.6	0.8	1.1
	2	0.15	0.3	0.45	0.6	0.8

	k_{def}	
	Service class	
	1	2
Hard gypsum plasterboards	3.0	4.0

As an alternative, the deformation and modification values may be evaluated according to EN 1156 with the provisions and specimen according to Annex 3.

The numeric value for k_{mod} and k_{def} shall be given in the ETA for the relevant service class and duration of load.

Alternatively, evaluation of the deformation and modification values according to EN 1156 and EN 1990. The expected time of use according to EN 1990, Table 5.1, shall be 50 years. The declared values of the deformation and modification values shall be given in the ETA. It is also possible to give a formula to express the characteristic value in the ETA.

2.2.1.8 Structure and cohesion of the core at high temperatures

Evaluation according to EN 520, Clause 5.10.

According to EN 520 for board type F, no failure shall occur during testing of the 6 samples.

2.2.1.9 Dimensions

The dimensions of the gypsum plasterboards shall be determined and declared for the specific board type according to EN 520.

2.2.1.10 Dimensional stability

Thickness and density of the gypsum plasterboard shall be evaluated following EN 323. Determination of the moisture content following EN 322, alternatively according to EN 520.

Evaluation of the dimensional stability shall be executed under EN 326-1, alternatively according to EN 520.

Testing of the effects of shrinkage and swelling shall be done in accordance with EN 318.

The dimension stability measured as shrinkage and swelling of the gypsum plasterboard shall be declared.

2.2.1.11 Density

The density is to be determined and declared according to EN 520.

According to EN 520 the minimum density for board type D is 800 kg/m³.

2.2.1.12 Surface hardness

Evaluation and declaration according to EN 520, Clause 5.12.

According to EN 520 the diameter of the impression for board type I must be ≤ 15 mm.

2.2.2 Safety in case of fire

2.2.2.1 Reaction to fire

The gypsum plasterboard is considered to satisfy the requirements for performance class A2-s1,d0 of the characteristic reaction to fire in accordance with the EC Decision 2006/673/EC² without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.

Therefore the performance of the product is A2-s1,d0.

When the product does not meet the provisions of EC Decision 2006/673/EC, the gypsum plasterboard shall be tested, using the test method(s) relevant for the corresponding reaction to fire class, in order to be classified according to EN 13501-1, taking into account the provisions of EN 520, Annex B.

2.2.3 Hygiene, health and environment

2.2.3.1 Content, emission and/or release of dangerous substances

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer using the following methods and criteria:

- EOTA TR034: "General Checklist for EADs/ETAs - Content and/or release of dangerous substances in products".

² OJEU L 276 of 7 October 2006
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2.2.3.2 Water vapour permeability – water vapour transmission

Evaluation and declaration according to EN ISO 12572.

According to EN 520 the determined water vapour transmission μ for gypsum plasterboards of board type E must be ≤ 25 .

2.2.3.3 Water absorption

Evaluation and declaration according to EN 520.

The provisions of EN 520 regarding board type H1 must be met.

2.2.4 Safety and accessibility in use

2.2.4.1 Hard body impact

Evaluation and declaration according to EN 1128.

2.2.5 Energy economy and heat retention

2.2.5.1 Thermal conductivity

Evaluation and declaration according to EN 520.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance

For the product covered by this EAD the applicable European legal act is: 1995/467/EC of the European Commission³ as amended by 2001/596/EC⁴ and 2002/592/EC⁵

The systems to be applied are:

- 1 for products/materials for which a clearly identifiable stage in the production process results in any improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material)
- 3 in regular case, and
- 4 for products/materials that do not require to be tested for reaction to fire

³ OJEU L 268 of 3 February 1999

⁴ OJEU L 209/33 of 2 August 2001

⁵ OJEU L 192/57 of 20 July 2002

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the process of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]*					
1	Visual inspection of gypsum plasterboards for load-bearing applications	1)	1)	100 %	—
2	Thickness of gypsum plasterboard	EN 520	EN 520	see 2.2 / test standard	for every type of gypsum plasterboard after onset of production
3	Density	EN 520	See 2.2.1.11	see 2.2 / test standard	
4	Water vapour permeability – Water vapour transmission	EN ISO 12572	EN 520, Type E	3	once per year
5	Bending strength and E-modulus regarding mechanical actions perpendicular to the gypsum plasterboard 1)	EN 520	1)	3	for every type of gypsum plasterboard after onset of production
6	Mass per unit area and content of organic additives in paper layers	EN 520	EN 520	EN 520	once per year
7	Reaction to fire of core and control of organic additives in the core	EN 13501-1	class according to EN 13501-1	see test standard referred to in EN 13501-1	once per year

1) According to the specifications and configurations of the gypsum plasterboards.

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the process of assessment and verification of constancy of performance for gypsum plasterboards are laid down in Table 3.

Table 3 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control (for system 1 only)					
1	The notified body shall ascertain that, in accordance with the test plan, the manufacturing plant of the single product manufacturer, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous and orderly manufacturing of the gypsum plasterboard according the European Technical Assessment.				—
Continuous surveillance, assessment and evaluation of factory production control (for system 1 only)					
2	It shall be verified that the system of factory production control and the specified manufacturing process are maintained taking account of the test plan.				2/year

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EOTA TR034 (2012-03): EOTA Technical Report for General ER 3 Checklist for ETAGs/CUPAs/ETAs-Content and/or release of dangerous substances in products/kits

ETAG 011 (2002-01): Guideline for European technical approvals for Light Composite Wood based Beams and Columns

EN 318: Wood based panels – Determination of dimensional changes associated with changes in relative humidity

EN 322: Wood-based panels – Determination of moisture content

EN 323: Wood-based panels - Determination of density

EN 326-1: Wood-based panels – Sampling, cutting and inspection – Part 1: Sampling and cutting of test pieces and expression of test results

EN 383: Timber structures — Test methods — Determination of embedment strength and foundation values for dowel type fasteners

EN 520: Gypsum plasterboards — Definitions, requirements and test methods

EN 594: Timber structures — Test methods — Racking strength and stiffness of timber frame wall panels

EN 789: Timber structures – Test methods – Determination of mechanical properties of wood based panels

EN 1128: Cement-bonded particleboards - Determination of hard body impact resistance

EN 1156: Wood based panels – Determination of duration of load and creep factors

EN 1990: Eurocode: Basis of structural design

EN 1995-1-1: Eurocode 5 – Design of timber structures – Part 1 1: General – Common rules and rules for buildings

EN 13501-1: Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 14358: Timber structures — Calculation of characteristic 5-percentile values and acceptance criteria for a sample

EN ISO 12572: Hygrothermal performance of building materials and products – Determination of water vapour transmission properties

ANNEX 1 DETERMINATION OF BENDING STRENGTH AND BENDING MODULUS OF ELASTICITY

Anx 1.1 General

The bending strength and the bending modulus of elasticity perpendicular to the plane of the board and in plane of the board shall be determined parallel and perpendicular to the production direction under normal climatic conditions of 20 °C at 65 %.

Anx 1.2 Sampling and making of samples

The gypsum plasterboards used for testing shall correspond to the average of the production. From these gypsum plasterboards 30 perpendicular board strips per production direction shall be cut off having the dimensions listed below. The cutting edges shall be placed perpendicular to the plane of the board. When cutting the samples a minimum distance of 200 mm off the edge and 100 mm away from the next sample shall be kept. The samples shall be marked.

Number of samples: 30 pieces / production direction

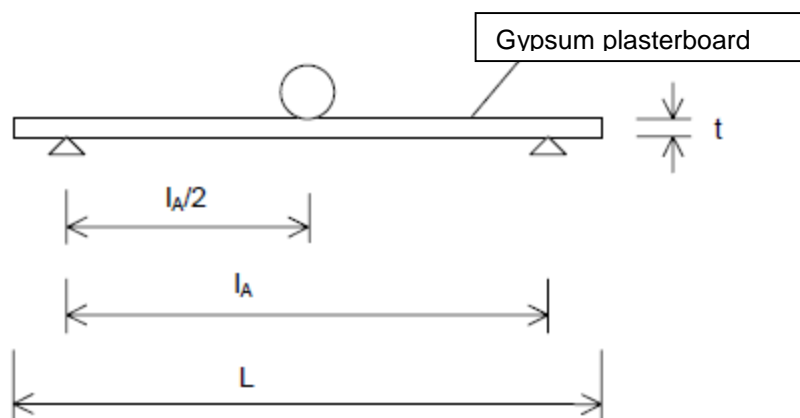
Dimensions: $w \times L \times H$

	Width w	Span l_A	Length L	Height H
	mm	mm	mm	mm
Bending perpendicular to the plane of the board	400	$40 \times t$	$l_A + 100$	t
Bending in plane of the board	t	$20 \times t$	$l_A + 100$	$3 \times t$

t ... nominal thickness of gypsum plasterboard

Anx 1.3 Assembly of the tester

The board strips are placed in a bending test machine on which the load of the strip acting as test load shall be placed in the middle of the span and depending on the production direction placed parallel or perpendicular to the direction of the fibre.



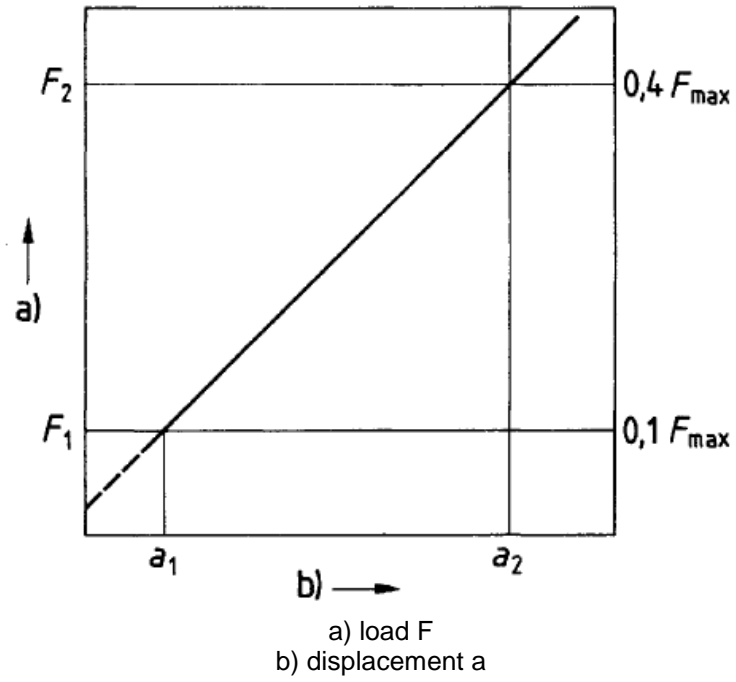
Anx 1.4 Bending test

The load F is applied at a constant rate of loading so that the maximum load is achieved within (300 ± 120) s. Hereby, the mean value is about 300 s for one sample. The load-displacement curve shall be recorded continuously until the ultimate load F_{max} is reached.

The bending strength and the bending modulus of elasticity perpendicular to the plane of the board and in plane of the board shall be determined from:

$$f_m = \frac{3F_{\max} l_A}{2wH^2}$$

$$E_m = \frac{l_A^3 (F_2 - F_1)}{4wH^3 (a_2 - a_1)}$$



ANNEX 2 USE CONSIDERATIONS FOR WALLS

Anx 2.1 General

Design of wall elements may be according to EN 1995-1-1, 9.2.4.2 “Simplified verification of wall elements – Method A”. Hereby, the following considerations shall be taken into account:

Anx 2.2 Construction

Single openings in the covering, smaller than 200 mm x 200 mm, may be neglected for calculation of load. For multiple openings the sum of lengths and the sum of heights must be smaller than 10 % of the covering length or height. Effects of bigger openings need to be considered.

Anx 2.3 Shear

The load-bearing capacity of the covering must be verified. A simplified verification of shear stress in the covering is allowed when a verification of load bearing capacity of the covering is not required during assessment of the wall elements. The maximum load bearing capacity of the covering results from the shear flow, which correlates to the load bearing capacity of the connection between the ribs and the covering. The following must be verified:

$$\frac{\tau_d}{f_{v,d}} = \frac{F_{f,Rd} / (t \cdot s)}{f_{v,d}} \leq 1$$

With

τ_d	...	design value of shear stress in the covering
$f_{v,d}$...	design value of shear strength for mechanical actions in plane of the gypsum plasterboard
$F_{f,Rd}$...	design value of the load bearing capacity for shearing off the single fastener
s	...	spacing of fasteners
t	...	thickness of the covering

Additional stress resulting from the spacing of ribs and middle areas of the covering as well as discontinuous forces and forces acting perpendicular to the rib axes may be considered by a reduction in the shear strength of the plates with a factor of 0.5 for both-sided and 0.33 for one-sided covering.

For thicknesses of plates smaller than 1/35 of rib distances, buckling of the covering must be considered through reduction of load bearing capacity by the factor $35 \cdot \frac{t}{b_{net}}$.

For this verification, the characteristic shear strength of the board must be taken equal or lower than the lowest tension strength of the board for mechanical actions in plane of the gypsum plasterboard.

Anx 2.4 Imperfection

Effects of imperfection of a vertically loaded wall in terms of inclination may be taken into account by the following horizontal equivalent load:

$$F_{Ed} = \frac{q_{Ed} \cdot l}{70}$$

Hereby l is the length of the wall, loaded vertically through a line load q_{Ed} . F_{Ed} acts as a pair of forces at the bottom and at the top of the wall on the stiffening elements.

The horizontal displacement of the components resulting from this equivalent load F_{Ed} as well as the external forces must be smaller than $h/100$.

Consideration of imperfections in terms of inclination as well as verification of horizontal deformations is not necessary in the following cases:

- The length of the covering is minimum $h/3$,
- Width of the plates is minimum $h/4$,
- The covering is embedded in a stiff underconstruction,
- An increase of characteristic values of load bearing capacity of fasteners according to EN 1995-1-1, 9.2.4.2(5) is not taken into account.

Anx 2.5 Edge distance

Edge distance of fasteners plates and ribs for wall elements with allover shear rigid connected plates may be taken as $a_{4,c}$.

Anx 2.6 Butt of coverings

There may be one butt for wall elements calculated according to this section if the edges of the plates are connected in a rigid manner. Without detailed verification of deformations and when the width of the plate is smaller than $0.5 h$, the load bearing capacity for slabs with horizontal butts under horizontal loads must be reduced by $1/6$.

Anx 2.7 Pressure in ribs

For verification of transmission of rip-pressure loads through for transverse ribs according to EN 1995-1-1, 9.2.4.2(14) the characteristic load bearing capacity may be considered with 20 % increased values.

ANNEX 3 DETERMINATION OF DEFORMATION AND MODIFICATION VALUES

Anx 3.1 General

The deformation and modification values of the board shall be determined under climatic conditions according to the conditions of the service classes named in EN 1995-1-1.

Anx 3.2 Sampling and making of samples

The gypsum plasterboards used for testing shall correspond to the average of the production. From these gypsum plasterboards 6 board strips per load level shall be cut off having the dimensions listed below. The cutting edges shall be placed perpendicular to the plane of the board. When cutting the samples a minimum distance of 100 mm off the edge and 100 mm away from the next sample shall be kept. The samples shall be marked.

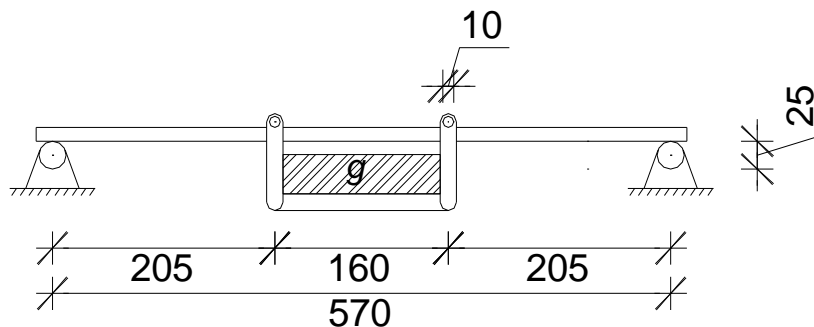
Number of samples: 6 pieces / per load level and climatic conditions
 Dimensions: w x L x H

	Width w mm	Span l_A mm	Length L mm	Height H mm
4 point bending with dead load	50	570	$l_A + 100$	t

t ... nominal thickness of gypsum plasterboard

Anx 3.3 Assembly of the tester

The board strips are placed in an assembly on which the dead load g is set up in a 4-point bending test.



Measurement of global deformations.

