Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment ETA-19/0120 of 1 August 2019

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Styrodur 3035 CS Styrodur 4000 CS Styrodur 5000 CS
Product family to which the construction product belongs	Extruded polystyrene foam boards as load bearing layer and/or thermal insulation outside the waterproofing
Manufacturer	BASF SE Carl-Bosch-Straße 38 67056 Ludwigshafen am Rhein DEUTSCHLAND
Manufacturing plant	BASF SE Carl-Bosch-Straße 38 67056 Ludwigshafen am Rhein
This European Technical Assessment contains	14 pages including 1 annex which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 040650-00-1201

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Specific Part

1 Technical description of the product

The extruded polystyrene foam boards are made of rigid cellular plastics material extruded from polystyrene or one of its copolymers and which has a closed cell structure. The blowing agent mixture is carbon dioxide (CO_2), isobutane and additives.The extruded polystyrene foam boards have a skin on both surfaces and a special edge treatment (shiplap).

The extruded polystyrene foam boards do not contain Hexabromocyclododecane (HBCD).

The extruded polystyrene foam boards have the following designations:

"Styrodur 3035 CS",

"Styrodur 4000 CS" and

"Styrodur 5000 CS".

The extruded polystyrene foam boards are manufactured with the following dimensions:

Nominal thicknesses:

50 mm to 200 mm for Styrodur 3035 CS,
60 mm to 160 mm for Styrodur 4000 CS,
60 mm to 120 mm for Styrodur 5000 CS

Nominal length: 1250 mm

Nominal widths: 600 mm

The European Technical Assessment has been issued for the products on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed. The European Technical Assessment applies only to products corresponding to this agreed data/information.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The extruded polystyrene foam boards are intended to be used as load bearing layer and /or thermal insulation outside the waterproofing. The boards are laid uniformly on the substrate to which they are applied. In particular the following applications are intended:

- Load bearing and thermal insulation underneath foundation slabs
- External horizontal and vertical thermal insulation of in-ground constructions in non-structural applications (also in case of groundwater)
- Inverted roof insulation (including park deck and green roof applications)

The performance according to section 3 only applies if the thermal insulation boards are installed according to the manufacture's installation instructions and if they are protected from precipitation, wetting or weathering during transport and storage before installation.

Concerning the application of the thermal insulation boards, also the respective national regulations shall be observed.

Where the thermal insulation boards are fixed by using adhesives, only such adhesions shall be used, which are suitable for this purpose. The assessment of these fixings is not subject of this European Technical Assessment.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the extruded polystyrene foam boards of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

For sampling, conditioning and testing the provisions of the EAD No 040650-00-1201 "Extruded polystyrene foam boards as load bearing layer and / or thermal insulation outside the waterproofing" apply.

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Compressive stress at 10 % deformation or compressive strength	Level (individual values may fall below this level up to 10 %):
test acc. to EN 826:2013	
"Styrodur 3035 CS"	≥ 300 kPa
"Styrodur 4000 CS"	≥ 500 kPa
"Styrodur 5000 CS"	≥ 700 kPa
Slip deformation	See Annex A
Compressive stress or compressive strength in the transverse and longitudinal directions	No performance assessed
Characteristic value of compressive stress or compressive strength	
5 %-fractile value for a one-sided confidence level of 75 % under unknown or known variance using ISO 12491:1997	
"Styrodur 3035 CS"	
thickness 50 mm ≤ d ≤ 120 mm	$\sigma_{0,05}$ = 323 kPa (n= 50; σ_{mean} = 410 kPa; s_σ = 55 kPa)
thickness 120 mm < d ≤ 200 mm	$\sigma_{0,05}$ = 313 kPa (n= 26; σ_{mean} = 376 kPa; s_σ = 36 kPa)
"Styrodur 4000 CS"	
thickness 60 mm ≤ d ≤ 80 mm	$\sigma_{0,05}$ = 504 kPa (n= 50; σ_{mean} = 572 kPa; s_σ = 40 kPa)
thickness 80 mm < d ≤ 160 mm	$\sigma_{0,05}$ = 420 kPa (n= 7; σ_{mean} = 543 kPa; s_σ = 63 kPa)
"Styrodur 5000 CS"	
thickness 60 mm ≤ d ≤ 120 mm	$\sigma_{0,05}$ =697 kPa (n= 35; σ_{mean} = 798 kPa; s_σ = 57 kPa)
Compressive creep	See Annex A
Behaviour under shear load (large-sized specimen)	See Annex A
Creep under shear load	See Annex A

Essential characteristic	Performance
Creep under combined compressive and shear load	See Annex A
Compressive modulus of elasticity	No performance assessed
Adhesion behaviour under compressive and shear load on large-sized samples	See Annex A
Shear strength	No performance assessed
Density test acc. to EN 1602:2013 "Styrodur 3035 CS" "Styrodur 4000 CS" "Styrodur 5000 CS"	 density range: 32 kg/m³ - 39 kg/m³ 38 kg/m³ - 43 kg/m³ 44 kg/m³ - 49 kg/m³

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire test acc. to EN ISO 11925-2:2010	Class E acc. to EN 13501-1:2007 + A1:2009

3.3 Energy economy and heat retention (BWR 6)

Essential characteristic	Performance
Thermal conductivity at mean reference temperature of 10 °C test acc. to EN 12667:2001 or EN 12939:2001 and aging procedure acc. EN 13164:2012+A1:2015, Annex C with deviating storage time period (sliced specimen) of (90 +2/-2) days prior to testing	
"Styrodur 3035 CS"	
thickness d = 50 mm	$\lambda_{D(90d)}$ = 0,033 W/(m · K)
thickness 50 mm < d ≤ 70 mm	$\lambda_{D(90d)}$ = 0,034 W/(m · K)
thickness 80 mm	$\lambda_{D(90d)}$ = 0,035 W/(m · K)
thickness 80 mm < d ≤ 100 mm	$\lambda_{D(90d)}$ = 0,037 W/(m · K)
thickness 100 mm < d ≤ 200 mm	$\lambda_{D(90d)}$ = 0,038 W/(m · K)
"Styrodur 4000 CS"	
thickness 60 mm ≤ d ≤ 70 mm	$\lambda_{D(90d)}$ = 0,034 W/(m · K)
thickness 80 mm	$\lambda_{D(90d)}$ = 0,035 W/(m · K)
thickness 80 mm < d ≤ 100 mm	$\lambda_{D(90d)}$ = 0,037 W/(m · K)
thickness 100 mm < d ≤ 160 mm	$\lambda_{D(90d)}$ = 0,038 W/(m · K)
"Styrodur 5000 CS"	
thickness 60 mm ≤ d ≤ 70 mm	$\lambda_{D(90d)}$ = 0,034 W/(m · K)
thickness 80 mm	$\lambda_{D(90d)}$ = 0,035 W/(m · K)
thickness 80 mm < d ≤ 100 mm	$\lambda_{D(90d)}$ = 0,037 W/(m · K)

Essential characteristic	Performance
Thermal conductivity "Styrodur 5000 CS" thickness 100 mm < d ≤ 120 mm	 $\lambda_{D(90d)}$ = 0,038 W/(m · K)
Moisture conversion coefficient	No performance assessed
Water absorption Long term water absorption by total immersion test acc. to EN 12087:2013 (method 2A)	 WL(T)0,7 (W_{lt} ≤ 0,7 Vol.%)
Long term water absorption by diffusion test acc. to EN 12088:2013 thickness < 100 mm thickness ≥ 100 mm	 WD(V)3 (W_{dV} ≤ 3,0 Vol.%) WD(V)1 (W_{dV} ≤ 1,0 Vol.%)
Freeze-thaw resistance test acc. to EN 12091:2013 using the wet test specimens from having done the water diffusion test in accordance with EN 12088: 2013 Reduction in compressive stress at 10 % deformation or in compressive strength of the re-dried specimens, when tested in accordance with EN 826:2013	 FTCD1 (W_V ≤ 1,0 Vol.%) ≤ 10 %
Water vapour diffusion resistance factor	No performance assessed
Geometrical properties Thickness test acc. EN 823:2013 (clause 7.2, figure 2, measuring set-up 3) thickness ≤ 120 mm thickness > 120 mm Length, width test acc. EN 822:2013 Squareness in direction of length and width; in direction of thickness test acc. EN 824:2013 Flatness in direction of length and width test acc. EN 825:2013 thickness ≤ 120 mm thickness > 120 mm	tolerance ± 2 mm +4/-2 mm ± 8 mm 5 mm/m 2 mm 3 mm

Essential characteristic	Performance
Deformation under specified compressive load and temperature conditions test acc. to EN 1605:2013	load: 40 kPa; temperature: (70 ± 1) °C; time: (168 ± 1) h ≤ 5 %
Dimensional stability under specified conditions test acc. to EN 1604:2013	temperature: 70 °C and 90 % R.H. DS(70,90) ($\Delta\varepsilon_l \leq 5$ %, $\Delta\varepsilon_b \leq 5$ %, $\Delta\varepsilon_d \leq 5$ %)
Tensile strength perpendicular to faces test acc. to EN 1607:2013	TR150 ($\sigma_{mt} \geq 150$ kPa)
Volume percentage of closed cells test acc. to EN ISO 4590:2016 (method 1 with correction)	≥ 95 %

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 040650-00-1201, the applicable European legal acts are: 1995/467/EC and 1999/91/EC[1].

The systems to be applied are:

System 1 for Essential characteristics concerning Mechanical resistance and stability (BWR 1)

System 3 all other Essential characteristics

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 1. August 2019 by Deutsches Institut für Bautechnik

Maja Tiemann
Head of Department

beglaubigt:
Wendler

[1] as amended

Deutsches Institut für Bautechnik DIBt

Styrodur 3035 CS
Styrodur 4000 CS
Styrodur 5000 CS

Annex A

1. Compressive stress

Slip deformation
acc. to EAD, chapter 2.2.1.2
Deformation until the conventional elastic zone(distinct straight portion of the force-displacement curve) is reached

Styrodur 3035 CS (φ =34 kg/m^3)			
thickness (mm)	1x100	2x100	3x100
compressive stress, σa	125	87	87
initial displacement Xa (mm)	**0,5**	**0,6**	**0,8**
Styrodur 5000 CS (φ =46 kg/m^3)			
thickness (mm)	1x100	2x100	3x100
compressive stress, σa	225	210	184
initial displacement Xa (mm)	**0,4**	**0,6**	**0,8**

2. Compressive creep

2.1 Compressive creep (single-layer board)
acc. to EAD, chapter 2.2.3.1

Styrodur 3035 CS	**thickness 50 mm**				**thickness 50 mm**	
density (kg/m^3)	28,2				29	
compressive stress/ deformation acc. EN 826 (kPa / %)	330/5				349/2	
load stage (kPa)	**70**	**100**	**130**	**160**	**130**	**160**
X_0 (mm)	0,18	0,25	0,33	0,40	0,31	0,39
X_{ct} (mm)	0,16	0,21	0,27	0,42	0,12	0,17
X_{ct50} (mm)	0,40	0,54	0,72	1,24	0,24	0,35
X_{t50} (mm)	**0,58**	**0,79**	**1,05**	**1,64**	**0,55**	**074**
Styrodur 3035 CS	**thickness 140 mm**				**thickness 120 mm**	
density (kg/m^3)	36				32	
compressive stress/ deformation acc. EN 826 (kPa / %)	415/2				374/2	
load stage (kPa)	**100**	**150**	**200**	**250**	**130**	**160**
X_0 (mm)	0,42	0,64	0,84	1,06	0,64	0,76
X_{ct} (mm)	0,69	0,86	1,16	1,56	0,20	0,25
X_{ct50} (mm)	0,75	0,94	1,27	1,71	0,74	0,60
X_{t50} (mm)	**1,17**	**1,58**	**2,11**	**2,77**	**1,38**	**1,36**

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Annex A

Styrodur 3035 CS	**thickness 200 mm**				**thickness 200 mm**	
density (kg/m^3)	38,3				37	
compressive stress/ deformation acc. EN 826 (kPa / %)	558/2				407/2	
load stage (kPa)	**100**	**150**	**200**	**250**	**130**	**160**
X_0 (mm)	0,49	0,74	0,99	1,26	0,86	0,99
X_{ct} (mm)	1,01	1,28	1,56	1,96	0,50	0,50
X_{ct50} (mm)	1,14	1,44	1,77	2,18	1,34	1,45
X_{t50} (mm)	**1,63**	**2,18**	**2,76**	**3,44**	**2,19**	**2,44**

Styrodur 4000 CS	**thickness 30 mm**				**thickness 60 mm**	
density (kg/m^3)	42,3				38	
compressive stress/ deformation acc. EN 826 (kPa / %)	687/6				596/2	
load stage (kPa)	**100**	**140**	**180**	**220**	**180**	**220**
X_0 (mm)	0,14	0,19	0,23	0,32	0,32	0,40
X_{ct} (mm)	0,13	0,18	0,24	0,31	0,08	0,13
X_{ct50} (mm)	0,37	0,49	0,65	0,88	0,19	0,24
X_{t50} (mm)	**0,51**	**0,68**	**0,90**	**1,20**	**0,51**	**0,64**

Styrodur 4000 CS	**thickness 100 mm**				**thickness 120 mm**	
density (kg/m^3)	40,1				38	
compressive stress/ deformation acc. EN 826 (kPa / %)	531/2				604/2	
load stage (kPa)	**100**	**140**	**180**	**220**	**180**	**220**
X_0 (mm)	0,26	0,36	0,46	0,54	0,52	0,64
X_{ct} (mm)	0,32	0,42	0,53	0,68	0,08	0,13
X_{ct50} (mm)	1,16	1,50	1,76	2,04	0,19	0,24
X_{t50} (mm)	**1,42**	**1,86**	**2,22**	**2,59**	**0,71**	**0,88**

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Styrodur 3035 CS
Styrodur 4000 CS
Styrodur 5000 CS

Annex A

Styrodur 4000 CS	**thickness 160 mm**			
density (kg/m^3)	37			
compressive stress/ deformation acc. EN 826 (kPa / %)	559/2			
load stage (kPa)	**100**	**150**	**200**	**250**
X_0 (mm)	0,46	0,70	0,93	1,16
X_{ct} (mm)	0,83	1,08	1,36	1,90
X_{ct50} (mm)	0,92	1,20	1,52	2,18
X_{t50} (mm)	**1,38**	**1,90**	**2,45**	**3,34**

Styrodur 5000 CS	**thickness 40 mm**				**thickness 60 mm**	
density (kg/m^3)	44,6				44	
compressive stress/ deformation acc. EN 826 (kPa / %)	779/4				747/2	
load stage (kPa)	**150**	**200**	**250**	**300**	**250**	**300**
X_0 (mm)	0,16	0,21	0,26	0,31	0,34	0,37
X_{ct} (mm)	0,29	0,38	0,43	0,54	0,30	0,20
X_{ct50} (mm)	0,44	0,58	0,65	0,81	0,30	0,60
X_{t50} (mm)	**0,59**	**0,77**	**0,89**	**1,11**	**0,64**	**0,80**

Styrodur 5000 CS	**thickness 100 mm**				**thickness 120 mm**	
density (kg/m^3)	45,8				43	
compressive stress/ deformation acc. EN 826 (kPa / %)	770/2				802/2	
load stage (kPa)	**150**	**200**	**250**	**300**	**250**	**300**
X_0 (mm)	0,31	0,41	0,52	0,62	0,57	0,66
X_{ct} (mm)	0,63	0,79	0,98	1,17	0,25	0,30
X_{ct50} (mm)	0,97	1,22	1,41	1,78	0,68	0,78
X_{t50} (mm)	**1,29**	**1,64**	**1,94**	**2,41**	**1,25**	**1,44**

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Styrodur 3035 CS
Styrodur 4000 CS
Styrodur 5000 CS

Annex A

2.2 Compressive creep (multi-layer installation)

acc. to EAD, chapter 2.2.3.1

Styrodur 3035 CS	**thickness 3x 100 mm**		
density (kg/m^3)	34		
compressive stress/ deformation acc. EN 826 (kPa / %)	514/10		
load stage (kPa)	**100**	**130**	**160**
X_0 (mm)	1,29	1,76	2,13
X_{ct} (mm)	2,12	2,48	3,17
X_{ct50} (mm)	2,95	3,54	4,44
X_{t50} (mm)	**4,24**	**5,31**	**6,75**

Styrodur 4000 CS	**thickness 3x 100 mm**		
density (kg/m^3)	38		
compressive stress/ deformation acc. EN 826 (kPa / %)	702/3		
load stage (kPa)	**140**	**180**	**220**
X_0 (mm)	1,88	2,41	2,99
X_{ct} (mm)	1,35	1,71	2,04
X_{ct50} (mm)	2,99	3,47	4,12
X_{t50} (mm)	**4,87**	**5,88**	**7,11**

Styrodur 5000 CS	**thickness 3x 100 mm**		
density (kg/m^3)	42		
compressive stress/ deformation acc. EN 826 (kPa / %)	744/3		
load stage (kPa)	**200**	**250**	**300**
X_0 (mm)	2,40	3,00	3,59
X_{ct} (mm)	1,43	1,71	2,34
X_{ct50} (mm)	2,67	3,40	4,21
X_{t50} (mm)	**5,07**	**6,40**	**7,79**

3 Behaviour under shear load (large-sized specimen)

acc. to EAD, chapter 2.2.4

Styrodur 3035 CS	**thickness 200 mm**	
density (kg/m^3)	40	36
shear strength τ_{large} acc. EAD chapter 2.2.4 and the guidelines in EN 12090 (kPa)	**146**	**126**

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Annex A

4 Creep under shear load
acc. to EAD, chapter 2.2.5

Styrodur 3035 CS			
thickness	**200 mm**	**200 mm**	**180 mm**
shear strength/ deformation acc. EAD (kPa)	143/-		
load stage (kPa)	**50**	**35,75**	**50**
$X_{\tau 0}$ (mm)	1,94	1,24	1,38
$X_{\tau ct}$ (mm)	0,84	0,52	0,48
$X_{\tau ct50}$ (mm)	3,23	2,47	2,87
$X_{\tau t50}$ (mm)	**5,17**	**3,71**	**4,25**

5 Creep under combined compressive and shear load
acc. to EAD, chapter 2.2.6

Styrodur 3035 CS				
thickness	**200 mm**		**200 mm**	
load stage (kPa)	**50**	**105**	**35,75**	**105**
deformation under	shear load	compressive load	shear load	compressive load
$X_{\tau 0}$ /X_0 (mm)	1,63	0,52	1,25	0,49
$X_{\tau ct}$ /X_{ct} (mm)	0,99	0,68	0,72	0,70
$X_{\tau ct50}$/X_{ct50} (mm)	3,49	5,28	2,62	4,51
$X_{\tau t50}$/X_{t50} (mm)	**5,12**	**5,80**	**3,87**	**5,00**

Styrodur 3035 CS		
thickness	**180 mm**	
load stage (kPa)	**50**	**105**
deformation under	shear load	compressive load
$X_{\tau 0}$ /X_0 (mm)	1,51	0,46
$X_{\tau ct}$ /X_{ct} (mm)	0,68	1,16
$X_{\tau ct50}$/X_{ct50} (mm)	2,17	3,94
$X_{\tau t50}$/X_{t50} (mm)	**3,68**	**4,40**

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Annex A

6 Adhesion behaviour under compressive and shear load on large-sized samples
acc. to EAD, chapter 2.2.8

Styrodur 3035 CS			
Adhesive friction coefficient between the extruded polystyrene foam boards Acc. EAD chapter 2.2.8, Annex A, A.3.1			
thickness	**2x 120 mm**		
density (kg/m³)	32-34		
Compression stress – load stage (kPa)	**15**	**45**	**90**
Adhesive friction coefficient regarding the compression stress – load stage	0,74	0,69	0,68
Adhesive friction coefficient	**0,70**		
Adhesive friction coefficient between the extruded polystyrene foam boards and in-situ concrete as well as a concrete finished part with foil Acc. EAD chapter 2.2.8, Annex A, A.3.2			
thickness	**1x 120 mm**		
density (kg/m³)	32		
Compression stress – load stage (kPa)	**15**	**45**	**90**
Adhesive friction coefficient regarding the compression stress – load stage	0,55	0,47	0,45
Adhesive friction coefficient	**0,49**		
Adhesive friction coefficient between the extruded polystyrene foam boards and in-situ concrete without foil Acc. EAD chapter 2.2.8, Annex A, A.3.3			
thickness	**1x 120 mm**		
density (kg/m³)	32		
Compression stress – load stage (kPa)	**15**	**45**	**90**
Adhesive friction coefficient regarding the compression stress – load stage	0,73	0,69	0,70
Adhesive friction coefficient	**0,71**		

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Annex A

Styrodur 3035 CS			
Adhesive friction coefficient between the extruded polystyrene foam boards and a concrete finished part without foil Acc. EAD chapter 2.2.8, Annex A, A.3.4			
thickness	**1x 120 mm**		
density (kg/m^3)	33-34		
Compression stress – load stage (kPa)	**15**	**45**	**90**
Adhesive friction coefficient regarding the compression stress – load stage	2,68	1,46	1,07
Adhesive friction coefficient	**1,74**		