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and types of construction

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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 (CO₂), 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 test acc. to EN 826:2013 "Styrodur 3035 CS" "Styrodur 4000 CS" "Styrodur 5000 CS" Slip deformation Compressive stress or compressive strength in the transverse and longitudinal directions	Level (individual values may fall below this level up to 10 %): ≥ 300 kPa ≥ 500 kPa ≥ 700 kPa See Annex A 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 thickness 120 mm < d ≤ 200 mm "Styrodur 4000 CS" thickness 60 mm ≤ d ≤ 80 mm thickness 80 mm < d ≤ 160 mm "Styrodur 5000 CS" thickness 60 mm ≤ d ≤ 120 mm	 $\sigma_{0,05} = 323 \text{ kPa}$ (n= 50; $\sigma_{\text{mean}} = 410 \text{ kPa}$; $s_{\sigma} = 55 \text{ kPa}$) $\sigma_{0,05} = 313 \text{ kPa}$ (n= 26; $\sigma_{\text{mean}} = 376 \text{ kPa}$; $s_{\sigma} = 36 \text{ kPa}$) $\sigma_{0,05} = 504 \text{ kPa}$ (n= 50; $\sigma_{\text{mean}} = 572 \text{ kPa}$; $s_{\sigma} = 40 \text{ kPa}$) $\sigma_{0,05} = 420 \text{ kPa}$ (n= 7; $\sigma_{\text{mean}} = 543 \text{ kPa}$; $s_{\sigma} = 63 \text{ kPa}$) $\sigma_{0,05} = 697 \text{ kPa}$ (n= 35; $\sigma_{\text{mean}} = 798 \text{ kPa}$; $s_{\sigma} = 57 \text{ kPa}$)
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/m ³ - 39 kg/m ³ 38 kg/m ³ - 43 kg/m ³ 44 kg/m ³ - 49 kg/m ³

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 thickness 50 mm < d ≤ 70 mm thickness 80 mm thickness 80 mm < d ≤ 100 mm thickness 100 mm < d ≤ 200 mm "Styrodur 4000 CS" thickness 60 mm ≤ d ≤ 70 mm thickness 80 mm thickness 80 mm < d ≤ 100 mm thickness 100 mm < d ≤ 160 mm "Styrodur 5000 CS" thickness 60 mm ≤ d ≤ 70 mm thickness 80 mm thickness 80 mm < d ≤ 100 mm	$\lambda_{D(90d)} = 0,033 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,034 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,035 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,037 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,038 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,034 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,035 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,037 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,038 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,034 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,035 \text{ W/(m} \cdot \text{K)}$ $\lambda_{D(90d)} = 0,037 \text{ W/(m} \cdot \text{K)}$

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

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/EC¹.

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

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 ($\varphi = 34 \text{ kg/m}^3$)			
thickness (mm)	1x100	2x100	3x100
compressive stress, σ_a	125	87	87
initial displacement X_a (mm)	0,5	0,6	0,8
Styrodur 5000 CS ($\varphi = 46 \text{ kg/m}^3$)			
thickness (mm)	1x100	2x100	3x100
compressive stress, σ_a	225	210	184
initial displacement X_a (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	0,74
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

Styrodur 3035 CS
Styrodur 4000 CS
Styrodur 5000 CS

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

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

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
$X_{\tau ct 50}$ (mm)	3,23	2,47	2,87
$X_{\tau t 50}$ (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
$X_{\tau ct 50} / X_{ct 50}$ (mm)	3,49	5,28	2,62	4,51
$X_{\tau t 50} / X_{t 50}$ (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
$X_{\tau ct 50} / X_{ct 50}$ (mm)	2,17	3,94
$X_{\tau t 50} / X_{t 50}$ (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/m ³)	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/m ³)	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/m ³)	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		