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Evaluation Report to European Technical Assessment

ETA 16/0325 – version 03 of 31/10/2025

Trade name of the construction product:	VARIANT-HAUS®
Product family to which the construction product belongs:	Product area code: 34 Building Kits, Units and Prefabricated Elements
Manufacturer:	VARIANT-HAUS-GROUP ICF Manufacturing & Sales GmbH Theodor-Heuss-Allee 112 60486 Frankfurt am Main Germany
Manufacturing plant:	POLYFORM, s.r.o. Terézie Vansovej 10 065 03 Podolínec Slovak Republic
This Evaluation Report contains:	8 pages
This Evaluation Report replaces:	Evaluation Report to ETA 16/0325 – version 02 issued on 31/07/2019

1 Introduction

This report describes the methods used to assess the fitness for the intended use of the POLYSTYRENE BUILDING MODULE VARIANT-HAUS® introduced by VARIANT-HAUS-GROUP, ICF Manufacturing & Sales GmbH, D-60325 Frankfurt am Main, Germany, in accordance with the Essential Requirements, as specified in EAD 340309-00-0305 – Non load-bearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete, Edition January 2019, if not determined differently in the following.

This assessment includes tests carried out in accordance with the EAD 340309-00-0305. The data were taken from the test reports listed in Annex of this report.

2 Description of the product and Intended use

The VARIANT-HAUS® is formwork comprising from factory assembled units, consisting of two expanded polystyrene (EPS) leaves mechanically fixed together using an arrangement of polystyrene or polypropylene spacers moulded into each leaf at production stage. Forms are white – STYROPOR® F 495 E or grey NEOPOR® F 2400 in colour. For the shuttering leaves NEOPOR® F 2400 expanded polystyrene EPS-EN 13163-T1-L1-W1-S2-P4-DS(70,-)1-BS200-DS(N)5-TR150-CS(10)150 according to EN 13163 is used. The EPS has a nominal density of 24 kg/m^3 with a nominal thermal conductivity of 0,030 W/(m·K).

For the shuttering leaves STYROPOR® F 495 E expanded polystyrene EPS-EN 13163-T1-L1-W1-S2-P4-DS(70,-)1-BS150-DS(N)5-TR120-CS(10)120 according to EN 13163 is used. The EPS has a nominal density of 26 kg/m^3 with a nominal thermal conductivity of 0,033 W/(m·K).

The modules VARIANT-HAUS® are forming nominal concrete core thickness of 150 mm and 200 mm.

The spacers are designed with slots to receive horizontal reinforcement built into the concrete core. The sum of the cross-sectional areas of the polypropylene spacers is less than 1 % of the area of the concrete core. Length of the modules is 1 250 mm and height is 250 mm.

The upper and lower surfaces of the EPS forms incorporate small castellations so that adjoining forms effectively lock together without fixings.

The forms are interlocked and built up horizontally and vertically into a tight rigid formwork. The wall is formed by filling of the forms with concrete. The formwork is used in conjunction with concrete class C 16/20 (according to EN 206-1) to build plain concrete walls or in conjunction with concrete of classes in the range from C 20/25 to C 30/37 to build reinforced concrete walls. Class of slump ≥ F2, recommended and maximum size of aggregate used in concrete walls is 32 mm. The applying of the concrete should be in accordance with the national rules.

The concrete can contain an admixture, which comply with EN 934-2 to allow its placement by either rodding or free flow and eventually allow adequate time of concreting. For the intended use it is essential to protect the formwork against effects of the weather.

Components and finishes used in conjunction with the formwork, not covered by this document, are as follow:

- steel reinforcement (where required), should comply with applicable national rules;
- external rendering or external masonry or gypsum plasterboards according to EN 520;
- internal finishing;
- brickwork/stonework wall ties according to EN 845-1;
- trestle supports.

VARIANT-HAUS® is for use in forming load-bearing and non-load-bearing internal or external walls. Once filled on site with concrete, the EPS formwork remains as a permanent part of the wall and so contributes to the overall thermal resistance of the completed wall construction. During the pouring of the concrete infill, the formwork resists the pressure of fresh concrete through the inherent strength and interlocking action of castellated horizontal joints and tying action of polypropylene spacers moulded into the EPS forms.

While using this system below ground, then, according to applicable national rules, the waterproofing membrane should be provided on the external surface. The membrane should be applied in

accordance with the manufacturer's instructions for installation and from damage should be protected by using an impact-resistant protective layer or sand blinding.

The provisions made for the VARIANT-HAUS® elements in this ETA are based on an assumed working life of the system for at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the manufacturer or approved body but are to be used as a means for selecting the appropriate product in relation to the expected economically reasonable working life of this system.

3 Evaluation of Available Data

3.1 Resulting structural pattern

The resulting structural pattern has been determined by visual inspection based on trial structure assembled and concreted according to Clause 2.2.1 of EAD 340309-00-0305 [1].

According to concrete infill structural pattern, the walls made of VARIANT-HAUS® shuttering elements with polypropylene spacers are according to Clause 1.3.3 of EAD 340309-00-0305 [1] classified as continuous type of walls. The structural pattern of the continuous type is a concrete wall, which is only perforated by spacers at points. The spacers are generally regularly arranged. The sum of the cross-sectional areas of the spacers is only a few percent of the area of the wall.

The walls made of VARIANT-HAUS® shuttering elements with EPS spacers are classified as grid type of walls. The structural pattern of the grid type consists of concrete columns connected by horizontal concrete ribs. Columns and ribs are formed by filling the voids of the shuttering hollow blocks or panels with concrete. The vertical columns extend the entire height of the wall without interruption or reduction of cross-sectional area. The results are documented in [31].

3.2 Efficiency of filling

The efficiency of filling has been determined by visual inspection based on trial structure assembled and concreted according to Clause 2.2.2 of EAD 340309-00-0305 [1].

The efficiency of filling was assessed by erection of a trial structure in-situ. Considering the installation guide of the ETA-holder the efficient filling without bursting of the shuttering and without voids or any uncovered reinforcement in the concrete column is possible. The results are documented in [31].

3.3 Possibility of steel reinforcement

The possibility of steel reinforcement has been determined by visual inspection based on trial structure assembled and concreted according to Clause 2.2.3 of EAD 340309-00-0305 [1].

Possibility of steel reinforcement has been assessed by visual inspection. The instructions in the installation guide of the ETA-holder enable installation of walls steel reinforcement according to EN 1992-1-1 [10] or corresponding national rules. The results are documented in [31].

3.4 Reaction to fire

The reaction to fire has been determined by the tests according to Clause 2.2.4 of EAD 340309-00-0305 [1] using testing method according to EN ISO 11925-2 [18]. The reaction to fire of the EPS blocks used in the polystyrene building module VARIANT-HAUS® covered in this ETA is class E according to EN 13501-1 [21]. The test results are documented in [32].

3.5 Influence of the shuttering kit on the fire resistance

The fire-resistance class of walls with polypropylene spacers (continuous type walls) of minimum concrete strength of C 16/20, exposed on one side is according to Table A.1 of Annex A of EAD 340309-00-0305 [1] for:

- load-bearing walls (thickness of concrete infill of 150 mm and 200 mm): REI 120;
- non-load-bearing walls (thickness of concrete infill of 150 mm and 200 mm): EI 120.

With the minimum thickness of the grid concrete core and minimum concrete strength C 16/20, the fire-resistance class of walls with EPS spacers (grid type walls) exposed on more than one side is according to Table A.2 of Annex A of EAD 340309-00-0305 [1] for:

- load-bearing walls (min. dimension of concrete infill of 150 mm): R 30

Limitations of the grid concrete core shuttering:

a) Non-load-bearing wall
   The ratio of clear height of wall l_w to concrete thickness t should not exceed 40 in case of non-load-bearing wall and EI duration criteria less or equal to 60 minutes
b) Load-bearing wall
   The μ_{fi} value, according to EN 1992-1-2, shall not exceed 0,7.
   The slenderness of the concrete infill shall not exceed 50.

3.6 Content, emission and/or release of dangerous substances

The performance of the product related to the content of dangerous substances was assessed according to EAD 340309-00-0305, Clause 2.2.6. The relevant and applicable use categories in accordance with EAD 340309-00-0305 [1] for the product are:

- Category IA3: product with no direct contact on indoor air;
- Category S/W3: product with no contact to and no impact on soil, ground or surface water.

Based on the information provided by the manufacturer the content of isopentane is < 1,4 % ww and the product does not contain substances of very high concern (SVHC), as detailed in the REACH regulation. The performance of the product related to the emissions and/or release of other substances have not been assessed. Within the scope of this assessment, there may be other requirements applicable to dangerous substances resulting from transposed European legislation or applicable national regulations and administrative provisions (see EU database and the different national regulations).

3.7 Water vapour permeability

The water vapour resistance factor (m) of expanded polystyrene has been determined by the tests according to EN 12086 [3]. The tests results are presented in Table 1 and documented in [25].

Table 1 – Water vapour permeability

Samples	Water vapour resistance factor of the NEOPOR® F 2400 m (-)	Water vapour resistance factor of the STYROPOR® F 495 E m (-)
1	50,4	43,4
2	43,6	42,2
3	35,7	42,9
Average value	43,2	42,8

3.8 Water absorption

The long-term water absorption of expanded polystyrene has been determined by the tests according to EN ISO 16535 [19]. The tests results are presented in Table 2 and documented in [23] and [24].

Table 2 – Water absorption

Samples	Long-term water absorption by partial immersion	
	NEOPOR® F 2400 w_p (kg/m²)	**STYROPOR® F 495 E** w_p (kg/m²)
1	0,04	0,02
2	0,04	0,02
3	0,04	0,02
4	0,03	0,02
Average value	0,04	0,02

3.9 Water tightness

No relevant.

3.10 Bond strength

Bond strength between shuttering leaf and concrete core

The bond strength between shuttering leaf and concrete core has been determined by the tests according to EAD 340309-00-0305 [1] and EN 1607 [15]. The tests results are presented in Table 3.

Table 3 – Bond strength between shuttering leaf and concrete

Samples	Bond strength between shuttering leaf and concrete core	
	NEOPOR® F 2400 (N/mm²)	**STYROPOR® F 495 E** (N/mm²)
1	0,078	0,062
2	0,072	0,057
3	0,071	0,060
4	0,069	0,080
5	0,058	0,068
6	0,057	0,083
Average value	0,067	0,068

3.11 Resistance to impact load

No performance assessed.

3.12 Resistance to filling pressure

The resistance to filling pressure has been determined by visual inspection based on trial structure assembled and concreted according to EAD 340309-00-0305 [1].

Resistance to filling pressure is sufficient for filling up to 1,00 m of height (4 layers of the shuttering) at once. The resistance to filling pressure was also determined by observation of lower sections of the shuttering during concreting.

The trial structure constructed on site was 2,75 m high. Wet concrete was delivered and poured from height of 1,00 m with observations being made throughout the pouring operations.

The following facts were observed:

- no bulging or distress was noted at any point of the formwork;
- there was no evidence of failure of the joint webs or pull-out of plastic spacer from the EPS panels;

- the all-castellated horizontal joints held firmly.

The resistance to filling pressure has been determined by tests of tensile failure load of spacers in EPS leaves and flexural strength of the leaves. Results of this measurement are in Table 4.

Table 4 – Tensile failure load of compact spacers in EPS leaves and flexural strength of the leaves

Samples	Tensile failure load of		
	Polypropylene spacer in STYROPOR® F 495 E leaves* (N)	**Polypropylene spacer in NEOPOR® F 2400 leaves*** (N)	**STYROPOR® F 495 E spacer in STYROPOR® F 495 E leaves**** (N)
1	924	631	733
2	1 004	686	709
3	936	638	834
4	1 040	724	706
5	916	675	712
6	1 014	623	758
Average value	972	663	742

* Failures were pull-out spacers from EPS leaves.
** Failures were cutting spacers near EPS leaves.

3.13 Safety to personal injuries

The safety to personal injuries has been determined by visual inspection based on trial structure assembled and concreted according to EAD 340309-00-0305 [1]. As delivered on site the shuttering blocks do not have sharp or cutting edges. Because of the soft surface of the shuttering blocks there is no risk of abrasion or cutting people. The results are documented in [31].

3.14 Airborne sound insulation

No performance assessed.

3.15 Sound absorption

No performance assessed.

3.16 Thermal resistance

The thermal conductivity of expanded polystyrene has been determined by the tests according to EN 12667 [16]. The tests results are presented in Table 5 and documented in [23] and [24].

In these calculations the following thermal conductivities were used: the test result of the expanded polystyrene NEOPOR® F 2400 is 0,030 W/(m·K), the test result of the expanded polystyrene STYROPOR® F 495 E is 0,033 W/(m·K) and tabulated value of 2,3 W/(m·K) for the reinforced concrete (2300 kg/m³), according to EN ISO 10456 [4].

Table 5 – Thermal conductivity of the EPS

Samples	**Thermal conductivity of the NEOPOR® F 2400** (W/(m·K))	**Thermal conductivity of the STYROPOR® F 495 E** (W/(m·K))
1	0,0301	0,0328
2	0,0304	0,0327
3	0,0302	0,0328
Average value	0,0302	0,0328

The thermal resistances for all wall sections which are included in the system VARIANT-HAUS® are presented in Table 6. The influence of spacer was taken into account by calculation the values.

Table 6 – Thermal resistance values (calculated without plaster)

Type of shuttering element	VARIANT-HAUS® Standard	VARIANT-HAUS® ISO block	VARIANT-HAUS® ISO block plus
	R ($m^2 \cdot K/W$)	***R*** ($m^2 \cdot K/W$)	***R*** ($m^2 \cdot K/W$)
NEOPOR® F 2400	3,11	6,44	9,77
STYROPOR® F 495 E	2,83	5,86	8,89

3.17 Thermal inertia

No performance assessed.

3.18 Resistance to deterioration

Not relevant.

4 References

[1] EAD 340309-00-0305 – Non load-bearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete, Edition January 2019.

[2] EN 934-2: 2009+A1: 2012 Admixtures for concrete, mortar and grout. Part 2: Concrete admixtures. Definitions, requirements, conformity, marking and labelling

[3] EN 12086: 2013 Thermal insulating products for building applications. Determination of water vapour transmission properties

[4] EN ISO 10456: 2007 Building materials and products. Hygrothermal properties. Tabulated design values and procedures for determining declared and design thermal values

[5] EN 520: 2004+A1: 2009 Gypsum plasterboards. Definitions, requirements and test methods

[6] EN ISO 6946: 2017 Building components and building elements. Thermal resistance and thermal transmittance. Calculation method

[7] EN 13163: 2012+A2: 2016 Thermal insulation products for buildings. Factory made products of expanded polystyrene (EPS). Specification

[8] EN 845-1: 2013+A1: 2016 Specification for ancillary components for masonry. Part 1: Ties, tension straps, hangers and brackets

[9] EN 206: 2013+A2: 2021 Concrete. Part 1: Specification, performance, production and conformity

[10] EN 1992-1-1: 2004/A1: 2014 Eurocode 2: Design of concrete structures. Part 1-1: General rules and rules for buildings

[11] EN 1992-1-2: 2004/A1: 2019 Eurocode 2: Design of concrete structures. Part 1-2: General rules. Structural fire design

[12] EN ISO 29767: 2019 Thermal insulating products for building applications. Determination of short term water absorption by partial immersion

[13] EN 826: 2013 Thermal insulating products for building applications. Determination of compression behaviour

[14] EN 1604: 2013 Thermal insulating products for building applications. Determination of dimensional stability under specified temperature and humidity conditions

[15] EN 1607: 2013 Thermal insulating products for building applications. Determination of tensile strength perpendicular to faces

[16] EN 12667: 2001 Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance

[17] EN ISO 717-1: 2020 Acoustics. Rating of sound insulation in buildings and of building elements. Part 1: Airborne sound insulation

[18] EN ISO 11925-2: 2020 Reaction to fire tests. Ignitability of products subjected to direct impingement of flame. Part 2: Single-flame source test

[19] EN ISO 16535: 2019 Thermal insulating products for building applications - Determination of long-term water absorption by immersion

[20] EN 15435: 2008 Precast concrete products. Normal weight and lightweight concrete shuttering blocks. Product properties and performance

[21] EN 13501-1: 2018 Fire classification of construction products and building elements. Part 1: Classification using data from reaction to fire tests

[22] Kontrolný a skúšobný plán (Production control plan), issued by POLYFORM, s. r. o., Terézie Vansovej 10, 065 03 Podolínec, Slovak Republic, 04. 10. 2010

[23] Test report No.: 40-10-0756 STYROPOR® F 495 E, Dimensional stability, density, compression behaviour, water absorption and nominal thermal conductivity, TSÚS, branch Nitra, Slovak Republic, 18. 11. 2010

[24] Test report No.: 40-10-0757 NEOPOR, Dimensional stability, density, compression behaviour, water absorption and nominal thermal conductivity, TSÚS, branch Nitra, Slovak Republic, 18. 11. 2010

[25] Test report No.: 40-10-1719, Water vapour permeability, TSÚS, branch Nitra, Slovak Republic, 14. 12. 2010

[26] Safety data sheet; NEOPOR® F 2400, issued by BASF SE, Ludwigshafen, Germany, 17. 11. 2022

[27] Safety data sheet; STYROPOR® F 495 E, issued by BASF SE, Ludwigshafen, Germany, 17. 12. 2015

[28] Safety data sheet; polypropylene TIPPLEN R 959 A, issued by Tiszai Vegyi Kombinát Nyilvánosan M_köd_ Részvénytársaság, H-3581 Pf. 20. Tiszaújváros, Hungary, last revision 16. 01. 2009

[29] VARIANT-HAUS Technical Information, issued by VARIANT-HAUS GmbH, Rostocker Strasse 19, 34225 Baunatal, Germany, 2010

[30] Test report No.: 20-10-1759, Determining the tensile strength of webs of shuttering block, TSÚS, branch Bratislava, Slovak Republic, 17. 12. 2010

[31] Report No.: 20-10-0279/1 The VARIANT-HAUS®, Mechanical resistance and stability, TSÚS, branch Bratislava, Slovak Republic, 20. 12. 2010

[32] Test report No. 90-25-0146, Reaction to fire, TSÚS, branch Tatranská Štrba, Slovak Republic, 29. 04. 2025

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