DNV·GL

Certificate No:
TAK000001N

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Sandwich Core Materials

with type designation(s)
ArmaFORM PET GR

Issued to
Armacell Benelux S.A.
Thimister - Clermont, Belgium

is found to comply with
Det Norske Veritas' Rules for Classification of High Speed, Light Craft and Naval Surface Craft
Det Norske Veritas Standards' for Certification No. 2.21, Craft, 2010
Det Norske Veritas' Type Approval Programme 1-501.10, 2009, Sandwich Core Materials

Application :

Polyethylene Terephtalate core material for use in sandwich constructions. Area of application will be evaluated during approval of classed objects.

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.

This Certificate is valid until **2019-08-31**.

Issued at **Høvik** on **2015-09-01**

for **DNV GL**

DNV GL local station: **Antwerp**

Approval Engineer: **Gisle Hersvik**

Martin Strande
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

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Product description

ArmaFORM PET GR 60, ArmaFORM PET GR 70, ArmaFORM PET GR 80, **ArmaFORM PET GR 100**, **ArmaFORM PET GR 115**, **ArmaFORM PET GR 135** and **ArmaFORM PET GR 150**.

Thermoplastic core material extruded closed cell structure foam made of recycled Polyethylene Terephtalate (PET).

The following manufacturer's specified values are confirmed by type testing:

		ArmaFORM PET GR				
Properties	**Test Method**	**60**	**70**	**80**		
Density	ISO 845	60	65	75	kg/m³	msmv
Density, nominal	ISO 845	65	70	80	kg/m³	msv
Tensile strength, 20°C	ASTM C297	0,9	1,2	1,6	MPa	msmv
Tensile strength, 20°C	ASTM C297	1,5	1,8	2,1	MPa	msv
Tensile modulus, 20°C	ASTM C297	40	45	50	MPa	msmv
Tensile modulus, 20°C	ASTM C297	60	66	75	MPa	msv
Compressive strength, 20°C	ASTM D1621 B	0,55	0,6	0,8	MPa	msmv
Compressive strength, 20°C	ASTM D1621 B	0,65	0,75	0,95	MPa	msv
Compressive modulus, 20°C	ISO 844	22	25	40	MPa	msmv
Compressive modulus, 20°C	ISO 844	30	40	57	MPa	msv
Compressive modulus, 20°C	ASTM D1621 B	40	45	60	MPa	msmv
Compressive modulus, 20°C	ASTM D1621 B	50	62	70	MPa	msv
Shear strength, 20°C	ISO 1922	0,3	0,4	0,45	MPa	msmv
Shear strength, 20°C	ISO 1922	0,4	0,5	0,55	MPa	msv
Shear modulus, 20°C	ISO 1922	8	10	10	MPa	msmv
Shear modulus, 20°C	ISO 1922	10	13	15	MPa	msv
Shear elongation, 20°C	ISO 1922	5	6	5	%	msmv
Shear elongation, 20°C	ISO 1922	12	15	15	%	msv
Heat resistance temperature, 80% retention of shear strength	ASTM C393	60	60	60	°C	
Water resistance, % retention of shear strength, 20°C	ASTM C393	>80	>80	>80	%	

Remarks:
The materials comply with the DNV GL requirement to maximum water absorption.

Legends:
msmv = Manufacturer's Specified Minimum Value
msv = Manufacturer's Specified Value (msv is mainly taken as the mean = Mean of Type Test results)

The table continues on the next page.

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Properties	Test Method	ArmaFORM PET GR 100	115	135	150		
Density	ISO 845	95	110	130	145	kg/m³	msmv
Density, nominal	ISO 845	100	115	135	150	kg/m³	msv
Tensile strength, 20°C	ASTM C297	1,9	2,2	2,5	2,9	MPa	msmv
Tensile strength, 20°C	ASTM C297	2,4	2,7	3,0	3,4	MPa	msv
Tensile modulus, 20°C	ASTM C297	70	85	110	140	MPa	msmv
Tensile modulus, 20°C	ASTM C297	105	120	140	190	MPa	msv
Compressive strength, 20°C	ASTM D1621 B	1,25	1,5	2,0	2,3	MPa	msmv
Compressive strength, 20°C	ASTM D1621 B	1,5	1,8	2,3	2,6	MPa	msv
Compressive modulus, 20°C	ISO 844	55	65	80	90	MPa	msmv
Compressive modulus, 20°C	ISO 844	70	80	90	105	MPa	msv
Compressive modulus, 20°C	ASTM D1621 B	95	110	140	170	MPa	msmv
Compressive modulus, 20°C	ASTM D1621 B	105	120	150	180	MPa	msv
Shear strength, 20°C	ISO 1922	0,65	0,75	1,0	1,2	MPa	msmv
Shear strength, 20°C	ISO 1922	0,75	0.9	1,2	1,4	MPa	msv
Shear modulus, 20°C	ISO 1922	16	20	28	34	MPa	msmv
Shear modulus, 20°C	ISO 1922	20	25	35	40	MPa	msv
Shear elongation, 20°C	ISO 1922	5	5	5	5	%	msmv
Shear elongation, 20°C	ISO 1922	10	10	7	7	%	msv
Heat resistance temperature, 80% retention of shear strength	ASTM C393	60	60	60	60	°C	
Water resistance, % retention of shear strength, 20°C	ASTM C393	>80	>80	>80	>80	%	

Remarks:
The materials comply with the DNV GL requirement to maximum water absorption.

Legends:
msmv = Manufacturer's Specified Minimum Value
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Application/Limitation

The uses of core materials for hull applications are to be approved in each individual case.

Documentation of additional material properties may be required.

Type Approval documentation
Tests carried out

Type Testing carried out in accordance with **Type Approval documentation**.

Fatigue testing has been carried out for ArmaFORM PET GR115 to establish S/N-curves. For further details, please contact the manufacturer.

Marking of product

Product shall be marked with:
- *manufacturer's name and/or trademark*; **Armacell Benelux S.A., Thimister-Clermont, Belgium**,
- *type designation/product name (**ArmaFORM PET GR**),*
- *density variant (**60 / 70 / 80 / 100 / 115 / 135 / 150**)* and
- *dimensions.*

The marking is to be carried out in such a way that it is visible, legible and indelible. The marking of product is to enable traceability to the DNV GL Type Approval Certificate.

Periodical assessment

The scope of the Periodical Assessment is to verify that the conditions stipulated for the Type Approval is complied with and that no alterations are made to the product design or choice of materials.

Periodical Assessment to be performed after two (2) years (Certificate Retention) and at renewal after four (4) years (Certificate Renewal).

The main elements of the Periodical Assessment are to:

- Ensure that **Type Approval documentation** is available.
- Review design, materials, production process, and performance with respect to possible changes, in order to ensure compliance with **Type Approval documentation** and/or referenced material specifications.
- Ensure traceability between manufacturer's product marking and the DNV GL Type Approval Certificate.

END OF CERTIFICATE