



DET NORSKE VERITAS

TYPE APPROVAL CERTIFICATE

CERTIFICATE NO. K-4829

This is to certify that the
Sandwich Core Materials

with type designation(s)
ArmaFORM AC

Manufactured by
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, 2008

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

Høvik, 2012-01-12
for Det Norske Veritas AS



This Certificate is valid until
2015-12-31

Rikard Törnqvist
Head of Section

DNV local office:
Antwerp

Gisle Hersvik
Surveyor

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.

If any person suffers loss or damage which is proved to have been caused by any negligent act or omission of Det Norske Veritas, then Det Norske Veritas shall pay compensation to such person for his proved direct loss or damage. However, the compensation shall not exceed an amount equal to ten times the fee charged for the service in question, provided that the maximum compensation shall never exceed USD 2 million. In this provision "Det Norske Veritas" shall mean the Foundation Det Norske Veritas as well as all its subsidiaries, directors, officers, employees, agents and any other acting on behalf of Det Norske Veritas.



Certificate No.: K-4829
 File No.: 332.40
 Job Id.: 262.1-011945-1

Product description

ArmaFORM AC 80, ArmaFORM AC 100, ArmaFORM AC 115, ArmaFORM AC 135 and ArmaFORM AC 150; Thermoplastic core material extruded closed cell structure foam made of Polyethylene Terephthalate (PET).

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

| Properties | Test Method | ArmaFORM AC | | | | | | |
|--|--------------|-------------|------|-----|-----|-----|-------------------|------|
| | | 80 | 100 | 115 | 135 | 150 | | |
| Density | ISO 845 | 75 | 95 | 110 | 130 | 145 | kg/m ³ | msmv |
| Density, nominal | ISO 845 | 80 | 100 | 115 | 135 | 150 | kg/m ³ | msv |
| Tensile strength, 20°C | ASTM C297 | 1,2 | 1,4 | 1,6 | 2,2 | 2,5 | MPa | msmv |
| Tensile strength, 20°C | ASTM C297 | 2,1 | 2,4 | 2,7 | 3,0 | 3,4 | MPa | msv |
| Tensile modulus, 20°C | ASTM C297 | 65 | 95 | 110 | 140 | 180 | MPa | msmv |
| Tensile modulus, 20°C | ASTM C297 | 75 | 105 | 120 | 150 | 190 | MPa | msv |
| Compressive strength, 20°C | ISO 844 | 0,8 | 1,25 | 1,5 | 2,0 | 2,3 | MPa | msmv |
| Compressive strength, 20°C | ISO 844 | 1,0 | 1,5 | 1,8 | 2,3 | 2,6 | MPa | msv |
| Compressive modulus, 20°C | ISO 844 | 45 | 55 | 65 | 80 | 90 | MPa | msmv |
| Compressive modulus, 20°C | ISO 844 | 60 | 70 | 80 | 90 | 105 | MPa | msv |
| Compressive modulus, 20°C | ASTM D1621 B | 65 | 95 | 110 | 140 | 170 | MPa | msmv |
| Compressive modulus, 20°C | ASTM D1621 B | 75 | 105 | 120 | 150 | 180 | MPa | msv |
| Shear strength, 20°C | ISO 1922 | 0,5 | 0,7 | 0,8 | 1,1 | 1,2 | MPa | msmv |
| Shear strength, 20°C | ISO 1922 | 0,6 | 0,9 | 1,0 | 1,3 | 1,4 | MPa | msv |
| Shear modulus, 20°C | ISO 1922 | 10 | 18 | 23 | 28 | 35 | MPa | msmv |
| Shear modulus, 20°C | ISO 1922 | 20 | 25 | 30 | 35 | 45 | MPa | msv |
| Shear elongation, 20°C | ISO 1922 | 20 | 15 | 10 | 5 | 5 | % | msmv |
| Shear elongation, 20°C | ISO 1922 | 35 | 30 | 20 | 15 | 10 | % | msv |
| Heat resistance temperature, 80% retention of shear strength | ASTM C393 | 60 | 60 | 60 | 60 | 70 | °C | |
| Water resistance, % retention of shear strength, 20°C | ASTM C393 | >80 | >80 | >80 | >80 | >80 | % | |

Remarks:

The materials comply with the DNV 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)

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

Submittal from DNV Antwerp including:

- Letter from ARMACELL of 2011-10-13 re. change of name to ArmaFORM AC,
- Test results for ArmaFORM AC 80, AC 100 and AC 150 (density, shear, tensile and compression),
- KTH Report No. C2008-15 of 2008-09-17, "Heat Resistance Temperature Test of Armacell PET 100 & 150",
- KTH Report No. C2008-17 of 2008-09-24, "Water Resistance Test of Armacell PET 100 & 150",
- KTH Report No. C2009-15 of 2009-10-20, "Fatigue Testing of Sandwich Core Material, AC 80, AC 100 and AC 115",
- KTH Report No. C2009-16 of 2009-10-20, "Water Absorption of PET Foam AC 80, AC 100 and AC 115",
- ARMACELL's "Certification of ArmaFORM AC Grade" dated Sep. 2011,
- Technical Data Sheet, ArmaFORM PET CORE AC 80, 100, 115, 135 and 150,
- Survey Report from DNV Antwerp of 2011-08-09.



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Tests carried out

Type Testing carried out according to **Type Approval documentation**.

Marking of product

Product shall be marked with:

- *manufacturer's name*; **Armacell Benelux S.A., Thimister-Clermont, Belgium**,
- *product name* (**ArmaFORM AC**) and
- *density variant* (**80 / 100 / 115 / 135 / 150**).

Certificate Retention/Renewal Survey

The scope of the Retention/Renewal Survey 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.

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

The main elements of the survey are:

- 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 Type Approval Certificate.

END OF CERTIFICATE