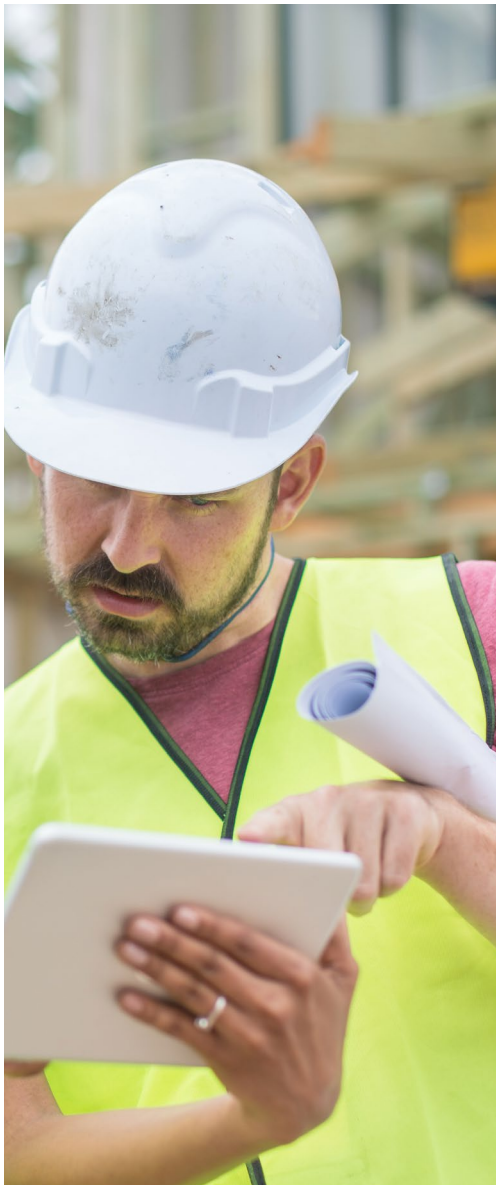
THE TRUSTED INSULATION

# ArmaFlex® Class 0 Technical Guide

This guide provides an overview about the certifications of ArmaFlex Class 0. Discover today why it is the preferred insulation to deliver safety, efficiency and better indoor air quality. **The trusted insulation system for HVAC applications.**

**www.armacell.com**



armacell®
ArmaFlex®

# ArmaFlex Class 0

Discover why it is the **trusted insulation** for reliable performance in safety, efficiency and indoor air quality, according to different test standards around the world.

## INTRODUCTION

ArmaFlex is an elastomeric foam material based on synthetic rubber, also known as nitrile butadiene rubber (NBR). Invented in 1954, ArmaFlex is in its seventh product generation and is the trusted flexible insulation material to reliably protect against water vapour ingress without the need for any additional water vapour barrier.

ArmaFlex Class 0 is one of Armacell's most well-known products around the world. Classified as a Class 0 product according to BS 476 Parts 6 and 7, it is infused with Microban® anti-microbial product protection to offer added resilience against mould and bacteria growth. The product's versatility and flexibility means it cuts easily and conforms to preferred shapes of pipe- and ductwork, minimising any potential for air gaps between the insulation and the equipment. This means installers can effectively deliver professionally installed insulation systems and facility owners can be assured of efficient, long-term system performance.

## USING THIS DOCUMENT

Fit-for-purpose insulation correctly selected and installed is one of the simplest, fastest and most cost-effective means of improving energy efficiency. To enhance standards of living and save energy, regulatory bodies all over the world have specified standards and requirements with regards to thermal and acoustic insulation. In this document, discover more about the certifications and standards that ArmaFlex Class 0 conforms to and learn about some of the equivalent standards that apply.

Hyperlinks have been set up in the electronic version of this document to facilitate ease of reading. Selection of the blue, underlined text will display information about the standard, test method or certification. Selection of the icon within the "Certificate" column will display the test certificate or report.



## TECHNICAL DATA

| | |
|---|---|
| Brief description | ArmaFlex Class 0 is a flexible insulation material that reliably protects against water vapour ingress due to its closed-cell structure. No additional water vapour barrier is required. |
| Material type | Elastomeric foam based on synthetic rubber. |
| Colour | Black |
| Special features | ArmaFlex sheets are infused with Microban anti-microbial protection to provide additional assurance against mould and bacteria growth. |
| Applications | Thermal insulation/protection of pipes, air ducts and vessels (incl. elbows, fittings, flanges, etc.) in hot and cold water services, chilled water lines, heating systems, air conditioning ductwork and refrigerated pipework, installed in commercial, industrial, residential and public buildings to control condensation, protect against frost and reduce energy loss. |
| Installation | Refer to the ArmaFlex installation manual for recommended installation method. ArmaFlex can be used together with ArmaFix® pipehangers for a complete insulation system. |

| Property | Value/Assessment | | | | | | Standard / Test method | Certificate |
|---|---|---|---|---|---|---|---|---|
| **Temperature range** | | | | | | | | |
| Service temperature | Max. service temperature | +105 °C | | | | +85°C if sheet or tape is glued to the object with its whole surface. | | |
| | Min. service temperature | -50 °C | | | | | | |
| **Thermal conductivity** | | | | | | | | |
| Declared thermal conductivity | θm | -20 | +/-0 | +20 | +40 | [°C] | Tested according to GB/T 10295, GB/T 10296, ASTM C518, EN ISO 8497 | |
| | λ ≤ | 0.032 | 0.034 | 0.036 | 0.039 | [W/(m·K)] | | |
| **Water vapour diffusion resistance** | | | | | | | | |
| Water vapour diffusion resistance factor | μ ≥ 10,000 | | | | | | Tested according to GB/T 17146-1997, DIN EN 13469, DIN EN 12086 | |
| Water vapour permeability | ≤ 1.96 x $10^{-11}$ g/(m·s·Pa) | | | | | | | |
| **Fire performance & approvals** | | | | | | | | |
| Surface spread of flame | Class 1 | | | | | | Tested according to BS 476 Part 7: 1997 | |
| Fire performance according to building regulations | Class 0 | | | | | | Tested according to BS 476 Part 6: 1997 | |
| Burning behaviour of building materials and products | Class B1 | | | | | | Tested according to GB 8624-2012 | |
| Flammability | V-0 rating | | | | | | Tested according to UL 94 | |
| | FM-Approved | | | | | | Tested according to FM 4924 | |
| Practical fire behaviour | Does not generate flaming droplets. | | | | | | | |
| Others | Marine application: Low flame spread material. | | | | | | Classified according to 2010 FTP-Code | |
| | Registered by the Fire Services Department of Hong Kong for the entire range of thickness. | | | | | | | |
| | Product conforms to the requirements for building products under the Fire Safety and Shelter Department, Singapore. | | | | | | | |
| **Other technical features** | | | | | | | | |
| Resilience after compression relief | ≥ 70% | | | | | | Tested according to GB/T 6669-2001 | |
| Water absorption by vacuum | ≤ 10% | | | | | | Tested according to GB/T 17794 | |
| Chemical resistance | Excellent resistance to ozone, oil and chemicals (consult product test list). | | | | | | | |
| UV resistance | For UV protection, ArmaFinish Paint or Arma-Chek® covering system is required. For outside use, ArmaFlex should be protected within 3 days of installation. | | | | | | | |
| Anti-microbial behaviour | Built-in Microban anti-microbial product protection in sheets. | | | | | | | |

| | | | |
|---|---|---|---|
| Fungal growth | No fungal growth is observed. | Tested according to ASTM G21 | |
| Health aspects | Free of fibre and formaldehyde.<br>Low volatile organic compounds (VOC), and total aldehyde.<br>GREENGUARD GOLD for even lower VOC and total chemical emissions. | Tested according to UL2818-2013 | |
| Environmental aspect | Zero ODP and GWP.<br>Complies with Restriction of Hazardous Substances Directive.<br><br>Singapore Green Building Product Certified: "Excellent" rating<br><br>Type III Environmental Product Declaration (EPD): Declaration number 4786944121.101.1, UL Environment. | | |
| Storage | Material shall be stored in dry, clean rooms at normal relative humidity (50% to 70%) and ambient temperature (0 °C to 35 °C). | | |
| Shelf (storage) life | Self-adhesive sheets, tubes and tapes: 1 year. | | |

All data and technical information are based on results achieved under typical application conditions. Recipients of this information should, in their own interest and responsibility, clarify with Armacell's Technical department in due time whether or not the data and information apply to the intended application area. For outside use, ArmaFlex should be protected with ArmaFinish or Arma-Chek-® covering within 3 days of installation.

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# THERMAL CONDUCTIVITY

**// Test method**

A heat flow meter is an instrument used to measure the steady-state heat transfer through a specimen and calculate its heat transfer properties.

**// Requirement**

Thermal conductivity, also known as the k-value, refers to the rate of steady-state heat flow through a unit thickness of a unit area of a homogeneous material, induced by a unit temperature increase. Using Fourier's law of heat conduction, the thermal conductivity of the test material is calculated. **The lower the value, the better the insulation property of the material.**

Due to its low thermal conductivity, ArmaFlex Class 0 offers excellent insulation property.

**// ArmaFlex Class 0 performance**

The thermal conductivity of ArmaFlex Class 0 is $\lambda_{0°C} \leq 0.034$ W/(m·K). Table 1 offers a comparison of the k-values for some common materials as reference.

Table 1: Thermal conductivity of different materials at 0°C.

| Material | Air | ArmaFlex Class 0 | Water | Copper |
|---|---|---|---|---|
| K-value [W/m·K] | 0.025 | 0.034 | 0.560 | 401 |

**// Equivalent test standards**

- The national standards in China, often referred to as GB standards, are developed for technical requirements. GB/T 10295 is equivalent to the ISO 8301:1991 (E) and defines the use of the heat flow meter method to measure steady-state thermal resistance and related properties. The GB/T 10296 is a test standard that is equivalent to the ISO 8497:1994. Both test reports are available from page 16.

- ASTM C518 defines the measurement of steady-state thermal transmission through flat slab specimens using a heat flow meter.

- EN ISO 8497 is a test standard for measuring the steady-state of thermal transmission properties for thermal insulation of circular pipes.

# WATER VAPOUR DIFFUSION RESISTANCE

**// Test method**

In this test, the specimen is sealed to an open side of a test dish containing a desiccant or an aqueous saturated salt solution. This assembly is then placed in a temperature- and humidity-controlled environment. Because of the difference between the partial water vapour pressures in the test assembly and in the atmosphere, water vapour flows through the test specimen.

**// Requirement**

The test assembly is periodically weighed so as to calculate the water vapour diffusion resistance factor and the water vapour permeability. Water vapour diffusion resistance factor is a measure of the material's reluctance to let

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water vapour pass through. It is commonly referred to as the μ-value. The higher the μ-value, the better the material is at limiting water vapour ingress over time.

Water vapour permeability is defined as the amount of water vapour that passes through unit thickness of a material, in unit time under a given pressure. Materials with very high resistance to water vapour transmission will have very low permeability values.

ArmaFlex Class 0 has a naturally high μ-value and does not require any vapour barrier.

**// ArmaFlex Class 0 performance**

The μ-value of ArmaFlex Class 0 is high, consistently achieving 10,000 and beyond in numerous tests over the years. According to simulated calculations by the Fraunhofer Institute, flexible elastomeric foam insulation materials like ArmaFlex Class 0 would have less than 5% moisture absorption after 10 years, as compared to almost 20% and 25% for mineral wool and polyurethane.

**// Equivalent test standards**

- GB/T 17146 defines the test method for water vapour transmission properties of building materials and was updated based on the ISO 12572:2001 standard, which specifies a method for determining water vapour permeance of building products and water vapour permeability of building materials under isothermal conditions. See the report here.

- DIN EN 12086 is a European standard that specifies the equipment and procedures for determining water vapour transmission properties of thermal insulating products, in the steady state, for building applications.

- DIN EN 13469 is a similar European standard for determining water vapour transmission properties of thermal insulating pipes for building equipment and industrial installations.

# FIRE PERFORMANCE (BS 476)

**// Test standard**

BS 476 refers to the British standard for fire tests on building materials and structures. Part 6 specifies a method of test for providing a comparative measure of a flat material or assembly's contribution to the growth of a fire. It takes into account the combined effect of factors such as ignition characteristics, amount and rate of heat release and thermal properties of the product in relation to its ability to accelerate the rate of fire growth. Part 7 specifies the test method for measuring the lateral spread of flame along the surface of a test specimen.

**// Part 6 Requirement**

In this test, the set-up consists of a combustion chamber with a specimen holder fixed to one face. The combustion chamber contains a horizontal gas burner tube and two electrical heating elements that is placed below a removable steel chimney and cowl. The sheet sample is placed into the specimen holder and clamped onto the combustion chamber such that the face of the sample is in contact with the walls of the combustion chamber. The sample is subjected to flame and heat from the heating element. Temperature measurements are taken frequently throughout the 20 minutes test and used to calculate the fire propagation index, I and sub-indices $i_1$, $i_2$ and $i_3$.The higher the fire propagation index, the greater is the influence of the product on accelerating the growth of a fire.

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A material is classified as Class 0 according to the UK Building regulations for fire safety if it is:

- composed throughout of materials of limited combustibility, or
- a Class 1 material (classified if the material passes the Part 7 test) which has a fire propagation index (I) of not more than 12 and sub-index ($i_1$) of not more than 6.

**// Part 7 Requirement**

In this test, a specimen is placed in a vertical test position adjacent to the radiation panel, within 5 seconds of igniting a pilot flame. A minute after this, the pilot flame is extinguished. The material might start to burn and the test is terminated when the flame front reaches the 825mm reference line, or after 10 minutes has lapsed, whichever is earlier. The following measurements are recorded:

- Time at which the flame front crosses each vertical reference line
- Maximum extent of flame spread during the first 1.5 minutes from the start of the test
- Maximum extent of flame spread during the whole test (i.e. 10 minutes or less, where applicable)
- Time (and distance) at which the maximum flame spread reached.

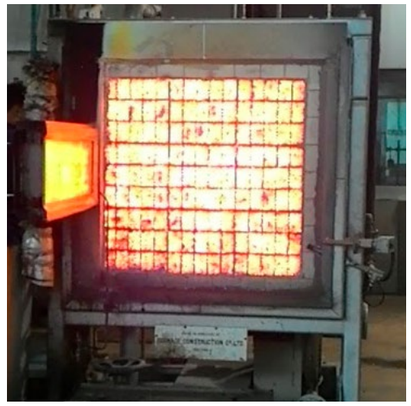

Figure 1: Test chamber for BS476 Part 7 fire test.

The flame spread at 1.5 minutes and the final flame spread results are then compared with the standard class limits as shown in Figure 2 and a classification is assigned (table 2).

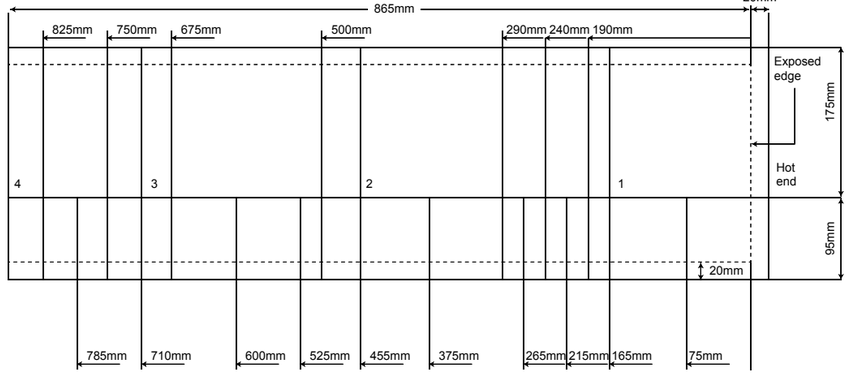


Figure 2: Reference lines to assist surface spread of flame classification.

Table 2: Standard class limits and classification of BS476 Part 7.

| | Spread of flame at 1.5 min | | Final spread of flame | |
|---|---|---|---|---|
| **Classification** | **Limited [mm]** | **Limit for one specimen in sample [mm]** | **Limit [mm]** | **Limit for one specimen in sample [mm]** |
| 1 | 165 | 25 | 165 | 25 |
| 2 | 215 | 25 | 455 | 25 |
| 3 | 265 | 25 | 710 | 25 |
| 4 | Exceeding the limits for class 3 | | | |

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**// ArmaFlex Class 0 performance**

ArmaFlex Class 0 is a Class 1 material with I < 12 and $i_1$ <6. Review the test report for part 6 from page 27 and part 7 from page 33.

# FIRE PERFORMANCE (GB 8624)

**// Test standard**

GB 8624 refers to a mandatory national standard in China, that classifies the burning behaviour of building materials and products. It references the EN 13501-1 "Fire classification of construction products and building elements" and establishes specifications to relate the grading classes of both standards. According to GB 8624, the burning behaviour of building materials and products are classified into four grades as shown in Table 3.

Table 3: Grades of burning behaviour of building materials and products.

| Grade | A | $B_1$ | $B_2$ | $B_3$ |
|---|---|---|---|---|
| Description | Incombustible materials (products) | Flame retardant materials (products) | Combustible materials (products) | Inflammable materials (products) |

There are seven product sub-categories in GB 8624, with each sub-category to be tested and classified with methods and requirements identified in different Chinese test standards as briefly shown in Table 4. Insulation is categorised under two of these product sub-categories, namely flat building materials and cylindrical / tube shaped insulation materials.

Table 4: Product categories of GB 8624.

| Product category | Product sub-category | Relevant test method |
|---|---|---|
| Building materials | Flat building materials | GB/T 5464, GB/T 14402, GB/T 20284, GB/T 8626 |
| | Flooring materials | GB/T 5464, GB/T 14402, GB/T 11785, GB/T 8626 |
| | Cylindrical / tube shaped insulation materials | GB/T 5464, GB/T 14402, GB/T 20284, GB/T 8626 |
| Building products | Curtains and decorating fabrics | GB/T 5454, GB/T 5455 |
| | Wire and cable casing, electrical equipment, enclosure and accessories | GB/T 2406, GB/T 2408, GB/T 5169 |
| | Electrical and furniture made of plastic | GB/T 16172, GB/T 8333 |
| | Furniture | GB/T 27904, GB/T 17927 |

For flat building materials, it is classified into grades as detailed in Table 5.

Table 5: Flat building materials test method and criteria.

| Grade | | Test method | | Criteria |
|---|---|---|---|---|
| A | A1 | GB/T 5464 and | | Temperature rise ΔT ⩽ 30°<br>Material loss Δm ⩽ 50%<br>Duration of sustained flaming $t_f$ = 0s |
| | | GB/T 14402 | | Gross calorific potential (PCS) ⩽ 2.0 MJ/kg<br>Gross calorific potential (PCS) ⩽ 1.4 MJ/m² |
| | A2 | GB/T 5464 or | and | Temperature rise ΔT ⩽ 50°<br>Material loss Δm ⩽ 50%<br>Duration of sustained flaming $t_f$ =20s |
| | | GB/T14402 | | Gross calorific potential (PCS) ⩽ 3.0 MJ/kg<br>Gross calorific potential (PCS) ⩽ 4.0 MJ/m² |
| | | GB/T 20284 | | Fire growth rate $FIGRA_{0.2\,MJ}$ ⩽ 120W / s<br>Lateral flame spread < edge of specimen<br>Total heat release at 600s $THR_{600s}$ ⩽ 7.5 MJ |

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| Grade | | Test method | Criteria |
|---|---|---|---|
| $B_1$ | B | GB/T 20284 and | Fire growth rate index $FIGRA_{0.2\,MJ}$ ⩽ 120W / s<br>Lateral flame spread < edge of specimen<br>Total heat release at 600s $THR_{600s}$ ⩽ 7.5 MJ |
| | | GB/T 8626<br>Time of ignition 30 seconds | Flame spread Fs ⩽ 150mm within 60 seconds<br>No flaming droplets / particles observed for 60 seconds |
| | C | GB/T 20284 and | Fire growth rate index $FIGRA_{0.4\,MJ}$ ⩽ 250W / s<br>Lateral flame spread < edge of specimen<br>Total heat release at 600s $THR_{600s}$ ⩽ 15 MJ |
| | | GB/T 8626<br>Time of ignition 30 seconds | Flame spread Fs ⩽ 150mm within 60 seconds<br>No flaming droplets / particles observed for 60 seconds |
| $B_2$ | D | GB/T 20284 and | Fire growth rate $FIGRA_{0.4\,MJ}$ ⩽ 750W / s |
| | | GB/T 8626<br>Time of ignition 30 seconds | Flame spread Fs ⩽ 150mm within 60 seconds<br>No flaming droplets / particles observed for 60 seconds |
| | E | GB/T 8626<br>Time of ignition 15 seconds | Flame spread Fs ⩽ 150mm within 20 seconds<br>No flaming droplets / particles observed for 20 seconds |
| $B_3$ | F | No performance requirement | |

**// ArmaFlex Class 0 performance**

ArmaFlex Class 0 meets the performance classification of $B_1$ (Table 5). See the test report from page 38.

# FIRE PERFORMANCE (UL94)

**// Test standard**

UL94 is a widely quoted flammability performance standard that provides a method for rating ignition characteristics of plastic materials. It is a small-scale test that evaluates the flammability of polymeric materials, in response to a small, open flame or radiant heat source under controlled laboratory conditions.

**// Requirement for vertical burning test**

Test samples are placed vertically with the test flame impinging on the bottom of the sample. The flame must extinguish within specified times, without burning to the top clamp or dripping molten material which would ignite a cotton indicator (Table 6).

Table 6: Criteria for UL 94 vertical burning rating.

| Rating | Criteria |
|---|---|
| V-0 | Burning stops within 10 seconds. No drips allowed. |
| V-1 | Burning stops within 30 seconds. No drips allowed. |
| V-2 | Burning stops within 30 seconds. Drips or flaming particles allowed. |

ArmaFlex Class 0 does not generate flaming droplets.

**// ArmaFlex Class 0 performance**

ArmaFlex Class 0 achieves V-0 rating. See the test report on page 41.

**// Equivalent test standard**

- ASTM D3801 is the ASTM-equivalent test method to the UL94 vertical burning test. This fire-test-response standard covers a small-scale laboratory procedure for determining comparative burning characteristics of solid-plastic material, using a 20mm (50W) premixed flame applied to the base of specimens held in a vertical position.

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# FIRE PERFORMANCE (FM APPROVED)

**// Test standard**
FM 4924 standard specifies the approval requirement for insulation material used on the exterior of non-combustible pipes or ducts. A pipe chase test apparatus is a three-sided 'L-shaped' channel that consists of a horizontal segment attached to a vertical segment. A test array comprised of three insulated pipes are laterally spaced inside the channel. A propane burner is placed at the end of vertical pipes and the sample is subjected to an exposed fire for 10 minutes (Figure 3).

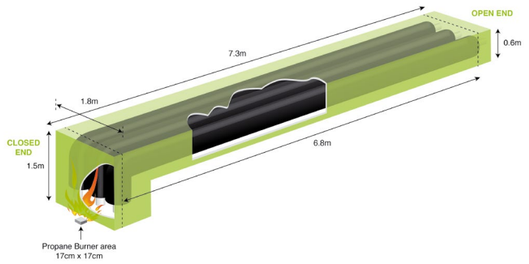

Figure 3: Pipe chase test apparatus set up.

Duct insulation (sheets) under this standard is specified according to the UBC Standard No. 26-3 or ISO 9705, where 8ft by 8ft test samples are mounted on the back wall and adjacent left wall of a room. A fire pan, starter material and wood crib are placed in the corner between these two walls. The room test runs for 15 minutes from the time the starter material is ignited (Figure 4).


Figure 4: FM 4924 room test.

**// Requirement**
For the pipe chase test, the fire shall not propagate to the end of the horizontal segment, the temperature must not exceed 300°C and the insulation fallen off the horizontal segment must extinguish within 10 seconds of hitting the base of the channel.

For the room test, the sheet insulation shall not burn on the floor for more than 10 seconds. Charring of the foam plastic panel cores do not extend to the outer extremities of the test area for 15 minutes, until flashover occurs as indicated by flaming out the doorway or a temperature in excess of 540°C.

**// ArmaFlex Class 0 performance**
ArmaFlex Class 0 is FM-Approved, and the certificate is available from page 45.

# FIRE PERFORMANCE (MARINE)

**// Background of Marine Equipment Directive (MED)**
The European Union (EU) directive (2014/90/EU) requires all marine equipment installed onboard ships flying the flag of an EU country, Norway, Iceland and other flag states to marked with the MED mark of conformity, also known as the "wheelmark". The MED sets out performance and testing standards that these equipment must meet.

There are two conformity assessment modules for thermal insulation that covers both the design and production phases. The EC Type Examination Module B examines the technical design of a product and verifies that the product meets the

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respective legislative requirements. The EC Type Examination Module D assesses the equipment manufacturer's production process quality system.

**// Requirement**
The thermal insulation product is tested for low flame spread characteristics according to IMO 2010 FTP Code part 5 – test for surface flammability.

**// ArmaFlex Class 0 performance**
The EC-Type examination certificate issued by DNV-GL for conformity in accordance with the Marine Equipment Directive 2014/90/EU is available from page 46.

# RESILIENCE AFTER COMPRESSION RELIEF

**// Test standard**
GB/T 6669 is a test standard identical to ISO 1856 and is used to determine the compression set of flexible cellular materials. The test sample is subjected to compression by either 50% or 75% of its thickness and maintained under this condition for a specific duration.

**// Requirement**
The sample subjected to 50% compression over 72 hours should recover more than 70%.

**// ArmaFlex Class 0 performance**
The compression recovery of ArmaFlex Class 0 after 72 hours is more than 70%, as shown in the results from page 54.

# WATER ABSORPTION BY VACUUM

**// Test standard**
GB/T 17794 standard specifies the test method for flexible elastomeric cellular thermal insulation to evaluate its performance in an accelerated water absorption test. In this test, the sample is submerged in water in a vacuum for 3 minutes.

**// Requirement**
Water absorption of the material in a vacuum should be less than 10%.

**// ArmaFlex Class 0 performance**
As reported from page 57, ArmaFlex Class 0 passed the test with less than 10% water absorption performance in a vacuum.

# FUNGAL GROWTH

**// Test standard**
ASTM G21 standard specifies a fungus resistance test that uses a high concentration of spores from five different fungal species, to determine the resistance of synthetic polymeric materials to fungal growth. The test samples are incubated at

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28°C at 90% relative humidity for 28 days and examined every 7 days.

**// Requirement**
The samples are examined under a microscope at 40x magnification and rated on a score of 0 to 4 based on the amount of growth that exists as described in table 7.

Table 7: Rating system based on observed growth on specimens after 28 days

| Grade | Description |
|---|---|
| 0 | Specimen remained free of fungal growth. |
| 1 | Traces of growth on specimen (less than 10%). |
| 2 | Light fungal growth on specimen (10 to 30%). |
| 3 | Medium fungal growth on specimen (30 to 60%) |
| 4 | Heavy fungal growth on specimen (60% to complete coverage) |

No fungal growth is observed on ArmaFlex Class 0, even at 50x magnification.

**// ArmaFlex Class 0 performance**
No fungal growth is observed on ArmaFlex Class 0. The report is available from page 60.

# GREENGUARD CERTIFICATION PROGRAMME

**// Test standard**
UL 2818 is a test standard in the GREENGUARD Certification Programme for chemical emissions from building materials, finishes and finishing. This standard specifies that products are tested and evaluated according to the dynamic environmental chamber processes and criteria defined in UL 2821. The test lasts for 168 hours where air flow is modelled to simulate actual product use conditions. Chamber air samples are collected and analysed for volatile organic compounds (individual and total) and aldehydes (individual and total) at specified time intervals.

**// Requirements**
Based on exposure modelling, the measurements are then calculated and converted into air concentrations values to represent what a person will actually breathe. These concentrations are determined based on expected use of the product, amount of product, its application process and the indoor building conditions, including building volume and fresh air exchange rate. The quantity of VOCs in the environmental chamber air is determined by gas chromatography/mass spectrometry and emissions of selected aldehydes are measured using reverse-phase high-performance liquid chromatography (HPLC) with UV detection.

The allowable levels for total volatile organic compounds (TVOC), individual VOCs, formaldehyde and other aldehyde emission levels are defined in Table 8.

Table 8: Allowable limits for UL GREENGUARD Certification

| | |
|---|---|
| Individual VOCs | ≤ 0.1 TLV |
| Formaldehyde<br>4-Phenylcyclohexene | ≤ 0.05 ppm<br>≤ 0.0065 mg/m$^3$ |
| Total VOCs | ≤ 0.5 mg/m$^3$ |
| Total aldehydes<br>Particle matter ≤ 10µm (PM10) | ≤ 0.1 ppm<br>≤ 0.05 mg/m$^3$ |

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GREENGUARD GOLD Certification offers **stricter** certification criteria, considering safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments, such as schools and healthcare facilities. It is also referenced by both The Collaborative for High Performance Schools (CHPS) and LEED® green building programme.

Table 9: Allowable limits for GREENGUARD Gold

| | | |
|---|---|---|
| Individual VOCs | ≤ 1/2 CA chronic REL or 0.01 TLV | Required for GREENGUARD Gold and "CDPH/EHLB/ Standard Method V1.1 "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers Version 1.1" |
| Formaldehyde | ≤ 0.0073 ppm / 7.3 ppb | |
| Total VOCs | ≤ 0.22 mg/m$^3$ | |
| Total aldehydes<br>Particle matter ≤ 10µm (PM10)<br>1-Methyl-2-pyrrolidinone | ≤ 0.043 ppm / 43 ppb<br>≤ 0.02 mg/m$^3$<br>≤ 0.16 mg/m$^3$ | |

**// ArmaFlex Class 0 performance**
Test results show that the chemical emissions of ArmaFlex Class 0 is within the allowable limits of GREENGUARD Gold Certification. More detailed information is available from page 64.

# RESTRICTION OF HAZARDOUS SUBSTANCES

**// Background**
The Restriction of Hazardous Substances (RoHS) Directive restricts the use of ten hazardous materials in the manufacture of various types of electronic and electrical equipment. All applicable products in the European Union must pass RoHS compliance.

**// Requirement**
The RoHS specifies maximum levels for ten restricted substances as shown in Table 10.

Table 10: Allowable limits for ten restricted substances according to RoHS.

| Substance | Maximum allowable limit |
|---|---|
| Cadmium (Cd) | < 100 ppm |
| Lead (Pb) | < 1000 ppm |
| Mercury (Hg) | < 1000 ppm |
| Hexavalent Chromium (Cr VI) | < 1000 ppm |
| Polybrominated Bipheyls (PBB) | < 1000 ppm |
| Polybrominated Diphenyl Ethers (PBDE) | < 1000 ppm |
| BIS (2-Ethylhexyl) phthalate (DEHP) | < 1000 ppm |
| Benzyl butyl phthalate (BBP) | < 1000 ppm |
| Dibutyl phthalate (DBP) | < 1000 ppm |
| Diisobutyl phthalate (DIBP) | < 1000 ppm |

**// ArmaFlex Class 0 performance**
The test results for ArmaFlex Class 0 on page 66 shows that it complies with the RoHS directive.

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# SINGAPORE GREEN BUILDING PRODUCT CERTIFICATION

**// Background**

The only industry-centric certification scheme for green building products and materials, the Singapore Green Building Product (SGBP) certification scheme is used to objectively evaluate building products and benchmark against similar products in its category. Building products are assessed on their environmental properties and performance through a comprehensive list of assessment criteria covering the five key areas of Energy Efficiency, Water Efficiency, Resource Efficiency, Health & Environmental Protection and Other Green Features.

Products are rated and scored accordingly to the stipulated criteria Depending on the assessed environmental qualities of the product, it is awarded a rating ranging from 1-tick to 4-ticks (Good to Leader).

**// Use of the SGBP rating**

The SGBP certification scheme is recognised under Singapore's Green Mark Scheme, the national green building rating tool. In the criteria for the Green Mark Scheme for New Buildings, SGBP certified products specified and used can score up to a maximum of 8 points[1]. In addition, usage of SGBP products rated 2-ticks and above can accrue a maximum of 2 additional points. These products can form part of functional systems or singular sustainable products[2].

Table 11: Additional points certified products can accrue based on its SGBP rating

| SGBP rating | | Additional points per product |
|---|---|---|
| ✓✓ | Very good | 0.25 |
| ✓✓✓ | Excellent | 0.5 |
| ✓✓✓✓ | Leader | 1 |

**// ArmaFlex Class 0 performance**

ArmaFlex Class 0 is rated Excellent and the certificate is available on page 72.

# ENVIRONMENTAL PRODUCT DECLARATION

**// Background**

An Environment Product Declaration (EPD) is a neutral, independently verified document that provides information about the impact a product has, especially on the environment, throughout its life cycle. Developed based on data compliant with ISO and Life Cycle Assessment (LCA) methodology, an EPD can be compared with other EPDs. This facilitates product evaluation, especially when designing green buildings in accordance with certification schemes such as LEED.

An LCA quantifies the direct and indirect environmental impact associated with the life cycle of a product, ranging from raw material extraction, materials processing and manufacturing to distribution, use and disposal. As an LCA provides specific information about an individual manufacturer's products, these results cannot be directly transferred or compared with similar products of another manufacturer.

[1] In the Green Mark Scheme for New Buildings (Non-Residential) 2015, under Section 3.02c Sustainable Products, SGBP certified products specified and used can score up to a maximum of 8 points under the Functional Systems Criteria and/or Singular Sustainable Products outside of Functional Systems Criteria.
[2] These products can form part of functional systems or singular sustainable products[2]. scored under Section 3.02c.

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In 2009, Armacell became the world's first manufacturer of flexible technical insulation materials to carry out LCA and publish EPDs.

**// Use of these documents**

**EPDs and LCAs provide objective and transparent information about a product's environmental impact** and facilitate understanding about a building's environmental footprint. EPDs also allow for a like-for-like comparison of similar products for specification and procurement purposes.

**Architects, specifiers and those inviting tenders**

**EPDs are used as the basis for calculating eco-balance, a prerequisite for green building certification.** Some of the key criteria considered when selecting construction products include technical performance, costs, environmental aspects and aesthetics.

**Real-estate companies and building owners**

**When EPDs and green building certifications are presented, the value of the building increases and it is easier to market properties that are certified as sustainable.** Long-term cost savings can also be enjoyed as the building is designed to make efficient use of its resources.

**End-users and governments**

As awareness of sustainability and healthy working environments for increased productivity increases, governments are keen to develop green building initiatives. Individuals are also driven to engage in energy consumption behavioural change and place higher emphasis on occupant well-being. **EPDs can provide assurance that the manufacturers' claims are substantiated.**

**// ArmaFlex Class 0 performance**

Certified by UL Environment, the EPD for ArmaFlex Class 0 is available from page 73.

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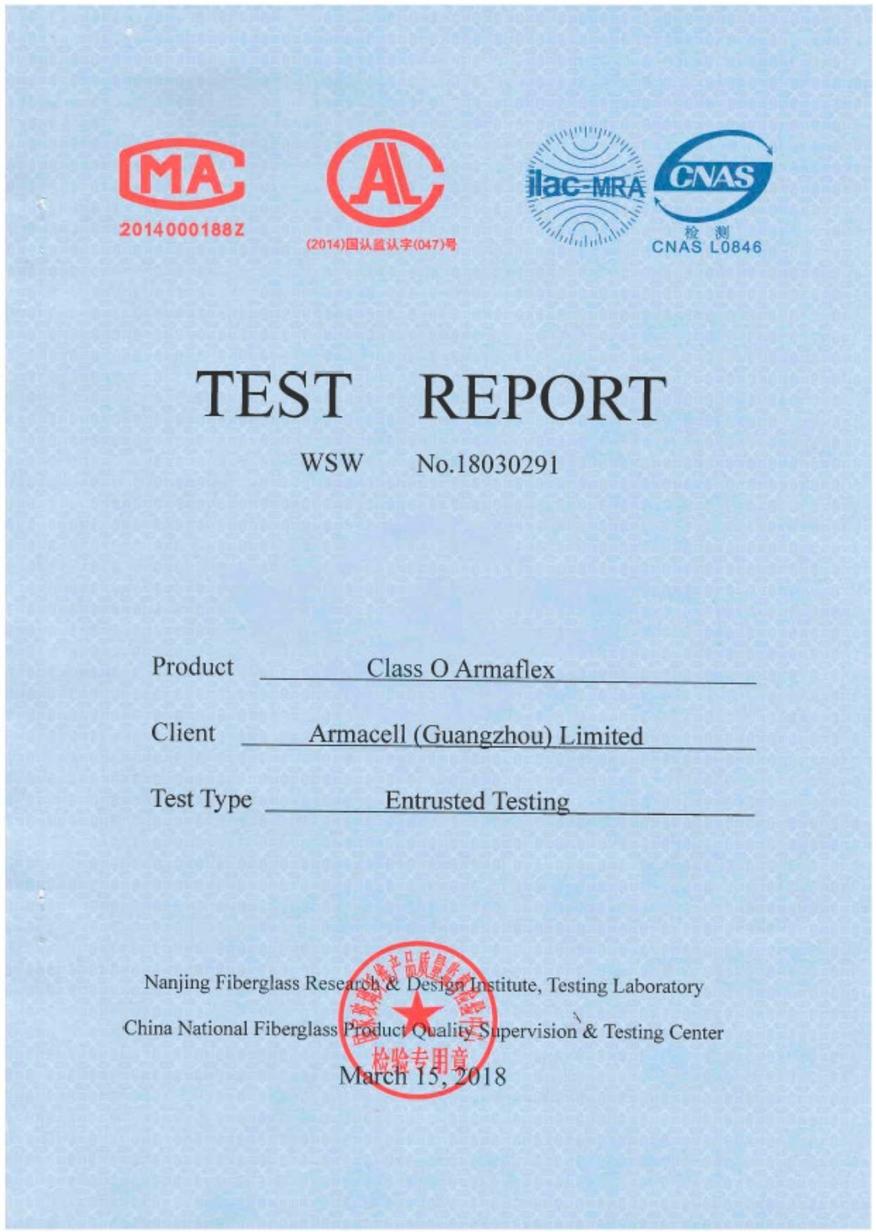
# Test reports and certificates

## GB/T 10295



TEST REPORT

WSW No.18030291

Product Class O Armaflex

Client Armacell (Guangzhou) Limited

Test Type Entrusted Testing

Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

March 15, 2018

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Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

Test Report

WSW No.18030291 Page 1 of 2

| | | | |
|---|---|---|---|
| Client | Armacell (Guangzhou) Limited | Address of client | Guanqiao, Shilou Town, Panyu District, Guangzhou City, Guangdong Province |
| Product | Class O Armaflex | Specification | 25mm board |
| Trade mark | Armaflex | Sample sender | Huang Guangfeng |
| Producer | Armacell (Guangzhou) Limited | Date of production | PCY-030-2018 |
| Inspections required | Thermal conductivity(-20°C, 0°C, 24°C, 40°C) of the sample. | | |
| Additional information | None. | | |
| The above information is provided by the client, the Center is not responsible for its truthfulness. | | | |
| Test type | Entrusted Testing | Date of sample received | March 9, 2018 |
| Sample state | Black foam board | | |
| Sample quantity | (600×600)mm, 4 pieces | Testing period | 2018.3.9~2018.3.14 |
| Test standard | GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation | | |
| Testing result | The sample has been tested. The test results of thermal conductivity conform to the stipulation of GB/T 17794-2008 *Preformed flexible elastomeric cellular thermal insulation.* Test results are detailed in the annex (page2). Seal for test report March 15, 2018 The test results only represent the technical properties of the samples received. | | |
| Remark | | | |

Approved by: /Technical Chief Checked by: Compiled by:

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«Return to "Thermal conductivity" on page 5

GB/T 10296

Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision And Testing Center

Annex to Test Report

WSW No.18030291 Page 2 of 2

| Test items | | Standard require-ments | Test results | Judgment |
|---|---|---|---|---|
| Thermal conductivity W/(m·K) | Average temperature -20℃ | ≤0.034 | 0.028 | Pass |
| | Average temperature 0℃ | ≤0.036 | 0.032 | Pass |
| | Average temperature 24℃ | —— | 0.034 | —— |
| | Average temperature 40℃ | ≤0.041 | 0.036 | Pass |

Attached product information (provided by client):

| Armacell no. | Dimension | Product-name | Producer | Material-description |
|---|---|---|---|---|
| PCY-030-2018 | 25-099 | Class O Armaflex | Armacell (Guangzhou) Ltd | FEF - Flexible Elastomeric Foam Pipe or duct insulation product called "Class O Armaflex " consisting of elastomeric foam made of synthetic rubber. The colour of the product is black. |

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«Return to "Technical data" on page 3

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CNAS L0846

# TEST REPORT

WSW No17050628

Product Class 0 Armaflex

Client Armacell (Guangzhou) Limited

Test Type Entrusted Testing

Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

June 21, 2017

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Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

## Test Report

WSW No.17050628 Page 1 of 2

| | | | |
|---|---|---|---|
| Client | Armacell (Guangzhou) Limited | Address of client | Guanqiao, Shilou Town, Panyu District, Guangzhou City, Guangdong Province |
| Product | Class 0 Armaflex | Specification | 25×038mm tube |
| Trade mark | Armaflex | Sample sender | Huang Guangfeng |
| Producer | Armacell (Guangzhou) Limited | Date of production | PCY-068-2017 |
| Inspections required | Resilience after compression relief, dimension stability, water absorption by vacuum, thermal conductivity, density of the sample. | | |
| Additional information | None. | | |
| The above information is provided by the client, the Center is not responsible for its truthfulness. | | | |
| Test type | Entrusted Testing | Date of sample received | May 24, 2017 |
| Sample state | Black cellular tube | | |
| Sample quantity | 1 mter-long, 6 pieces | Testing period | 2017.05.24~2017.06.20 |
| Test standard | GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation | | |
| Testing result | The sample has been tested. The items tested conform to the stipulation of *GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation*. The test results are detailed in the annex (page 2).<br>Seal for test report<br>June 21, 2017<br>The test results only represent the technical properties of the samples received. | | |
| Remark | | | |

Approved by: Technical Chief Checked by: Compiled by:

«Return to "Technical data" on page 3

«Return to "Thermal conductivity" on page 5



Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision And Testing Center

## Annex to Test Report

WSW No.17050628 Page 2 of 2

| Test item | | Standard requirement | Test result | Judgement |
|---|---|---|---|---|
| Thermal conductivity W/(m・K) | Average temperature -20℃ | ≤0.034 | 0.032 | Pass |
| | Average temperature 0℃ | ≤0.036 | 0.034 | Pass |
| | Average temperature 24℃ | ---- | 0.036 | ---- |
| | Average temperature 40℃ | ≤0.041 | 0.038 | Pass |
| Density kg/m³ | | ≤95 | 51 | Pass |
| Water absorption by vacuum % | | ≤10 | 4 | Pass |
| Dimension stability % (105℃, 7d) | | ≤10.0 | -5.0 "-" contract | Pass |
| Resilience after compression relief % (50% compression, 72h) | | ≥70 | 79 | Pass |

Attached product information (provided by client):

| Armacell no. | Dimension | Product-name | Producer | Material-description |
|---|---|---|---|---|
| PCY-068-2017 | 25x038 | Class O Armaflex | Armacell (Guangzhou) Ltd | FEF - Flexible Elastomeric Foam Pipe or duct insulation product called "Clas O Armaflex " consisting of elastomeric foam made of synthetic rubber. The colour of the product is black. |

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## GB/T 17146

CMA 170010260188 CAL ilac-MRA CNAS 中国认可 国际互认 检测 TESTING CNAS L0846

# TEST REPORT

WSW No.18010135

Product Class 0

Client Armacell (Guangzhou) Limited

Test Type Entrusted Testing

Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

April 10, 2018

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Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

## Test Report

WSW No.18010135 Page 1 of 4

| | | | |
|---|---|---|---|
| Client | Armacell (Guangzhou) Limited | Address of client | Guanqiao, Shilou Town, Panyu District, Guangzhou City, Guangdong Province |
| Product | Class 0 Armaflex | Specification | 25 mm sheet |
| Trade mark | Armaflex | Sample sender | Huang Guangfeng |
| Producer | Armacell (Guangzhou) Limited | Date of production | PCY-007-2018 |
| Inspections required | Moisture permeability, moisture resistance factor, moisture flow rate density of the sample. | | |
| Additional information | None. | | |
| The above information is provided by the client, the Center is not responsible for its truthfulness. | | | |
| Test type | Entrusted Testing | Date of sample received | January 22, 2018 |
| Sample state | Black cellular board | | |
| Sample quantity | (300×300) mm, 4 pieces | Testing period | 2018.01.22~2018.04.04 |
| Test standard | GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation | | |
| Testing result | The sample has been tested. The items tested conform to the stipulation of *GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation*. The test results are detailed in the annex (page 2-4).<br>Seal for test report<br>April 10, 2018<br>The test results only represent the technical properties of the samples received. | | |
| Remark | | | |

Approved by: /Technical Chief Checked by: Compiled by:

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Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision And Testing Center

Annex to Test Report

WSW No.18010135 Page 2 of 4

| Test item | Standard requirement | Test result | Judgment |
|---|---|---|---|
| Moisture permeability g/(m·s·Pa) | $\leqslant 1.3\times10^{-10}$ | $1.8\times10^{-11}$ | Pass |
| Moisture resistance factor | $\geqslant 1.5\times10^{3}$ | $1.1\times10^{4}$ | Pass |
| Moisture flow rate density g/(m²·s) | ---- | $1.8\times10^{-6}$ | ---- |
| Detailed in the page 3-4. | | | |

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Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision And Testing Center

Annex to Test Report

WSW No.18010135 Page 3 of 4

Moisture permeability test details of Class 0 Armaflex

**1. Test item**

Moisture permeability, moisture resistance factor and Moisture flow rate density.

**2. Test method**

GB/T 17146-1997 *Test methods for water vapor transmission of building materials*, desiccant method.

**3. Sample description**

Black foamed board products with nominal thickness 25mm.

The sample's information provided by the client is detailed in the table1.

Table1 Sample's information provided by the client

| Armacell no. | Dimension | Product-name | Producer | Material-description |
|---|---|---|---|---|
| PCY-007-2018 | 25-099 | Class O Armaflex | Armacell (Guangzhou) Ltd | FEF - Flexible Elastomeric Foam Pipe or duct insulation product called "Class O Armaflex" consisting of elastomeric foam made of synthetic rubber. The colour of the product is black. |

**4. Specimen information**

4.1 Dimension and number

Dimension : board, normal thickness 26mm (Initial sample thickness).

Number: 2 testing specimens.

4.2 Conditioning

The specimens are conditioned at the temperature 23℃, and relative humidity 50% for 96 hours.

4.3 Testing process

4.3.1 After the specimens are conditioned, put the desiccant into the specimen, then attach the sample to the dish to form the sample dish assembly. One sample dish assembly without desiccant is also prepared

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Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision And Testing Center

Annex to Test Report

WSW No.18010135 Page 4 of 4

for improving the test accuracy.

4.3.2 There are two testing specimen dishes and a dummy specimen dish for the test.

4.3.3 Put all of the dish assemblies into the environment of temperature 25°C±1°C, and relative humidity 75%±2%, weigh regularly until the test end.

**5. Test result**

5.1 Sample weight gain curve

During the test, the weight increment curve of the sample with time is shown in Figure 1 (2 specimens in total).

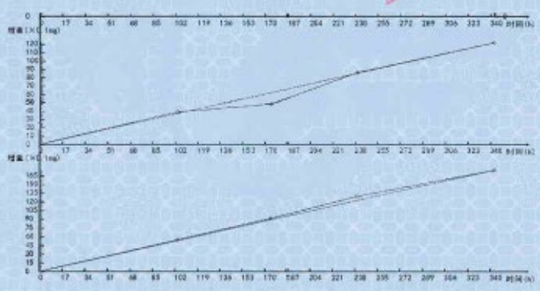

Figure1 the weight increment curve of the sample with time

5.2 Test data and calculation

By calculation, the moisture permeability of the sample is shown in Table 2。

Table 2 Test data

| Test item | No.1 | No.2 | Mean value |
|---|---|---|---|
| Moisture permeability g/(m·s·Pa) | $1.512\times10^{-11}$ | $2.171\times10^{-11}$ | $1.8\times10^{-11}$ |
| Moisture resistance factor | $1.296\times10^{4}$ | $9.028\times10^{3}$ | $1.1\times10^{4}$ |
| Moisture flow rate density g/(m²·s) | $1.455\times10^{-6}$ | $2.081\times10^{-6}$ | $1.8\times10^{-6}$ |

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## BS 476 PART 6

**Test Report No. 7191146701-MEC16/B-YWA/PIC**
**dated 27 Sep 2016**

PSB Singapore

Choose certainty. Add value.

**Note:** This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD Group and the General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.

**SUBJECT:**

Fire propagation test on Armacell no.: "PCY-135-2016", Dimension: "06-099", Product name: "Armaflex Class 0" Thermal Insulation material bonded on one face of an approximately 1mm thick steel plate submitted by Armacell Asia Pte Ltd on 13 Sep 2016.

**TESTED FOR:**

Armacell Asia Pte Ltd
1 Kim Seng Promenade
#12-01
Great World City East Tower
Singapore 237994

**DATE OF TEST:**

25 Sep 2016

**PURPOSE OF TEST:**

To determine the Index of Performance of the material when it is exposed to the conditions of the test specified in British Standard 476 : Part 6 : 1989 + A1 : 2009 "Method of test for fire propagation for products".

The test was conducted at TÜV SÜD PSB's fire test laboratory located at No. 10 Tuas Avenue 10, Singapore 639134.

TÜV SÜD PSB

ilac-MRA ACCREDITED LABORATORY SAC-SINGLAS LA-2007-0380-A LA-2007-0384-G LA-2007-0381-F LA-2007-0385-E LA-2007-0382-B LA-2007-0386-C LA-2007-0383-G LA-2010-0464-D

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

**Laboratory:**
TÜV SÜD PSB Pte. Ltd.
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Co. Reg : 199002667R

**Regional Head Office:**
TÜV SÜD Asia Pacific Pte. Ltd.
1 Science Park Drive, #02-01
Singapore 118221



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PSB Singapore

**DESCRIPTION OF SPECIMENS:**

Six pieces of specimen, said to be Armacell no.: "PCY-135-2016", Dimension: "06-099", comprised of a FEF – Flexible Elastomeric Foam Pipe or duct insulation product called "Armaflex Class 0" consisting of elastomeric foam made of synthetic rubber (6mm thick) bonded with "Armaflex 520" adhesive on one face of an approximately 1mm thick steel plate, each of nominal test size of 225mm x 225mm were submitted. The colour of the product is black. As declared by test sponsor, the bulk density of the Elastomeric Foam was said to be 40kg/m$^3$ - 60kg/m$^3$. The overall bulk density of the specimen was found to be approximately 1154kg/m$^3$. As declared by test sponsor, the manufacturer was said to be Armacell (Guangzhou) Ltd.

**TEST PROCEDURE:**

Prior to test, the specimens were prepared and conditioned in accordance with paragraph 4.4 of the standard.

Three specimens, backed with calcium silicate board, were tested with the foam face exposed to the specified heating conditions, in an apparatus conforming to paragraph 5 and illustrated in Figures 1 to 3 of the Standard.

The calibration and test procedures were as defined in paragraphs 8 and 9, respectively, of the specification. The apparatus was calibrated prior to test and the actual calibration curve obtained is shown in Figure 1 of this report.

The mean temperature rise above ambient obtained from three specimens is also shown in Figure 1 (i.e. with the actual calibration curve). The mean temperature readings for the material and the calibration curve were obtained at the following intervals from the start of the test: at 1/2 minute intervals up to 3 minutes, at 1 minute intervals from 4 to 10 minutes, and at 2 minutes intervals from 12 to 20 minutes.



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Test Report No. 7191146701-MEC16/B-YWA/PIC
dated 27 Sep 2016

PSB Singapore

From these readings, the index of performance for the material was determined as follows:

$$s_1 = \sum_{t=0.5}^{t=3} \frac{\Theta_s - \Theta_c}{10t}; \quad s_2 = \sum_{t=4}^{t=10} \frac{\Theta_s - \Theta_c}{10t}$$

and $$s_3 = \sum_{t=12}^{t=20} \frac{\Theta_s - \Theta_c}{10t};$$

$$S = s_1 + s_2 + s_3$$

where $S$ = Index of performance for each of the specimens tested and $s_1$, $s_2$ and $s_3$ are sub-indices

$t$ = Time in minutes from the origin at which readings are taken.

$\Theta_s$ = Temperature rise in deg. C for the specimen at time, t

$\Theta_c$ = Temperature rise in deg. C for the calibration sheet at time, t

In computations only the positive value of $\frac{\Theta_s - \Theta_c}{10t}$ was used.



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PSB Singapore

**RESULTS OF TEST:**

The following test results were obtained for each specimen tested:

| Specimen | Sub-Indices | | | Index of Performance |
|---|---|---|---|---|
| | $s_1$ | $s_2$ | $s_3$ | S |
| A | 4.4 | 2.7 | 0.6 | 7.7 |
| B | 3.5 | 2.2 | 0.4 | 6.1 |
| C | 3.5 | 2.2 | 0.5 | 6.2 |

**CONCLUSION:**

The test results obtained, as an average of the 3 samples tested are as follows:

Index of overall performance, I = 6.7
(Fire propagation index)

Sub-index, $i_1$ = 3.8

Sub-index, $i_2$ = 2.4

Sub-index, $i_3$ = 0.5

**REMARKS:**

The test results relate only to the behaviour of the test specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Ye Wint Aung
Associate Engineer

Ong Kian Huat
Senior Associate Engineer
Fire Property
Mechanical



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Test Report No. 7191146701-MEC16/B-YWA/PIC
dated 27 Sep 2016

PSB Singapore

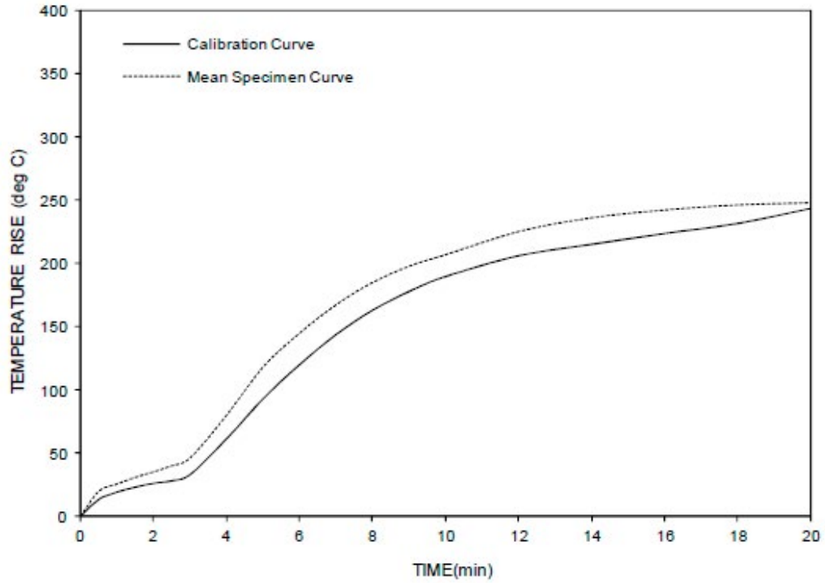


FIGURE 1 : COMPARISON OF MEAN SPECIMEN AND CALIBRATION CURVES



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**Test Report No. 7191146701-MEC16/B-YWA/PIC**
**dated 27 Sep 2016**

PSB Singapore

**Please note that this Report is issued under the following terms :**

1. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.
2. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
3. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
4. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
5. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

July 2011



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# BS 476 PART 7

**Test Report No. 7191142282-MEC16/B-YWA/PIC**
**dated 25 Jul 2016**

PSB Singapore

Choose certainty.
Add value.

**Note:** This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD Group and the General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.

**SUBJECT:**

Large scale surface spread of flame test on Armacell no.: "PCY-108-2016", Dimension: "06-099", Product name: "Armaflex Class 0" Thermal Insulation material bonded on one face of an approximately 1mm thick steel plate submitted by Armacell Asia Pte Ltd on 08 Jul 2016.

**TESTED FOR:**

Armacell Asia Pte Ltd
1 Kim Seng Promenade
#12-01
Great World City East Tower
Singapore 237994

**DATE OF TEST:**

13 Jul 2016

**PURPOSE OF TEST:**

To determine the tendency of the surface of a material or a combination of materials to support the spread of flame across its surface and to classify the surface according to the test given in British Standard 476 : Part 7 : 1997.

The test was conducted at TÜV SÜD PSB's fire test laboratory located at No. 10 Tuas Avenue 10, Singapore 639134.

TÜV SÜD PSB

ilac-MRA ACCREDITED LABORATORY SAC-SINGLAS

LA-2007-0380-A LA-2007-0384-G LA-2007-0381-F LA-2007-0385-E LA-2007-0382-B LA-2007-0395-C LA-2007-0383-G LA-2010-0464-D

The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council. Inspections/Calibrations/Tests marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our inspection body/laboratory.

**Laboratory:**
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1 Science Park Drive, #02-01
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PSB Singapore

## DESCRIPTION OF SPECIMENS:

Nine pieces of specimen, said to be Armacell no.: "PCY-108-2016", Dimension: "06-099", Product name: "Armaflex Class 0" Thermal Insulation material bonded on one face of an approximately 1mm thick steel plate comprising of FEF – Flexible Elastomeric Foam Pipe or duct insulation product called "Armaflex Class 0" consisting of elastomeric foam (6mm thick) made of synthetic rubber, each of nominal test size of 885mm x 270mm were submitted. As declared by test sponsor, the bulk density of the Elastomeric Foam was said to be 45kg/m$^3$. The overall thickness of the specimen was found to be approximately 7mm. As declared by test sponsor, the manufacturer was said to be Armacell (Guangzhou) Ltd.

## TEST PROCEDURE:

Prior to test, the specimens were prepared and conditioned in accordance with paragraphs 5.3 to 5.6 of the standard and secured to a specimen holder as described in paragraph 6.3.

Six specimens, backed with calcium silicate board, were tested with the elastomeric foam face exposed to the specified thermal radiation from the apparatus described in paragraph 6.1 of the standard. The intensity of the radiated heat incident on the specimen varies with distance from the hotter end, so that when the specified calibration panel is mounted in the place to be occupied by the specimen, the irradiance of the radiometer is as given in Table 1. The test was terminated when the flame front reached the 825mm reference line, or after 10 minutes has elapsed, whichever is the shorter.

**Table 1 : Irradiance Along Horizontal Reference Line on the Calibration Board**

| Distance along reference line from inside edge of specimen holder | Irradiance kW/m$^2$ | | |
|---|---|---|---|
| mm | specified | min. | max. |
| 75 | 32.5 | 32.0 | 33.0 |
| 225 | 21.0 | 20.5 | 21.5 |
| 375 | 14.5 | 14.0 | 15.0 |
| 525 | 10.0 | 9.5 | 10.5 |
| 675 | 7.0 | 6.5 | 7.5 |
| 825 | 5.0 | 4.5 | 5.5 |



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Test Report No. 7191142282-MEC16/B-YWA/PIC
dated 25 Jul 2016

PSB Singapore

## RESULTS OF TEST:

| Specimen No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Spread of flame at first 1½ minutes (mm) | 0 | 0 | 0 | 0 | 0 | 0 |
| Distance (mm) | Time of spread of flame to indicated distance (minutes • seconds) | | | | | |
| Start of flaming | nil | nil | nil | nil | nil | nil |
| 75 | - | - | - | - | - | - |
| 165 | - | - | - | - | - | - |
| 190 | | | | | | |
| 215 | | | | | | |
| 240 | | | | | | |
| 265 | | | | | | |
| 290 | | | | | | |
| 375 | | | | | | |
| 455 | | | | | | |
| 500 | | | | | | |
| 525 | | | | | | |
| 600 | | | | | | |
| 675 | | | | | | |
| 710 | | | | | | |
| 750 | | | | | | |
| 785 | | | | | | |
| 825 | | | | | | |
| 865 | | | | | | |
| Time of maximum spread of flame (minutes • seconds) | - | - | - | - | - | - |
| Distance of maximum spread of flame (mm) | 0 | 0 | 0 | 0 | 0 | 0 |
| Comments | None | | | | | |



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**Test Report No. 7191142282-MEC16/B-YWA/PIC**
**dated 25 Jul 2016**

PSB Singapore

## Classification of Surface Spread of Flame

| Classification | Spread of flame at 1.5 min. | | Final spread of flame | |
|---|---|---|---|---|
| | Limit (mm) | Limit for one specimen in sample (mm) | Limit (mm) | Limit for one specimen in sample (mm) |
| Class 1 | 165 | 165 + 25 | 165 | 165 + 25 |
| Class 2 | 215 | 215 + 25 | 455 | 455 + 45 |
| Class 3 | 265 | 265 + 25 | 710 | 710 + 75 |
| Class 4 | Exceeding the limits for class 3 | | | |

**CONCLUSION:**

In accordance with the class definitions specified in the Standard, the test results show that the sample tested has a Class One Surface Spread of Flame.

**REMARKS:**

1. The test results relate only to the behaviour of the test specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.
2. The testing of Specimen 1 was witnessed by Mr. Peter Cheng from Armacell Asia Pte Ltd.

Ye Wint Aung
Associate Engineer

Ong Kian Huat
Senior Associate Engineer
Fire Property
Mechanical



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**Test Report No. 7191142282-MEC16/B-YWA/PIC**
**dated 25 Jul 2016**

PSB Singapore

**Please note that this Report is issued under the following terms :**

1. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.
2. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
3. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
4. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
5. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

July 2011



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GB 8624

报告编号：2019100719

CMA 170002020425　(2017)国认监认字(043)号　ilac-MRA　CNAS 中国认可 国际互认 检测 TESTING CNAS L0698

# 检 验 报 告

送检单位名称： 阿乐斯绝热材料（广州）有限公司

产品名称型号： 柔性泡沫橡塑绝热制品
零级福乐斯管材 32×022m 厚度32mm

检 验 类 别： 型式检验（安全性能）

NFTC

国家防火建筑材料质量监督检验中心

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国家防火建筑材料质量监督检验中心

检 验 报 告

报告编号：2019100719　　共 4 页 第 1 页

| | | | |
|---|---|---|---|
| 产品名称 | 柔性泡沫橡塑绝热制品 | 型号规格 | 零级福乐斯管材 32×022m 厚度32mm |
| 委托单位 | 阿乐斯绝热材料（广州）有限公司 | 商　　标 | 福乐斯 |
| 生产单位 | 阿乐斯绝热材料（广州）有限公司 | 检验类别 | 型式检验（安全性能） |
| 送检单位 | 阿乐斯绝热材料（广州）有限公司 | 抽样基数 | 1000根 |
| 抽样单位 | 广州质量监督检测研究院 | 抽样日期 | 2019. 04. 19 |
| 抽样地点 | 企业成品仓库 | 到样日期 | 2019. 04. 29 |
| 检验地点 | 本中心 | 检验日期 | 2019. 05. 22～2019. 05. 29 |
| 样品数量 | 2m×72根 | 样品编号 | 2019100719 |
| 检验依据 | GB 8624-2012 《建筑材料及制品燃烧性能分级》 | | |
| 检验项目 | 燃烧性能$B_1$级（管状绝热材料）适用项目 | | |
| 检验结论 | 经检验，该制品所检项目符合燃烧性能B-s3, d0, t1级的规定要求。<br>按GB 8624-2012判定，该制品燃烧性能达到难燃$B_1$(B-s3, d0, t1)级。<br>（以下空白）<br>（检验专用章）<br>签发日期： 2019 年 06月 03日 | | |
| 备注 | 本报告仅对所承检项目负责。本报告仅对所承检项目负责。 | | |

批准：　　审核：　　编制：

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## 国家防火建筑材料质量监督检验中心
## 检验结果汇总表

报告编号：2019100719　　共 4 页 第 2 页

| 序号 | 检验项目 | | 检验方法 | 标准要求 | | 检验结果 | 结论 |
|---|---|---|---|---|---|---|---|
| 1 | 可燃性 | 60s内焰尖高度，mm | GB/T 8626-2007 | B级 | ≤150 | 90 | 合格 |
| | | 燃烧滴落物引燃滤纸现象 | | | 过滤纸未被引燃 | 过滤纸未被引燃 | |
| 2 | 单体燃烧性能 | 燃烧增长速率指数，W/s | GB/T 20284-2006 | | ≤270 | 126 | 合格 |
| | | 600s总热释放量，MJ | | | ≤7.5 | 5.6 | |
| | | 火焰横向蔓延 | | | 未到达试样长翼边缘 | 未到达试样长翼边缘 | |
| | | 烟气生成速率指数，$m^2/s^2$ | | s2级 | ≤580 | 648 | s3级 |
| | | 600s总烟气生成量，$m^2$ | | | ≤1600 | 378 | |
| | | 燃烧滴落物/微粒 | | d0级 | 600s内无燃烧滴落物/微粒 | 600s内无燃烧滴落物/微粒 | 符合 |
| 3 | 烟气毒性等级 | | GB/T 20285-2006 | t1级 | 达到$ZA_3$级 | $ZA_3$级 | 符合 |
| | 以 | | 下 | 空 | | 白 | |
| | | | | | | | |
| | | | | | | | |
| 备注 | | | | | | | |

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## UL94

SGS

**Test Report**　No.: GZHL1606024764OT　Date: Jul 04, 2016　Page 1 of 4

ARMACELL (GUANGZHOU) LIMITED
GUANQIAO, SHILOU TOWN, PANYU DISTRICT, GUANGZHOU CITY GUANGDONG PROVINCE CHINA 511447

The following sample(s) was/were submitted and identified on behalf of the client as:

| | |
|---|---|
| Sample Description | : CLASS O ARMAFLEX |
| SGS Ref No. | : SDHL1606010158FB |
| Style / Item No. | : 25mm SHEET |
| Manufacturer | : ARMACELL (GUANGZHOU) LIMITED |
| Other Info | : SEE ATTACHMENT |
| Sample Receiving Date | : Jun 13, 2016 |
| Test Performing Date | : Jun 13, 2016 to Jun 21, 2016 |

**Test Result Summary**

| Test(s) Requested | Result(s) |
|---|---|
| UL 94-2015 Clause 8 | Classification: V-0 |

**Summary:**
1. For further details, please refer to the following page(s).

Signed for and on behalf of
Guangzhou Branch
SGS-CSTC Ltd.

Arthur Mak
Approved Signatory



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Attachment:

| Armacell no. | Dimension | Product-name | Producer | Material-description |
|---|---|---|---|---|
| PCY-101-2016 | 25-099 | Class O Armaflex | ARMACELL (GUANGZHOU) Ltd. | FEF - Flexible Elastomeric Foam Pipe or duct insulation product called "Class O Armaflex " consisting of elastomeric foam made of synthetic rubber. The colour of the product is black. |



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**TESTS AND RESULTS**

**Test Conducted:**
UL 94-2015 Clause 8. 50W (20 mm) Vertical Burning Test; V-0, V-1, or V-2

**Conditioning:**
Set 1(Initial): Temperature: (23±2)℃; Relative Humidity:(50±5)%; Duration:48h;
Set 2(Oven Aging): Temperature: (70±2)℃; Duration:168h

| Acceptance Criteria: | V-0 | V-1 | V-2 |
|---|---|---|---|
| Afterflame time for each individual specimen $t_1$or $t_2$ | ≤10s | ≤30s | ≤30s |
| Total afterflame time for any condition set ($t_1$ plus $t_2$ for the 5 specimens) | ≤50s | ≤250s | ≤250s |
| Afterflame plus afterglow time for each individual specimen after the second flame application ($t_2$+ $t_3$) | ≤30s | ≤60s | ≤60s |
| Afterflame or afterglow of any specimen up to the holding clamp | No | No | No |
| Cotton indicator ignited by flaming particles or drops | No | No | Yes |

**Retest Provision:**
For each set of tests (Initial and After Oven Aging):
If only one specimen from a set of 5 specimens fails to comply with the Acceptance Criteria or the total number of seconds of flaming is in the range of 51 – 55 seconds for V-0 or 251 – 255 seconds for V-1 or V-2, an additional set of 5 specimens shall be tested.

**Test Results:**

| No. | | $t_1$ (sec.) | $t_2$ (sec.) | $t_3$ (sec.) | SUM ($t_2$, $t_3$) | Whether the afterflame or afterglow of any specimen up to the holding clamp | Whether the cotton indicator ignited by flaming particles or drops |
|---|---|---|---|---|---|---|---|
| Set1 | 1 | 0 | 0 | 0 | 0 | No | No |
| | 2 | 0 | 0 | 0 | 0 | No | No |
| | 3 | 0 | 0 | 0 | 0 | No | No |
| | 4 | 0 | 0 | 0 | 0 | No | No |
| | 5 | 0 | 0 | 0 | 0 | No | No |
| | SUM | 0 | 0 | $\sum t_1$, $\sum t_2$: 0 | | --- | |
| Set2 | 1 | 0 | 0 | 0 | 0 | No | No |
| | 2 | 0 | 0 | 0 | 0 | No | No |
| | 3 | 0 | 0 | 0 | 0 | No | No |
| | 4 | 0 | 0 | 0 | 0 | No | No |
| | 5 | 0 | 0 | 0 | 0 | No | No |
| | SUM | 0 | 0 | $\sum t_1$, $\sum t_2$: 0 | | --- | |

**Classification:**
V-0



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SGS

**Test Report** No.: GZHL1606024764OT Date: Jul 04, 2016 Page 4 of 4

**SAMPLE INFORMATION AND PICTURES**

Specified size of sample: 125 ±5 mm × 13.0 ±0.5 mm, thickness≤13mm

Actual size of sample*: 130mm × 13mm × 13mm

Remark: * - Measured by the laboratory.

Remark : This test was subcontracted to SGS other qualified subcontractor.

***End of Report***



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# FACTORY MUTUAL (FM) APPROVAL

FM APPROVED

## Certificate of Compliance

This certificate is issued for the following:

NH/Armaflex, Armaflex Class 0 and Armaflex Class 1

**Prepared for:**

Armacell (Guangzhou) Ltd
Guanqiao, Shilou Town, Panyu District
Guangzhou City, Guangdong 511447
China

FM Approvals Class: 4924

Approval Identification: 3062016 Approval Granted: 12/20/2017

To verify the availability of the Approved product, please refer to www.approvalguide.com or www.roofnav.com

Said Approval is subject to satisfactory field performance, continuing Surveillance Audits, and strict conformity to the constructions as shown in the Approval Guide, an online resource of FM Approvals.

Cynthia E Frank

Cynthia Frank
VP - Manager of Materials
FM Approvals
1151 Boston-Providence Turnpike
Norwood, MA 02062

FM Approvals®

*Member of the FM Global Group*

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# FIRE PERFORMANCE (MARINE)

DNV·GL

Certificate No:
**MEDB00004AV**

## EC-TYPE EXAMINATION CERTIFICATE (MODULE B)

Application of: Directive 2014/90/EU of 23 July 2014 on marine equipment (MED), issued as "Forskrift om Skipsutstyr" by the Norwegian Maritime Authority. This Certificate is issued by DNV GL AS under the authority of the Government of Norway.

**This is to certify:**

**That the Surface materials and floor coverings with low flame-spread characteristics: pipe insulation covers**

with type designation(s)
**Class 0 Armaflex**

Issued to
**Armacell (Guangzhou) Ltd.**
**GUANGZHOU, GUANGDONG, China**

is found to comply with the requirements in the following Regulations/Standards:
Regulation **(EU) 2018/773,**
**item No. MED/3.18d. SOLAS 74, Reg. II-2/3, II-2/5 & X/3, IMO MSC/Circ. 1120, 2000 HSC Code 7 and IMO 2010 FTP Code**

Further details of the equipment and conditions for certification are given overleaf.

This Certificate is valid until **2023-10-21**.
Issued at **Høvik** on **2018-10-22**

DNV GL local station:
**China South NB**

Approval Engineer:
**Karolina Kusmider**

Notified Body
No.: **0575**

for **DNV GL AS**
Digitally Signed By: Hoff, Øyvind
Location: DNV GL Høvik, Norway
on behalf of

**Roald Vårheim**
**Head of Notified Body**

The mark of conformity may only be affixed to the above type approved equipment and a Manufacturer's Declaration of Conformity issued when the production-surveillance module (D, E or F) of Annex B of the MED is fully complied with and controlled by a written inspection agreement with a Notified Body. The product liability rests with the manufacturer or his representative in accordance with Directive 2014/90/EU.
This certificate is valid for equipment, which is conform to the approved type. The manufacturer shall inform DNV GL AS of any changes to the approved equipment. This certificate remains valid unless suspended, withdrawn, recalled or cancelled.
Should the specified regulations or standards be amended during the validity of this certificate, the product is to be re-approved before being placed on board a vessel to which the amended regulations or standards apply.





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Job Id: **344.1-004019-4**
Certificate No: **MEDB00004AV**

### Product description
"Class 0 Armaflex"
An elastomeric insulation foam for pipe insulation.

Nominal thickness: 9 – 32 mm.
Density: 41 kg/m³
Colour: black

### Application/Limitation
Approved for use as low flame spread surface material, not generating excessive quantities of smoke nor toxic products in fire.

The product may be used on cold service pipework / fittings for refrigeration system everywhere onboard, and for pipework, fittings, air ducts and tanks insulation in cargo areas, mail rooms, baggage rooms and refrigerated compartments of service spaces, and exterior locations (SOLAS II-2/5.3.1.1)". (Piping for hot and cold sanitary water can not be considered "cold service pipe work/fittings")

Any adhesive used, other than the one used during testing, has to be tested for low flame spread characteristics according to IMO 2010 FTP Code part 5 and to be approved according to the Marine Equipment Directive and bear the Mark of Conformity and bear the Mark of Conformity.

Extent of application is to be considered and accepted for each case/project.

Each product is to be supplied with its manual for its installation, use and maintenance.

### Type Examination documentation
Test reports Nos. FT13164 and FT13165 both dated 8 June 2013 from Far East Fire Testing Centre (FTFTC), Shanghai, China.

### Tests carried out
Tested according to IMO 2010 FTP Code Part 5 and Annex 2 Item 2.2.

### Marking of product
The product or packing is to be marked with name and address of manufacturer, type designation, MED Mark of Conformity and USCG approval number (see page 1).



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DNV·GL

Certificate No:
**MEDD00001KC**

# QS - CERTIFICATE OF ASSESSMENT - EC (MODULE D)

Application of: Directive 2014/90/EU of 23 July 2014 on marine equipment (MED), issued as "Forskrift om Skipsutstyr" by the Norwegian Maritime Authority. This Certificate is issued by DNV GL AS under the authority of the Government of Norway.

## This is to certify:

**That the Quality System for the products**

with type designation(s) as specified in the Appendix to this Certificate

Issued to

**Armacell (Guangzhou) Limited**
**GUANGZHOU, GUANGDONG, China**

is found to comply with the applicable requirements.
The quality system has been assessed with respect to the procedure of conformity assessment described in Annex II, Module D in the directive 2014/90/EU and regulation (EU) 2018/773.

This Certificate is valid until **2023-10-21**.
Issued at **Høvik** on **2018-10-22**

DNV GL local station:
**China South NB**

Approval Engineer:
**Karolina Kusmider**

Notified Body
No.: **0575**

for **DNV GL AS**
Digitally Signed By: Hoff, Øyvind
Location: DNV GL Høvik, Norway
on behalf of
**Roald Vårheim**
**Head of Notified Body**

0575/yyyy

0575: Notified Body number undertaking quality surveillance
yyyy: The year in which the mark is affixed

The product liability rests with the manufacturer or his representative in accordance with Directive 2014/90/EU.
This certificate authorizes the manufacturer in conjunction with the valid EC Type Examination (Module B) Certificate(s) of the equipment listed before to affix the Mark of Conformity (wheelmark) to the product described herein.
This certificate loses its validity if the manufacturer makes any changes to the approved quality system which have not been notified to and agreed with the notified body named on this certificate.
This certificate remains valid unless suspended, withdrawn, recalled or cancelled.
The Manufacturer has to apply for periodical audits to verify the maintenance and application fo the quality system every 12 months.





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Job Id: **344.1-004029-4**
Certificate No: **MEDD00001KC**

## APPENDIX

**Item no. MED/3.18d Surface materials and floor coverings with low flame-spread characteristics: pipe insulation covers**

| Type designation | EC Type-Examination Certificate No. | Expiry date | Notified Body No. | USCG approval number |
|---|---|---|---|---|
| Class 0 Armaflex[1] | MEDB00004AV | 2023-09-19 | 0575 | N/A |

### Places of production

1.Armacell (Guangzhou) Limited, Guanqiao, Shilou Town, Panyu, GUANGZHOU, China



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# APPROVAL FROM HONG KONG FIRE SERVICE DEPARTMENT

消 防 處
牌 照 及 審 批 總 區
通 風 系 統 課
香港九龍尖沙咀東康莊道 1 號 5 樓
消防總部大廈

FIRE SERVICES DEPARTMENT
LICENSING & CERTIFICATION COMMAND
Ventilation Division
5/F, FIRE SERVICES HEADQUARTERS BUILDING
No. 1 Hong Chong Road,
Tsim Sha Tsui East, Kowloon,
Hong Kong

本處檔號 Our Ref.: FP(LC) 316/14
來函檔號 Your Ref.: AAL/17/966
圖文傳真 Fax: 2367 3206
電 話 Tel. No.: 2733 1557

21 July 2017

Armacell Asia Ltd.
Room 1501-08, Millennium City 5
418 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
(Attn.: Mr. Sam YEUNG)

Dear Sir,

**Class 0 "Armaflex" Closed Cell Nitrile-based Elastomeric Insulation Materials**

I refer to your above referenced letter of 27.3.2017 enclosing a set of catalogue and test reports; and the subsequent letter ref. no. AAL/17/988 of 19.7.2017 enclosing the laboratory's clarification letter with respect to the captioned materials.

We have no objection in principle to the use of Class 0 "Armaflex" closed cell nitrile-based flexible elastomeric insulation material for ventilating system in Hong Kong subject to compliance with the requirements stipulated in Part XI of FSD Circular Letter No. 4/96 and according to the following details:

| | | |
|---|---|---|
| Manufacturer | : | Armacell (Guangzhou) Limited, PRC |
| Brand Name | : | Armacell Armaflex |
| Material | : | Closed cell nitrile based flexible elastomeric insulation |
| Thickness/ Density | : | 6 mm, 9 mm, 13 mm, 19 mm, 25 mm, 30 mm, 32 mm, 40 mm and 50 mm having density of 65 kg/$m^3$ Approx. |
| Test Reports | : | By SGS-CSTC Standard Technical Services Co. Ltd. |

a) No. GZHL 1702006191OT of 10.3.2017
b) No. GZHL 1611050525OT of 2.12.2016
c) No. GZHL 1611050528OT of 2.12.2016
d) No. GZHL 1611050530OT of 2.12.2016
e) No. GZHL 1702006200OT of 13.3.2017

/2...



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| | | |
|---|---|---|
| Test Reports (cont.) | : | f) No. GZHL 1701000932OT of 22.1.2017<br>g) No. GZHL 1611050532OT of 2.12.2016<br>h) No. GZHL 1701000934OT of 22.1.2017<br>i) No. GZHL 1702003857OT of 20.2.2017 |
| Test Standards | : | a) BS 476: Part 6: 1989 + A1: 2009<br>b) BS 476: Part 7: 1997 |
| Test Results | : | a) Fire Propagation Index<br>For the specimens : I <= 12, $i_1$ <= 6<br>b) Surface Spread of Flame<br>For other specimens: Class 1 |
| Application | : | For internal or external insulation of ductwork and pipework in ventilating system. |
| Remarks | : | a) No assessment was made on the density and toxicity of smoke generated by the product under fire conditions as that are not our requirements.<br>b) This assessment letter supersedes our previous one of the same series dated 11.12.2013.<br>c) This assessment is subject to review by June 2022. |

Yours faithfully,

(LAM Sui-hang)
for Director of Fire Services

SHL/MM
FileCode: armacell armaflex class 0 20170721.doc



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# CERTIFICATE OF CONFORMITY (COC) SINGAPORE

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

PSB Singapore

## CERTIFICATE OF CONFORMITY

**No. CLS2 18 03 80741 005**

| | |
|---|---|
| **Certificate Holder:** | **Armacell Asia Limited**<br>Suite No 60 of Jumpstart Business Centre<br>Flat/RM 01-08 15/F Millennium City 5<br>418 Kwun Tong Road<br>Kwun Tong<br>HONG KONG |
| **Product:** | Thermal Insulation Materials |
| **Brand Name:** | Armaflex |
| **Model(s):** | Armaflex Class 0 |
| **Product Details:** | Elastomeric foam bonded on a steel place<br>Foam Density: 40kg/m³ ~ 60kg/m³<br>Foam Thickness: 6mm ~ 50mm<br>Bulk Density: 221kg/m³ ~ 1166kg/m³<br>Tested on the foam face<br>(Rating: Class 0) |
| **Standard(s):** | BS 476-6:1989/A1:2009<br>BS 476-7:1997 |
| **Country of Origin:** | People's Republic of China |
| **Test Report(s):** | See COC Appendix (1 pg) |
| **Issued on:** | 2018-03-27 |
| **Valid until:** | 2023-03-26 |

Vice-President (Certification Department)
TÜV SÜD PSB

Page 1 of 2

This Certificate is part of a full report and should be read in conjunction with it. This Certificate remains the property of TÜV SÜD PSB Pte Ltd and shall be returned upon request. The use of this Certificate is subjected to TÜV SÜD Group Testing and Certification Regulations; TÜV SÜD PSB Pte Ltd (PSB) General Terms and Conditions of Business and PSB Product Listing Scheme (PLS) Application Fact Sheet. The manufacturer is solely responsible for compliance of any product that has the same designation as the product type-tested. Persons relying on this Certificate should verify its validity by checking TÜV SÜD PSB's website at www.tuv-sud-psb.sg

ACCREDITED CERTIFICATION BODY SAC

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TÜV®

PSB 13003.21

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PSB Singapore

## PRODUCT LISTING SCHEME APPENDIX

TO CERTIFICATE OF CONFORMITY NUMBER: CLS2 18 03 80741 005

| | | |
|---|---|---|
| Date of Issue | : | 2018-03-27 |
| Issued To | : | **Armacell Asia Limited**<br>Suite No 60 Jumpstart Business Centre<br>Flat/RM 01-08 15/F Millennium City 5<br>418 Kwun tong Road<br>Kwun Tong<br>HONG KONG |
| Test Report (s) | : | 7191028108-MEC12/2-YWA<br>7191142282-MEC16/B-YWA/PIC<br>7191146701-MEC16/A-YWA/PIC<br>7191146701-MEC16/B-YWA/PIC |

Vice President (Certification Department)
TÜV SÜD PSB

Page 2 of 2

Amendments or additions to this appendix other than those authorised by TÜV SÜD PSB Pte Ltd render the appendix invalid.

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## GB/T 6669-2001

CMA 20140001887

(2014)国认监认字(047)号

ilac-MRA CNAS 检 测 CNAS L0846

# TEST REPORT

WSW No.18040439

Product Class 0 Armaflex

Client Armacell (Guangzhou) Limited

Test Type Entrusted Testing

Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

April 13, 2018

«Return to "Technical data" on page 3

«Return to "Resilience after compression relief" on page 11

Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

## Test Report

WSW No.18040439 Page 1 of 2

| | | | |
|---|---|---|---|
| Client | Armacell (Guangzhou) Limited | Address of client | Guanqiao, Shilou Town, Panyu District, Guangzhou City, Guangdong Province |
| Product | Class 0 Armaflex | Specification | 25mm sheet |
| Trade mark | Armaflex | Sample sender | Huang Guangfeng |
| Producer | Armacell (Guangzhou) Limited | Date of production | PCY-030-2018 |
| Inspections required | Resilience after compression relief of the sample. | | |
| Additional information | None. | | |
| The above information is provided by the client, the Center is not responsible for its truthfulness. | | | |
| Test type | Entrusted Testing | Date of sample received | April 4, 2018 |
| Sample state | Black cellular board | | |
| Sample quantity | (300×300) mm, 2 pieces | Testing period | 2018.04.04~2018.04.12 |
| Test standard | GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation | | |
| Testing result | The sample has been tested. The test result of resilience after compression relief conforms to the stipulation of *GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation*. The test result is detailed in the annex (page 2).<br>Seal for test report<br>April 13, 2018<br>The test results only represent the technical properties of the samples received. | | |
| Remark | | | |

Approved by: /Technical Chief Checked by: Compiled by:

«Return to "Technical data" on page 3

«Return to "Resilience after compression relief" on page 11

GB/T 17794

Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision And Testing Center

Annex to Test Report

WSW No.18040439 Page 2 of 2

| Test item | Standard requirement | Test result | Judgment |
|---|---|---|---|
| Resilience after compression relief % (50% compression, 72h) | ≥70 | 85 | Pass |

Attached product information (provided by client):

| Armacell no. | Dimension | Product-name | Producer | Material-description |
|---|---|---|---|---|
| PCY-030-2018 | 25-099 | Class O Armaflex | Armacell (Guangzhou) Ltd | FEF - Flexible Elastomeric Foam Pipe or duct insulation product called "Class O Armaflex " consisting of elastomeric foam made of synthetic rubber. The colour of the product is black. |

(Blank below)

«Return to "Technical data" on page 3

«Return to "Resilience after compression relief" on page 11

CNAS L0846

# TEST REPORT

WSW No.18030292

Product Class 0 Armaflex

Client Armacell (Guangzhou) Limited

Test Type Entrusted Testing

Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

March 21, 2018

«Return to "Technical data" on page 3

«Return to "Water absorption by vacuum" on page 11

Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision & Testing Center

## Test Report

WSW No.18030292 Page 1 of 2

| | | | |
|---|---|---|---|
| Client | Armacell (Guangzhou) Limited | Address of client | Guanqiao, Shilou Town, Panyu District, Guangzhou City, Guangdong Province |
| Product | Class 0 Armaflex | Specification | 25mm sheet |
| Trade mark | Armaflex | Sample sender | Huang Guangfeng |
| Producer | Armacell (Guangzhou) Limited | Date of production | PCY-030-2018 |
| Inspections required | Water absorption by vacuum of the sample. | | |
| Additional information | None. | | |
| The above information is provided by the client, the Center is not responsible for its truthfulness. | | | |
| Test type | Entrusted Testing | Date of sample received | March 9, 2018 |
| Sample state | Blue cellular board | | |
| Sample quantity | (600×600) mm, 4 pieces | Testing period | 2018.03.09~2018.03.19 |
| Test standard | GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation | | |
| Testing result | The sample has been tested. The water absorption by vacuum conforms to the stipulation of *GB/T 17794-2008 Preformed flexible elastomeric cellular thermal insulation*. The test results are detailed in the annex (page 2).<br>Seal for test report<br>March 21, 2018<br>The test results only represent the technical properties of the samples received. | | |
| Remark | | | |

Approved by: /Technical Chief Checked by: Compiled by:

«Return to "Technical data" on page 3

«Return to "Water absorption by vacuum" on page 11



Nanjing Fiberglass Research & Design Institute, Testing Laboratory

China National Fiberglass Product Quality Supervision And Testing Center

## Annex to Test Report

WSW No.18030292 Page 2 of 2

| Test item | Standard requirement | Test result | Judgement |
|---|---|---|---|
| Water absorption by vacuum % | ≤10 | 8 | Pass |

Attached product information (provided by client):

| Armacell no. | Dimension | Product-name | Producer | Material-description |
|---|---|---|---|---|
| PCY-030-2018 | 25-099 | Class O Armaflex | Armacell (Guangzhou) Ltd | FEF - Flexible Elastomeric Foam<br>Pipe or duct insulation product called "Class O Armaflex"<br>consisting of elastomeric foam made of synthetic rubber.<br>The colour of the product is black. |

(Blank below)

«Return to "Technical data" on page 3

«Return to "Water absorption by vacuum" on page 11

# ASTM G21-15

SGS

**Test Report** No.: GZHL1705017570OT-01 Date: Jul 12, 2017 Page 1 of 4

ARMACELL (GUANGZHOU) LIMITED
GUANQIAO, SHILOU TOWN, PANYU DISTRICT, GUANGZHOU CITY GUANGDONG PROVINCE CHINA
511447

The following sample(s) was/were submitted and identified on behalf of the client as:

| | |
|---|---|
| Sample Description | : CLASS O ARMAFLEX |
| SGS Ref No. | : GZAFN1705006130P001 |
| Style / Item No. | : 25 MM SHEET |
| Manufacturer | : ARMACELL (GUANGZHOU) LIMITED |
| Other Info | : SEE ATTACHMENT |
| Sample Receiving Date | : May 04, 2017 |
| Test Performing Date | : May 04, 2017 to Jun 19, 2017 |

**TEST(S) REQUESTED:**
Selected test(s) as requested by the applicant

**TEST METHOD(S):**
Please refer to next page(s)

**TEST RESULT(S):**
Please refer to next page(s)

Signed for and on behalf of
Guangzhou Branch,
SGS-CSTC Ltd.

Johnny Lee
Approved Signatory

**This test report refers only to the sample(s) tested. This document cannot be used for improper publicity, without prior written approval of the SGS.**



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«Return to "Fungal growth" on page 11

SGS

**Test Report** No.: GZHL1705017570OT-01 Date: Jul 12, 2017 Page 2 of 4

ATTACHMENT:

| Armacell no. | Dimension | Product-name | Producer | Material-description |
|---|---|---|---|---|
| PCY-067-2017 | 25-099 | Class O Armaflex | Armacell (Guangzhou) Ltd | FEF - Flexible Elastomeric Foam Pipe or duct insulation product called "Class O Armaflex " consisting of elastomeric foam made of synthetic rubber. The colour of the product is black. |



«Return to "Technical data" on page 3

«Return to "Fungal growth" on page 11

SGS

**Test Report** No.: GZHL1705017570OT-01 Date: Jul 12, 2017 Page 3 of 4

**TEST RESULT(S):**
Antimicrobial activity test
Test method: With reference to ASTM G 21-15
Test organisms: *Aspergillus brasiliensis*[A] ATCC 9642, *Penicillium funiculosum*[B] ATCC 11797, *Aureobasidium pullulans* ATCC 15233, *Chaetomium globosum* ATCC 6205, *Trichoderma virens*[C] ATCC 9645

| Test Fungi | Concentration of spores (spores /mL) | Rating observed growth on specimens (after 28 days) |
|---|---|---|
| *Aspergillus brasiliensis*[A] ATCC 9642 | $1.1x10^6$ | 0 Grade* |
| *Penicillium funiculosum*[B] ATCC 11797 | | |
| *Aureobasidium pullulans* ATCC 15233 | | |
| *Chaetomium globosum* ATCC 6205 | | |
| *Trichoderma virens*[C] ATCC 9645 | | |

Notes:
1.According to ASTM G 21-15 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi, observed fungi growth rating on the specimens include:
0 – None
1 – Traces of growth (less than 10%)
2 – Light growth (10 to 30%)
3 – Medium growth (30 to 60%)
4 – Heavy growth (60% to complete coverage)
2.History name of test organism
[A]Historically known as *A. niger*.
[B]Historically known as *P. pinophilum*.
[C]Historically known as *Gliocladium virens*.
3.* The microscope(50 X) was used to confirm the observation.

Remark: This test report is to supersede No. GZHL1705017570OT test report which was issued on Jun 20, 2017. And the original test reports (paper and electronic) are invalid.



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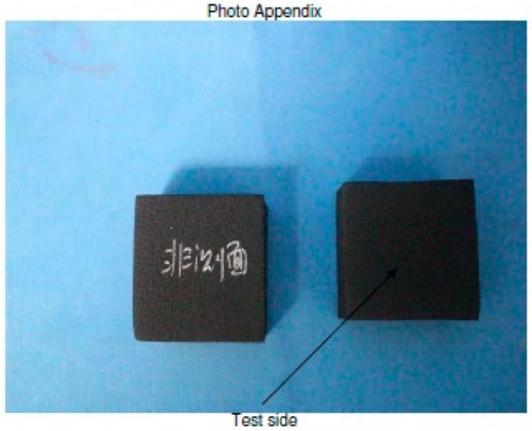
SGS

**Test Report** No.: GZHL1705017570OT-01 Date: Jul 12, 2017 Page 4 of 4

**SAMPLE DESCRIPTION:** Block sample

Photo Appendix



Test side

***End of Report***



«Return to "Technical data" on page 3

«Return to "Fungal growth" on page 11

## UL 2818

# CERTIFICATE
# OF COMPLIANCE

GREENGUARD
PRODUCT CERTIFIED FOR LOW CHEMICAL EMISSIONS
UL.COM/GG
UL 2818
GOLD

**Armacell Asia Ltd**

Armaflex® Class 0

13152-420
Certificate Number

10/28/2015 - 10/28/2019
Certificate Period

Certified
Status

UL 2818 - 2013 Gold Standard for Chemical Emissions for Building Materials, Finishes and Furnishings

Building products and interior finishes are determined compliant in accordance with California Department of Public Health (CDPH) Standard Method V1.2-2017 using an Office and Classroom Environment.

Product tested in accordance with UL 2821 test method to show compliance to emission limits on UL 2818. Section 7.1 and 7.2.

Environment

*UL Environment investigated representative samples of the identified Product(s) to the identified Standard(s) or other requirements in accordance with the agreements and any applicable program service terms in place between UL Environment and the Certificate Holder (collectively "Agreement"). The Certificate Holder is authorized to use the UL Environment Mark for the identified Product(s) manufactured at the production site(s) covered by the ULE Test Report, in accordance with the terms of the Agreement. This Certificate is valid for the identified dates unless there is non-compliance with the Agreement.*

*Certificate is renewed annually. Contact the Technical Services department for the latest certificate.

«Return to "Technical data" on page 3

«Return to "Greenguard Certification Programme" on page 12

**GREENGUARD Gold Certification Criteria for Building Products and Interior Finishes**

| Criteria | CAS Number | Maximum Allowable Predicted Concentration | Units |
|---|---|---|---|
| TVOC (A) | - | 0.22 | mg/m³ |
| Formaldehyde | 50-00-0 | 9 (7.3 ppb) | µg/m³ |
| Total Aldehydes (B) | - | 0.043 | ppm |
| 4-Phenylcyclohexene | 4994-16-5 | 6.5 | µg/m³ |
| Particle Matter less than 10 µm (C) | - | 20 | µg/m³ |
| 1-Methyl-2-pyrrolidinone (D) | 872-50-4 | 160 | µg/m³ |
| Individual VOCs (E) | - | 1/2 CREL or 1/100th TLV | - |

(A) Defined to be the total response of measured VOCs falling within the C6 – C16 range, with responses calibrated to a toluene surrogate. Maximum allowable predicted TVOC concentrations for GREENGUARD Gold (0.22 mg/m³) fall in the range of 0.5 mg/m³ or less, as specified in CDPH Standard Method v1.2.

(B) The sum of all measured normal aldehydes from formaldehyde through nonanal, plus benzaldehyde, individually calibrated to a compound specific standard. Heptanal through nonanal are measured via TD/GC/MS analysis and the remaining aldehydes are measured using HPLC/UV analysis.

(C) Particle emission requirement only applicable to HVAC Duct Products with exposed surface area in air streams (a forced air test with specific test method) and for wood finishing (sanding) systems.

(D) Based on the CA Prop 65 Maximum Allowable Dose Level for inhalation of 3,200 µg/day and an inhalation rate of 20 m³/day

(E) Allowable levels for chemicals not listed are derived from the lower of 1/2 the California Office of Environmental Health Hazard Assessment (OEHHA) Chronic Reference Exposure Level (CREL) as required per the CDPH/EHLB/Standard Method v1.2 and BIFMA level credit 7.6.2 and 1/100th of the Threshold Limit Value (TLV) industrial work place standard (Reference: American Conference of Government Industrial Hygienists, 6500 Glenway, Building D-7, and Cincinnati, OH 45211-4438).

Environment

*UL Environment investigated representative samples of the identified Product(s) to the identified Standard(s) or other requirements in accordance with the agreements and any applicable program service terms in place between UL Environment and the Certificate Holder (collectively "Agreement"). The Certificate Holder is authorized to use the UL Environment Mark for the identified Product(s) manufactured at the production site(s) covered by the ULE Test Report, in accordance with the terms of the Agreement. This Certificate is valid for the identified dates unless there is non-compliance with the Agreement.*

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# ROHS

SGS

ilac-MRA CNAS 中国认可 国际互认 检测 TESTING CNAS L0167

**Test Report** No. CANEC1826492901 Date: 26 Dec 2018 Page 1 of 6

ARMACELL (SUZHOU) LIMITED

ZHENXING ROAD, ZHANGJIAGANG ECONOMIC DEVELOPMENT ZONE, ZHANGJIAGANG, JIANGSU PROVINCE , CHINA

The following sample(s) was/were submitted and identified on behalf of the clients as : ArmaFlex Class 0

| | |
|---|---|
| SGS Job No. : | CP18-068328 - GZ |
| Date of Sample Received : | 20 Dec 2018 |
| Testing Period : | 20 Dec 2018 - 26 Dec 2018 |
| Test Requested : | Selected test(s) as requested by client. |
| Test Method : | Please refer to next page(s). |
| Test Results : | Please refer to next page(s). |
| Conclusion : | Based on the performed tests on submitted sample(s), the results of Lead, Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls (PBBs), Polybrominated diphenyl ethers (PBDEs) and Phthalates such as Bis(2-ethylhexyl) phthalate (DEHP) , Butyl benzyl phthalate (BBP), Dibutyl phthalate (DBP) , and Diisobutyl phthalate (DIBP) comply with the limits as set by RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU. |

Signed for and on behalf of
SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

Dirk.Yang

Dirk Yang
Approved Signatory



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SGS

ilac-MRA CNAS 中国认可 国际互认 检测 TESTING CNAS L0167

**Test Report** No. CANEC1826492901 Date: 26 Dec 2018 Page 2 of 6

Test Results :

Test Part Description :

| Specimen No. | SGS Sample ID | Description |
|---|---|---|
| SN1 | CAN18-264929.001 | Black foam w/ white printing |

Remarks :

(1) 1 mg/kg = 0.0001%
(2) MDL = Method Detection Limit
(3) ND = Not Detected ( < MDL )
(4) "-" = Not Regulated

RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU

Test Method : With reference to IEC 62321-4:2013+A1:2017, IEC 62321-5:2013, IEC 62321-7-2:2017 , IEC 62321-6:2015 and IEC 62321-8:2017, analyzed by ICP-OES , UV-Vis and GC-MS .

| Test Item(s) | Limit | Unit | MDL | 001 |
|---|---|---|---|---|
| Cadmium (Cd) | 100 | mg/kg | 2 | ND |
| Lead (Pb) | 1,000 | mg/kg | 2 | 8 |
| Mercury (Hg) | 1,000 | mg/kg | 2 | ND |
| Hexavalent Chromium (CrVI) | 1,000 | mg/kg | 8 | ND |
| Sum of PBBs | 1,000 | mg/kg | - | ND |
| Monobromobiphenyl | - | mg/kg | 5 | ND |
| Dibromobiphenyl | - | mg/kg | 5 | ND |
| Tribromobiphenyl | - | mg/kg | 5 | ND |
| Tetrabromobiphenyl | - | mg/kg | 5 | ND |
| Pentabromobiphenyl | - | mg/kg | 5 | ND |
| Hexabromobiphenyl | - | mg/kg | 5 | ND |
| Heptabromobiphenyl | - | mg/kg | 5 | ND |
| Octabromobiphenyl | - | mg/kg | 5 | ND |
| Nonabromobiphenyl | - | mg/kg | 5 | ND |
| Decabromobiphenyl | - | mg/kg | 5 | ND |
| Sum of PBDEs | 1,000 | mg/kg | - | ND |
| Monobromodiphenyl ether | - | mg/kg | 5 | ND |
| Dibromodiphenyl ether | - | mg/kg | 5 | ND |
| Tribromodiphenyl ether | - | mg/kg | 5 | ND |
| Tetrabromodiphenyl ether | - | mg/kg | 5 | ND |
| Pentabromodiphenyl ether | - | mg/kg | 5 | ND |

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Attention: To check the authenticity of testing /inspection report & certificate, please contact us at telephone: (86-755) 8307 1443, or email: CN.Doccheck@sgs.com
198 Kezhu Road,Scientech Park Guangzhou Economic & Technology Development District,Guangzhou,China 510663 t (86-20) 82155555 f (86-20) 82075113 www.sgsgroup.com.cn
中国·广州·经济技术开发区科学城科珠路198号 邮编: 510663 t (86-20) 82155555 f (86-20) 82075113 e sgs.china@sgs.com
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SGS

ilac-MRA CNAS 中国认可 国际互认 检测 TESTING CNAS L0167

Test Report No. CANEC1826492901 Date: 26 Dec 2018 Page 3 of 6

| Test Item(s) | Limit | Unit | MDL | 001 |
|---|---|---|---|---|
| Hexabromodiphenyl ether | - | mg/kg | 5 | ND |
| Heptabromodiphenyl ether | - | mg/kg | 5 | ND |
| Octabromodiphenyl ether | - | mg/kg | 5 | ND |
| Nonabromodiphenyl ether | - | mg/kg | 5 | ND |
| Decabromodiphenyl ether | - | mg/kg | 5 | ND |
| Dibutyl phthalate (DBP) | 1000 | mg/kg | 50 | ND |
| Butyl benzyl phthalate (BBP) | 1000 | mg/kg | 50 | ND |
| Bis (2-ethylhexyl) phthalate (DEHP) | 1000 | mg/kg | 50 | ND |
| Diisobutyl Phthalates (DIBP) | 1000 | mg/kg | 50 | ND |

Notes :

(1) The maximum permissible limit is quoted from RoHS Directive (EU) 2015/863.IEC 62321 series is equivalent to EN 62321 series
http://www.cenelec.eu/dyn/www/f?p=104:30:1742232870351101::::FSP_ORG_ID,FSP_LANG_ID:12586 37,25



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SGS

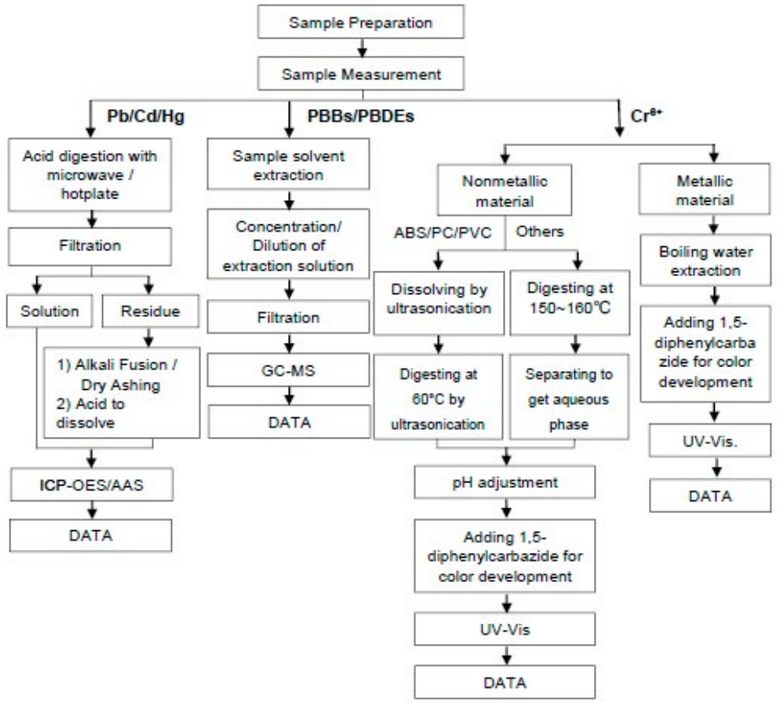
ilac-MRA CNAS 中国认可 国际互认 检测 TESTING CNAS L0167

Test Report No. CANEC1826492901 Date: 26 Dec 2018 Page 4 of 6

## ATTACHMENTS

### Pb/Cd/Hg/$Cr^{6+}$/PBBs/PBDEs Testing Flow Chart

1) These samples were dissolved totally by pre-conditioning method according to below flow chart.
($Cr^{6+}$ and PBBs/PBDEs test method excluded).



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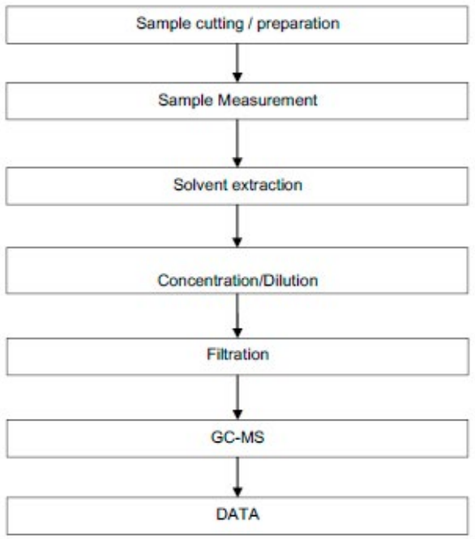
ATTACHMENTS

Phthalates Testing Flow Chart



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Sample photo:


SGS authenticate the photo on original report only

*** End of Report ***



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## SINGAPORE GREEN BUILDING PRODUCT

SINGAPORE GREEN BUILDING COUNCIL

### SINGAPORE GREEN BUILDING PRODUCT CERTIFICATE

AWARDED TO

**Armacell Asia Ltd**

Suite No. 60 Jumpstart Business Centre
Flat/RM 01-08 15/F Millennium City 5
418 Kwun Tong Road, Kwun Tong, Kowloon, Hong Kong, Hong Kong

FOR THE PRODUCT

**Thermal Insulation**

PRODUCT BRAND

**Armaflex**

PRODUCT MODEL

**Armaflex Class 0**

THE PRODUCT HAS BEEN ASSESSED ACCORDING TO THE ASSESSMENT CRITERIA OF THE SINGAPORE GREEN BUILDING PRODUCT CERTIFICATION SCHEME. IT HAS BEEN AWARDED THE RATING :

SINGAPORE GREEN BUILDING PRODUCT SGBC ✓✓✓ EXCELLENT

Director
SGBC Pte Ltd

| Certificate Number | Original Issue Date | Last Revision Date | Valid Till |
|---|---|---|---|
| SGBP 2018-1973 | 16th November 2018 | - | 15th November 2020 |

✓Good ✓✓ Very Good ✓✓✓ Excellent ✓✓✓✓ Leader

The use and reliance on this certificate is subject to the terms and conditions of the Singapore Green Building Product Certification Scheme. Revised certificates may also be issued at the discretion of the Council. The certification status may be verified at the Singapore Green Building Council website (www.sgbc.sg).

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«Return to "Singapore Green Building Product certification" on page 14



## ENVIRONMENTAL PRODUCT DECLARATION (EPD)

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

### EPD Transparency Summary

| | |
|---|---|
| COMPANY NAME | **Armacell Asia Pte. Ltd.** |
| PRODUCT TYPE | **Mechanical Insulation** |
| PRODUCT NAME | Armaflex® Class 0 |
| PRODUCT DEFINITION | Flexible Elastomeric Foam Insulation made of synthetic rubber, for the insulation of pipes and ducts |
| PRODUCT CATEGORY RULE (PCR) | Mechanical Insulation, Version 1.3, UL 2014 |
| CERTIFICATION PERIOD | August 25, 2015 - August 25, 2020 |
| DECLARATION NUMBER | 4786944121.101.1 |

### LIFECYCLE IMPACT CATEGORIES

The environmental impacts listed below were assessed throughout the product's lifecycle – including raw material extraction, transportation, manufacturing, packaging, use, and disposal at end of life.

| | ATMOSPHERE | | | WATER | | EARTH | |
|---|---|---|---|---|---|---|---|
| | **Global Warming Potential** refers to long-term changes in global weather patterns – including temperature and precipitation – that are caused by increased concentrations of greenhouse gases in the atmosphere. | **Ozone Depletion Potential** is the destruction of the stratospheric ozone layer, which shields the earth from ultraviolet radiation that's harmful to life, caused by human-made air pollution. | **Photochemical Ozone Creation Potential** happens when sunlight reacts with hydrocarbons, nitrogen oxides, and volatile organic compounds, to produce a type of air pollution known as smog. | **Acidification Potential** is the result of human-made emissions and refers to the decrease in pH and increase in acidity of oceans, lakes, rivers, and streams – a phenomenon that pollutes groundwater and harms aquatic life. | **Eutrophication Potential** occurs when excessive nutrients cause increased algae growth in lakes, blocking the underwater penetration of sunlight needed to produce oxygen and resulting in the loss of aquatic life. | **Depletion of Abiotic Resources (Elements)** refers to the reduction of available non-renewable resources, such as metals and gases, that are found on the periodic table of elements, due to human activity. | **Depletion of Abiotic Resources (Fossil Fuels)** refers to the decreasing availability of non-renewable carbon-based compounds, such as oil and coal, due to human activity. |
| TRACI | | | | | | | |
| CML | 6.84E+00 kg CO2 eq | 2.30E-07 kg CFC-11 eq | 2.35E-03 kg C2H4 eq | 3.73E-01 kg SO2 eq | 9.40E-02 kg PO4 | | |

FUNCTIONAL UNIT 1 kg of insulation material without facing with a building service life of 60 years

UL Environment

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# Environment

## MATERIAL CONTENT

Material content measured to 1%.

| COMPONENT | MATERIAL | AVAILABILITY | MASS% | ORIGIN |
|---|---|---|---|---|
| | Rubber and Polymers | | 25 | |
| | Fillers and pigments | | 4 | |
| | Blowing agent | | 13 | |
| | Vulcanization system, additives, plasticizers | | 26 | |
| | Flame retard | | 32 | |
| | | | | |

## ADDITIONAL ENVIRONMENTAL INFORMATION

| | |
|---|---|
| PRE-CONSUMER RECYCLED CONTENT | % |
| POST-CONSUMER RECYCLED CONTENT | % |
| VOC EMISSIONS | GREENGUARD Gold |
| WATER CONSUMPTION | |

## RECYCLING OR REUSE

## ENERGY

| | | |
|---|---|---|
| RENEWABLE ENERGY | 5.1 % | 3.85 MJ |
| NON-RENEWABLE ENERGY | 94.9 % | 72.27 MJ |

## STANDARDS

ASTM C534
EN 14304
GB/T 17794
BS 476 Part 6&7 - Class 0 Rating
FM 4924
UL2818

## CERTIFICATIONS

## MANUFACTURER CONTACT INFO

| | |
|---|---|
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# ABOUT ARMACELL

As the inventors of flexible foam for equipment insulation and a leading provider of engineered foams, Armacell develops innovative and safe thermal, acoustic and mechanical solutions that create sustainable value for its customers. Armacell's products significantly contribute to global energy efficiency making a difference around the world every day. With 3,100 employees and 24 production plants in 16 countries, the company operates two main businesses, Advanced Insulation and Engineered Foams. Armacell focuses on insulation materials for technical equipment, high-performance foams for high-tech and lightweight applications and next generation aerogel blanket technology.

For more information, please visit:
**www.armacell.com**

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