Certificate no.:
TAK00002M1

TYPE APPROVAL CERTIFICATE

This is to certify:

that the Insulation Materials for Gas Carriers

with type designation(s)
PF-50C

issued to
Hankuk Carbon Co., Ltd.
Miryang-si, Gyeongsangnam-do, **Republic of Korea**

is found to comply with
DNV rules for classification – Ships Pt.5 Ch.7 Liquefied gas tankers

Application:

Rigid cellular polyurethane foam for insulation.

Issued at **Hamburg** on **2025-12-01**
This Certificate is valid until **2030-11-30**.
DNV local unit: **Busan, CMC Korea**

Approval Engineer: **Gisle Hersvik**

for **DNV**

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

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to USD 300 000.

Product description

PF-50C: Two-component rigid Polyisocyanurate Foam for production of insulating panels

P(PIPE) **F**(FOAM) – **50**(Norminal Density) **C**(Cover)

Component A: Polyester-derived polyol (PLO)
Component B: Methylene diphenyl diisocyanate (MDI/ISO)

Material Properties

Raw materials

Properties	Standard	PLO	MDI	Unit
Viscosity, at 25°C	ASTM D4878	5000 – 8000 cps		mPa·s
Viscosity, at 25°C	ASTM D1638		150 – 250	mPa·s
Density, at 25°C	ASTM D4052	1.08 ± 0.04		g/cm³
Density, at 25°C	ASTM D1638		1.23 – 1.25	g/cm³

Foam properties

Density, nominal: 40 - 50 kg/m³ according to ASTM D1622
Thermal conductivity at 23°C: ≤ 0.023 W/mK according to ASTM C518 (non-aged)
Flame retardance: B2 according to DIN 4102, Part 1

Application/Limitation

Polyisocyanurate Foam for a variety of cryogenic insulation.
PF-50C is produced as a continuous foam bunstock with the ability to be fabricated into any shape and sizes such as pipe shells, tank and vessel coverings and custom parts for a variety of insulation, core material and carving applications.

Compatibility with cargo has not been evaluated. Compatibility testing with the actual kind of cargoes or fuels must be carried out prior to installation on DNV classed ships.

Area of application will be evaluated during approval of classified objects.

For each installation on DNV classed vessel the complete insulation scheme shall be reviewed and approved by DNV prior to installation.

Storage, handling and installation of the insulation material shall be in accordance with manufacturer's recommendations.

When installed, the insulation material shall be adequately protected against penetration of water vapor and mechanical damage.

Where the thermal insulation is located on or above the exposed deck, and in way of tank cover penetrations, it shall have suitable fire resistance properties in accordance with recognized standards or be covered with a material having low flame-spread characteristics and forming an efficient approved vapor seal.

Any significant changes in design and / or quality of the material will render the approval invalid.

Type Approval documentation

Tests carried out

Type Testing carried out in accordance with **Type Approval documentation** including:

No.	Test item	Test method
1	Density	ISO 845 (23°C)
2	Thermal conductivity	ASTM C518 (23°C)
3	Closed cell content	ASTM D2856 / D6226
4	Thermal conductivity	ISO 8302 (-160°C)
5	Coefficient of linear thermal expansion	ASTM E228 (-170°C to 30°C)
6a	Tensile strength, perpendicular	ASTM D1623 (-170°C and 20°C)
6b	Tensile strength, parallel	ASTM D1623 (-170°C and 20°C)
7a	Compressive strength, perpendicular	ASTM D1621 (-170°C and 20°C)
7b	Compressive strength, parallel	ASTM D1621 (-170°C and 20°C)
8	Water absorption	KS M 3809
9	Flammability characteristics	DIN4102 Part 1, B2 Class

Other properties may need to be documented for specific installations.

Marking of product

Product/package shall be marked at least with *manufacturer's name*: **Hankuk Carbon Co., Ltd., Korea** and *type designation:* ***PF-50C*** and *Lot no*.

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

Periodical assessment

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

Periodical assessments (for Certificate Retention / Certificate Renewal) shall be performed according to DNV-CP-0338.

This certificate is only valid if required Periodical assessments are carried out with satisfactory results. To check the validity of this certificate, please look it up in https://approvalfinder.dnv.com

END OF CERTIFICATE