



Certificate No:
TAK000028H

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Insulation Materials for Gas Carriers

with type designation(s)
Polypropylene glycol (PPG): KRPPGS302C

Issued to
Kangrim Insulation Co., Ltd.
Busan, Republic of Korea

is found to comply with
DNV rules for classification – Ships

Application :

Insulation material for LNG/LGP/LEG independent cargo and fuel tanks, and pipeworks.

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

Issued at **Hamburg** on **2023-07-05**

This Certificate is valid until **2028-07-04**.

DNV local unit: **Gimhae Station**

Approval Engineer: **Gisle Hersvik**

for **DNV**

Thorsten Lohmann
Head of Section

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

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 300,000 USD.



Form code: TA 251

Revision: 2022-12

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Product description

KRPPGS302C: a two-component unflammable Polyurethane (PU) insulation material for LPG / LEG / LNG Carriers.

- Nominal density: 40 kg/m³.
- Mixing ratio as per Manufacturer' Technical Data Sheet (TDS).

General properties of KRPPGS302C Polyurethane Spray Foam System

Properties	Test Method	Manufacturer's Specification	Test results	Units
Density	ASTM D1622	36-50	45.1	kg/m ³
Aging (thermal conductivity)	ASTM C518	-	15 days: 0.01997 180 days: 0.02048	W/mK
Thermal conductivity	ISO 8302 / ASTM C177	-	-160°C: 0.01106 -120°C: 0.01141 -80°C: 0.01425 -40°C: 0.0173 -20°C: 0.0187 +20°C: 0.02006 +40°C: 0.02245	W/mK
Tensile strength (RT)	ASTM D1623	≥35	37.12	N/cm ²
Tensile strength (-170°C)	ASTM D1623	≥35	40.39	N/cm ²
Compressive strength (RT)	ASTM D1621	≥0.17	0.38	MPa
Compressive strength (-170°C)	ASTM D1621	≥0.17	0.74	MPa
Cohesion	ASTM D1623	Foam breaking	Foam breaking	MPa
Closed Cell Content	ASTM D6226	≥90	94	%
Resistance to fire and flame spread	DIN 4102-1	B2	B2	-
Water absorption	KS M 3809	≤3.0	2.16	g/100 cm ²

Properties of KRPPGS302C Polyurethane Spray Foam System after immersion in LNG (15 days)

Properties	Test Method	Manufacturer's Specification	Test results	Units
Tensile strength (+23°C)	ASTM D1623	≥35	37.44	N/cm ²
Tensile strength (-170°C)	ASTM D1623	≥35	40.82	N/cm ²
Compressive strength (+23°C)	ASTM D1621	≥0.17	0.45	MPa
Compressive strength (-170°C)	ASTM D1621	≥0.17	0.72	MPa
Cohesion test	ASTM D1623	Foam breaking	Foam breaking	-
Solubility & Absorption	DIN 53428	-	Variation in volume: -0.1%	-
Shrinkage	ASTM D2126	-	Variation in volume: -0.1%	-

Other properties may need to be documented for specific installations.

Manufactured by

PU-CHEM Ltd., 66-42, Gimhae-daero 927beon-gil, Hallim-myeon, Gimhae-si, Gyeongsangnam-do, Republic of Korea

DNV local station: Gimhae

Responsibility

The Company (stated on the front page of this Certificate) takes the responsibility that both design and production are in compliance with Rules, Standards and/or Regulations listed on page 1 of this certificate.

Application/Limitation

Insulation material for LNG/LGP/LEG independent cargo and fuel tanks and pipeworks for marine applications. It should be noted that the 'reaction to liquids' is only documented for LNG immersion.

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

Depending on the thickness of the insulation material the need for any crack arrestors or similar must be evaluated by the insulation system designer.

The insulation material applicators must have adequate training and relevant experiences in accordance with manufacturer's recommendations.

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:

- Type test for General Properties
- Type test for LNG immersion. Note that the compatibility testing has been carried out only for LNG. Compatibility testing with the actual kind of cargoes or fuels must be carried out prior to installation on DNV classed ships.
- Solubility in the cargo: DIN 53428.
- Compatibility with the cargo: DIN 53428, ASTM D1621, ASTM D1623, ASTM D2126
 - DIN 53428 Absorption of the cargo [Reaction to liquids, vapors, gases and solid materials]
 - DIN 53428 Shrinkage
 - ASTM C518 Aging (Thermal conductivity)
 - ASTM D1621 Compressive Strength
 - ASTM D1623 Tensile Strength
 - ASTM D1623 Cohesion
 - ASTM D6226 Closed cell content
 - ASTM D1622 Density
 - ASTM C177, ISO 8302 Thermal conductivity
 - DIN 4012 Part 1 B2 Flammability (Resistance to fire and flame spread)
 - KS M 3809 Water absorption
 - ASTM D2126 Thermal and Humid Aging [Dimensional stability]

Other tests may be required for specific applications/projects.

Marking of product

Product/package shall be marked with *manufacturer's name*: **Kangrim Insulation Co., Ltd., Korea**, *place of manufacture and type designation*: **KRPPGS302C**.

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