

# Reinforced Spray Foam System on IMO Type-C Tank





**IMO Type-C tanks** are normally cylindrical pressure vessels vertically or horizontally mounted. The C-Tank type is the most common tank technology for Small & Middle scale liquified gas cargo/fuel containment.

**Typical applications**

- LNG Fuel Ship**
  - Oil tank
  - Container ship
  - Chemical tanker
  - Bulk carrier
- Liquefied Gas Carrier**
  - Small and middle size liquified gas carrier (appx.10k~30k cbm)
  - LPG/LEG/CO2/NH3 carrier
- Others**
  - LNG bunker ship
  - Small and middle size FSRU
  - Small and middle size FLNG
  - LNG power generation Ship
  - Liquified H2 carrier (in future)

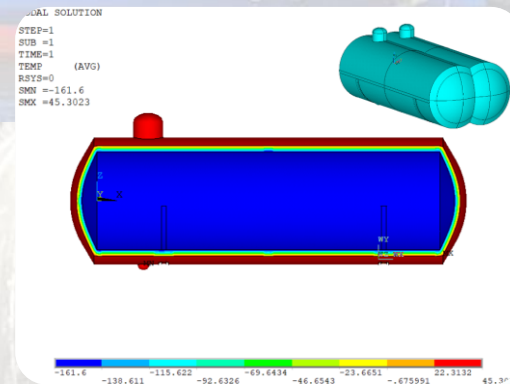
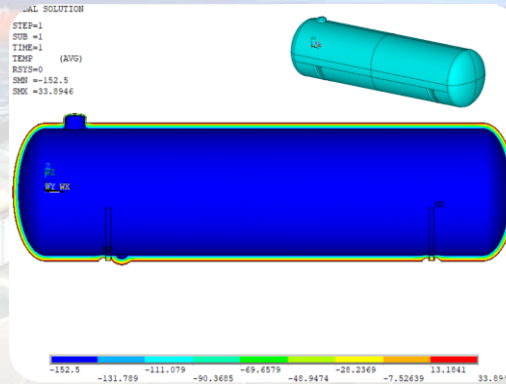


# PASSER-Technology Research & Development

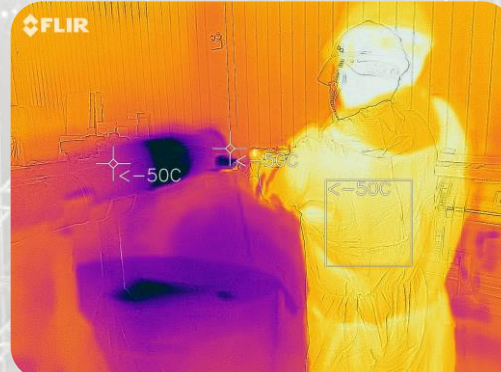
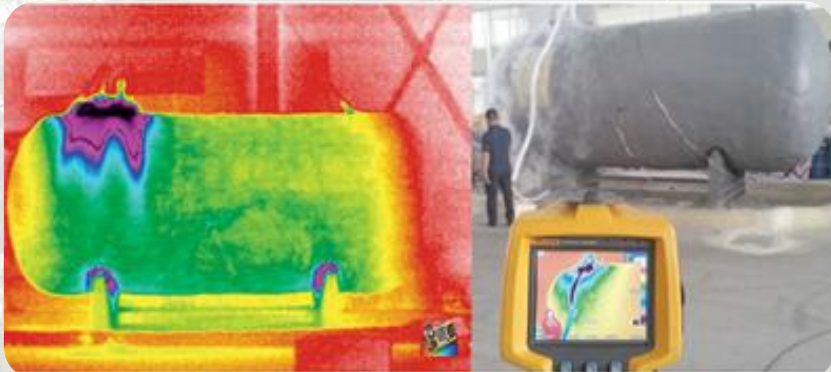
## Tank Insulation Design & Calculation

PASSER MARINE/PASSER LANYU is specialized in providing effective, safety and reliable cryogenic insulation solutions on Liquefied Gas Tank and Pipelines. All in accordance with theoretical simulations, abundant installation and maintenance experiences and sufficient test supports.

- Boil-Off Rate Calculation (free online)
- Holding Time Calculation
- Heat Transmission Calculation
- Finite Element Analysis
- Dynamic Cargo Condition Simulation
- Professional & Suitable Insulation Design



## Professional Workshop with Type A/B/C and Mock Ups





# PASSER-Technology Research & Development

## Patents on Type-C Tank Insulation

PASSER MARINE/PASSER LANYU has developed dozens of patents based on theoretical simulations, abundant installation- and maintenance experiences.

- Flame retardant high-strength tough coat
- Improved crack resistance arrangement-crack barrier
- Improved bonded inner insulation structure
- Improved fixation arrangement on Support
- Improved buffer arrangement on Support
- Improved vapor barrier arrangement solution
- Buffer & Reinforced arrangement on Bi-lobe Y joint
- Removable insulation arrangement on temp. sensor
- Buffer FRP arrangement solution
- Improved crack resistance FRP arrangement solution
- Vacuum panel insulation arrangement
- Aerogel insulation arrangement solution

## Qualification Certificates (BV,RINA,CCS,LR,DNVGL,ABS,NK,USCG)

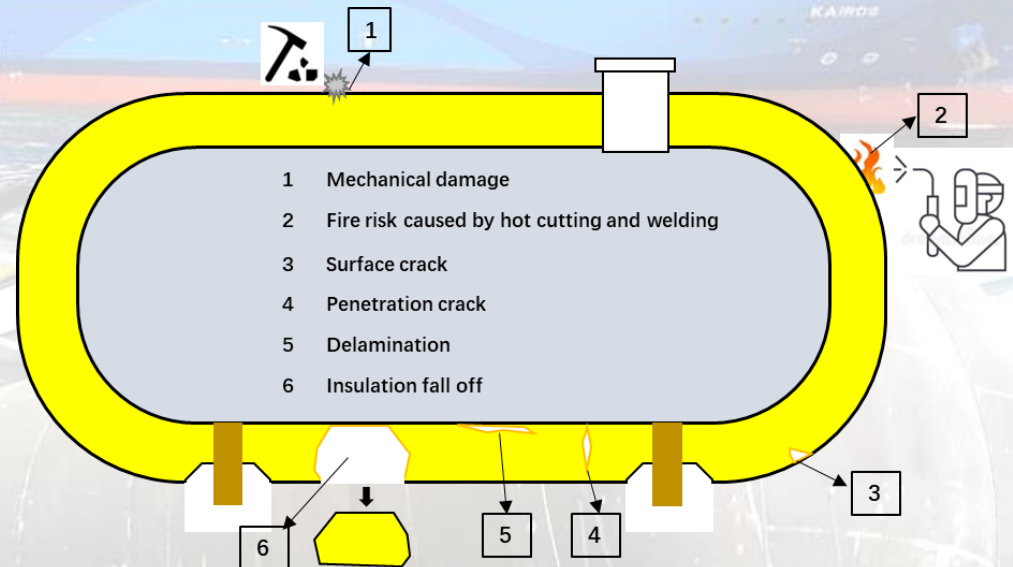


# General Insulation Introduction

## Typical Insulation Failures

Insulation is applied on Type-C tank to minimize loss of boil off cargo and protect hull structure from cryogenic temperatures, ice formation and condensation according to specified criteria and design.

**Due to thermal contraction caused by cryogenic cargo temperature, worse sea condition, insulation design failures, poor constructions etc, abundant insulation failures happened over the past years on dozens of different vessels carried Type-C tank. This may affect Opex and generate technical difficulties during design-life.**



FRP Crack



Surface Crack



Delamination & Fall Off



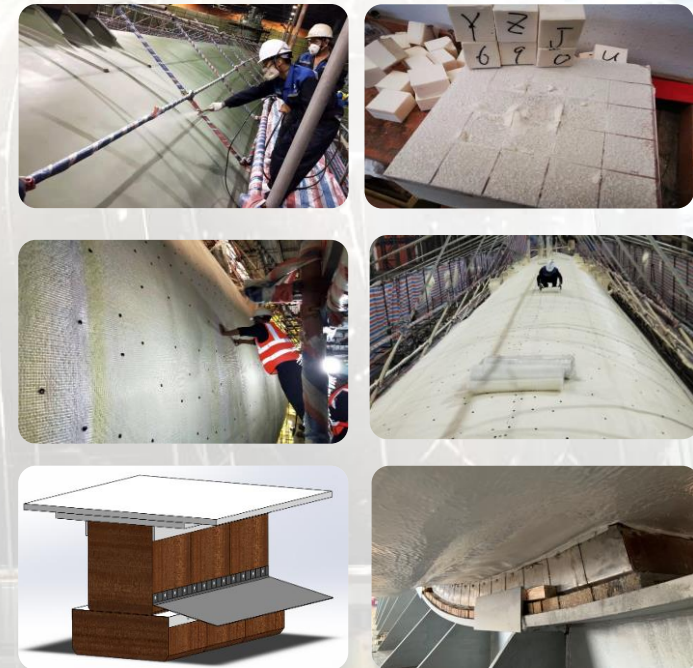
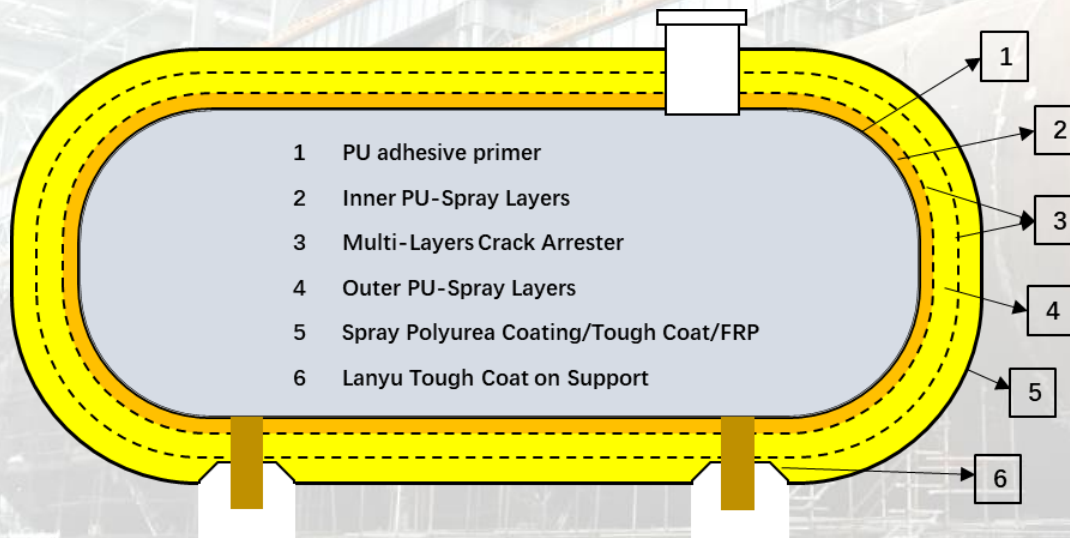
Penetration Crack

# PASSER-Reinforced Spray Foam System on Single Type C Tank

## Single Type-C Tank Insulation Solution

Triple Reinforced Arrangements are applied in typical Type C Single Tank Insulation System with **patents**:

- PU Adhesive Primer-to reinforced the bonding affect between insulation and tank surface.
- Multi-Layers Crack Arrester-Glass Fibre Mesh to reinforced the tensile strength and avoid penetration cracks due to thermal contraction. The amount will be in accordance with total insulation thickness.
- PASSER Lanyu Tough Coat with improved mechanical property and fixation on support area to avoid crack and delamination caused by different thermal contractions among Tank Shell/Wood/Insulation under cryogenic conditions.



# Reinforced Spray Foam System on Single Type C Tank

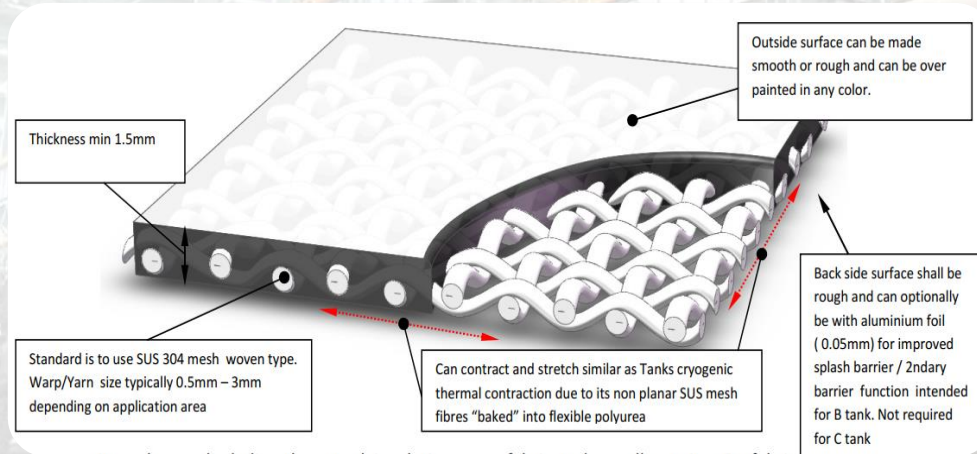
## Single Type-C Tank Insulation Solution-Outer Protective Layer

Lanyu Tough Coat (LTC), FRP, Polyurea coating will be applied as outer mechanical & vapor barrier with patents technology accordingly to each project:

➤ **Solution 1: Lanyu Tough Coat (LTC) as whole insulation coating.**

Patent Lanyu tough coat is made of polyurea coating reinforced with SUS mesh.

To strengthen the physical property & fire-retardant property of insulation outer protective layer, withstand the weight of insulation to avoid fall off and act as surface foam crack arrester, flexible and tough under thermal contraction.



**LTC in Principle**



**LTC on Whole Tank Insulation**

# *Reinforced Spray Foam System on Single Type C Tank*

## *Single Type-C Tank Insulation Solution-Outer Protective Layer*

### **Solution 2: FRP Covering.**

#### **Combined with Partial Lanyu Tough Coat**

- a) Patent unbonded FRP technology which is more flexible under thermal contraction.
- b) Patent Partial Lanyu Tough Coat (LTC) applied on support as fixation zone to avoid crack & delamination on support under thermal contraction. As well as middle cylinder part as buffer zone, to avoid crack occurred on hard FRP under shrinkage.



**Unbonded FRP Covering**



**LTC Buffer Zone**

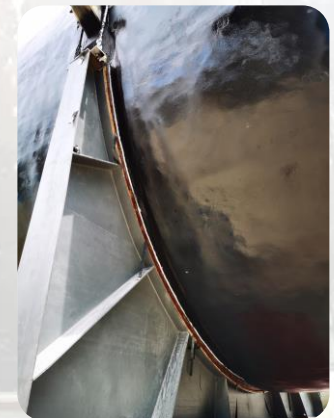
### **Solution 3: Spray Polyurea coating (SPC),**

#### **Combined with Partial Lanyu Tough Coat**

- a) Normal Spray Polyurea Coating technology.
- b) Patent Partial Lanyu Tough Coat (LTC) applied on support as fixation zone.



**Spray Polyurea Coating (SPC)**



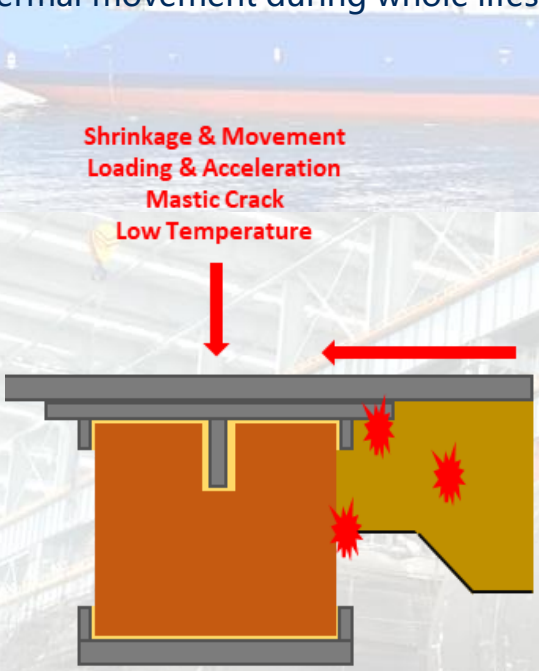
**LTC Fixation Zone**



# PASSER-Reinforced Spray Foam System on Single Type C Tank

## Single Type-C Tank Insulation Solution-Support Area

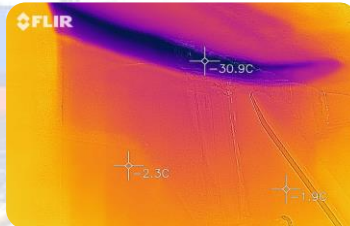
Supports are key area on tank to bear the weight with acceleration of whole tank, absorbing and then recovering from the thermal movement during whole lifespan.



Shrinkage & Movement  
Loading & Acceleration  
Mastic Crack  
Low Temperature

Crack  
Ice  
Delamination

Typical Insulation Failures  
on Support Area



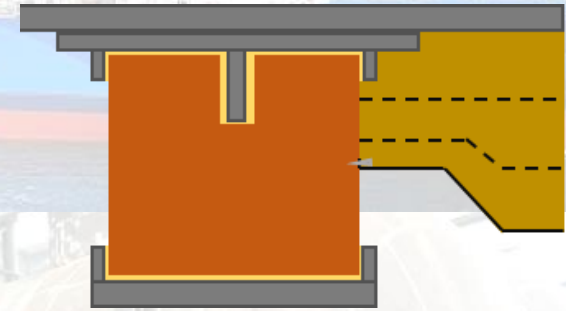
Cryogenic caused by wood  
& decreased insulation



Moisture & Ice Accumulated  
by Low Temperature

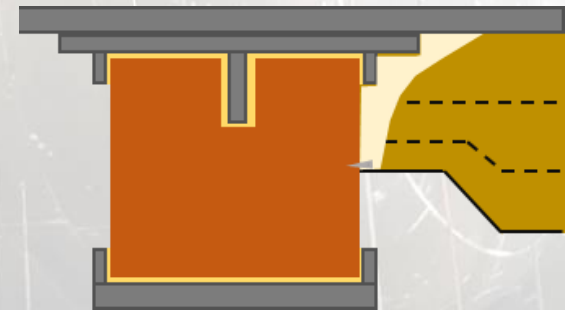


Crack & Delamination due to  
Shrinkage & Movement



### Patent Technology

**Improved Fixation Arrangement on Support Area**  
Reinforced Insulation and Tough Coat fixed tightly on  
wooden block to bear the thermal contraction.  
Crack Barrier applied to avoid crack under shrinkage.



### Patent Technology

**Improved Buffer Arrangement on Support Area**  
Soft buffer zone applied on support to bear the  
deformation by loading/acceleration/mastic crack.



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## ***PASSER-Single Tank Insulation Reference***

### ***Single Type-C Tank Insulation Reference***

PASSER MARINE/PASSER LANYU provides dozens of Type-C Single Tank Insulation all over the world. Including the world's largest Single Type-C tank with **14,000cbm** gross volume. Tough Coat, Spray polyurea coating or FRP is applied as outer layer to match customer's requirement with specified patent technology accordingly.



**1100cbm LNG Fuel Tank**



**1800cbm LNG Fuel Tank**



**3000cbm LNG Fuel Tank**



**3500cbm LNG Fuel Tank**



**3750cbm LNG Fuel Tank**



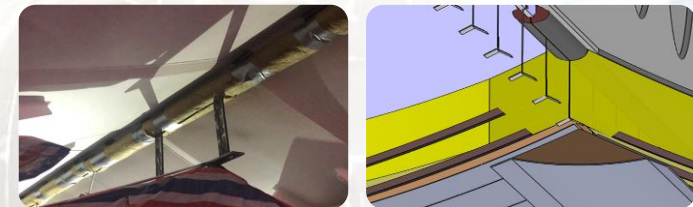
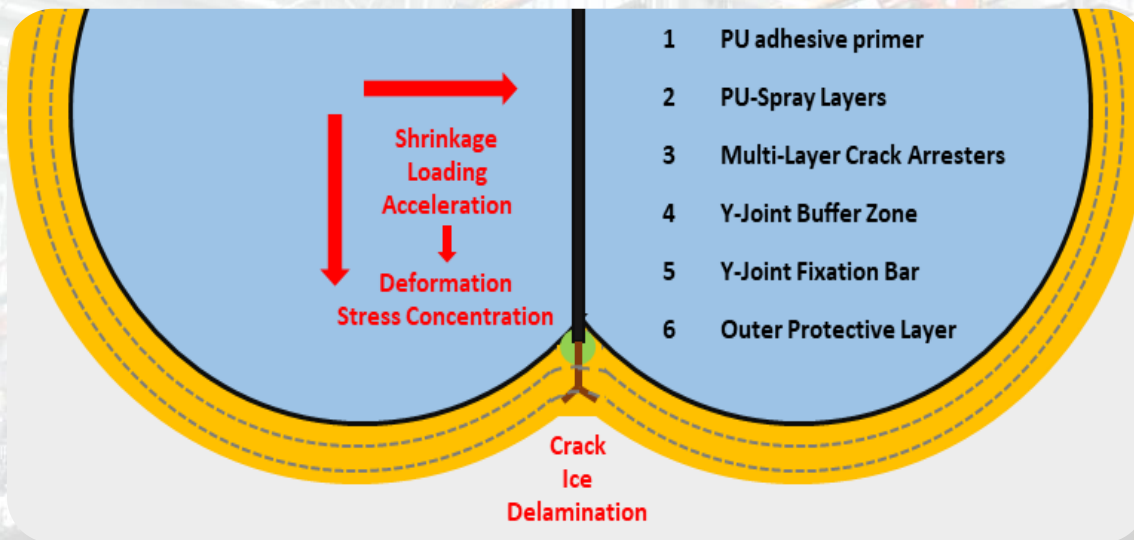
**14,000cbm LNG FRU Tank**

# PASSER-Reinforced Spray Foam System on Bilobe Type C Tank

## Bilobe Type-C Tank Insulation Solution

Patented Reinforced Arrangement can be applied on typical Type C Bilobe Tank Insulation Systems:

- To deal with tank deformations and thermal contractions, the bottom Y-joints are installed in longitudinal direction in the bottom of the bilobe. Mineral wool or similar soft materials will act as a flexible zone close to the tank bottom. Covered by reinforced spray foam with crack arrestors to improve physical properties.
- SS steel clamping is fixed to center-knuckle plate for each meter approximately. Length of SS clamping to be adjusted for tank shape and size. This is an additional safeguard to prevent cracks or worse on the sensitive bilobe bottom.





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## *PASSER-Bilobe Tank Insulation Reference*

### *Bilobe Type-C Tank Insulation Reference*

PASSER MARINE/PASSER LANYU provides dozens of Type-C bilobe tank insulation all over the world. Including the world's largest Bilobe Type-C tank with **16,020cbm** gross volume. Tough Coat or Spray polyurea coating as outer layer to match clients requirement with specified patent technology accordingly.



**1800cbm LNG Fuel Tank**



**2010cbm LNG Fuel Tank**



**2320cbm LNG Fuel Tank**



**2500cbm LNG Bunker Tank**



**3573cbm LEG Cargo Tank**



**16,020cbm LNG Cargo Tank**



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