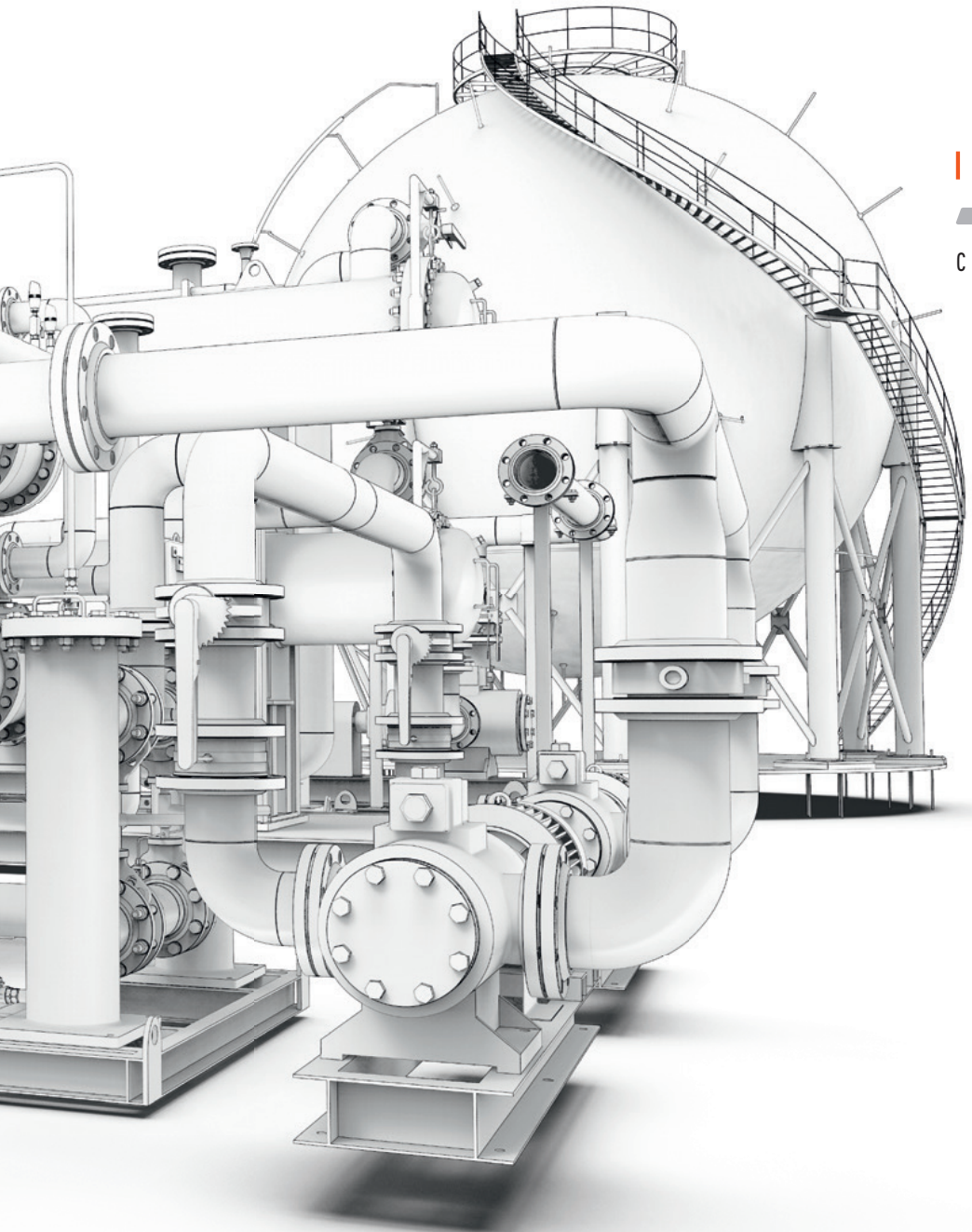
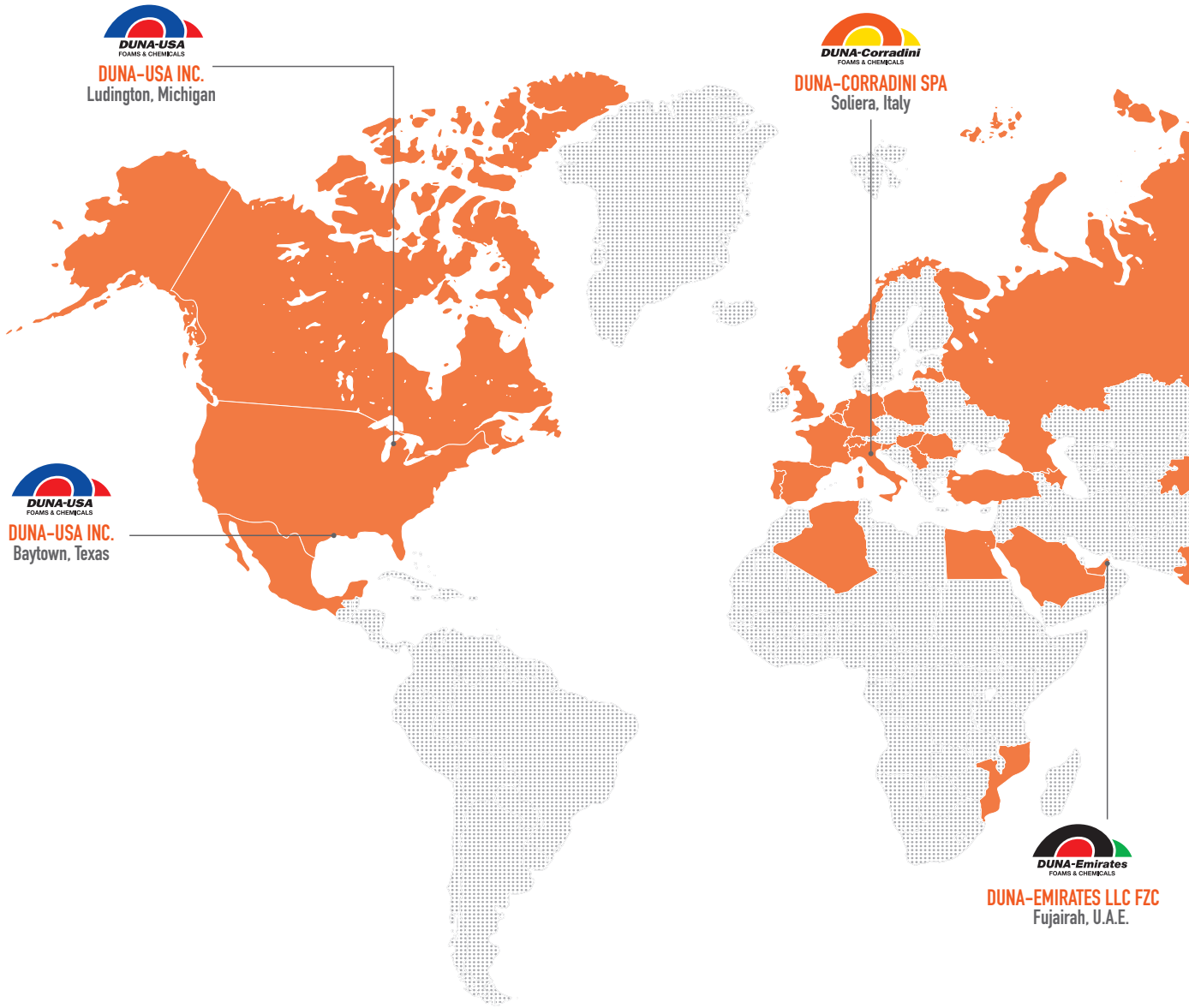
DUNA-Corradini
FOAMS & CHEMICALS



INNOVATION PROVIDERS

CRYOGENIC SOLUTIONS

PASSION CHEMISTRY SOLUTIONS



WHERE WE ARE

4 PRODUCTION PLANTS WORLDWIDE
OVER 1500 CLIENTS SERVED
IN 118 COUNTRIES

56 CRYOGENIC PROJECTS IN 45 COUNTRIES*

*data refer to 2018-2023 period

WHY DUNA?

SINCE 1957, DUNA MEANS HIGH-PERFORMANCE INSULATION

With over 65 years of experience in PUR/PIR foams and formulated systems' production, the DUNA-Group represents a **specialized and reliable Partner for industrial cold and cryogenic insulation.**

Thanks to constant R&D investments, state-of-the-art technology and decades-long technical expertise, DUNA is committed to meet the **specific needs of cold and cryogenic applications,** providing **tailor-made insulating solutions** and dedicated technical service.

The DUNA-Group comprises of **DUNA-Corradini SPA,** the italian Headquarter in Soliera (MO, Italy), **DUNA-Emirates LLC FZC,** the strategic subsidiary based in the Arab Emirate of Fujairah, and **DUNA-USA Inc.**, the overseas company with two production plants in Texas and Michigan.
Our international presence enables us to support with highest efficiency the **most challenging LNG, LPG, fertilizer, refinery and petrochemical projects worldwide.**

MOST RECENT SUPPLY RECORDS

PROJECT NAME	ENGINEERING COMPANY	TYPE	PROJECT SITE	YEAR
NFE EPC1	Samsung C&T	LNG Liquefaction	Qatar	2023 - ongoing
YUNGAN LNG	China Engineers Associates	LNG Import Terminal	Taiwan	2023
PETKIM PETROCHEMICAL	USTAY YAPE TAAHUS AS	Piping	Turkey	2023
CANADA LNG	JGC Fluor BC LNG JV (JFJV)	LNG Liquefaction	Canada	2021-2022
LNG JETTY AND PORT INFRASTRUCTURES AT THE SKIKDA HYDROCARBON PORT	Sonatrach	LNG Jetty Loading Line	Algeria	2021 - 2022
TANGGUH LNG EXPANSION TRAIN 3	CSTS (Chiyoda, Tripatra, Saipem, Suluh Ardhi Engineering)	LNG Liquefaction	Indonesia	2019-2022
CORAL SOUTH FLOATING LNG - AREA 4 MOZAMBIQUE	TechnipFMC, JGC Corporation, Samsung Heavy Industries	Floating LNG Liquefaction	Mozambique	2021
ARCTIC 2 LNG	Technip FMC	LNG Liquefaction	Russia	2020 - 2021
LONG SON PETROCHEMICAL COMPLEX	POSCO JV PVC-MS	Ethylene - Petrochemical	Vietnam	2020
USTAY POLYPROPYLE PKLANT SUMGAYIT	Technip FMC	Ethylene - Petrochemical	Azerbaijan	2019
GC-GV MEG FEED	CTCI McDermott Integrated (CMI)	Ethylene - Petrochemical	China	2019

WHY PIR & PUR FOAMS?

PIR/PUR – TECHNICAL ADVANTAGES

Thermal insulation represents a critical factor for cold and cryogenic projects' efficiency and safety, a valuable investment to ensure productivity and continuity of plants and pipelines' operation while reducing operating costs due to energy losses. Thanks to their insulating and mechanical properties, **rigid polyurethane/polyisocyanurate foams and formulated systems are the ideal solution** for LNG, LPG and other industrial applications where extreme process temperatures (from -200°C/-328°F up +120°C/+248°F) are to be maintained with **minimum heat gain and relevant structural properties** are required.

LOW THERMAL CONDUCTIVITY

PIR/PUR foams provide the **lowest thermal conductivity rating among expanded materials for insulation**, ensuring the **minimum heat conduction and avoiding thermal bridges**. This way the required thermal performance can be achieved in fewer insulating layers and total thickness compared to other more thermally conductive materials.

OPERATING TEMPERATURES

Rigid PIR/PUR foams are suitable for application at a wide range of temperatures **down to extreme cryogenics (-200°C / -328°F)**

MECHANICAL STRENGTH

Polyurethane and Polyisocyanurate foams provide an **excellent strength-to-weight ratio**, granting insulation integrity even at cryogenic temperatures. Foams' mechanical properties gradually increase with chosen density.

THERMAL STRESS RESISTANCE

All PIR/PUR solutions by DUNA feature a **CTSR** (Coefficient of Thermal Stress Resistance) **compliant with CINI 2.7.01 requirement** (>1,5 for -165 < T < +23 °C).

LOW WATER ABSORPTION

The PIR/PUR foams **closed cells structure** guarantees low water-absorption, preserving the integrity and efficiency of the insulation system.

DIMENSIONAL STABILITY

Thanks to its specific composition and polymer structure, rigid PIR/PUR foams show excellent dimensional stability at a wide range of operating temperatures.

CHEMICAL RESISTANCE & COMPATIBILITY

Rigid polyurethane foam offers maximum **resistance to chemicals, solvents and oils**, while ensuring excellent compatibility with adhesives and mastics.

FIRE REACTION

Polyurethane and polyisocianurate foams and systems can be formulated to meet the most stringent fire protection standards and local safety regulations. For instance, all the foams proposed by DUNA for industrial insulation are **classified Euroclass E according to EN 13501** and all DUNA PIR foams are **ASTM E84 Class A and ASTM D3014 complaint.**

SUSTAINABILITY

All PUR/PIR foams and systems by DUNA are **blown with environmentally friendly blowing agents** (NO CFC/HCFC/HFC) and have **Ozone Depletion Potential = 0 and Global Warming Potential <1.**

APPLICATIONS

The DUNA-Group provides a complete range of PUR/PIR foams, systems and customised solutions for thermal insulation and structural reinforcement to support multiple industrial applications at cryogenic conditions.

PIPE INSULATION

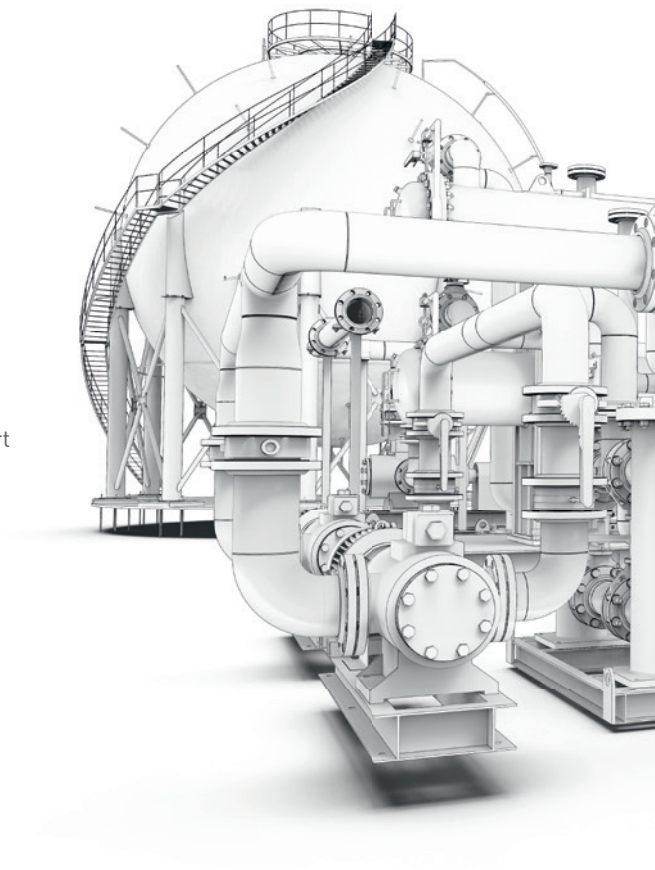
- **CORAFOAM®** low-medium density PIR/PUR blocks
- **CORAFOAM® DUNAPIPE** low density PIR/PUR special items, factory-made and ready to install, as pipe sections, elbows, reducers, tees..
- **DUNAPOL® C** in-situ injection PUR systems
- **DUNAPOL® SPINPIPE** pouring PIR system and **DUNAPOL® S 050 RP** PIR spray system for pipe pre-insulation

PIPE SUPPORTS and THERMAL BREAKS

- **CORAFOAM® DUNAPIPE** high-density PIR/PUR ready-to-install pipe support inserts (in-house fabricated)
- **CORAFOAM®** high-density PIR/PUR thermal breaks
- **DUNAPOL® C** in-situ high density injection PUR systems

LAND STORAGE TANKS/CARGO TANKS

- **DUNAPOL® S** spray PUR systems
- **CORAFOAM®** low density PIR/PUR panels
- **DUNAPOL® C** in-situ low density injection PUR systems



INDUSTRIAL PLANTS SUPPORTED

LNG

ETHYLENE

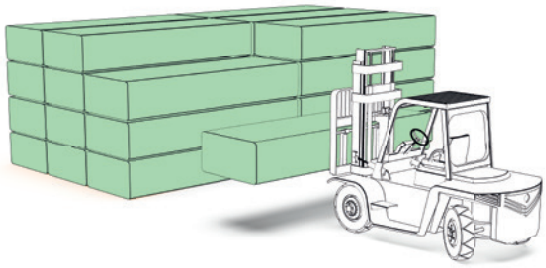
LPG

AMMONIA/FERTILIZERS

OTHER

Chilled Water, Technical Gases Liquefaction, Liquid Hydrogen

OUR SOLUTIONS



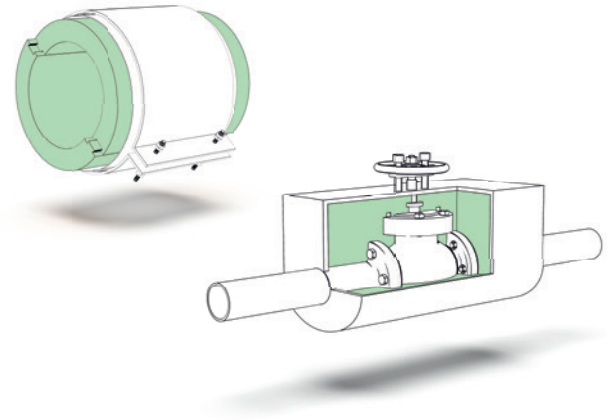
CORAFOAM®

PIR/PUR foams for cryo insulation

The **CORAFOAM®** line comprises of high-performance **PIR/PUR foams available in a wide range of densities** (PIR from 35 up to 320 kg/m^3 and PUR from 35 up to 600 kg/m^3), ensuring excellent **insulation performance, fire resistance and mechanical properties at extreme operating temperatures** ranging from -200°C/-328°F to +80°C/+ 176°F (PUR foams) and up to +120°C/+248°F (PIR foams).

PIR foams are recommended for all cryo applications where **highest fire resistance and maximum operating temperature range** are required.

CORAFOAM® foams are supplied in blocks, boards and tailor-made special parts (DUNAPIPE), fabricated through **5Axis CNC milling to meet customer's design needs**. Our pipes, flanges, valves, elbows, tees and reducers can be single or multilayered, butt-jointed or shiplapped, and, upon request, coated with DUNAPAP secondary vapour barrier film.



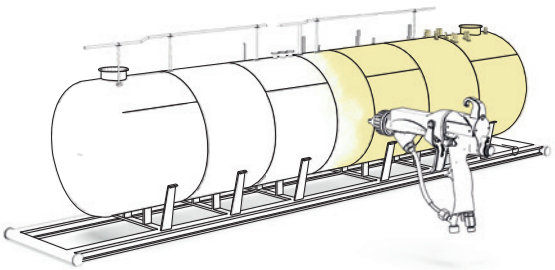
DUNAPOL® C

Insulating injection PU systems

Formulated liquid systems (polyol & isocyanate) for thermal insulation through on-site injection, available in **tailor-made formulations with different densities**, able to match the specific cryogenic/industrial requirements and client's needs.

While DUNAPOL® C high density systems are suitable for pipe supports' manufacturing, the low density formulations are recommended for insulating valves, flanges, pipes, tanks and other equipments.

All DUNAPOL® C systems ensure **maximum productivity, ease of application** (manually or automated - with 1:1 ratio by weight) **and low environmental impact** (HFO or water blown foams with ODP = 0 and GWP < 1).



DUNAPOL® S

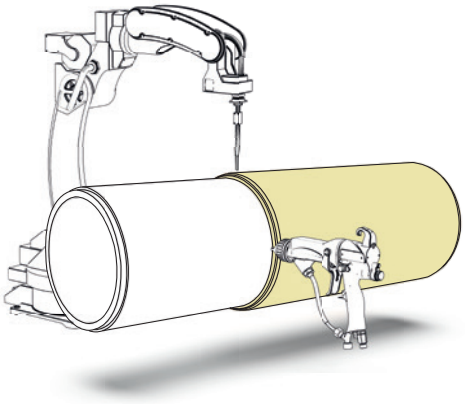
Spray PU systems for seamless insulation

Formulated spray PU systems **for tanks and naval insulation,** suitable for both offshore and onshore application. **Conceived for either horizontal and over-head application** to create seamless insulating layers of customized thicknesses on floors, walls, ceilings, tanks and curved or irregular surfaces.

DUNAPOL® SPINPIPE
DUNAPOL® S 050 RP

Unique pre-insulation PIR systems

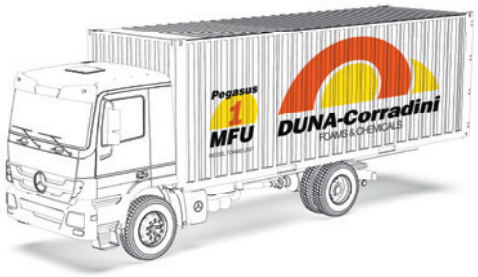
The first PIR systems for LNG pre-insulation able to create a seamless insulating layer by **pouring or spraying** on rotating pipes. The fast yet precise application process (before on-site pipe installation) guarantees full compliance to the strictest cryogenic specifications, maximum quality control under indoor conditions, high repeatability and operators' safety.



PEGASUS

Mobile Foaming Lines

The most customer-oriented solution by DUNA Group to support the largest cryogenic projects in faraway locations: these **complete foaming lines,** able to produce CORAFOAM® PIR foam blocks within the space of 4 containers, **can be shipped and transported on customer's site to produce large quantities of foam,** saving huge transport costs. DUNA technical Team takes care of the Unit installation and production process, assuring constant supervision and strict quality control.



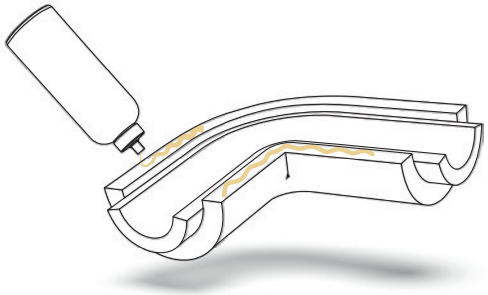
ANCILLARIES

FOR ASSEMBLING

DUNAPOL® AD

Cryo structural PU adhesives

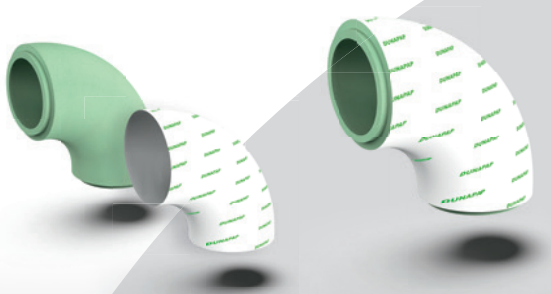
Solvent-free PU structural adhesives, one or bi-component, for industrial application at cryogenic temperatures, available in **customized formulations from thin liquids to thixotropic pastes.** Supplied in handy ready-to-use cartridge or larger steel cans, DUNAPOL® AD are suitable for bonding PIR, PUR, metals, wood, cellular glass and other LNG-grade materials.



DUNAPAP

Secondary vapour barrier film

LNG-grade secondary vapour barrier (12/25/12 µm Polyester-Aluminum-Polyester) **applied by DUNA on fabricated items to prevent water-vapour transmission** through the insulation layer, ensuring pipelines and plants' perfect insulation, long durability and maximum safety.



MANUFACTURING METHODS

RIGID FOAMS FOR PIPING AND PIPE SUPPORTS

CUTTING/MILLING – CORAFOAM®

CORAFOAM® PIR/PUR Foam blocks and CORAFOAM® DUNAPIPE are blown and milled/cut in DUNA plants

The DUNA-Group is specialised in the **in-continuous foaming production of PIR and PUR foams available in a wide range of densities and operating temperatures.** By the **CNC machining of** CORAFOAM® blocks, DUNA is able to provide **customized pre-formed items** meeting the customer design requirements in terms of shape, thicknesses and technical features. **Tailor-made ready-to-install parts** include pipe sections, elbows, tees, reducers, valves, flanges, thermal breaks, pipe supports, vessel heads for equipment; they can be supplied in **single or multiple layers, with or without shiplap (circumferential and longitudinal) and with pre-applied vapour barrier.** DUNA Special Item Design service is conceived to support clients in the most challenging projects and provide insulation layer of any required complex shape.

CORAFOAM®		NOMINAL DENSITY	OPERATING TEMPERATURE	ASTM C591 GRADE 2 TYPE					CINI	
		Kg/m³ *Lb/Ft³*	°C °F	I	II	III	IV	V	2.7.01	2.7.03
PIR	PB 35 M1 HC	35 *2.18*	-200/+120 *-328/+248*				•			
	PB 40 M1 HC	40 *2.49*	-200/+120 *-328/+248*		•					
	PB 45 M1 HC	45 *2.80*	-200/+120 *-328/+248*		•				•	
	PB 50 M1 HC	50 *3.12*	-200/+120 *-328/+248*			•			•	
	RTS 60	60 *3.75*	-200/+120 *-328/+248*					•		
	RTS 80	80 *5.00*	-200/+120 *-328/+248*					•		
	RTS 120	120 *7.50*	-200/+120 *-328/+248*						•	
	RTS 160	160 *9.98*	-200/+120 *-328/+248*							•
	RTS 240	240 *14.98*	-200/+120 *-328/+248*							•
	RTS 320	320 *19.97*	-200/+120 *-328/+248*							•
PUR	MD 100	100 *6.24*	-200/+80 *-328/+176*							
	MD 160	160 *9.98*	-200/+65 *-328/+149*							
	MD 200	200 *12.49*	-200/+65 *-328/+149*							
	MD 250	250 *15.60*	-200/+65 *-328/+149*							
	MD 300	300 *18.73*	-200/+65 *-328/+149*							
	MD 350	350 *21.85*	-200/+65 *-328/+149*							
	MD 400	400 *24.97*	-200/+65 *-328/+149*							
	MD 500	500 *31.21*	-200/+65 *-328/+149*							
	MD 600	600 *37.46*	-200/+65 *-328/+149*							

For further information about CORAFOAM® installation and technical recommendations, please scan the QRCODE or contact your DUNA commercial referent.

MANUFACTURING METHODS

RIGID FOAMS FOR PIPING AND PIPE SUPPORTS

INJECTION – DUNAPOL®C

DUNAPOL® C Systems enable autonomous production by injection molding technique on client's plant

The injection process enables the manufacturing of **largest single-part supports with customized shape, fast demoulding and good surface finishing.** DUNAPOL®C guarantees full compliance to strictest tolerances even with unheated molds. Regardless if manually or automated cast, DUNAPOL® enhances **productivity (fast demolding time), ease of application (1:1 ratio by weight) and efficiency (no material waste).**

- Resulting supports' operating temperature: -200°C/+100°C (-328°F/+212°F)
- Compressive strength ensures perfect insulation integrity under thermal stress CTSR >1,5
- Shelf life: 6 months.

The DUNA-Group has developed **3 high density PUR systems' families to meet the specific cryogenic needs** in terms of pipe-supports' sizes, thicknesses, manufacturing techniques and demolding time. Product selection must keep into consideration also client's available equipment, required density and thickness of support/number of layers.

PRODUCT RANGE	CREAM TIME	APPLIED DENSITY	THERMAL CONDUCTIVITY Initial (10°C/50°F) EN 12667 / ASTM C518	
	h min' s"	Kg/m³ *Lb/Ft³*	W/mK *BTU•in/hr•ft²•°F*	
DUNAPOL® C 160 R	12"± 2"	175 *10,9*	0,031 *0,21*	FAST
DUNAPOL® C 224 R	12"± 2"	240 *14,9*	0,038 *0,26*	FAST
DUNAPOL® C 320 R	12"± 2"	350 *21,8*	0,048 *0,33*	FAST
DUNAPOL® C 160	40"± 5	180 *11,2*	0,031 *0,21*	MEDIUM
DUNAPOL® C 224	30"± 5	240 *14,9*	0,038 *0,26*	MEDIUM
DUNAPOL® C 320	30"± 5	350 *21,8*	0,048 *0,33*	MEDIUM
DUNAPOL® C 160 L	1'10"± 5"	180 *11,2*	0,032 *0,22*	SLOW
DUNAPOL® C 224 L	1'10"± 5"	260 *16,2*	0,039 *0,27*	SLOW
DUNAPOL® C 320 L	1'10"± 5"	360 *22,4*	0,049 *0,34*	SLOW

PRODUCT FAMILIES PER DEMOLDING TIME

20' FAST

- **Molding thickness 40 - 80 mm (1,6" - 3,2").**
- Injection of low thickness, multi layered supports to avoid radially-propagated cracks induced by stress from cryogenic thermal gradients
- Excellent flow rate within narrow molds

60' MEDIUM

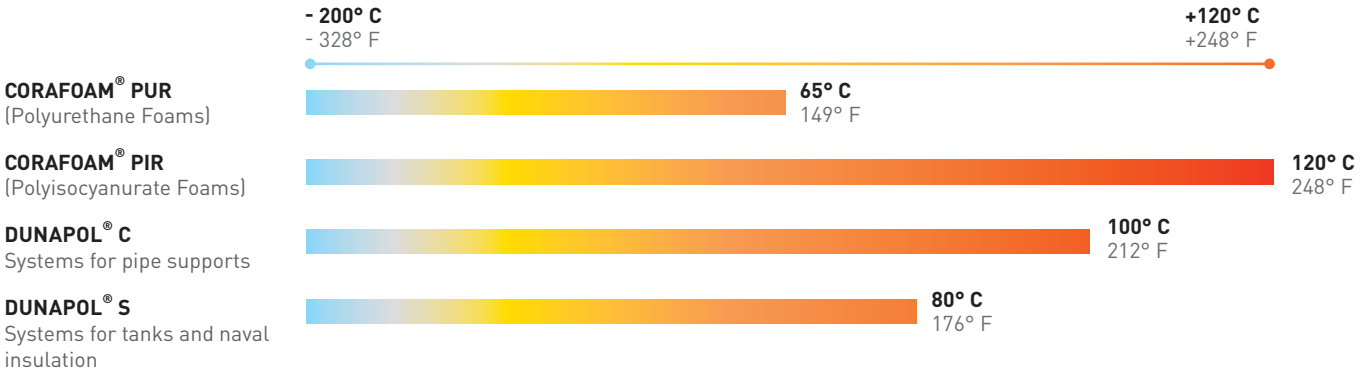
- **Molding thickness 80 - 150 mm (3,2" - 6")**
- Injection of medium-thickness, monolithic supports
- Moderate cream-time to allow longer pouring operations

180' SLOW

- **Molding thickness 150 - 200 mm (6" - 7,9").**
- Injection of large-size, high-thickness monolithic supports
- The long cream-time allows singleshot injection through manual process or by metering machine
- Customized higher density systems (up to 500 kg/m³ - 31,2 Lb/ft³) also available

For further information about Injection Application, please contact your DUNA commercial referent or visit www.dunagroup.com/contact.

OPERATING TEMPERATURES



DUNAPOL® AD

BONDING SOLUTIONS

High performance structural PU adhesives able to **withstand cryogenic temperatures (down to -165°C/-265°F) and accommodate materials' contractions** thanks to their flexibility.

Suitable for bonding various materials (PIR, PUR, metals, phenolic, fiberglass laminates, mineral wools, cellular glass, wood, ceramics...) and recommended for assembling cryogenic system components such as PIR layers, pipe section joints, supports cradle etc...

DUNAPOL® AD range includes one and bi-component solutions with **different density, viscosity and reaction times.**

ONE COMPONENT ADHESIVES

- Ready-to-use and easy to apply
- Same mechanical performance of bi-component solutions

BI-COMPONENT ADHESIVES

- Requiring mixing - able to complete the reaction/ perform in any environmental conditions.
- Available in practical cartridges and convenient larger-size packagings

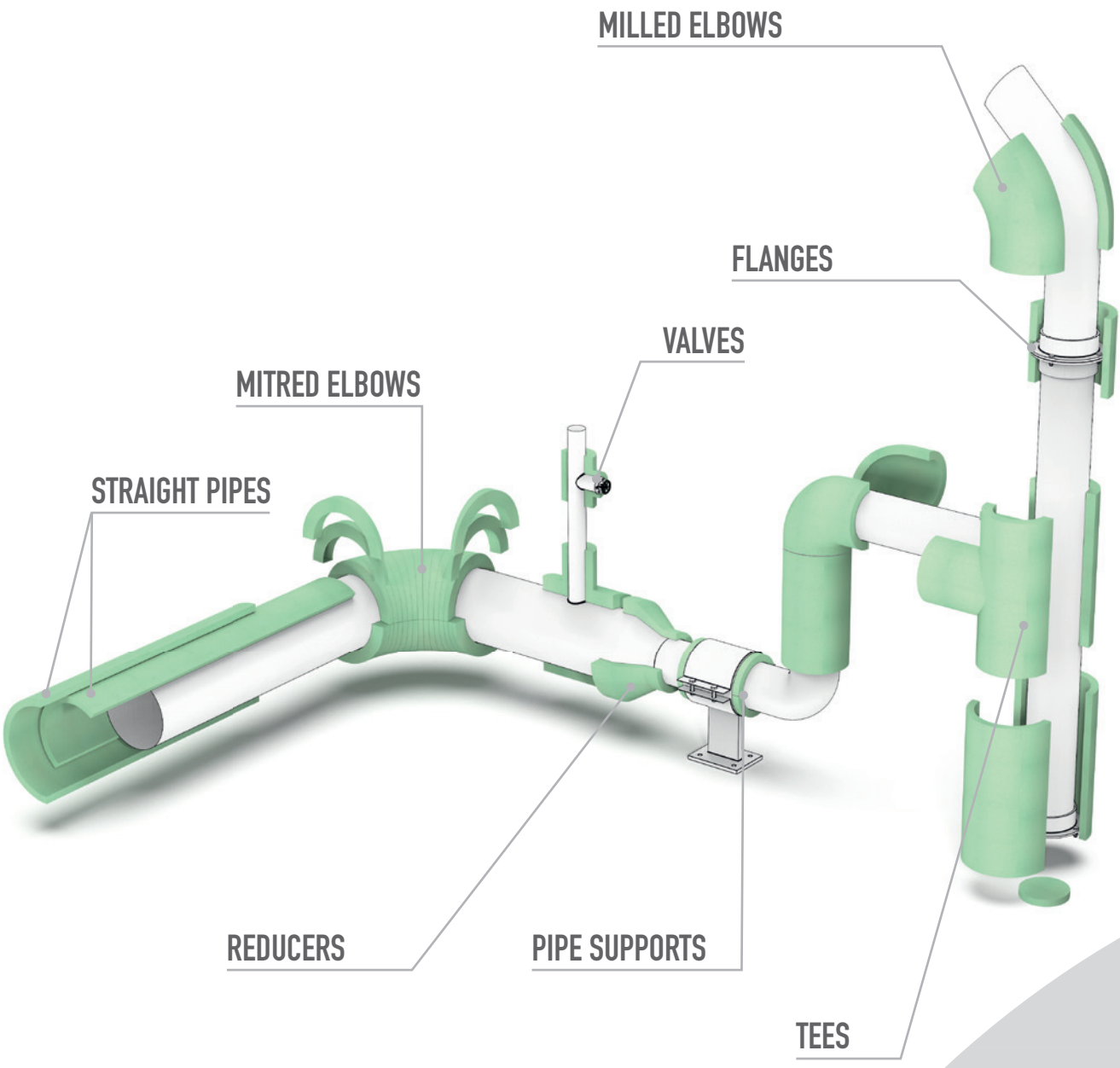
PRODUCT	TYPE	DENSITY ASTM D891	OPERATING TEMPERATURE	VISCOSITY ASTM D2196	OPEN TIME
	one vs bi-component	g/ml	°C *°F*	(25°C/77°F)	(25°C/*77°F*) h min' s''
DUNAPOL® AD 3290 V5 MCP	one component	1,09	-200/+80 *-328/+176*	15000 150	18'-22'
DUNAPOL® AD 1575 M	bi-component	1,42-1,48	-200/+93 *-328/+199*	Thixotropic	1h40'-2h10'
DUNAPOL® AD 1575 MV2	bi-component	1,42-1,48	-200/+93 *-328/+199*	Thixotropic	11'-13'

For further information about Adhesives' application, please contact your DUNA commercial referent or visit www.dunagroup.com/contact.

INSULATING SOLUTIONS WITH DUNA PRODUCTS

PREFORMED SPECIAL ITEMS

All special items supplied by DUNA guarantee the best insulating performance in the most challenging cryogenic conditions and support the most complex piping line design.

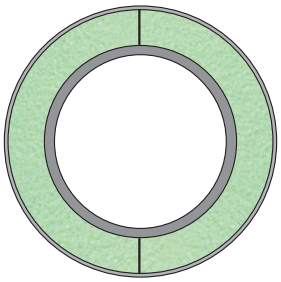


STRAIGHT PIPES

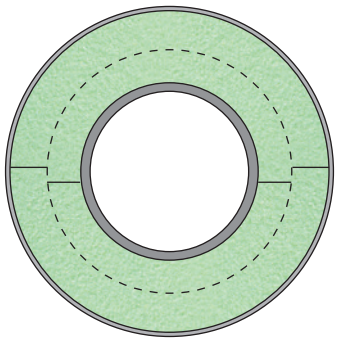
All pieces can be single or multilayered, butt jointed or circumferentially and/or longitudinally shiplapped.
All multilayered pipes must be staggered.

SINGLE LAYER

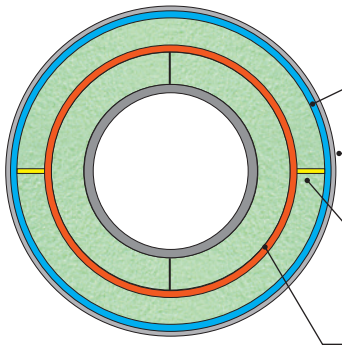
Butt jointed



Longitudinally and circumferentially shiplapped



DOUBLE LAYER



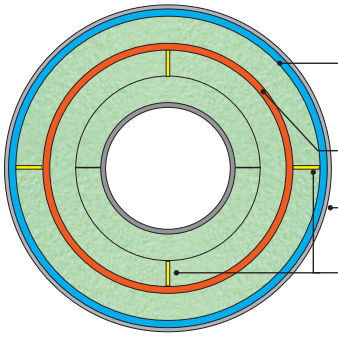
PRIMARY VAPOUR BARRIER

JACKETING

JOINT SEALANT

DUNAPAP SECONDARY VAPOUR BARRIER

TRIPLE LAYER



PRIMARY VAPOUR BARRIER

DUNAPAP SECONDARY VAPOUR BARRIER

JACKETING

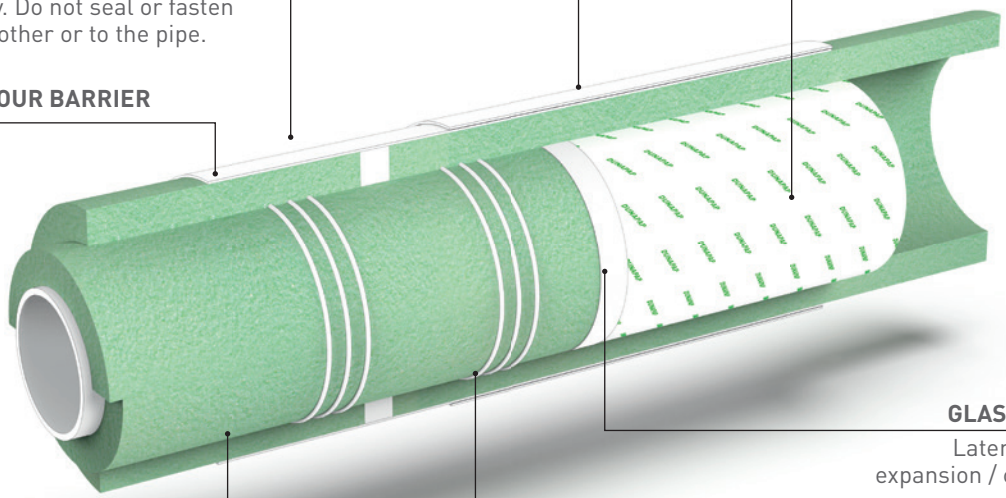
JOINT SEALANT

OUTER LAYER
Stagger butt joints to inner layer.
Seal joints only. Do not seal or fasten layers to each other or to the pipe.

PRIMARY VAPOUR BARRIER

JACKETING

DUNAPAP SECONDARY VAPOUR BARRIER



GLASS FIBER FILLER
Laterally compressed expansion / contraction joint.

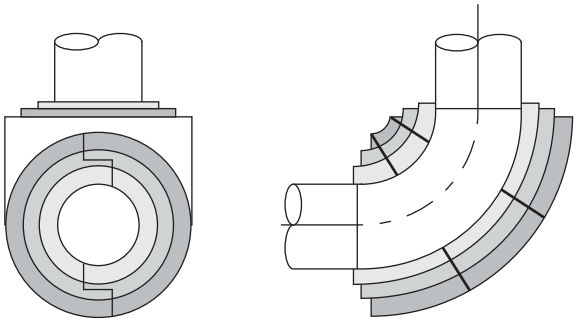
INNER LAYER
Staggered butt joints.

VAPOUR STOPS
Three beads of sealant on each side of the contraction joint.

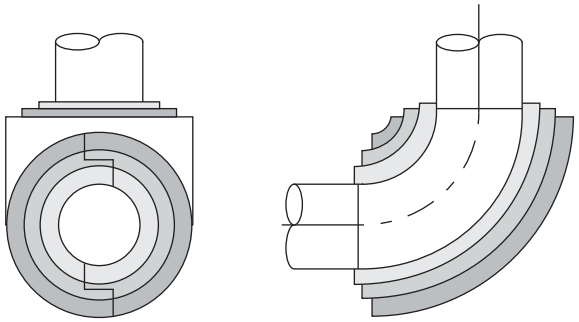
ELBOWS

All pieces can be single or multilayered, butt jointed or circumferentially and/ or longitudinally shiplapped.

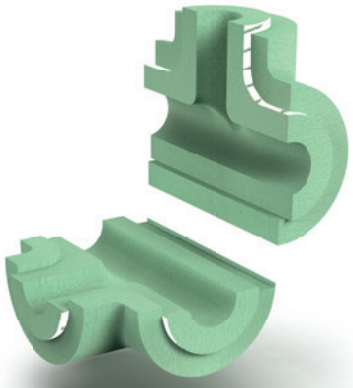
MITRED ELBOW



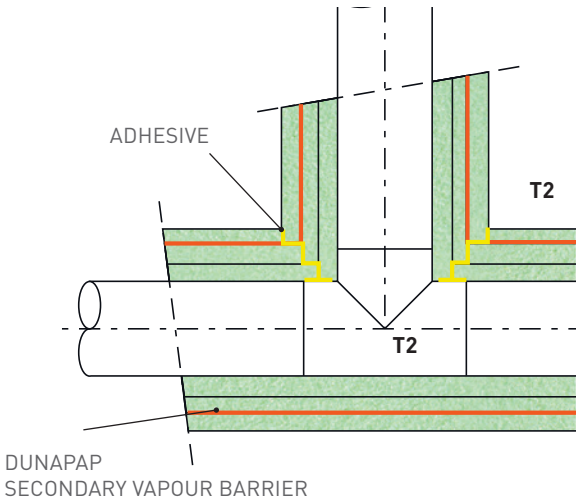
MILLED ELBOW



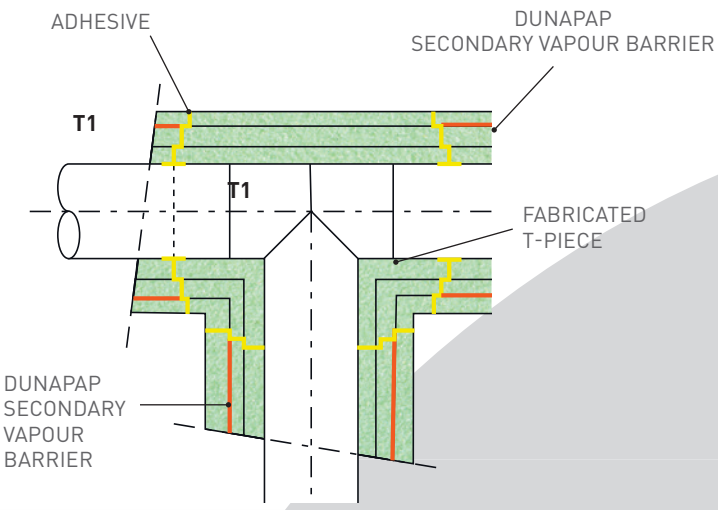
TEES



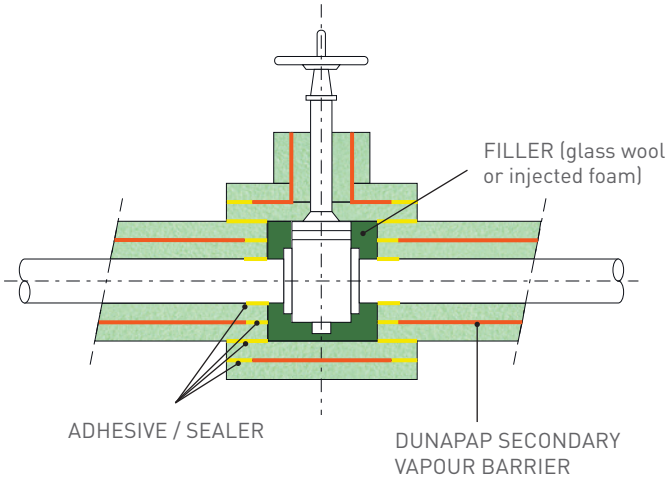
ASSEMBLED



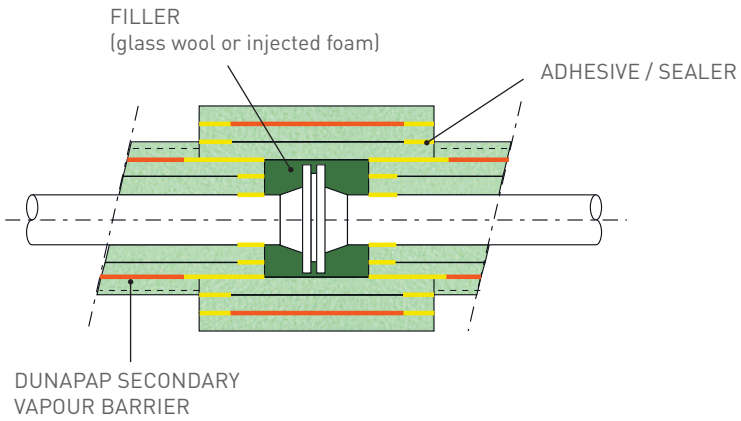
FABRICATED in customised shapes & sizes



VALVES

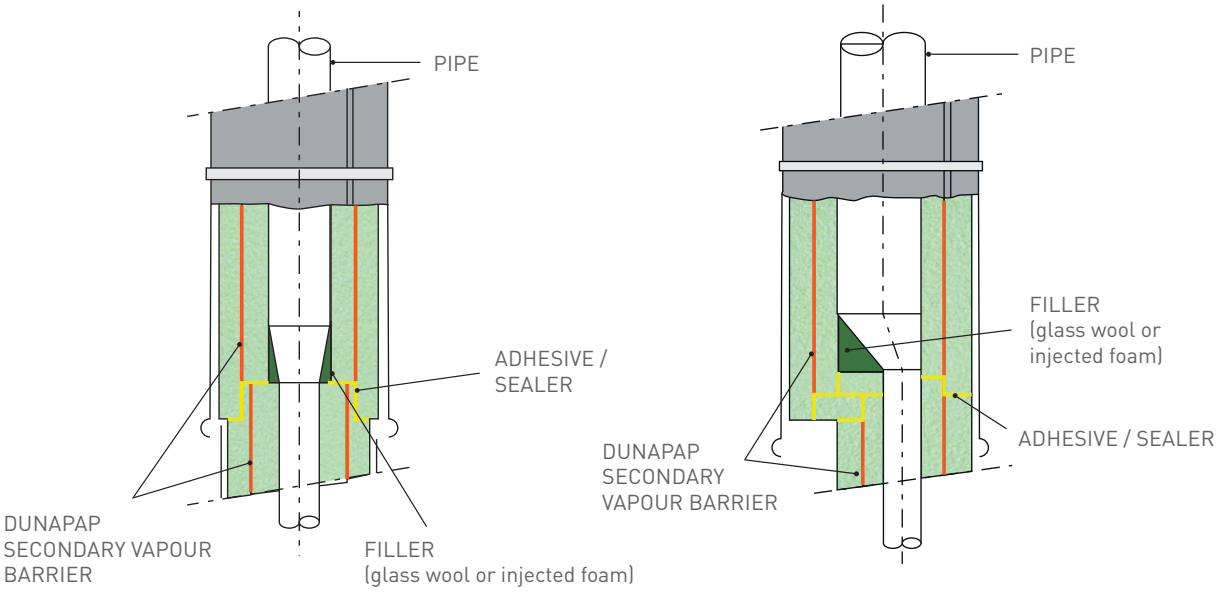


FLANGES

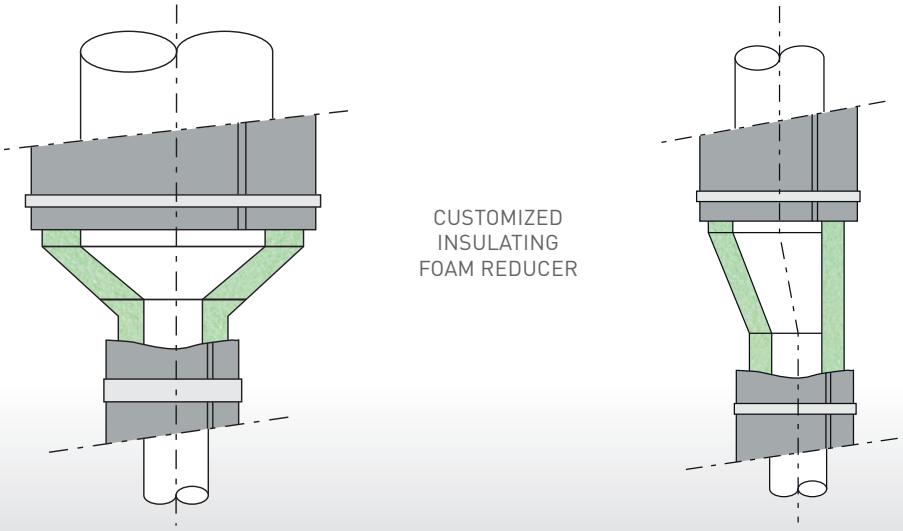


REDUCERS

STANDARD REDUCER - CONCENTRIC OR ECCENTRIC SHAPE



CUSTOMIZED REDUCERS – CONCENTRIC OR ECCENTRIC SHAPE

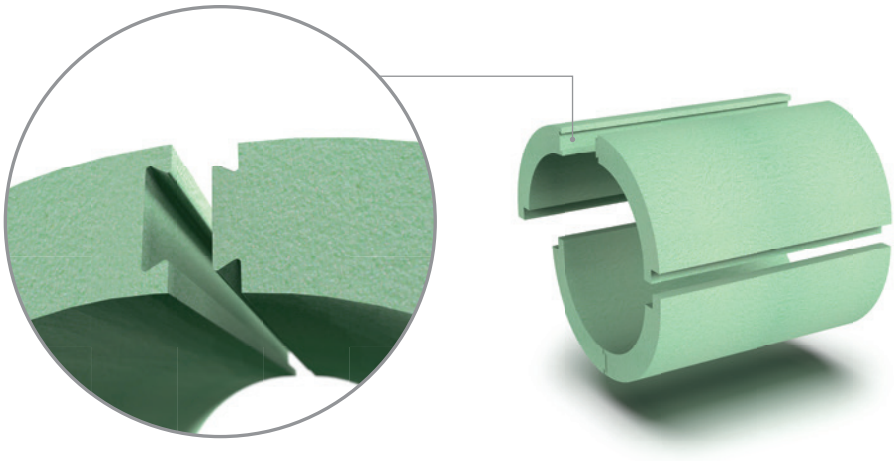


HIGH DENSITY SPECIAL ITEMS

FOR PIPE SUPPORTS INSULATION

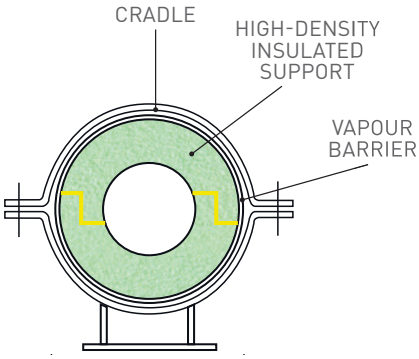
DOVE-TAIL

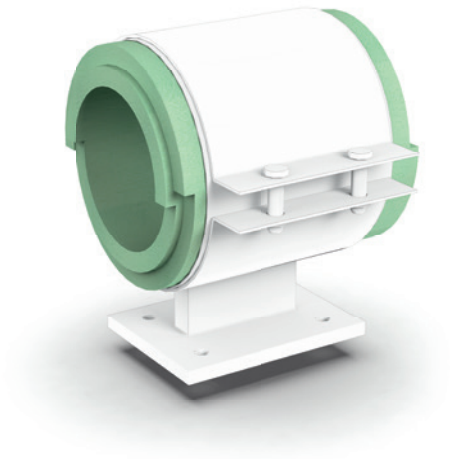
Large size supports are manufactured in multiple circumferential segments with dove-tail joints, bonded with cryogenic adhesive. These insulating systems ensure equivalent mechanical performances compared to single piece supports.



INSULATED SUPPORTS

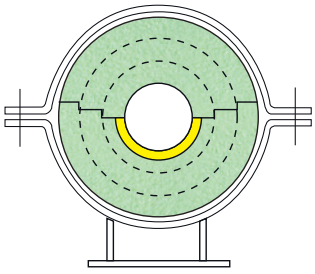
High Density CORAFOAM® RTS and CORAFOAM® MD lines by DUNA combine high insulating properties with mechanical performance, ensuring a stable and effective insulation for cryogenic pipe supports.

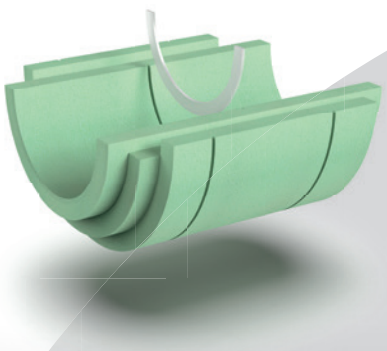




SLOTS

Tailor-made high-density supports can be grooved to accomodate any slots in the metallic cradle.





Cryogenic Solutions by DUNA-Group – 20230730

All values shown in this leaflet are determined from laboratory tests and obtained under controlled conditions; they outline typical characteristics and do not constitute in any way a sales specification. They are based on DUNA-Group's current knowledge and experience of the products when properly stored, handled and applied in accordance with the recommendations in the Safety Data Sheet (SDS) or the Product Safe Use Information Sheet. It is also the customer's responsibility to ensure that handling, storage and disposal are carried out in accordance with applicable laws and to ensure that application methods, personal protective equipment (PPE) and workstations are suitable and compliant with applicable regulations.

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DUNA-Corradini FOAMS & CHEMICALS
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DUNA CORRADINI S.p.A.
Via Modena-Carpi (S.P. 413), 388
41019 Soliera (Modena) / Italia

t: +39 059 893 911
f: +39 059 565 403
info@dunagroup.com

C.F./P.IVA IT01803960366
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