Aquaduct Insulation System

Thermal Insulation for Sub-Sea Pipelines

ROCKWOOL®
FIRESAFE INSULATION
MARINE & OFFSHORE

Courtesy of Technip

Aquaduct - Thermal Insulation solutions for Sub-Sea Pipelines

Certificate No FM 02262

Certificate No EMS 70301

A1

ZERO ODP
OZONE DEPLETING POTENTIAL

ZERO GWP
GLOBAL WARMING POTENTIAL

ROCKWOOL's unique product properties of fire resistance, excellent thermal performance, outstanding sound reduction qualities, as well as high water repellency capabilities, which have been utilised within the Marine & Offshore market sectors for many years, are now also available for the insulation of Sub Sea pipelines.

ROCKWOOL Marine & Offshore is a division of the Rockwool Group, the world's largest producer of stone wool. ROCKWOOL products have for many years been used in the industrial and process markets worldwide and we have also been closely involved with the offshore and oil processing industries during that time.

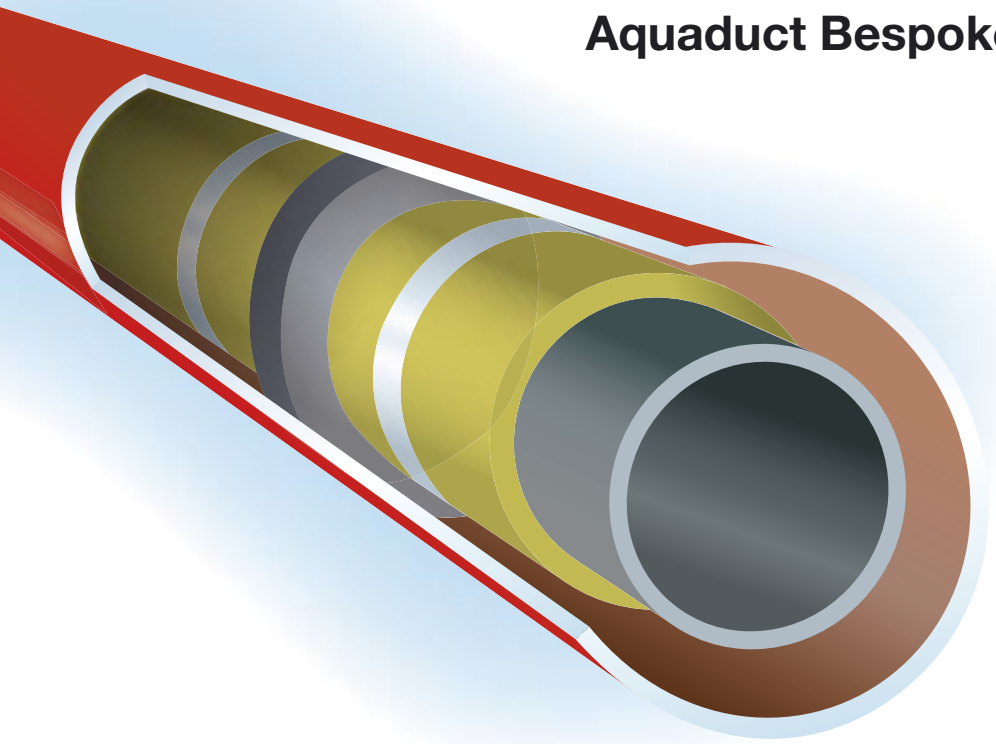
As a result of the ever increasing demand for oil on a worldwide basis and the need for more efficient development of the world's oil reserves, developers are today operating in deeper water. Inevitably this results in discoveries being of higher temperature. It is precisely here that ROCKWOOL's capability to offer combined resistance to high temperature and excellent thermal performance comes into its own.

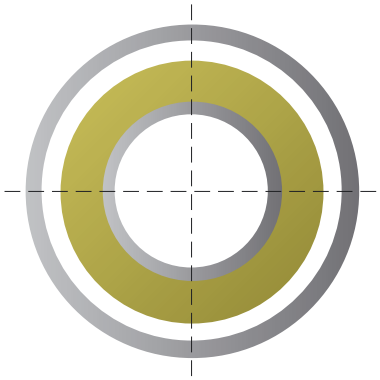
The Aquaduct range of systems has already been used successfully for several years in Sub Sea projects worldwide. We offer specific solutions to meet specific conditions and project demands.

Advantages

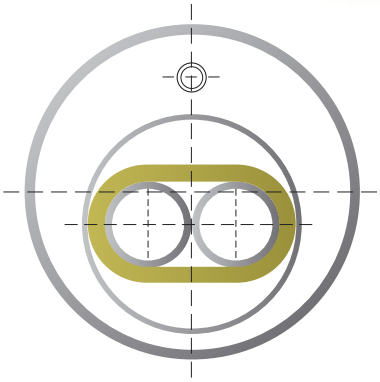
- Resistant to high temperature
- Resilient; good recovery following deformation
- Unaffected by welding of field joints
- Free from HFCs and other blowing gases
- Reliable performance; thermal conductivity cannot degrade due to loss of entrapped gas
- Easy to handle and install
- Rockwool Insulation is recyclable and its life cycle analysis proves that it contributes actively to improve the environment.

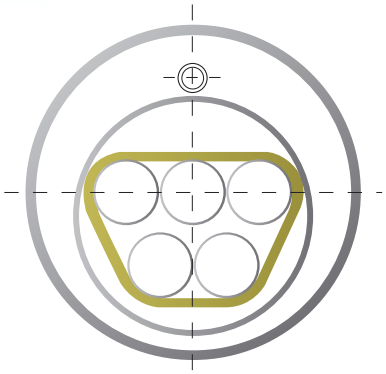
Aquaduct Bespoke Solutions

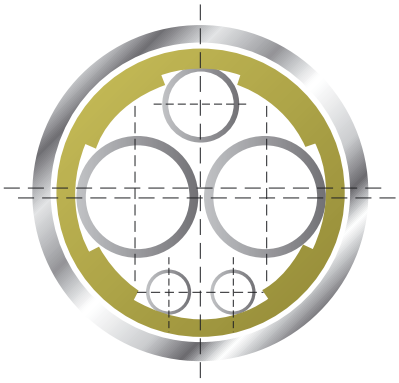




Traditional solution; Aquaduct CL used for Pipe in Pipe.







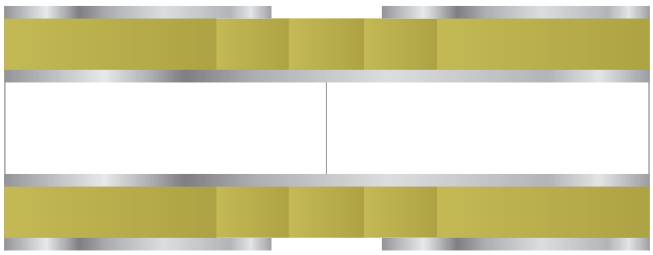
Due to the flexibility of the range of Aquaduct Solutions, we have the capability to offer specific solutions to meet specific demands, regardless of the complexity of Pipe Bundle configurations.

These are some examples of the solutions that we have previously offered.

Field Joint Applications

Rockwool Aquaduct systems can be used to complete field joints when the insulation material specified will not accept welding or when this type of construction is required.

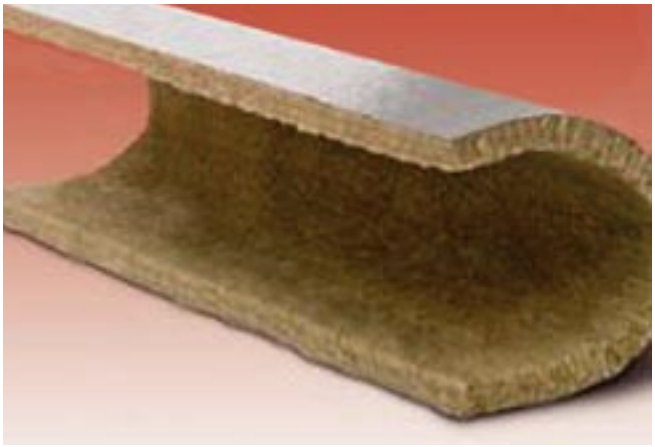
The pipe insulation is ''cut back'' typically 600mm. The outer carrier pipe has a 250mm (typ) gap to allow welding of inner process pipe.



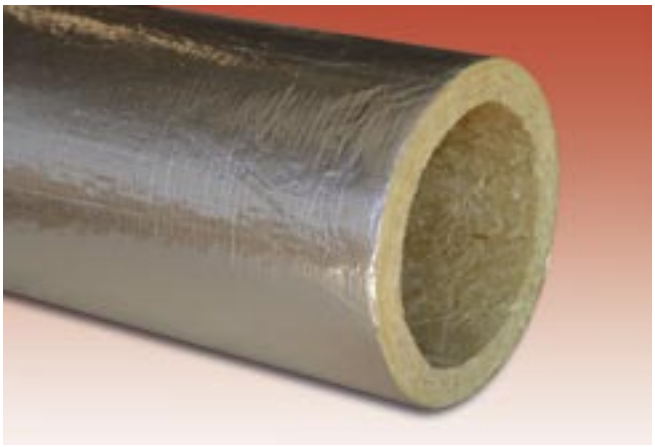
The gap is filled with 3 pieces of Aquaduct stepwise. The carrier pipe is bridged and welded.

Product Range

Aquaduct Insulation system incorporate a number of different Rockwool products which can be tailor made for the individual project and purpose. Some of the products are described below:



Aquaduct CL are special patented Rockwool products where the vertical direction of the fibres provides an excellent compression resistance at low thicknesses (down to 10 mm thickness). The fibres are bonded to a reinforced aluminium foil outer facing and the product can be supplied with very low tolerances. In most cases Aquaduct CL will be the optimal choice for Pipe in Pipe solutions.



Aquaduct Sections are rigid pre-formed circular units of Rockwool insulation supplied with or without an outer covering. Aquaduct is available in almost any combination of diameter, thickness and length and can be adapted to individual needs and specifications. Aquaduct Sections is the optimal choice for bigger sizes of pipe.

Aquaduct PSM is a rigid Rockwool slab having a glass scrim or reinforced aluminium foil facing bonded to one side and triangular grooves in the other. The grooves allow the slab to wrap around and closely fit specified large diametres.

Aquaduct Bevelled Lags are trapezoidal strips of Rockwool rigid slab designed to contour specified large diametres. The lags can be supplied loose or bonded to a reinforced foil or metal outer sheet.

The use of Aquaduct Bevelled Lags offers the designer the facility to incorporate inset strips of varying thicknesses.

Aquaduct Loose Fill is a specially graded, granular insulation designed to in-fill around pipe bundles and to fully fill irregular voids. Aquaduct Loose Fill can be installed at a wide range of densities, either by hand packing or by use of specially designed blowing equipment.

Technical information

Unrivalled Performance and Flexibility

Rockwool Aquaduct Insulation Systems are manufactured to meet the most stringent requirements of today's sub-sea pipeline designer. Rockwool Aquaduct Insulation Systems utilise Rockwool mineral wool insulation to provide the pipeline designer with an unrivalled combination of high performance and flexibility of design.

Fire Performance

Rockwool Aquaduct Insulation Products are rated non combustible in accordance with ISO 1182.

Temperature Range

Depending upon constructional details, Rockwool Aquaduct Insulation Products can be used at temperatures up to 600°C. Max. temperature for alu foil 80°C.

Thermal Conductivity

Aquaduct Sections - 0.033W/mK
Aquaduct PSM - 0.033W/mK
Aquaduct Bevelled Lags - 0.033W/mK
Aquaduct Loose fill* - 0.038W/mK

*Mean product temperature: 10°C * Installed density 45 kg/m³*

Lambda Values of Aquaduct CL 9 (mW/mK)

Insulation Thickness	Pipe O.D.	Mean Temperature (°C)						
		20	30	40	50	60	70	75
10 mm	219	32.4	33.6	34.8	36.0	37.2	38.4	39.0
	89	33.7	35.3	37.0	38.7	40.3	42.0	42.8
40 mm	219	42.6	42.9	43.3	44.0	44.8	45.9	46.5
	89	39.0	39.4	41.6	42.7	44.9		46.6

Lambda Values of Aquaduct CL 12 (mW/mK)

Insulation Thickness	Pipe O.D.	Mean Temperature (°C)						
		20	30	40	50	60	70	75
10 mm	89	35,3	37,0	38,6	40,2	41,8	43,4	44,2
40 mm	219	43,7	44,4	45,1	45,8	46,6		47,6

The material tested was faced with white aluminium foil.

Lambda Values of Aquaduct Sections, PSM and Bevelled Lags (mW/mK)

Mean Temperatures (°C)						
20	30	40	50	60	70	75
33.9	35.0	36.1	37.2	38.4	39.7	40.3

Compressive Strength

Aquaduct pre-formed products offer a unique combination of high resistance to compression and good recovery following deformation.

Indicative Compression Resistance of Aquaduct CL Products

Product	σ_m min	σ_m ave
Aquaduct CL9	40 kPa	50 kPa
Aquaduct CL12	60 kPa	75 kPa

Note: all testing carried out on flat panels

Chemical Properties

pH 7 or slightly alkaline – Halide free, chloride less than 10 ppm.

Minimum Pipe O.D. for Aquaduct CL Products

Due to Aquaduct CL products special characteristic the products have som minor limitations in respect to minimum pipe O.D.
The limitations are illustrated by the table below. For smaller pipe OD's we recommend the use of Aquaduct Sections.

Thickness (mm)	Minimum Pipe O.D. (mm)
10	114
20	169
30	356
40	406

Wetted Rockwool Insulation

1. The Effects of Water

It is generally accepted that insulation materials (regardless of type) should not be wet when applied, or be applied to surfaces that are themselves wet.

Furthermore, water should not be allowed to enter the insulation system subsequent to installation. The presence of water can cause corrosion of metallic surfaces and can reduce the thermal effectiveness of the insulation.

We, therefore, recommend that Rockwool Insulation Products are applied in a dry state to surfaces which are clean, dry and free from grease, dirt, loose rust and scale and are weather protected when used in external applications (reference paragraphs 23.1 and 27 of BS5970:1992).

2. Water Repellency

Water is unlikely to penetrate to a depth greater than a few mm into the body of Rockwool Insulation unless the product is held in water and the air forced out. Subsequent to total immersion testing in accordance with BS2972, Rockwool products will typically absorb less than 2% water by volume.

3. Drying Out of Wet Rockwool

Rockwool Insulation Products should recover their original properties once fully dried, dependent upon:

(i) Not having been significantly compressed or otherwise damaged whilst wet.

(ii) Not having been contaminated or degraded by harmful chemicals borne by the water.

Drying out is, of course, dependent upon the prevailing environmental conditions and the free venting of any subsequent water vapour build up. It is, therefore, not possible to quantify or guarantee this process.

4. Storage

Rockwool products are supplied shrink-wrapped in polyethylene, which provides short-term protection. For long-term purposes, Rockwool Insulation should be stored safely indoors.

If stored outside, Rockwool Insulation should be stacked clear of the ground and covered with a securely anchored weatherproof sheet. Rockwool products should not be left exposed to the weather.

Welding –
Effects on Rockwool Insulation

1. Introduction

Bench tests were carried out to determine the likely effects on Rockwool Insulation of welding in close proximity.

2. Test Conditions

Test date: 2nd February 1996.
Rockwool Insulation test sample: 406 × 90 mm thick Rockwool Aquaduct Section flattened to provide a plane surface. Two 200 mm × 100 mm × 5 mm mild steel plates edge prepared for welding and butt jointed. The gap between the plates was 0 mm at one end and approximately 5 mm at the other.

A MIG welder was used to join the two plates together.

3. Results

Where the gap was small (up to approximately 1 mm wide) no appreciable effect was apparent on the Rockwool surface other than a slight, localised darkening in colour.

As the gap increased (notably in the region of 2 to 5 mm wide) a thin black line was apparent on the Rockwool surface where shrinkage had occurred. This localised line of shrinkage was between 2 and 5 mm deep.

4. Conclusions

It has clearly been shown that Rockwool Insulation behaves satisfactorily in close proximity to welding activity. However, it should be noted that the above bench tests are not representative of all weld conditions.

Environment

Rockwool Insulation Products are, and always have been, free from gases that are harmful to the environment, such as CFCs, HCFCs, HFCs, pentane or any gases that have Ozone Depletion Potential (ODP) or Global Warming Potential (GWP).

Health and safety

Current HSE 'CHIP' Regulations and EU directive 97/69/EC confirm the safety of Rockwool mineral wool; Rockwool fibres are not classified as a possible human carcinogen. The maximum exposure limit for mineral wool is 5 mg/m^3, 8 hour time-weighted average.

A Material Safety Data Sheet is available from the Rockwool Marine & Offshore Services Department to assist in the preparation of risk assessments, as required by the Control of Substances Hazardous to Health Regulations (COSHH).

Technical Helpline

Technical advice relating to the Aquaduct range is available from the Rockwool Technical Service Department.

Aquaduct Insulation System references

Aquaduct Insulation Systems have over the past years already been used in several projects world wide. Below you will find some of the projects:

Client	Projekt	Product	Size	Year	Location
British Gas	Blake	Aquaduct Sections	250 field joints	1999	-
Statoil	Gulfaks	Aquaduct PSM	13,6 km	2000	Subsea North Sea Norwegian Sector
Shell	Penguin	Aquaduct PSM	5,500 field joints	2002	Subsea North Sea UK Sector
CNR International	Baobab	Aquaduct Sections	14 km	2004	Subsea Offshore Ivory Coast
Shell	Howe	Aquaduct CL 12	13 km	2004	Subsea North Sea UK Sector
Talisman	Wage	Aquaduct CL 9	5,5 km	2006	Subsea North Sea UK Sector

For further information please visit our website www.rockwool-marine.com or contact our local Rockwool companies.

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