FyreWrap®

Marine & Offshore Fire Divisions

Bulkhead & Deck Systems

ALKEGEN

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Marine & Offshore Fire Divisions

Fire Protection Solution

FyreWrap®

1 Introduction

Alkegen manufactures a wide range of high temperature insulating materials especially suited for use in marine and offshore passive fire protection installations. These products and their variants are parts of our FyreWrap® brand. For more than 30 years, FyreWrap materials have provided lightweight fire insulation for structures exposed to both cellulosic and hydrocarbon fires in cruise ships, yachts, high-speed ferries, military defence vessels and offshore platforms. This manual also presents our new, improved, systems based on our FyreWrap LT blanket.

FyreWrap Blanket products offer the following outstanding characteristics:

- Non-combustible (tested and certificated)
- High insulation performance
- High melting temperature
- Simple installation techniques providing easy application
- Lower weight designs, reducing contribution to structures
- Combined fire, thermal and acoustic insulation

FyreWrap Blankets are typically manufactured from a high temperature Alkaline Earth Silicate (AES) wool that incorporate fibres with low bio-persistence and hence are exonerated from any carcinogen classification. They are based on a calcium-magnesiumsilica chemistry, giving excellent thermal and physical stability, melting above 1330°C.

These blankets are also available in a water repellent form, especially suited for fire protection in offshore and other high humidity environments.

Supplied in rolls of 610mm or 1220mm width, the length of these blanket rolls depends upon their thickness (see table below):

Thickness	25mm	35mm	38mm	40mm	45mm	50mm	55mm	60mm
Length	7.32m	5.0m	5.0m	5.0m	5.0m	3.66m	3.66m	3.66m

The above thicknesses are available in a variety of densities. The thickness and density used depends upon the required fire resistance rating and application (see individual system details). Full technical, acoustic and health & safety data are available on request.

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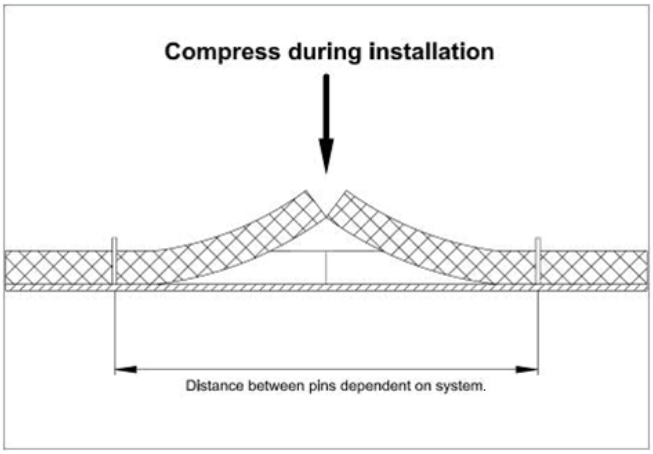
2. Installation

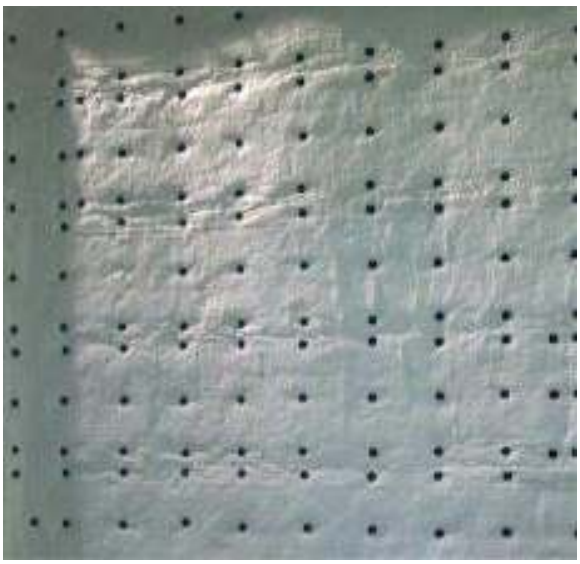
2.1 General Principles

The system installed should be in accordance with the design of the test panel detailed in the appropriate system drawing.



FyreWrap Blanket is typically held in place by 3mm diameter pins over which the blanket is impaled and retained by 30 or 38mm diameter spring washers.

In most cases the blanket strips are butt jointed and compressed during the installation process from the standard 610mm roll width to 600mm (or 580mm), as shown in the sketch below. For details see the individual system summaries.



To achieve this, the anchor pattern is designed to introduce an overlap. The blanket strips are impaled symmetrically over the pins and thus overlap the neighbouring strip. The two adjacent strips at the overlap are pulled outwards together, aligned centrally and then pushed back into position forming a neat and compressed butt joint.

In multiple layer systems successive layers, the joints in each layer must be offset by approximately 300mm, thus maximising the thermal integrity by avoiding coincident joints.

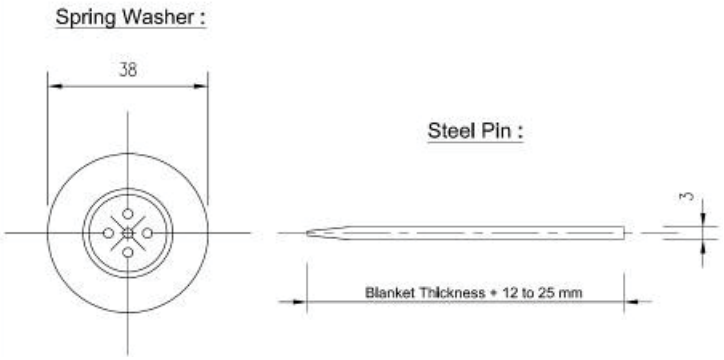
For structural members supporting the bulkhead/deck or where penetrations pass through, it is usually recommended that the FyreWrap Blanket is continued along the member/penetration for a distance of 450mm.

Where the bulkhead/deck connects with another division of a lower fire rating then the higher rated lining should be continued for 450mm along the length of the lower rated division.

2. Installation (Continued)

2.2 Anchors

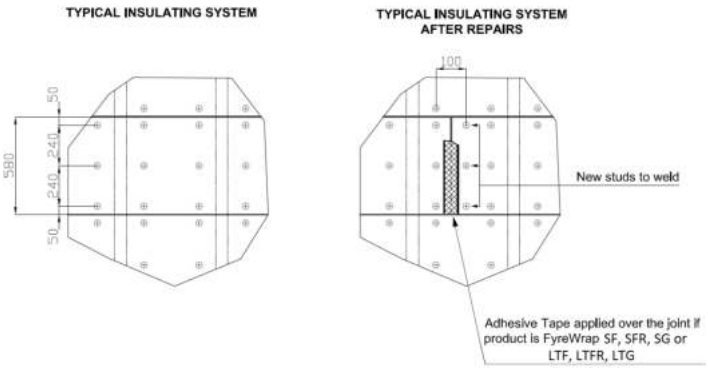
Typical systems for steel bulkheads and decks use mild steel copper plated CD fixing pins, 3mm diameter, with a length equal to the total insulation thickness plus 5—25mm. These are welded to the bulkhead or deck with a standard capacitive discharge welding system. The retaining asher is a zinc coated spring washer. In the case of aluminium bulkheads and decks, a similar pin and washer system is used, except in this instance, the mild steel fixing pins are supplied with an aluminium boss or ferrule which is welded to the aluminium bulkhead or deck. This is known as a bi-metallic anchor system. In areas of high vibration threaded fixing pins with a washer and lock nut are recommended. Please note: it is the responsibility of those undertaking the work to ensure compatibility of the metals used.



2.3 System Repair and Maintenance

Where repairs are necessary the following procedure is to be followed:

- Cut the blanket plus any protective coating or foil, with a sharp knife at a distance of 60mm from a line of studs and remove the insulation which needs to be replaced.
- Weld a line of new studs parallel to, and 100mm away from, the original line, adjacent to the edge of the remaining blanket.
- Install new blanket of the same specification as originally used. The new blanket should overlap that remaining by 10mm.
- Compress the joints as described on page 5.
- Finish the joint with a self adhesive aluminium tape, glass cloth tape or coating, as appropriate.



3. Surface Coverings

Choice Of Surface Coverings

When the insulation is used in areas exposed to weather or potential physical damage, protective methods should be adopted, the following are typical examples:

Aluminium Foil

Helps limit condensation ingress and offers some surface protection. Unifrax recommends that the aluminium foil is supplied pre-bonded to the FyreWrap Blanket and recommends the use of FyreWrap SF (LTF) Blanket or FyreWrap SFR (LTFR) Blanket (glass fibre reinforced aluminium foil backed blanket). 30µm aluminium foil is used as standard; other thicknesses can be supplied upon request. Joint edges should be sealed with self-adhesive aluminium foil tape 70mm to 100mm in width.

Non-combustibility is maintained in SF (LTF) and SFR (LTFR) products.

Glass Cloth

If increased mechanical protection is required, Unifrax recommends the use of FyreWrap SG (LTG) Blanket. This product has a glass cloth pre-bonded to the blanket. Joint edges should be sealed with selfadhesive glass cloth tape 70mm to 100mm in width.

Non-combustibility is maintained in SG (LTG) products.

Weather Protection Or Cladding

In external areas proprietary water and fire resistant coatings can be applied.

4. System Summary Tables

4.1 A-Class Steel

Application	Rating	Product	System	Weight on flat plate	Weight around stiffeners
Deck	A60	FyreWrap Blanket	25mm x 64kg/m³	1.60 kg/m²	1.60 kg/m²
Deck	A60	FyreWrap Blanket	38mm x 96kg/m³	3.65 kg/m²	3.65 kg/m²
Deck	A15	FyreWrap LT Blanket	15mm x 64kg/m³	0.96 kg/m²	0.96 kg/m²
Deck	A30	FyreWrap LT Blanket	25mm x 64kg/m³	1.60 kg/m²	1.60 kg/m²
Deck	A60	FyreWrap LT Blanket	45mm x 64kg/m³	2.88 kg/m²	2.88 kg/m²
Deck	A60	FyreWrap LT Blanket	50mm x 48kg/m³	2.40 kg/m²	2.40 kg/m²
Bulkhead restricted	A30	FyreWrap Blanket	25mm x 64kg/m³	1.60 kg/m²	1.60 kg/m²
Bulkhead restricted	A60	FyreWrap Blanket	38mm x 96kg/m³	3.65 kg/m²	3.65 kg/m²
Bulkhead	A60	FyreWrap Blanket	38mm x 96kg/m³ + 25mm x 96 kg/m³ over stiffeners	3.65 kg/m²	2.40 kg/m²
Bulkhead	A60	FyreWrap Blanket	25mm + 38mm x 128kg/m³	8.06 kg/m²	4.86 kg/m²
Bulkhead	A60	FyreWrap Blanket	55mm x 64 kg/m³ + 25mm x 64 kg/m³ over stiffeners	3.65 kg/m²	1.60 kg/m²
Bulkhead	A60	FyreWrap Blanket	55mm x 96 kg/m³ + 25mm x 96 kg/m³ over stiffeners	5.28 kg/m²	2.40 kg/m²
Bulkhead (corrugated)	A60	FyreWrap Blanket	50mm x 64 kg/m³	3.20 kg/m²	n/a
Bulkhead restricted	A30	FyreWrap LT Blanket	25mm x 64kg/m³	1.60 kg/m²	1.60 kg/m²
Bulkhead	A30	FyreWrap LT Blanket	25mm x 64kg/m³	1.60 kg/m²	1.60 kg/m²
Bulkhead	A30	FyreWrap LT Blanket	45mm x 64kg/m³ + 25mm x 64kg/m³ over stiffeners	2.88 kg/m²	1.60 kg/m²
Bulkhead	A60	FyreWrap LT Blanket	50mm x 64kg/m³ + 25mm x 64 kg/m³ over stiffeners	4.80 kg/m²	1.60 kg/m²
Bulkhead	A60	FyreWrap LT Blanket	60mm x 80 kg/m³ (single layer system)	4.80 kg/m²	4.80 kg/m²
Bulkhead	A60	FyreWrap LT Blanket	40mm + 40mm x 48 kg/m³	3.84 kg/m²	1.92 kg/m²
Bulkhead restricted	A60	FyreWrap LT Blanket	45mm x 64kg/m³	2.88 kg/m²	2.88 kg/m²
Bulkhead restricted	A60	FyreWrap LT Blanket	50mm x 48kg/m³	2.40 kg/m²	2.40 kg/m²

4. System Summary Tables (Continued)

4.2 Aluminium A-Class & HSC

Application	Rating	Product	System	Weight on flat plate	Weight around stiffeners
Deck	A30	FyreWrap Blanket	38mm x 96kg/m³	3.65kg/m²	3.65kg/m²
Deck	A60	FyreWrap Blanket	50mm x 96kg/m³	4.80kg/m²	4.80kg/m²
Deck	A30	FyreWrapLT Blanket	40mm x 70kg/m³	2.80kg/m²	2.80kg/m²
Deck	A60	FyreWrapLT Blanket	50mm x 70kg/m³	3.50kg/m²	3.50kg/m²
Deck 4mm plate	A60	FyreWrapLT Blanket	55mm x 70kg/m³	3.85kg/m²	3.85kg/m²
Bulkhead restricted	A30	FyreWrap Blanket	38mm x 96kg/m³	3.65kg/m²	3.65kg/m²
Bulkhead restricted	A60	FyreWrap Blanket	50mm x 96kg/m³	4.80kg/m²	4.80kg/m²
Bulkhead restricted	A30	FyreWrapLT Blanket	40mm x 70kg/m³	2.80kg/m²	2.80kg/m²
Bulkhead restricted 4mm plate	A30	FyreWrapLT Blanket	55mm x 70kg/m³	3.85kg/m²	3.85kg/m²
Bulkhead restricted	A60	FyreWrapLT Blanket	50mm x 70kg/m³	3.50kg/m²	3.50kg/m²
Bulkhead	A60	FyreWrapLT Blanket	50mm x 70kg/m³ each face	7.00kg/m²	3.50kg/m²
Bulkhead 4mm plate	A60	FyreWrapLT Blanket	55mm x 70kg/m³ each face	7.70kg/m²	3.85kg/m²

Application	Rating	Product	System	Weight on flat plate	Weight around stiffeners
Deck 2mm plate	HSC 30	FyreWrapLT Blanket	35mm x 70kg/m³	2.45kg/m²	2.45kg/m²
Deck 2mm plate	HSC 60	FyreWrapLT Blanket	50mm x 70kg/m³	3.50kg/m²	3.50kg/m²
Bulkhead restr. 2mm plate	HSC 30	FyreWrapLT Blanket	35mm x 70kg/m³	2.45kg/m²	2.45kg/m²
Bulkhead restr. 2mm plate	HSC 60	FyreWrapLT Blanket	50mm x 70kg/m³	3.50kg/m²	3.50kg/m²

4. System Summary Tables (Continued)

4.3 H-Class Steel

Application	Rating	Product	System	Weight on flat plate	Weight around stiffeners
Deck	H120	FyreWrap Blanket	38mm + 50mm x 96kg/m³	8.45kg/m²	8.45kg/m²
Deck	H0	FyreWrap LT Blanket	40mm x 70kg/m³	2.80kg/m²	2.80kg/m²
Deck	H60	FyreWrap LT Blanket	35mm +35mm x 70kg/m³	4.90kg/m²	4.90kg/m²
Deck	H120	FyreWrap LT Blanket	40mm +40mm x 70kg/m³	5.60kg/m²	5.60kg/m²
Bulkhead	H120	FyreWrap Blanket	50mm + 50mm + 50mm x 128kg/m³ + 25mm over stiffeners	19.20kg/m²	16.00kg/m²
Bulkhead restricted	H0	FyreWrap LT Blanket	40mm x 70kg/m³	2.80kg/m²	2.80kg/m²
Bulkhead restricted	H60	FyreWrap LT Blanket	40mm + 40mm x 70kg/m³	5.60kg/m²	5.60kg/m²
Bulkhead	H60	FyreWrap LT Blanket	40mm + 40mm + 40mm x 70kg/m³	8.40kg/m²	5.60kg/m²
Bulkhead restricted	H120	FyreWrap LT Blanket	50mm + 50mm x 70kg/m³ + 50mm x 70kg/m³ over stiffener	7.00kg/m²	7.00kg/m²
Bulkhead	H120	FyreWrap LT Blanket	50mm + 50mm + 50mm x 70kg/m³	10.50kg/m²	7.00kg/m²

4.4 Other Systems

Jet Fire Protection System

Application	Rating	Product	System
Pipes & Structural Members	J60	FyreWrap Blanket	25mm x 128kg/m with 37mm Foamglas® T4 & 0.7mm stainless steel cladding

Corrugated Approvals

For corrugated plate approvals (both H-Class and A-Class) please contact your local Unifrax office.

5. Thermal Insulation Properties

R Value

The R Value of an insulation material can be calculated from its thermal conductivity and is typically measured at a temperature of 10°C.

The R Value or Thermal Resistance is a measure of the insulation performance of a material, at a specified thickness. It can be expressed as the material thickness divided by its thermal conductivity value.

The higher the R value, the higher the insulation performance of the material.

R Value (m^2K/W) = Thickness (m) / Thermal conductivity (W/mK)

U Value

Thermal insulation performance of a material or structure is often expressed as a 'U-Value'.

The U-Value or Thermal Transmittance Coefficient represents the flow of heat through a material or structure and is expressed as $W/(m^2K)$.

The lower the U value, the higher the insulation performance of the material or structure.
The U value is generally calculated from the R Value.

U Value (W/m^2K) = 1 / R Value

The R and U values for various FyreWrap Blanket grades and thicknesses are provided in the adjacent tables.

FyreWrap Blankets—Thermal Characteristics

Ambient Insulation Performance of 64kg/m³		
Blanket Thickness (mm)	R Value	U Value
25	0.78	1.28
38	1.19	0.84
50	1.56	0.64
55	1.72	0.58

Based on thermal conductivity of FyreWrap Blanket 64 kg/m³ density measured to BS EN 12667 at 10°C of 0.0320 W/mK. For blanket densities above 64kg/m³ the same values may be used.

FyreWrap LT Blankets—Thermal Characteristics

Ambient Insulation Performance of 64kg/m³		
Blanket Thickness (mm)	R Value	U Value
15	0.47	2.13
25	0.78	1.28
35	1.09	0.91
40	1.25	0.80
45	1.41	0.71
50	1.56	0.64
55	1.72	0.58
60	1.88	0.53

Based on thermal conductivity of FyreWrap LT Blanket 64 kg/m³ density measured to BS EN 12667 at 10°C of 0.0320 W/mK. For blanket densities above 64kg/m³ the same values may be used.

Ambient Insulation Performance of 48kg/m³		
Blanket Thickness (mm)	R Value	U Value
40	1.24	0.81
50	1.55	0.65
80	2.48	0.40

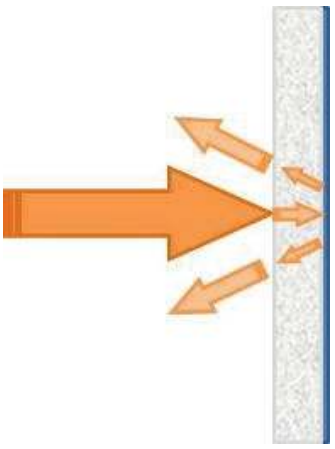
Based on thermal conductivity of FyreWrap LT Blanket 48 kg/m³ density measured to BS EN 12667 at 10°C of 0.0323 W/mK.

6. Acoustic Insulation Properties

In addition to their thermal insulation properties for fire resistance, FyreWrap Marine/Offshore blankets from Unifrax also provide excellent acoustic insulation properties.
Acoustic insulation properties of materials can be measured by their ability to absorb sound or how they reduce sound transmission through a structure (i.e. a wall or floor).

Sound Absorption

Sound absorption can be described as the process in which sound waves are transferred into another kind of energy, when they pass through or strike the surface of a material. Absorption is expressed as a "sound absorption coefficient" – the fraction of sound energy absorbed by a material. It is expressed as a value between 0, zero absorption (total reflection) and 1.0*, perfect absorption (no reflection). This is measured over a range of frequencies (Hz).



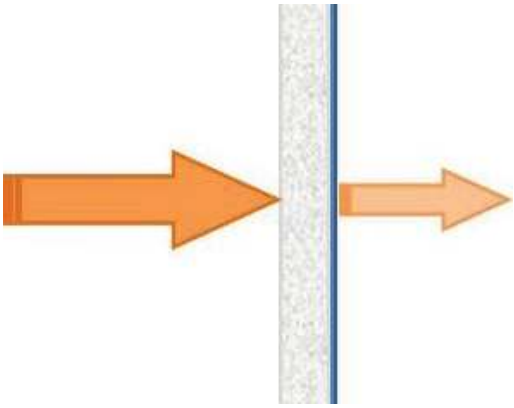
For acoustic engineering purposes, the ability of a division (e.g. deck or bulkhead) to absorb noise is important in reducing noise reflected back (i.e. sound absorption of an insulation lining material is relevant when considering noise levels in the same area as the noise source).

Sound Adsorption is tested in accordance with BS EN ISO 354:2003

* Please note test data values may exceed the theoretical limit 1.0 for materials that are highly sound absorptive.

Sound Reduction Or Sound Transmission Loss

Sound reduction can be described as the process in which sound intensity is reduced as sound waves pass through a structure or division. Sound reduction is typically expressed as a single figure, the "weighted sound reduction" value (Rw) in dB. This single value or rating is calculated from the sound reduction values at various frequencies, as described in ISO 717-1.



For acoustic engineering purposes, the ability of a division (e.g. deck or bulkhead) to prevent sound transmission is important in reducing noise passing through to adjacent rooms (i.e. the sound reduction of an insulation lining material is relevant when considering noise levels in a separate area from the noise source).

Sound Reduction is tested in accordance with BS EN ISO 10140-2:2010 and rated in accordance with BS EN ISO 717-1:2013.

6. Acoustic Insulation Properties (Continued)

Sound Absorption

Sound Absorption Coefficient							
Frequency (Hz)	FyreWrap LT Blanket		FyreWrap Blanket				
	50mm x 70kg/m³	50mm x 96kg/m³	25mm x 96kg/m³	38mm x 96kg/m³	50mm x 96kg/m³	25mm x 128kg/m³	50mm x 128kg/m³
125	0.47	0.26	0	0.14	0.31	0.02	0.11
250	1.05	0.94	0.18	0.56	1.08	0.40	0.93
500	1.09	1.03	0.61	1.05	1.17	0.96	1.10
1000	1.09	1.03	0.90	1.16	1.13	1.06	1.06
2000	1.12	1.09	1.04	1.09	1.08	1.05	1.10
4000	1.12	1.14	1.09	1.06	1.03	1.06	1.12
5000	1.18	1.09	1.12	1.08	0.95	1.08	1.12
NRC	1.10	1.00	0.68	0.96	1.12	0.87	1.05

Tested in accordance with BS EN ISO 354:2003 or BS EN 20354:1993. Please note testing was conducted using plain blanket. Use of Aluminium Foil or Glass Cloth facing will reduce the sound absorption characteristics.

Sound Reduction Or Sound Transmission Loss

Steel divisions insulated with FyreWrap LT Blanket		
Noise to Steel Side (5mm steel plate with stiffeners)		**R_W (ISO 717-1)**
25mm x 64kg/m³	(1 layer of 25mm over plate and stiffeners)	43 dB
45mm x 64kg/m³	(1 layer of 45mm over plate and stiffeners)	45 dB
45mm x 64kg/m³	(1 layer of 45mm over plate + 200mm wide strips of 25mm over stiffeners)	45 dB
75mm x 64kg/m³	(1 layer of 50mm over plate + 1 layer of 25mm over plate and stiffeners)	47 dB
40mm x 70kg/m³	(1 layer of 40mm over plate and stiffeners)	45 dB
70mm x 70kg/m³	(2 layers of 35mm over plate and stiffeners)	47 dB
80mm x 70kg/m³	(2 layers of 40mm over plate and stiffeners)	48 dB
120mm x 70kg/m³	(1 layer of 40mm over plate + 2 layers of 40mm over plate and stiffeners)	51 dB
60mm x 80kg/m³	(1 layer of 60mm over plate and stiffeners)	47 dB
Noise to Insulated Side		**R_W (ISO 717-1)**
25mm x 64kg/m³	(1 layer of 25mm over plate and stiffeners)	42 dB
45mm x 64kg/m³	(1 layer of 45mm over plate and stiffeners)	45 dB
45mm x 64kg/m³	(1 layer of 45mm over plate + 200mm wide strips of 25mm over stiffeners)	45 dB
75mm x 64kg/m³	(1 layer of 50mm over plate + 1 layer of 25mm over plate and stiffeners)	47 dB
40mm x 70kg/m³	(1 layer of 40mm over plate and stiffeners)	44 dB
70mm x 70kg/m³	(2 layers of 35mm over plate and stiffeners)	47 dB
80mm x 70kg/m³	(2 layers of 40mm over plate and stiffeners)	49 dB
120mm x 70kg/m³	(1 layer of 40mm over plate + 2 layers of 40mm over plate and stiffeners)	52 dB
60mm x 80kg/m³	(1 layer of 60mm over plate and stiffeners)	47 dB

Steel divisions insulated with FyreWrap Blanket		
Noise to Steel Side (5mm steel plate with stiffeners)		R_W (ISO 717-1)
38mm x 96kg/m³	(1 layer of 38mm over plate and stiffeners)	45 dB
Noise to Insulated Side		R_W (ISO 717-1)
38mm x 96kg/m³	(1 layer of 38mm over plate and stiffeners)	44 dB

Tested in accordance with ISO 10140-2:2010 and rated in accordance with ISO 717-1:2013. Please note testing was conducted using plain blanket, use of Aluminium Foil or Glass Cloth facings will likely improve the sound reduction rating.

7. Blast Resistance

FyreWrap Offshore Fire Divisions (H Rated Deck and Bulkheads) have also been tested for blast resistance. This is to determine their effectiveness for use in areas where there is a risk of explosion. The aim of the testing was to demonstrate that the integrity of the FyreWrap systems remain intact, and would be able to provide the same level of fire protection, following an explosion.

Blast Testing

Two blast tests were carried out on a selection of FyreWrap and FyreWrap LT systems (H60 and H120), with the insulation / stiffened side exposed to the blast. All testing was witnessed by Lloyds Register.

Tests were conducted on systems with :

- No covering on the insulation
- A protective stainless steel wire mesh covering

Two levels of blast pressure were tested, 0.65 bar (on both covered and uncovered systems) and 1.25 bar (on the covered system only). The duration of the blasts were 221ms and 279ms respectively and considered "long duration blast loads".

Summary table

Test	Pressure, Duration & Impulse	Systems with no covering	Systems with Stainless steel mesh
1	Pressure 0.65 bar Duration 221 ms Peak Impulse 453 psi-ms	Passed	Passed
2	Pressure 1.25 bar Duration 279 ms Peak Impulse 1571 psi-ms	Not tested	Passed

Results

The test specimens were inspected for damage that would be deemed to affect their fire integrity and performance. Subsequent examination showed the insulation withstood the blast and did not display any significant delamination from the substrate (see summary table).

Conclusion

Based on the tests conducted, it was determined that the FyreWrap Blanket systems without coverings will remain in place and will not be significantly compressed by a 0.65 bar pressure. Furthermore, the FyreWrap Blanket systems with a stainless steel mesh covering will remain in place and will not be significantly compressed by a 1.25 bar pressure. Therefore these systems are able to maintain their required fire protection performance post-blast.

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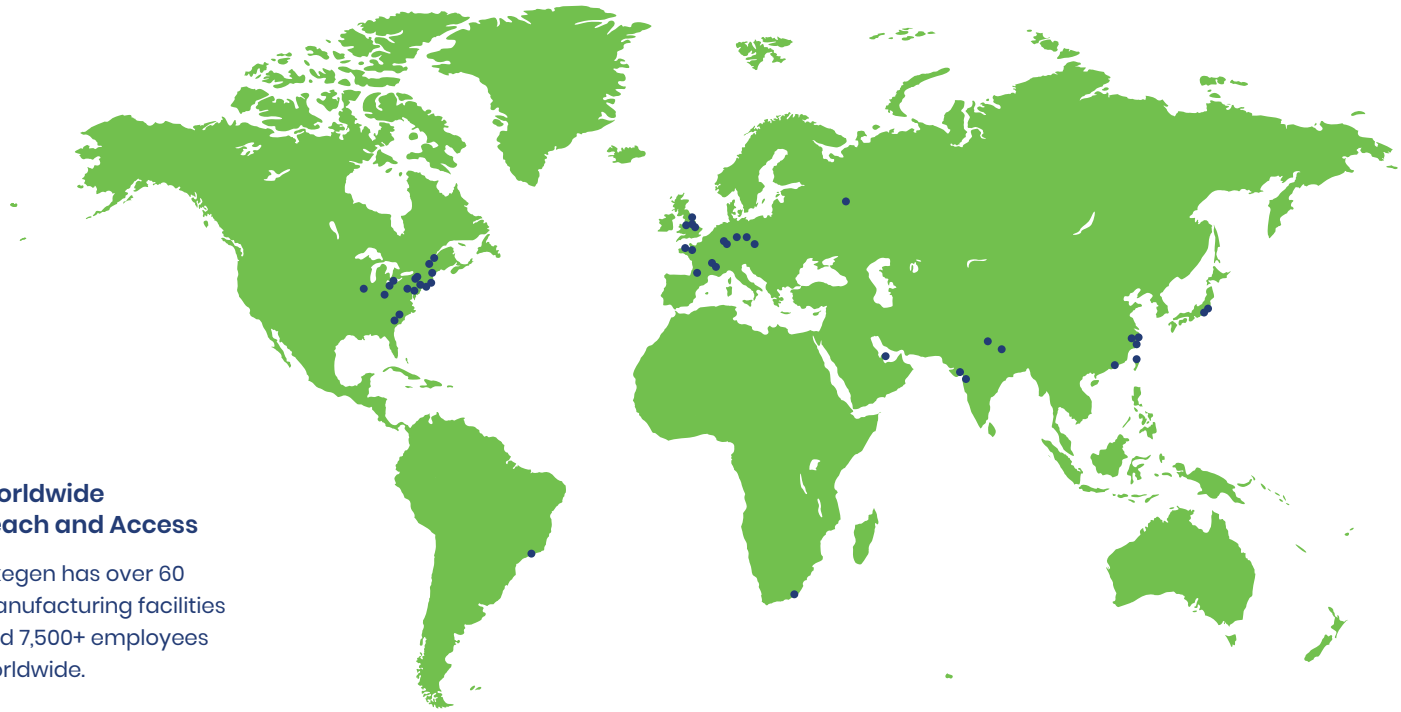

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