

OPTIM-R®

Inverted Roofing System

Next generation insulation solution for protected membrane roofs



- Ideal for constructions where a lack of construction depth or space is an issue
- Optimum performance rigid vacuum insulation panel
- Insulating performance up to five times better than other commonly available insulation materials
- Withstands freeze / thaw cycling
- Compatible with green roof systems
- Resistant to the passage of water vapor
- Ideal for new build and retrofit

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Introduction & Design Consideration

The Problem

When constructing a roof in new build situations or replacing a roof in existing buildings there may be a requirement for both low U-values / high R-values and the thinnest possible roof build-up.

For new-build applications, there are increasing regulatory requirements and economic reasons to improve energy efficiency. One of the approaches is to improve the thermal performance of the building envelope whilst keeping the overall construction as thin as possible. There are already high performance insulation products available that will fulfil the majority of these requirements, however in certain areas, for example where the design demands it, a new, thinner, product is needed.

In refurbishment, there is arguably a greater need to keep roof build-ups as thin as possible. In certain applications, internal space may be at a premium or there may be little space for installing new roof insulation, for example in buildings with planning height restrictions.

The Solution

The Kingspan OPTIM-R Inverted Roofing System has been developed to help solve these problems and is an optimum performance next generation insulation from Kingspan Insulation. It comprises rigid vacuum insulation panels with a microporous core which is evacuated, encased and sealed in a thin, gas-tight envelope, giving outstanding thermal conductivity, with the thinnest possible solution to insulation problems. The vacuum insulation panels are accompanied by rigid extruded polystyrene insulation infill panels which can be cut to fit around problem areas such as roof lights or ventilator curbs.

In retrofit applications, the Kingspan OPTIM-R Inverted Roofing System provides solutions for areas that previously would have remained uninsulated because of insufficient space available.

In new constructions, the Kingspan OPTIM-R Inverted Roofing System can significantly enhance U-values in areas that would otherwise be accepted as diminishing the overall thermal performance.

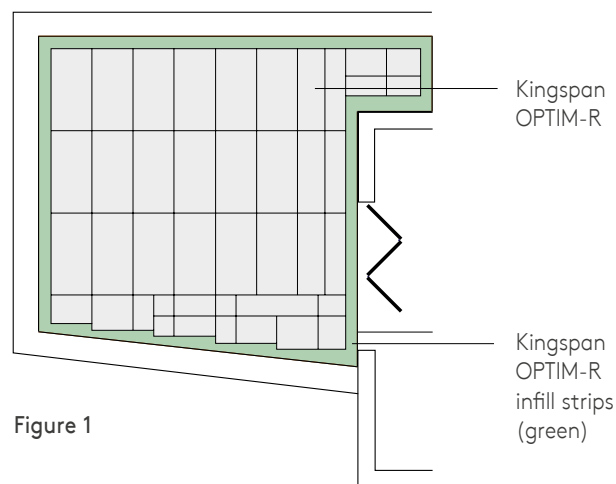
The high level of thermal efficiency with minimal thickness, achieved by the Kingspan OPTIM-R Inverted Roofing System provides solutions for applications where a lack of construction depth or space is an issue.

Design Services

The Kingspan OPTIM-R Inverted Roofing System comprises three elements: Kingspan OPTIM-R panels, Kingspan GreenGuard® infill strips and Kingspan GreenGuard® overlay. It comes with a supporting design service which ensures the ratio of the Kingspan OPTIM-R panels to Kingspan GreenGuard® infill strips for each project is maximized. The panel layout will be designed quickly and effectively, ready for client approval. Each layout will illustrate the size, number and location of the Kingspan OPTIM-R panels. It will also illustrate the size, number and location of any Kingspan GreenGuard® infill strips required.

For more details please contact the Kingspan Insulation Technical Service Department (see rear cover).

Typical Roofing Designs for the Kingspan OPTIM-R Roofing System



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Design Consideration

Responsible Sourcing

The Kingspan OPTIM-R Inverted Roofing System is manufactured under a management system certified to ISO 14001: 2015.

Sustainability & Responsibility

Kingspan Insulation has a long-term commitment to sustainability and responsibility: as a manufacturer and supplier of insulation products; as an employer; as a substantial landholder; and as a key member of its neighboring communities.

A report covering the sustainability and responsibility of Kingspan Insulation Ltd's operations is available at www.kingspaninsulation.co.uk/sustainabilityandresponsibility.



Figure 2: Kingspan OPRIM-R

Specification Clause

The Kingspan OPTIM-R element of the Inverted Roofing System should be described in specifications as: The roof insulation shall be the Kingspan OPTIM-R Inverted Roofing System ___ mm thick: comprising a rigid vacuum insulation panel with a microporous core which is evacuated, encased and sealed in a thin, gas-tight envelope. The product shall be manufactured under a management system certified to ISO 9001: 2015 (Quality Management Systems. Requirements), ISO 14001: 2015 (Environmental Management Systems. Requirements), ISO 45001: 2018 (Occupational Health and Safety Management Systems. Requirements) and ISO 50001: 2018 (Energy Management Systems. Requirements) and installed in accordance with the instructions issued by Kingspan Insulation LLC.

Protected Membrane Roofs

This literature describes the use of the Kingspan OPTIM-R Inverted Roofing System as a component of protected membrane roofing systems using either a gravel or paving slab finish, and as a component of green roof systems.

Protected membrane roofing systems place the insulation above the waterproofing, and offer several advantages over traditional warm flat roofs.

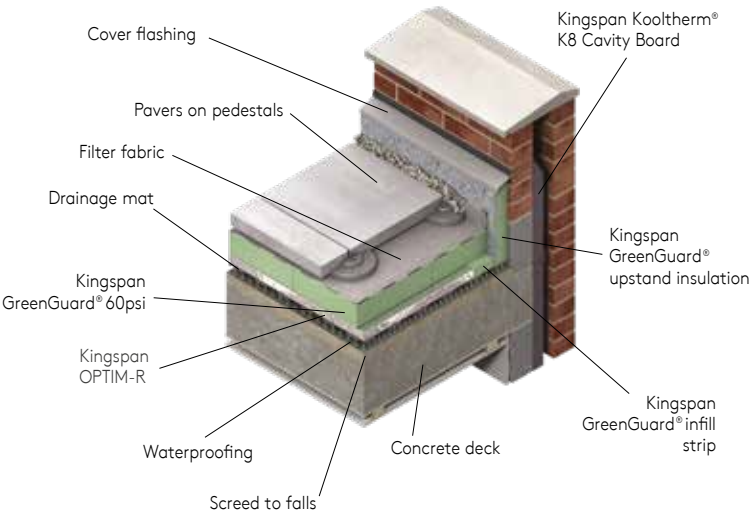
- The waterproofing system can be expected to have a life in excess of that obtained in an exposed situation, as it is protected from mechanical damage, UV degradation from solar radiation and temperature extremes (both daily and seasonal).
- The roof is safe from condensation risk.
- Insulation can be lifted to allow inspection of the waterproofing system.
- Additional insulation can be added at a later date.
- The installation of the insulation is not weather dependent.

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Typical Construction

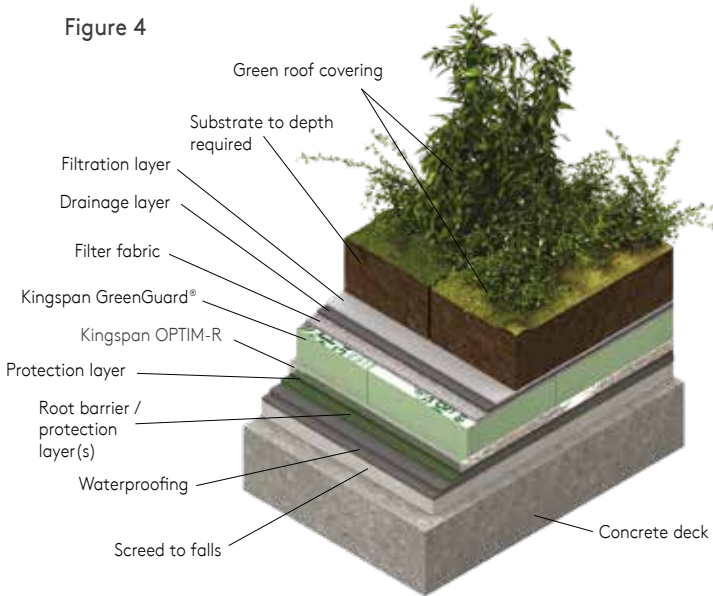
■ Concrete Deck with Paving Slab

Figure 3



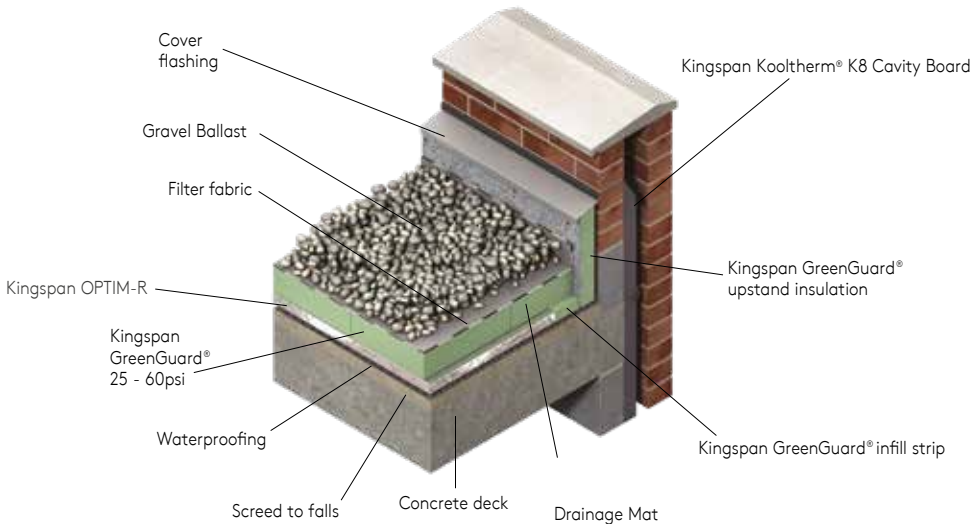
■ Green Roofs

Figure 4



■ Concrete Deck with Gravel Ballast

Figure 5



Green Roofs

Benefits

Green roofs are an alternative to the standard protected membrane roof that offer many advantages but require precise design and detailing.

Specifically they can:

- Reduce urban island heat effect
- Provide a habitat for wildlife
- Create usable areas for recreational activities
- Retain rainfall thus prevent water surges into the drainage system
- Improve sound insulation
- Provide a visually more attractive finish than protected membrane roofs with gravel or paving slab ballast

Types of Green Roof

Extensive green roofs comprise a relatively shallow growing medium and low maintenance vegetation such as grass. They are lightweight, simple to design, construct and maintain, but should not be considered suitable for regular traffic or recreational activities. Extensive systems are especially useful in creating green areas for both ecological and aesthetic reasons.

Semi-intensive green roofs comprise a deeper growing medium and vegetation such as grass, perennials and shrubs. They are designed to be more garden-like and to accommodate limited access for maintenance and recreation.

Intensive green roofs have a much deeper growing medium and a wider variety of flora, including grass, shrubs and smaller trees. They are comparable with normal gardens in respect of maintenance, and can be used for recreation activities. The self weight of the system can be very high due to the increased soil depth.

Careful design and detailing of both roof types is important and includes the following elements.

Growing Medium

In its simplest form this is normal soil. Specialist mixtures are available, incorporating expanded clay and lava rock, which form the growing medium and have filtration, drainage and moisture retention functions.

Drainage Layer

The drainage layer normally consists of either: a layer of washed gravel 8/16; expanded clay; or a specialist 'egg carton' or castellated plastic (HDPE) sheeting; all overlaid with a filtration membrane. The drainage layer allows the rapid removal of excess rainwater from the roof, thus avoiding saturation of the soil and the associated increase in weight.

Moisture Retention Layer

The limited depth of soil, especially in the extensive type of roof, may require the use of a moisture retention layer to ensure sufficient water is available for the vegetation.

Root Barrier

The roots of growing plants can seriously damage waterproof membranes by growing into any small cracks, lap joints or other discontinuities. A root barrier may be formed by a separate cap sheet of polyethylene or bitumen felt. The cap sheet is either adhered or loose-laid onto the waterproof membrane with all joints sealed by bonding or welding, and must be continued up vertical faces of upstands.

Waterproofing

- Prior to installing the Kingspan OPTIM-R Inverted Roofing System, it is essential to ensure that the waterproofing system has been installed correctly and that the roof is watertight and clean. The surface of the waterproofing should be smooth, flat and free from projections.
- Single-ply membranes, in particular, need careful attention to ensure that there has been no damage from following trades, and that puncturing from below the membrane (from nail heads or debris) cannot occur.
- If a single-ply membrane or mastic asphalt waterproofing system has been installed, a non-woven polyester fleece separation layer should be laid on top of the membrane prior to the installation of the insulation.

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Sitework

Insulation Boards

- An optional protection layer may be used under the Kingspan OPTIM-R Inverted Roofing System. For further information please contact the Kingspan Insulation Technical Service Department (see rear cover).
- The Kingspan OPTIM-R panels should be laid break bonded where practical, with joints lightly butted. There should be no gaps at abutments.
- Where runs of the Kingspan OPTIM-R panel do not accurately fit the dimension of the roof, the use of Kingspan GreenGuard® infill strips is required to make up this difference. Each Kingspan GreenGuard® infill strip is to be the same thickness as the panels.
- The Kingspan GreenGuard® overlay should be laid as soon as possible to avoid exposure of the Kingspan to direct foot traffic.
- At the perimeter of the roof and where upstands or any penetrations (e.g. drainage outlets) are present, Kingspan GreenGuard® infill strips should be laid abutting these areas, to take account of building tolerances.
- A minimum distance of 12 in should be maintained between the top of the insulation upstand and the bottom of the horizontal roof insulation.
- The Kingspan OPTIM-R Inverted Roofing System can be laid in any weather but care must be taken in windy conditions.

Wheeled / Foot Traffic

- The Kingspan OPTIM-R panels should not be directly walked on. A protective foot or crawl board should be used during the installation process.
- The Kingspan GreenGuard® infill strips and the Kingspan GreenGuard® overlay may be walked on.

General

- The Kingspan OPTIM-R Inverted Roofing System should not be used in association with solvent-based adhesive systems. The Kingspan OPTIM-R Inverted Roofing System should not be exposed to open flames or excessive heat.

Cutting

- The Kingspan OPTIM-R panels should not be cut or penetrated. The substrate must be clean, dry and level, and free of sharp objects or edges.
- Cutting of the Kingspan GreenGuard® infill strips should be carried out either by using a fine toothed saw, or by scoring with a sharp knife, snapping the board over a straight edge and then cutting the facing on the other side.
- Ensure accurate trimming of the Kingspan GreenGuard® infill to achieve close-butting joints and continuity of insulation.

Availability

- Please contact Kingspan Insulation for availability of the Kingspan OPTIM-R Inverted Roofing System.

Packaging and Storage

- The packaging of the Kingspan OPTIM-R Inverted Roofing System should not be considered adequate for outdoor protection. The Kingspan OPTIM-R Inverted Roofing System should be stored inside a building and raised off the floor.

Health and Safety

- Kingspan Insulation products are chemically inert and safe to use.
- A Safety Information Data Sheet for this product is available from the Kingspan Insulation website www.kingspaninsulation.us.

Warning – do not stand on or otherwise support your weight on this product unless it is fully supported by a load bearing surface.

Please note that the reflective surface on this product is designed to enhance its thermal performance. As such, it will reflect light as well as heat, including ultraviolet light. Therefore, if this panel is being installed during very bright or sunny weather, it is advisable to wear UV protective sunglasses or goggles, and if the skin is exposed for a significant period of time, to protect the bare skin with a UV block sunscreen.

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Product Details

Composition

The Kingspan OPTIM-R panels comprise of a rigid vacuum insulation panel with a microporous core which is evacuated, encased and sealed in a thin, gas-tight envelope.

The Kingspan GreenGuard® infill strips and overlay comprise a high performance rigid extruded polystyrene insulation.

Standards and Approvals

Kingspan OPTIM-R® is manufactured to the highest standards under a management system certified to ISO 9001: 2015 (Quality Management Systems. Requirements), ISO 14001: 2015 (Environmental Management Systems. Requirements), ISO 45001: 2018 (Occupational Health and Safety Management Systems. Requirements) and ISO 50001: 2018 (Energy Management Systems. Requirements)



CERTIFIED TO:
ASTM C1667
ASTM C165
ASTM D2126

Density

The density of Kingspan OPTIM-R® falls within the range of 10.6 - 13.10 pcf /170 - 210 kg/m³ when tested to BS EN 1602: 2013 (Thermal insulating products for building applications. Determination of the apparent density).

Durability

If installed correctly and protected from damage and penetration, the Kingspan OPTIM-R Inverted Roofing System can provide reliable long-term thermal performance over the lifetime of the building.

Resistance to Solvents, Fungi & Pests

The Kingspan OPTIM-R Inverted Roofing System should not be used in association with solvent-based adhesive systems.

Damaged boards or boards that have been in contact with solvents or acids should not be used.

The insulation core and facings used in the manufacture of the Kingspan OPTIM-R Inverted Roofing System resist attack by mold and microbial growth, and do not provide any food value to pests.

Product Data		
Property	Test Method	Result
General		
Nominal Thickness (in / mm)		0.79 - 1.97 / 20 - 50
Standard Dimensions		
Width (in / mm)		11.8 - 23.6 / 300 - 600
Length (in / mm)		11.8 - 47.2 / 300 - 1200
Nominal Panel Mass (lbs per sq. ft. / kg per m)		
20 mm thickness		0.82 / 4
25 mm thickness		1.02 / 5
30 mm thickness		1.23 / 6
35 mm thickness		1.43 / 7
40 mm thickness		1.64 / 8
Compressive Strength, Min. (psi) @ 10% deformation	ASTM C165	23
Dimensional Stability	ASTM D2126	
20 mm (0.79 in)-50 mm (1.97 in)	Length max Width max	0.5 % 0.6 %

* Contact Kingspan Insulation for available non-stock sizes.

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Thermal Resistance

ASTM C1667 (Standard Test Method for Using Heat Flow Meter Apparatus to Measure the Center-of-Panel Thermal Transmission Properties of Vacuum Insulation Panels) is the only test method designated by ASTM to be used specifically for testing center panel thermal resistance of Vacuum Insulated Panels. ASTM C1667 further states that Vacuum Insulated Panels fall outside the scope of test method ASTM C518. All of the below stated thermal resistance values are based on Certified ASTM C1667 testing.

Thermal resistance (R-value) of the Kingspan OPTIM-R® panels of the Roofing System varies with thickness and is calculated by dividing the thickness of the panel by its thermal conductivity.

ASTM C1667 Center Panel Thermal Resistance Properties		
Insulant Thickness		Thermal Resistance (R-value)
(in)	(mm)	ft ² ·°F·hr/Btu
0.79	20	26
0.98	25	32*
1.18	30	37*
1.57	40	49*
1.97	50	60

Refer to Kingspan Insulation for current stock and non-stock sizes.

*These values are based on linear interpolation of test results for 20mm and 50mm Optim-R boards.

Calculated Edge Effect Thermal Resistance Properties*		
Insulant Thickness		Thermal Resistance (R-value)
(in)	(mm)	ft ² ·°F·hr/Btu
0.79	20	22
0.98	25	28
1.18	30	33
1.57	40	46
1.97	50	57

* Based on ASTM C1667 Thermal Resistance Values. Edge effect R-values vary based on panel size. The listed edge effect R-values in the table are based on the average edge effect R-values from six of the most commonly used panel sizes. Refer to Kingspan Insulation for current stock and non-stock sizes.

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Kingspan Insulation

Company Details

Kingspan Insulation LLC is part of the Kingspan Group plc., one of Europe's leading construction product manufacturers. The Kingspan Group was formed in the late 1960s and is a publicly traded group of companies headquartered in Kingscourt, County Cavan, Ireland.

Kingspan Insulation LLC, headquartered in Atlanta, GA, is a leading manufacturer in energy efficiency and moisture management products, offering high performance insulation, building wraps and pre-insulated HVAC ductwork.

Products & Applications

Kingspan Insulation LLC has a vast product range that includes optimum, premium and high performance rigid insulation products and moisture management products suitable for both new build and renovation in a variety of applications within both residential and non-residential buildings.

Insulation Product Benefits

Kingspan Kooltherm® K-range Products

- Higher R-value per inch than any commonly used insulation
- Each product achieves the required fire performance for its intended application.
- ASTM E84 rating of 25/20 (flame/smoke).
- Manufactured with a blowing agent that has zero ODP, low GWP, HCFC and CFC free.

Kingspan GreenGuard® Products

- Rigid extruded polystyrene insulation (XPS) for use as general purpose insulation for roofing, wall and foundation applications requiring a minimum compressive strength.
- R-value of 5.0 per inch of thickness.
- Continuous Insulation (Ci) for above grade walls, as well as below grade walls and floors.
- Provides an extra barrier against moisture infiltration.

All Products

- Their closed cell structure resists both moisture and water vapor ingress – a problem which can be associated with open cell materials such as mineral fiber and which can result in reduced thermal performance.
- Unaffected by air infiltration – a problem that can be experienced with mineral fiber and which can reduce thermal performance.
- Safe and easy to install.
- If installed correctly, can provide reliable long term thermal performance over the lifetime of the building.

Contact Details

USA

Kingspan Insulation LLC
2100 Riveredge Parkway | Suite 175
Atlanta | Georgia 30328

T: +1 (800) 241 4402

F: +1 (678) 589 7325

E: info@kingspaninsulation.us

www.kingspaninsulation.us



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For the most current installation guidelines and compliance information go to www.kingspaninsulation.us.

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Version 2 - 07/2022

