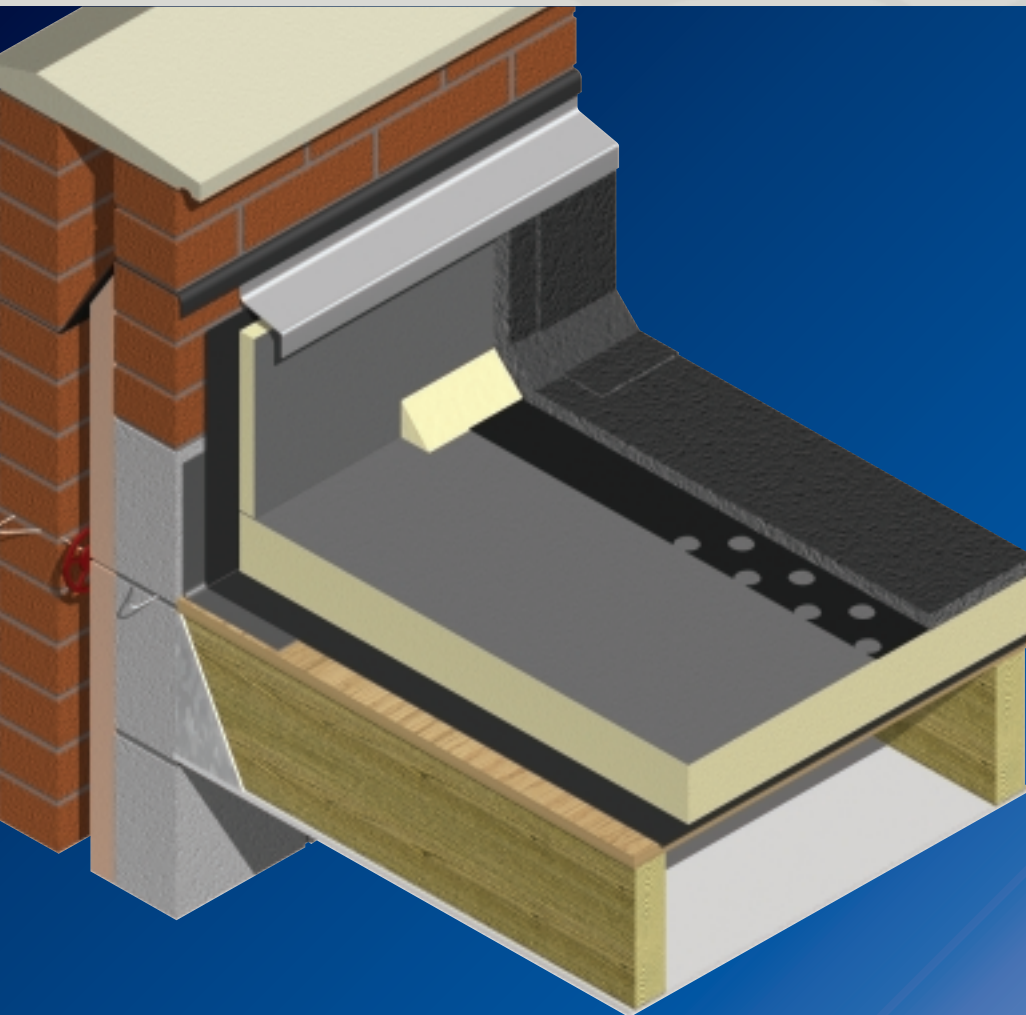


# Thermaroof™ TR21

## INSULATION BENEATH PARTIALLY BONDED BUILT-UP FELT AND MASTIC ASPHALT

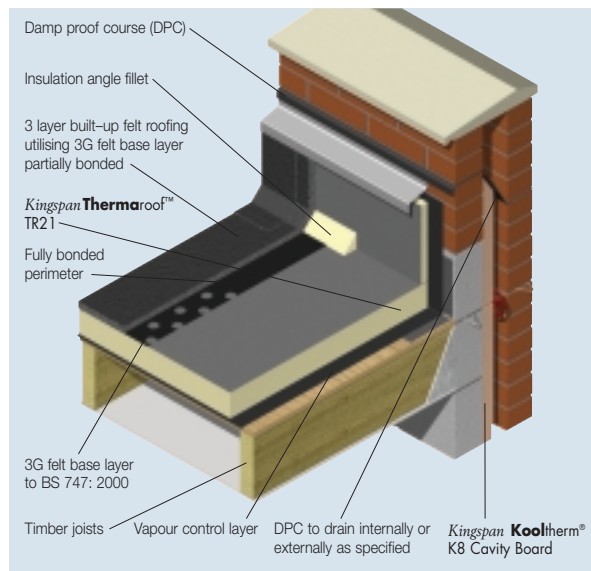
Other than Insulated Balconies Waterproofed with Mastic Asphalt with a Porous Promenade Tile Overlay



- High performance rigid urethane insulation – thermal conductivity 0.025–0.027 W/m-K
- Fully compatible with most bitumen based and mastic asphalt waterproofing systems
- Can accommodate partially bonded roofs up to a 10° pitch
- Unaffected by temperatures associated with mastic asphalt (up to 240°C)
- No need for a fibreboard overlay – asphalt with sheathing felt can be laid directly on top of the insulation
- Resistant to the passage of water vapour
- Easy to handle and install
- Ideal for new build and refurbishment
- Non-deleterious material
- CFC/HCFC-free with zero Ozone Depletion Potential (ODP)



## Typical Design Details



## Specification Clause

Kingspan **Therma<sup>roof</sup>™ TR21** should be described in specifications as:-

The roof insulation shall be **Kingspan Therma<sup>roof</sup>™ TR21** \_\_\_\_\_mm thick comprising a CFC/HCFC-free rigid urethane insulation core with bitumen impregnated glass tissue facings on both sides manufactured to the highest standards in accordance with both the requirements of BS 4841-3 and quality control systems approved to BS EN ISO 9001: 2000 / I.S. EN ISO 9001: 2000 by Kingspan Insulation Limited and shall be applied in accordance with the instructions issued by them.

Details also available in NBS Plus.

NBS users should refer to clause(s):  
 J21 420, J21 430, J41 420, J41 430  
 (Standard and Intermediate)  
 J21 10, J41 10 (Minor Works)



## Design Considerations

### Sustainability

In the past, erroneously, the relative environmental sustainability of insulation materials has been compared on the basis of embodied energy and ozone depletion potential. It is now recognised that a much wider basket of embodied environmental impacts (including those caused by their embodied energy), rather than embodied energy alone, is the only credible tool of comparison. Time has also annulled ozone depletion potential as an issue as all insulation materials are now banned from using CFC and HCFC blowing agents by law.

For buildings designed to today's Building Regulations energy use standards it is now also known that the embodied environmental impacts of all of the materials and labour used to create a building are insignificant in comparison with the lifetime operational environmental impacts of that building, and so are of very limited importance. Since it is operational energy use that creates the vast majority of operational environmental impact, saving energy by specifying the lowest U-values possible is the most environmentally sustainable action to take.

However, one of the most neglected facts about environmentally sustainable buildings is that the longevity of their standards of operational energy use, and therefore the longevity of their operational environmental impacts, is critical. The performance of some insulants, such as mineral fibre, can deteriorate rapidly if exposed to water penetration, air movement or compression. This may increase operational energy use and hence compromise the environmental sustainability of the finished building to an alarming degree. Other insulation materials, such as rigid phenolic or rigid urethane, are not vulnerable to any of these problems.

In summary, designers should:

- specify the lowest possible U-value regardless of insulation type;
- design out the risk of their chosen insulant not performing as specified; and
- if the latter is not possible, choose an insulant that is at low risk of failure e.g. a cellular plastic insulation material.

However, manufacturers should not rest on their laurels; it is a matter of social responsibility to be open and honest about the environmental impact of the manufacture of a product, and a full Life Cycle Analysis (LCA) based on a much wider basket of environmental impacts, rather than embodied energy alone, is recognised as the preferred tool to achieve this. Kingspan Insulation was the first insulation manufacturer to openly complete and publish independently certified Ecoprofiles (a type of LCA) on its product ranges. The Ecoprofile for the **Kingspan Therma<sup>roof</sup>™** range of rigid urethane insulation products was performed by Building Research Establishment (BRE). The product range comfortably achieves a BRE Green Guide A rating.



But there is far more to sustainability than whether or not a product, process or company affects the environment in a positive or a negative way. A company can, and should, demonstrate its financial viability and social responsibility, as well as ensure that its materials and methods do not add unduly to the burden placed on the planet.

Kingspan Insulation has now put the manufacture of its products at its Pembridge facility in Herefordshire through a rigorous independent appraisal of its economic, social, environmental and natural resource impacts using Arup's SPeAR® tool.

The results show a well balanced performance in terms of sustainability, and that Kingspan Insulation is already meeting legislation or best practice in most areas, even moving beyond best practice in some. Kingspan Insulation is the first and only construction material manufacturer to have taken this bold move and openly publish the results.

### Wind Loading

Wind loadings should be assessed in accordance with BS 6399-2: 1997 (Loading for buildings. Code of practice for wind loads).

### Roof Waterproofing

*Kingspan Thermaroof™* TR21 is designed for use with most bitumen based waterproofing systems, including high performance types which incorporate a Type 3G perforated base layer to BS 747: 2000 (Reinforced bitumen sheets for roofing. Specification). The 3G felt layer is laid dry and loose, mineral face down with a fully bonded perimeter zone. The roof waterproofing should be applied as soon as possible after the laying of the boards. The built-up roof specification should be laid where applicable in accordance with BS 8217: 2005 (Reinforced bitumen membranes for roofing. Code of practice). It is also suited to mastic asphalt waterproofing systems. The mastic asphalt roof specification should be laid where applicable in accordance with BS 8218: 1998 (Code of practice for mastic asphalt roofing). Mastic asphalt should always be laid over an isolating layer of Type 4A sheathing felt to BS 747: 2000. The roof waterproofing should be applied as soon as possible after laying the boards.

### Falls

The fall on a flat roof should be smooth and steep enough to prevent the formation of rainwater pools. To ensure adequate drainage, BS 6229: 2003 (Flat roofs with continuously supported coverings. Code of practice), recommends uniform gradients of not less than 1 in 80. The fall on a flat roof constructed using *Kingspan Thermaroof™* TR21 is normally provided by the supporting structure being directed towards the rainwater outlets. However, because of building settlement, it is advisable to design in even greater falls. These can be provided by the use of a Kingspan Insulation Tapered Roofing System. Further details of the *Kingspan Thermatape®* System and a complete design service are available from the Kingspan Insulation Tapered Roofing Department (see rear cover).

### Water Vapour Control

*Kingspan Thermaroof™* TR21 should be installed over a separate vapour control layer. A minimum vapour control layer should consist of a coated roofing felt complying with BS 747: 2000 Type 3B, or any appropriate metal-cored vapour control layer. Allowance should be made for the adequate bonding of the vapour control layer to the deck so as to provide a suitable surface for *Kingspan Thermaroof™* TR21 to be laid upon, and sufficient resistance to wind up-lift (see 'Wind Loading').

### Roof Loading

Depending on the chosen waterproofing system, *Kingspan Thermaroof™* TR21 is suitable for use on access roof decks subject to limited foot traffic. Where continuous or excessive loadings are liable to occur it is recommended that the roof surface is protected by promenade tiles. The roof should be adequately protected when building works are being carried out on or over the roof surface. This is best achieved by close boarding. The completed roof must not be used for the storage of heavy building components such as bricks or air conditioning equipment.

### Spanning on Metal Decks

The designer's attention is drawn to the requirement that insulation boards comply with the minimum thicknesses shown in the table below, when used over metal decks with trough openings as shown.

Trough Opening (mm)	Minimum Insulant Thickness (mm)
≤ 75	25
76–100	30
101–125	35
126–150	40
151–175	45
176–200	50

## Typical U-values

The following examples have been calculated using the Combined Method for compliance with Building Regulations / Standards revised after 2002. These examples are based on **Kingspan Therma<sup>roof</sup>™ TR21** waterproofed either using 3 layers of built-up felt or 2 layers of mastic asphalt, with the surface covered with mineral chippings. The board is bedded in bitumen on top of a vapour control layer which is fully bonded to the type of deck stated for each application. The ceiling, where applicable, is taken to be a 3 mm skim coated 12.5 mm plasterboard with a cavity between it and the underside of the deck. If your construction is any different, please consult the Kingspan Insulation Technical Service Department (see rear cover).

Combined Method – U-values were calculated using the method which has been adopted to bring National standards in line with the European Standard calculation method, BS / I.S. EN ISO 6946: 1997 (Building components and building elements. Thermal resistance and thermal transmittance. Calculation method).

*NB For the purposes of these calculations the standard of workmanship has been assumed good and therefore the correction factor for air gaps has been ignored.*

*NB The figures quoted are for guidance only. A detailed U-value calculation together with condensation risk analysis should be completed for each individual project. Please call the Kingspan Insulation Technical Service Department (see rear cover) for assistance.*

### Metal Deck with no Ceiling

Insulant Thickness (mm)	U-value (W/m <sup>2</sup> ·K)
75	0.33
80	0.30
90	0.27
100	0.25
60+60	0.21
60+75	0.19
60+80	0.18
80+75	0.16

*NB There is a limit to the maximum thickness of Kingspan Therma<sup>roof</sup>™ TR21 that is available. In order to achieve low U-values two layers of insulation may be required. Where two layers are shown, the first thickness refers to the thickness laid directly onto the deck / vapour control layer, the second thickness to the overlay.*

### Dense Concrete Deck with Suspended Ceiling

Insulant Thickness (mm)	U-value (W/m <sup>2</sup> ·K)
65	0.34
70	0.32
75	0.30
80	0.27
90	0.25
60+50	0.22
60+60	0.20
60+75	0.18
60+85	0.16

*NB There is a limit to the maximum thickness of Kingspan Therma<sup>roof</sup>™ TR21 that is available. In order to achieve low U-values two layers of insulation may be required. Where two layers are shown, the first thickness refers to the thickness laid directly onto the deck / vapour control layer, the second thickness to the overlay.*

### Timber Deck with Plasterboard Ceiling

Insulant Thickness (mm)	U-value (W/m <sup>2</sup> ·K)
60	0.35
70	0.31
75	0.29
80	0.27
90	0.24
100	0.22
30+85	0.20
30+100	0.18
60+85	0.16

*NB There is a limit to the maximum thickness of Kingspan Therma<sup>roof</sup>™ TR21 that is available. In order to achieve low U-values two layers of insulation may be required. Where two layers are shown, the first thickness refers to the thickness laid directly onto the deck / vapour control layer, the second thickness to the overlay.*

## Sitework

### Vapour Control Layer

Metal decks and concrete decks should be primed in accordance with the appropriate manufacturers instructions prior to the application of the hot bitumen or suitable alternative proprietary adhesive system used to bond the vapour control layer to the deck. The specified vapour control layer should be continued 250 mm past the insulation abutting the parapet and sealed.

### Fixing over Metal Decks

On metal decks, *Kingspan Thermaroof™* TR21 should be laid into hot bitumen (max. temperature 240°C) mopped or poured over the vapour control layer. The boards should be laid break-bonded, either with the long edges at right angles to the trough openings or diagonally across the corrugation line. Whichever system is chosen, care must be taken to ensure that all joints are supported by the deck. The joints should be lightly butted.

### Fixing over Concrete Decks

Concrete decks should be clean, dry, without large projections, steps or gaps, and should be graded to allow correct falls to all rainwater outlets. To ensure an adequate bond between the vapour control layer and the concrete deck, the concrete or screeded surface should be suitably primed, in accordance with the specified manufacturer's instructions. The vapour control layer should be fully bonded to the deck and similarly the *Kingspan Thermaroof™* TR21 to the vapour control layer by laying into hot bitumen mopped or poured over the vapour control layer. The boards should be laid break-bonded with all joints lightly butted.

### Fixing over Plywood Decks

*Kingspan Thermaroof™* TR21 should be fully bedded in hot bitumen over a continuous vapour control layer which has been nailed or bonded to the deck with laps at the side and end sealed with hot bitumen. The boards should be laid break-bonded, either with the long edges at right angles to the edge or diagonally across the roof. Joints should be lightly butted.

### Fixing over Tongue & Groove Decks

On timber tongue and groove decks, the vapour control layer should be nailed. During the laying of *Kingspan Thermaroof™* TR21 the nail heads will become sealed in hot bitumen to the vapour control layer by the subsequent bonding of the roofboard. The *Kingspan Thermaroof™* TR21 is then applied as described under plywood decks.

### Fixing over Woodwool Decks

Woodwool decks should be clean and free of large projections, steps or gaps and should be graded to allow correct falls to all rainwater outlets. *Kingspan Thermaroof™* TR21 should be fully bedded in hot bitumen over a continuous vapour control layer. Boards should be laid diagonally across the roof, or with their long edges at right angles to the slabs. Board joints should not coincide with those of the slabs. The boards should be laid break-bonded, either with the long edges at right angles to the edge or diagonally across the roof. Joints should be lightly butted. Board joints should not coincide with those of the slabs.

### Fixing Two Layer Systems

In situations where two layers of insulation are required, both layers of insulation should be installed in the same manner, which varies according to the deck type (as detailed in the preceding five sections). In all cases, the two layers should be horizontally offset relative to each other so that no two board joints in the two layers coincide with each other.

### Reflective coatings

Bitumen based built up waterproofing systems laid over *Kingspan Thermaroof™* TR21 should always incorporate a solar reflective layer such as chippings or specialist coatings.

### Daily Working Practice

At the completion of each day's work, or whenever work is interrupted for extended periods of time, a night joint must be made in order to prevent water penetration of the roof construction.

### Cutting

Cutting 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 to achieve close-butting joints and continuity of insulation.

### Availability

*Kingspan Thermaroof™* TR21 is available through specialist insulation distributors and selected roofing merchants throughout the UK, Ireland and Europe.

### Packaging

The boards are supplied in labelled packs shrink-wrapped in polythene.

### Storage

The polythene packaging of Kingspan Insulation products should not be considered adequate for long term outdoor protection. Ideally, boards should be stored inside a building. If, however, outside storage cannot be avoided, then the boards should be stacked clear of the ground and covered with a polythene sheet or weatherproof tarpaulin. Boards that have been allowed to get wet should not be used.

### Health and Safety

Kingspan Insulation products are chemically inert and safe to use. A leaflet on this topic which satisfies the requirements set out in the Control of Substances Hazardous to Health Regulations 1988 (COSHH) is available from the Kingspan Insulation Marketing Department (see rear cover).

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

*NB PU adhesive must not be used either secure the *Kingspan Thermaroof™* TR21 or secure the waterproofing to *Kingspan Thermaroof™* TR21.*

# Therma<sup>roof</sup>™ TR21

## Product Description

### The Facings

*Kingspan Therma<sup>roof</sup>™ TR21* is faced on both sides with glass reinforced perforated cellulose autohesively bonded to the insulation core during manufacture.

### The Core

The core of *Kingspan Therma<sup>roof</sup>™ TR21* is a high performance CFC/HCFC-free rigid urethane insulant of typical density 32 kg/m<sup>3</sup>.

### CFC/HCFC-free

*Kingspan Therma<sup>roof</sup>™ TR21* is manufactured without the use of CFCs/HCFCs and has zero Ozone Depletion Potential (ODP).



## Product Data

### Standards and Approvals

*Kingspan Therma<sup>roof</sup>™ TR21* is manufactured to the highest standards in accordance with requirements of BS 4841-3 (Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building end-use applications. Specification for laminated boards (roofboards) with auto-adhesively or separately bonded facings for use as roofboard thermal insulation under built-up bituminous roofing membranes) and under quality control systems approved to BS EN ISO 9001: 2000 / I.S. EN ISO 9001: 2000 (Quality management systems. Requirements).

Its use is covered by BBA Certificate 06/4384.



Manufactured to BS EN ISO 9001: 2000  
Certificate No. 388



I.S. EN ISO 9001: 2000  
Registration No. 19.0633



### Standard Dimensions

*Kingspan Therma<sup>roof</sup>™ TR21* is available in the following standard size:

Nominal Dimension		Availability
Length	(m)	1.2
Width	(m)	0.6
Insulant Thickness	(mm)	Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

### Compressive Strength

The compressive strength of *Kingspan Therma<sup>roof</sup>™ TR21* typically exceeds 150 kPa at 10% compression and 125 kPa at 5% when tested to BS EN 826: 1996 (Thermal insulating products for building applications. Determination of compression behaviour).

### Water Vapour Resistance

Modified to include board facings, the boards achieve a resistance greater than 15 MN-s/g, when tested in accordance with BS 4370-2: 1993 (Methods of test for rigid cellular materials. Methods 7 to 9). *Kingspan Therma<sup>roof</sup>™ TR21* should always be installed over a vapour control layer (see 'Water Vapour Control' page 3).

### Durability

If correctly applied, *Kingspan Therma<sup>roof</sup>™ TR21* has an indefinite life. Its durability depends on the supporting structure and the conditions of its use.

### Resistance to Solvents, Fungi & Rodents

The insulation core is resistant to short-term contact with petrol and with most dilute acids, alkalis and mineral oils. However, it is recommended that any spills be cleaned off fully before the boards are installed. Ensure that safe methods of cleaning are used, as recommended by the suppliers of the spilt liquid. The insulation core is not resistant to some solvent-based adhesive systems, particularly those containing methyl ethyl ketone. Adhesives containing such solvents should not be used in association with this product. Damaged boards or boards that have been in contact with harsh solvents or acids should not be used.

The insulation core and facings used in the manufacture of *Kingspan Therma<sup>roof</sup>™ TR21* resist attack by mould and microbial growth, and do not provide any food value to vermin.

### Fire Performance

*Kingspan Therma<sup>roof</sup>™ TR21* when subjected to British Standard fire tests achieve the following typical results when waterproofed with 3 layer built-up felt and a loading coat of 10 mm chippings. For specifications without the chippings please consult the manufacturer of the mineral surfaced cap sheet for their fire classification details.

Further details on the fire performance of Kingspan Insulation products may be obtained from the Kingspan Insulation Technical Service Department (see rear cover).

Test	Result
BS 476-3: 1958 (External fire exposure roof test)	FAA rating

## Thermal Properties

The  $\lambda$ -values and R-values quoted are in accordance with the Harmonised European Standard BS EN 13165: 2001 (Thermal insulation products for buildings – Factory made rigid polyurethane foam (PUR) products – Specification) using so called 90 / 90 principles. Comparison with alternative products may not be appropriate unless the same procedures have been followed.

### Thermal Conductivity

The boards achieve a thermal conductivity ( $\lambda$ -value) of 0.027 W/m·K (insulant thickness < 80 mm) and 0.026 W/m·K (insulant thickness 80–119 mm).

### Thermal Resistance

Thermal resistance (R-value) varies with thickness and is calculated by dividing the thickness of the board (expressed in metres) by its thermal conductivity.

Product Thickness (mm)	Thermal Resistance (m <sup>2</sup> ·K/W)
30	1.10
50	1.85
60	2.20
65	2.40
70	2.55
75	2.75
80	3.05
85	3.25
90	3.45
100	3.80

Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

For thickness above 100 mm a double layer of insulation is required.

## The Kingspan Insulation Product Range

### The Kingspan Kooltherm® K-range

- With a thermal conductivity of 0.021–0.024 W/m·K CFC/HCFC-free rigid phenolic insulation is the most thermally efficient insulation product commonly available.
- Utilises the thinnest possible insulation board to achieve required U-values.
- Fire performance can be equivalent to mineral fibre.
- Achieves a Class 0 fire rating to the Building Regulations and Low Risk rating for the Technical Standards in Scotland.
- Achieves the best possible rating of < 5% smoke obscuration when tested to BS 5111: Part 1: 1974.
- CFC/HCFC-free with zero Ozone Depletion Potential (ODP).

### The Kingspan Therma™ Range

- With a thermal conductivity of 0.023–0.028 W/m·K CFC/HCFC-free rigid urethane insulation is one of the most thermally efficient insulation products commonly available.
- Easily achieves required U-values with minimum board thickness.
- Achieves the required fire performance for the intended application.
- CFC/HCFC-free with zero Ozone Depletion Potential (ODP).

### The Kingspan Styrozone® & Purlcrete® Ranges

- Rigid extruded polystyrene insulation (XPS) has the highest compressive strength of any commonly available insulant.
- Ideal for specialist applications such as inverted roofing and heavy-duty flooring.
- Easily achieves required U-values with minimum board thickness.
- Achieves the required fire performance for the intended application.
- CFC/HCFC-free with zero Ozone Depletion Potential (ODP).

### All Products

- Their closed cell structure resists both moisture and water vapour ingress – problems which can be associated with open cell materials such as mineral fibre and which can result in reduced thermal performance.
- Unaffected by air movement – problems that can be experienced with mineral fibre and which can reduce thermal performance.
- Safe and easy to install – non-fibrous.
- Provide reliable long term thermal performance over the lifetime of the building.

# Contact Details

## Customer Service

For quotations, order placement and details of despatches please contact the Kingspan Insulation Customer Service Department on the numbers below:

UK	- Tel:	+44 (0) 870 850 8555
	- Fax:	+44 (0) 870 850 8666
	- email:	commercial.uk@insulation.kingspan.com
Ireland	- Tel:	+353 (0) 42 97 54200
	- Fax:	+353 (0) 42 97 54299
	- email:	commercial.ie@insulation.kingspan.com

## Literature & Samples

Kingspan Insulation produces a comprehensive range of technical literature for specifiers, contractors, stockists and end users. The literature contains clear 'user friendly' advice on typical design; design considerations; thermal properties; sitework and product data.

Available as a complete Design Manual or as individual product brochures, Kingspan Insulation technical literature is an essential specification tool. For copies please contact the Kingspan Insulation Marketing Department on the numbers below:

UK	- Tel:	+44 (0) 870 733 8333
	- Fax:	+44 (0) 1544 387 299
	- email:	literature.uk@insulation.kingspan.com
Ireland	- Tel:	+353 (0) 42 97 54298
	- Fax:	+353 (0) 42 97 54299
	- email:	literature.ie@insulation.kingspan.com

## Tapered Roofing

For technical guidance, quotations, order placement and details of despatches please contact the Kingspan Insulation Tapered Roofing Department on the numbers below:

UK	- Tel:	+44 (0) 870 761 7770
	- Fax:	+44 (0) 1544 387 289
	- email:	tapered.uk@insulation.kingspan.com
Ireland	- Tel:	+353 (0) 42 97 54297
	- Fax:	+353 (0) 42 97 54296
	- email:	tapered.ie@insulation.kingspan.com

## Technical Advice / Design

Kingspan Insulation supports all of its products with a comprehensive Technical Advisory Service for specifiers, stockists and contractors.

This includes a computer-aided service designed to give fast, accurate technical advice. Simply phone the Kingspan Insulation Technical Service Department with your project specification. Calculations can be carried out to provide U-values, condensation / dew point risk, required insulation thicknesses etc... Thereafter any number of permutations can be provided to help you achieve your desired targets.

The Kingspan Insulation Technical Service Department can also give general application advice and advice on design detailing and fixing etc... Site surveys are also undertaken as appropriate.

Please contact the Kingspan Insulation Technical Service Department on the numbers below:

UK	- Tel:	+44 (0) 870 850 8333
	- Fax:	+44 (0) 1544 387 278
	- email:	techline.uk@insulation.kingspan.com
Ireland	- Tel:	+353 (0) 42 97 54297
	- Fax:	+353 (0) 42 97 54296
	- email:	techline.ie@insulation.kingspan.com

## General Enquiries

For all other enquiries contact Kingspan Insulation on the numbers below:

UK	- Tel:	+44 (0) 870 850 8555
	- Fax:	+44 (0) 870 850 8666
	- email:	info.uk@insulation.kingspan.com
Ireland	- Tel:	+353 (0) 42 97 54200
	- Fax:	+353 (0) 42 97 54299
	- email:	info.ie@insulation.kingspan.com

*Kingspan Insulation Ltd. reserves the right to amend product specifications without prior notice. Product thicknesses shown in this document should not be taken as being available ex-stock and reference should be made to the current Kingspan Insulation price-list or advice sought from Kingspan Insulation's Customer Service Department (see above left). The information, technical details and fixing instructions etc. included in this literature are given in good faith and apply to uses described. Recommendations for use should be verified as to the suitability and compliance with actual requirements, specifications and any applicable laws and regulations. For other applications or conditions of use, Kingspan Insulation offers a Technical Advisory Service (see above) the advice of which should be sought for uses of Kingspan Insulation products that are not specifically described herein. Please check that your copy of the literature is current by contacting the Kingspan Insulation Marketing Department (see left).*



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