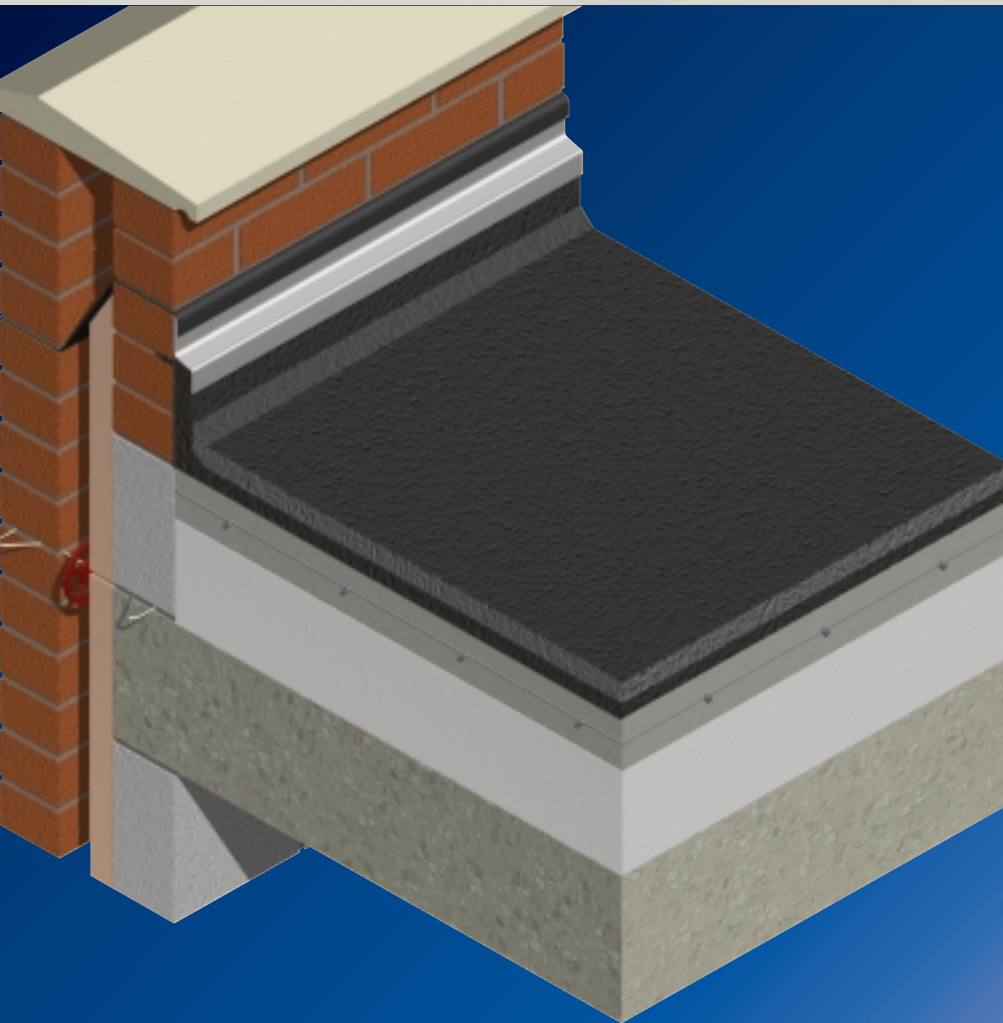


Styrozone[®]

PROTECTED MEMBRANE HEAVY DUTY CAR PARK DECKS



- High performance rigid extruded polystyrene insulation – thermal conductivity 0.029 – 0.036 W/m-K
- Protects waterproofing membrane
- Closed cell structure minimises water absorption
- High compressive strength withstands vehicle loads
- Withstands freeze / thaw cycling
- 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

H 350 R / H 500 R

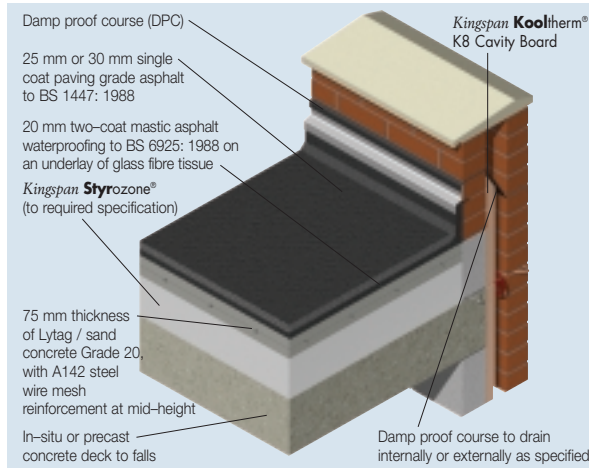


Figure 1 Concrete Slab Finish Parking Decks, Cars and Light Commercial Vehicles (Non HGV) (Maximum Individual Wheel Load – 1 Tonne)

H 350 R / H 500 R

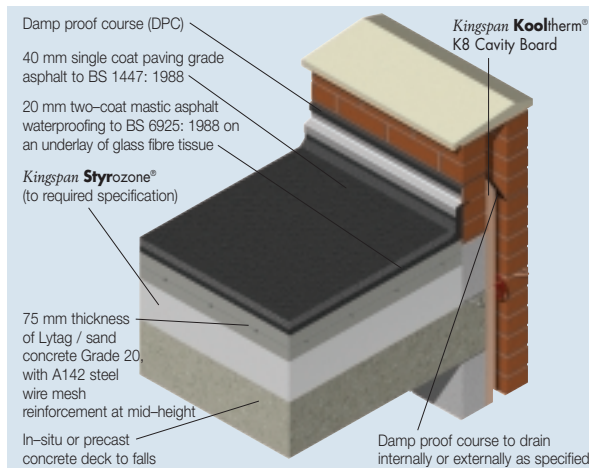


Figure 2 Concrete Slab Finish Loading Bays and Service Decks Commercial Vehicles (Design Should be Verified as to Suitability for Specific Wheel Loads)

H 500 R / N 700 R

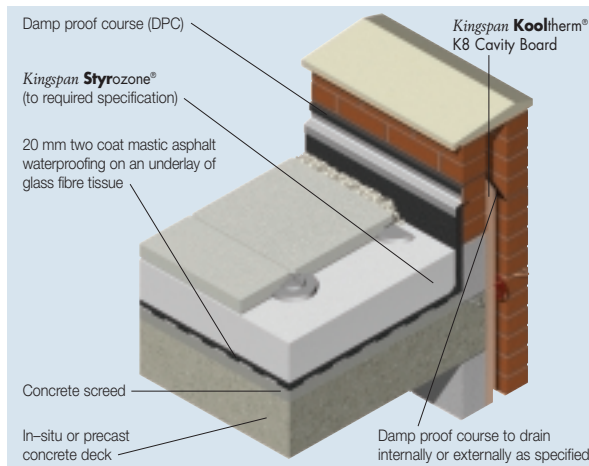


Figure 3 Paving Slab Finish

Specification Clause

Kingspan Styrozone® should be described in the specification as:-

The protected membrane roof insulation shall be *Kingspan Styrozone®* H 350 R / H 500 R / N 700 R comprising ___mm thick CFC/HCFC-free rigid extruded polystyrene insulation manufactured to BS EN ISO 9001: 2000 and shall be applied in accordance with the instructions issued by Kingspan Insulation Limited.

Details also available in NBS Plus.

NBS users should refer to clause(s):

J21 440, J41 440

(Standard and Intermediate)



Product Selection

Kingspan Styrozone® H 350 R and *Kingspan Styrozone®* H 500 R use a HFA blowing agent in compliance with the Montreal Protocol. The blowing agent has a zero Ozone Depletion Potential.

Kingspan Styrozone® H 350 R and *Kingspan Styrozone®* H 500 R have a compressive strength typically exceeding 300 and 500 kPa at 10% compression respectively.

Kingspan Styrozone® N 700 R uses a carbon dioxide blowing agent in compliance with the Montreal Protocol. The blowing agent has zero Ozone Depletion Potential.

Kingspan Styrozone® N 700 R has a compressive strength typically exceeding 700 kPa at 10% compression.

Design Considerations

General

This literature shows the use of *Kingspan Styrozone*[®] in a protected membrane roofing system for car park decks using both cast in situ concrete slab (Figure 1 & 2) and paving slab (Figure 3) finishes.

Protected membrane roofing systems place the insulation above the waterproof system 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, solar radiation, UV degradation and temperature extremes (both daily and seasonal). Extruded polystyrene with its closed cell structure and minimal water absorption is the only material suitable and approved for this application where it will be subject to wetting / drying and freeze / thaw cycles.

Within the *Kingspan Styrozone*[®] range three grades are available for car park deck applications – *Kingspan Styrozone*[®] H 350 R, *Kingspan Styrozone*[®] H 500 R and *Kingspan Styrozone*[®] N 700 R. These grades encompass the properties required for specifications ranging from cars and light commercial vehicles to loading bays and service decks for heavy goods vehicles. Please contact the Kingspan Insulation Technical Service Department (see rear cover) for further information. Insulation systems can be designed to maintain a protected membrane roofing system or to utilise a combined waterproof and traffic wearing asphalt.

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:

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

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.

Wearing Surface

Data on specific concentrated loads is contained in BS 6399-1: 1996 (Loading for buildings. Code of practice for dead and imposed loads). Department of Transport departmental standard BD 21 / 84 gives typical single wheel loads, depending on the type of vehicle, that act over a 150 mm square or 170 mm diameter contact area. The tyre pressure is taken as 1.1 N/mm², in practice real tyre pressures are lower than this thus giving a lower load intensity.

Vehicle type (weight in tonnes)	Nominal single wheel load (kN)
Cars and vans (<3)	25
Vehicles generally (3-7.5)	50
Vehicles generally (7.5-40)	100
Fire engines (up to 60 kN axle load)	30
Fire engines (up to 120 kN axle load)	60

Roof Structure

Whilst almost any form of roof deck (timber, metal or concrete) can be used with protected membrane roofing systems, the traffic load and additional dead load from the ballast layer invariably limits this type of roof to concrete decks.

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 the use of 150 mm concrete deck, 50 mm screed and mastic asphalt waterproofing with paving slab finish. If your construction is any different please contact the Kingspan Insulation Technical 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 When calculating U-values using the combined method as detailed in BS / I.S. EN ISO 6946: 1997, the type of mechanical fixing used may change the thickness of insulation required. The effect of fixings has been ignored for the purposes of these calculations. Please contact the Kingspan Insulation Technical Service Department (see rear cover) for project calculations.

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 contact the Kingspan Insulation Technical Service Department (see rear cover) for assistance.

The tables below are valid for the use of **Kingspan Styrozone® H 350 R**, **Kingspan Styrozone® H 500 R** and the **Kingspan Styrozone® N 700 R** as shown in the figures on page 2.

Concrete Slab Finish – Figures 1 + 2

Insulant Thickness (mm) H 350 R / H 500 R	U-value (W/m ² ·K)
30	0.70
50	0.47
60	0.40
80	0.32
100	0.26
120	0.22
140	0.20
160	0.18
170	0.16

NB at greater thicknesses it may prove more cost effective to use a double layer system of thinner boards.

For U-values greater than 0.16 W/m²·K please contact the Kingspan Insulation Technical Service Department (see rear cover).

Paving Slab Finish for use with Kingspan Styrozone® H 500 R – Figure 3

Insulant Thickness (mm) H 500 R	U-value (W/m ² ·K)
30	0.83
50	0.56
60	0.49
80	0.38
100	0.31
120	0.27
140	0.24
160	0.21
170	0.20
190	0.19
200	0.18
220	0.16

NB at greater thicknesses it may prove more cost effective to use a double layer system of thinner boards.

For U-values greater than 0.16 W/m²·K please contact the Kingspan Insulation Technical Service Department (see rear cover).

Paving Slab Finish for use with Kingspan Styrozone® N 700 R – Figure 3

Insulant Thickness (mm) N 700 R	U-value (W/m ² ·K)
50	0.66
100	0.38
150	0.27
200	0.21
250	0.17
300	0.14

NB at greater thicknesses it may prove more cost effective to use a double layer system of thinner boards.

Sitework

General

Prior to installing the insulation it is essential to ensure that the waterproofing system has been installed correctly and that the roof is watertight and clean. 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. Existing roofs should be swept clean and any loose gravel chippings removed, if the chippings are bonded, a foamed polyethylene cushion layer should be used prior to laying the insulation.

Filtration and cushioning membranes should be installed in accordance with recommendations above depending upon the insulation and ballast system used. The boards should be laid tightly butted and there must be no gaps where they meet upstands, rooflights etc. The boards are easily cut and shaped using a fine toothed saw, sharp knife or a rasp.

Start laying the boards from the point of access to the roof and as soon as possible apply the ballast layer. This ensures that the waterproof membrane is always protected and excessive heat build up or high winds do not damage boards. Ensure that ballast awaiting laying is not concentrated in one area where it may overload the roof structure.

Kingspan Styrozone[®] insulation boards can be laid in any weather, but due to the light weight of the boards care must be taken in windy conditions.

Cast In-situ Concrete Slab

A 25 mm layer of washed, rounded gravel, nominal 6 mm diameter, is laid on a filtration membrane laid on the insulation boards. A building paper is then loose laid on to gravel, this prevents mixing of the concrete and gravel during placing and compaction. The reinforcement can then be fixed and the concrete placed and compacted in accordance with BS 8110-1: 1997 (Structural use of concrete. Code of practice for design and construction).

Paving Slab Ballast

Paving slabs, minimum 50 mm thick, are laid on proprietary paving slab supports of minimum diameter 175 mm (or equivalent base area) in order to maintain drainage below the slabs and to ensure that moisture vapour can escape.

Site Protection

Where the roof deck is to be used by other trades as a working platform after the *Kingspan Styrozone*[®] has been laid, the roof should be close-boarded to prevent any damage to the completed deck.

Site Practice

On completion the roof should be swept clean and all contractual equipment or debris removed.

Availability

Kingspan Styrozone[®] is available through specialist insulation distributors and selected builders merchants throughout Britain and Ireland.

Packaging

Depending on quantity, the boards are supplied in labelled packs shrink-wrapped in polythene.

Storage

The packaging of *Kingspan Styrozone*[®] should not be considered adequate for long term outside protection.

Kingspan Styrozone[®] should be stored flat in a ventilated area and protected generally from accidental damage, contact with volatile solvents, flames and extended exposure to UV and sunlight. If it is stored outside for more than a few weeks, it must be covered with a pale pigmented plastic sheet.

Kingspan Styrozone[®] should not be left in the sun covered by either a transparent or a dark plastic sheet, since in both cases, board temperatures can build up to a level hot enough to appreciably alter their dimensions or warp them.

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.

Product Description

Composition

Kingspan Styrozone® H 350 R, H 500 R and N 700 R are high performance rigid extruded polystyrene insulants of typical density 30, 35 and 45 kg/m³ respectively, with a smooth, dense skin on both faces.

CFC/HCFC-free

Kingspan Styrozone® is manufactured without the use of CFCs/HCFCs and has zero Ozone Depletion Potential (ODP).



Product Data

Standards and Approvals

Kingspan Styrozone® is manufactured to the highest quality standards under a quality management system which complies with the requirements of BS EN ISO 9001: 2000 (Quality management systems. Requirements).



Manufactured to BS EN ISO 9001: 2000

Standard Dimensions

Kingspan Styrozone® H 350 R, H 500 R and N 700 R are available in the following standard size:

Nominal Dimension	Availability
Length (m)	1.25
Width (m)	0.6
Insulant Thickness (mm)	Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.
Edge Profile	Rebated to all four edges

Compressive Strength

The compressive strengths of *Kingspan Styrozone*® H 350 R, H 500 R and N 700 R typically exceed 300, 500 and 700 kPa respectively at 10% compression when tested to BS EN 826: 1996 (Thermal insulating products for building applications. Determination of compression behaviour).

Thermal Expansion

The linear thermal expansion coefficient of *Kingspan Styrozone*® is 0.07 mm/m·K when tested to BS 4370-3: 1988 (2002) (Methods of test for rigid cellular materials. Method 13).

Water Vapour Resistivity

The boards achieve a resistivity greater than 825 MN·s/gm when tested in accordance with BS EN 12086: 1997 (Thermal insulating products for building applications. Determination of water vapour transmission properties).

Absorption of Moisture

Kingspan Styrozone® is highly resistant to water absorption. Boards are very resistant to the passage of water vapour and are unaffected by repeated freeze / thaw cycles.

Durability

Properly installed, *Kingspan Styrozone*® boards have a service life comparable with that of the building or structure.

Resistance to Solvents, Fungi & Rodents

Kingspan Styrozone® boards are resistant to most commonly occurring construction materials such as lime, cement, plaster, anhydrous gypsum, solvent-free bituminous compounds, water-based wood preservatives, as well as alcohols, acids and alkalis. Certain organic materials such as solvent-based wood preservatives, coal tar and derivatives (creosote), paint thinners and common solvents (e.g. acetone, ethyl acetate, petrol, toluene and white spirit) will attack *Kingspan Styrozone*®, resulting in softening, shrinkage and possible dissolution, with a consequent loss of performance.

Kingspan Styrozone® does not provide any food value to vermin and is not normally attractive to them.

Fire Performance

Kingspan Styrozone® meets Euroclass E requirement. See BS EN 13164: 2001 Fire Classification Reaction to Fire.

When tested in accordance with the requirements of DIN 4102 – B1 is obtained – not readily ignitable.

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

Maximum Service Temperature

Kingspan Styrozone® should not be brought into direct contact with high temperature heat sources. The maximum service temperature of *Kingspan Styrozone*® is 75°C.

Thermal Properties

The declared λ -values and R-values quoted are in accordance with the Harmonised European Standard BS / I.S. EN 13164: 2001 (Thermal insulation products for buildings – Factory made products of extruded polystyrene (XPS) – 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 declared thermal conductivity (λ -value) of *Kingspan Styrozone*® H 350 R and H 500 R is 0.029 W/m·K (insulant thickness \leq 120 mm), 0.031 W/m·K (insulant thickness $>$ 120 mm). The declared thermal conductivity (λ -value) of *Kingspan Styrozone*® N 700 R is 0.036 W/m·K (insulation thickness \leq 50 mm).

Thermal Resistance

The declared thermal resistance (R-value), varies with thickness and is calculated by dividing the thickness of the individual element (expressed in metres) by its thermal conductivity.

Insulant Thickness (mm)	Thermal Resistance (m ² ·K/W)
	H 350 R and H 500 R
80	2.75
100	3.40
120	4.10
140	4.80
160	5.50

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

For thickness above 120 mm a double layer of insulation is required.

Insulant Thickness (mm)	Thermal Resistance (m ² ·K/W)
	N 700 R
50	1.35
100	2.75
150	4.15
200	5.55

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

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

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– 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
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– 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
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– 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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