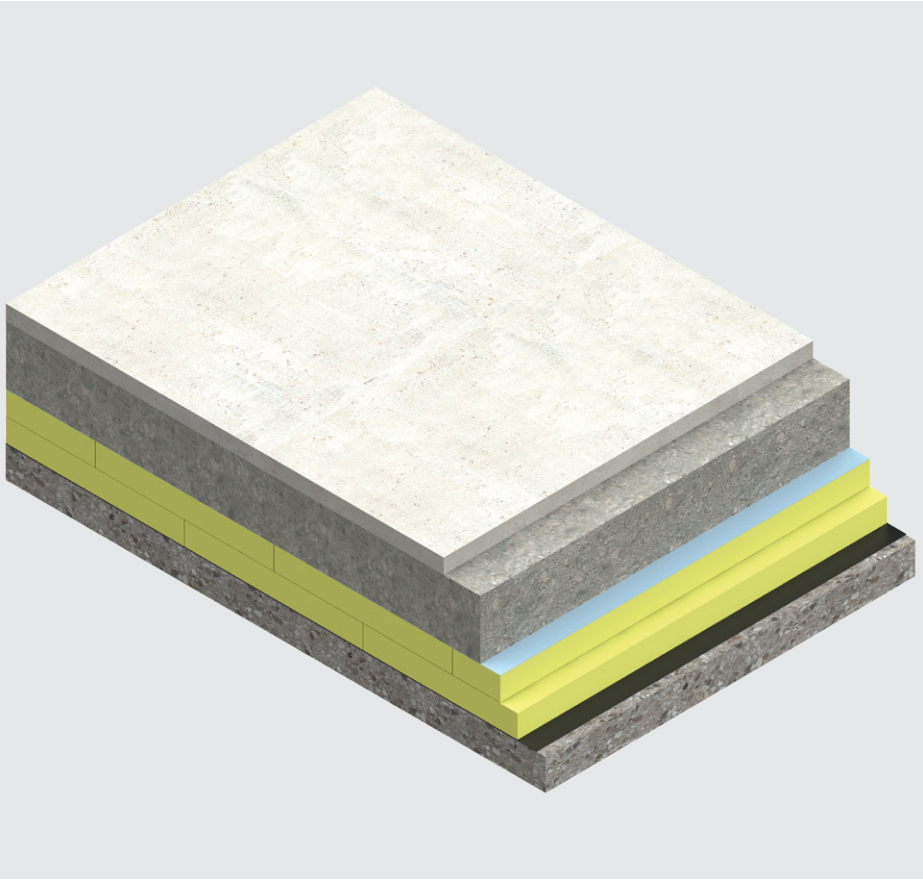
Seventh Issue | 08/2024

Kingspan GreenGuard® Heavy Duty Floors

Insulation for heavy duty commercial, industrial and cold store flooring



- Rigid extruded polystyrene insulation - thermal conductivities as low as 0.033 W/mK
- High compressive strength - available in a number of grades to suit a range of service loads
- Resistant to ground moisture penetration
- Unaffected by air infiltration
- Easy to handle and install
- Ideal for new build and refurbishment

Kingspan®

Typical constructions and U-values

Assumptions

The U–values in the tables that follow have been calculated using the method detailed in BS EN ISO 13370: 2017 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods), and using the conventions set out in BR 443 (Conventions for U-value calculations). They are valid for the constructions shown in the details immediately above each table.

Unlike roofs, walls and intermediate floors, U-value calculations for basement floors cannot be calculated with reference to the construction detail alone. Heat loss from basement floors depends upon the ratio of exposed floor perimeter to the total floor area, the thickness of the basement wall and depth of the basement.

Floor dimensions should be measured between the finished internal surfaces of the external walls. Non-usable heated space such as ducts and stairwells should be included when determining the area of the floor. Unheated spaces outside of the insulated fabric, such as attached garages or porches, should be excluded when determining the area of the floor, but the length of the wall between the heated building and the unheated space should be included when determining the perimeter. The floor dimensions of semi-detached, terraced or other joined premises / dwellings can be taken either as those of the premises / dwelling itself or those of the whole building. Where extensions to existing buildings are under consideration, the floor dimensions should be taken as those of the extension.

If the P/A ratio lies between two of the numbers shown in the tables to follow, for a safe estimate, please use the P/A ratio shown that is the next highest i.e. for 0.57 use 0.6.

For buildings with relatively small ground floor areas (primarily domestic properties), if the ground floor is left uninsulated, the thermal performance will be poor. To enhance the thermal performance, complete insulation of the ground floor should be adopted (Figure 1).

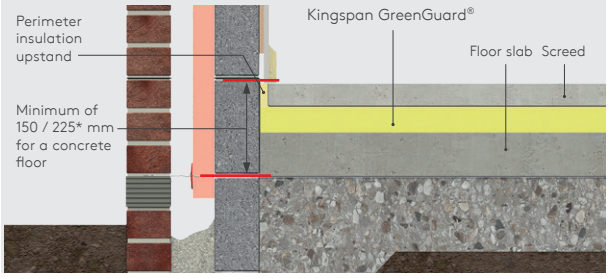


Figure 1 - Complete concrete floor insulation

For buildings with large ground floor areas, complete insulation of the ground floor may be unnecessary. Insulating the perimeter in a 1.2 metre wide strip may provide adequate thermal performance (Figure 2). For further advice on the width of the perimeter insulation please contact the Kingspan Insulation Technical Service Department.

Calculations in the tables that follow assume complete insulation of the floor area, please contact the Kingspan Insulation Technical Service Department for calculations with perimeter insulation only.

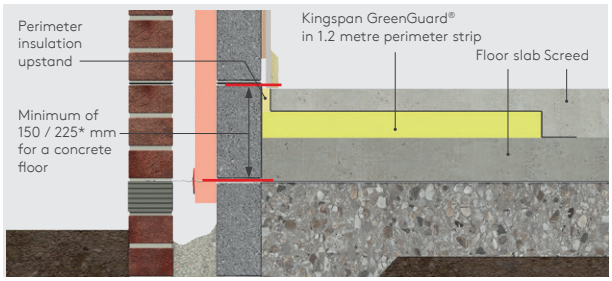


Figure 2 - Perimeter strip concrete floor insulation

NB The figures quoted are for guidance only. A detailed U-value calculation should be completed for each project.

NB For the purposes of these calculations, using the method as detailed in BS EN ISO 13370: 2017 / I.S. EN ISO 13370: 2007, the soil has been assumed to be sand or gravel, the wall insulation is assumed to overlap the floor insulation by minimum 150 / 225* mm, and the standard of workmanship has been assumed good, and therefore the correction factor for air gaps has been ignored.

NB If your construction is different from those specified, and / or to gain a comprehensive U-value calculation for your project, please consult the Kingspan Insulation Technical Service Department for assistance (see rear cover).

NB These calculations were completed on the assumption that the insulation present in the floor construction is installed above the damp proof membrane, therefore declared thermal conductivity values were used.

NB For guidance regarding the routes to compliance for meeting the fire safety requirements of the Building Regulations / Standards, refer to the relevant Technical Bulletins and links to Government websites at **www.kingspaninsulation.co.uk/fireregulations** (for GB) or contact technical services at **technical@kingspaninsulation.ie** (for Ireland).

* 150 mm applies to the UK and 225 mm to the Republic of Ireland.

U-value table key

Further information on the applicable notional and area weighted average U-values is available in the relevant geographical documentation:

- Approved Documents L to the Building Regulations for England;
- Approved Documents L to the Building Regulations for Wales;
- Technical Handbooks Section 6 to the Building Standards for Scotland;
- Technical Booklets F1 & F2 to the Building Regulations for Northern Ireland; and
- Technical Guidance Document L (Dwellings) and Technical Guidance Document L (Buildings other than Dwellings) to the Building Regulations for the Republic of Ireland.

Typical constructions and U-values

Solid concrete ground floors

Medium compressive loads

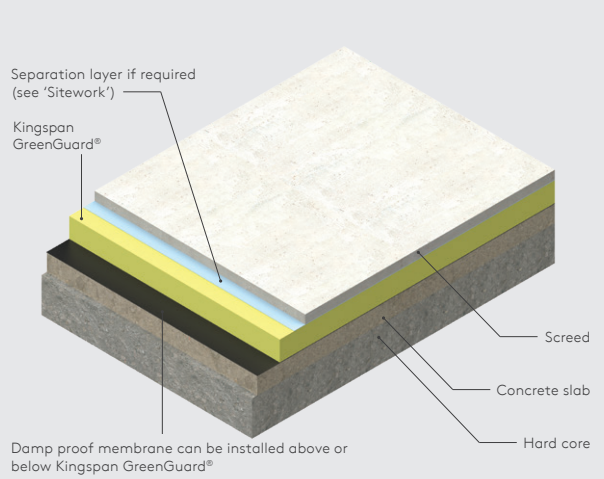


Figure 3

U-values (W/m²K) for various thicknesses of Kingspan GreenGuard® GG300* and floor perimeter / area ratios					
Insulant thickness (mm)	Perimeter / area (m^{-1})				
	0.1	0.2	0.3	0.4	0.5
30	0.16	0.24	0.30	0.35	0.39
40	0.15	0.22	0.28	0.32	0.34
50	0.14	0.21	0.25	0.29	0.31
60	0.13	0.20	0.24	0.26	0.28
80	0.12	0.17	0.20	0.22	0.24
90 (50 + 40)	0.12	0.16	0.19	0.21	0.22
100	0.11	0.16	0.18	0.20	0.21
110 (60 + 50)	0.11	0.15	0.17	0.18	0.20
120	0.10	0.14	0.16	0.17	0.18
130 (80 + 50)	0.10	0.14	0.15	0.17	0.17
150	0.09	0.13	0.13	0.15	0.16
160 (80 + 80)	0.09	0.12	0.13	0.14	0.15
170 (120 + 50)	0.09	0.12	0.12	0.14	0.14
180	0.09	0.11	0.12	0.13	0.14
190 (150 + 40)	0.08	0.11	0.12	0.13	0.13
200 (100 + 100)	0.08	0.10	0.12	0.12	0.13
210 (150 + 60)	0.08	0.10	0.11	0.12	0.12
220 (120 + 100)	0.08	0.10	0.11	0.11	0.12
230 (150 + 80)	0.08	0.09	0.10	0.11	0.11
240 (120 + 120)	0.07	0.09	0.10	0.11	0.11
250 (150 + 100)	0.07	0.09	0.10	0.10	0.11
270 (150 + 120)	0.07	0.08	0.09	0.10	0.10
280 (100 + 180)	0.07	0.08	0.09	0.09	0.10
300 (150 + 150)	0.06	0.08	0.09	0.09	0.09
320 (100 + 100 + 120)	0.06	0.08	0.08	0.08	0.09
340 (100 + 120 + 120)	0.06	0.07	0.08	0.08	0.08
360 (180 + 180)	0.06	0.07	0.07	0.08	0.08

* The above table contains figures for Kingspan GreenGuard® GG300 only. Please consult the Kingspan Insulation Technical Service Department (see rear cover) or U-value Calculator for calculations for other products in the range.

NB Where multiple layers of insulation of different thicknesses are used, the thickest layer should be installed as the outermost layer in the construction.

NB If the insulation is installed below the damp proof membrane then design thermal conductivty values should be used for the purposes of U-value calculations.

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

High to severe compressive loads

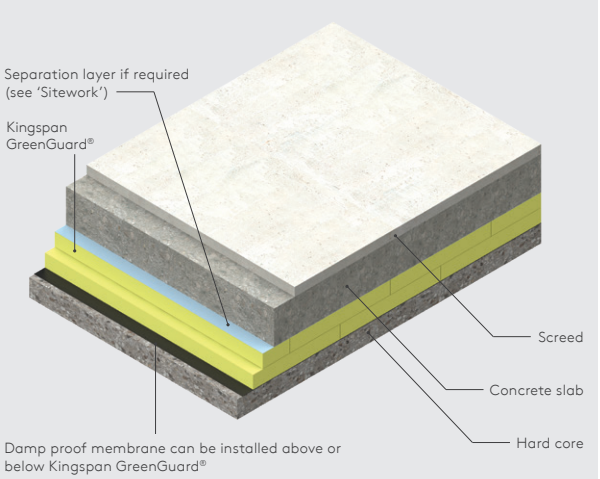


Figure 4

U-values (W/m²K) for various thicknesses of Kingspan GreenGuard® and floor perimeter / area ratios					
Insulant thickness (mm)	Perimeter / area (m^{-1})				
	0.1	0.2	0.3	0.4	0.5
Kingspan GreenGuard® GG500*					
50	0.17	0.25	-	-	-
80	0.15	0.21	0.24	-	-
100	0.14	0.18	0.21	0.23	0.24
130 (80 + 50)	0.12	0.16	0.17	0.19	0.20
150 (100 + 50)	0.11	0.14	0.16	0.17	0.18
160 (80 + 80)	0.11	0.14	0.15	0.16	0.17
180 (100 + 80)	0.10	0.13	0.14	0.15	0.16
200 (100 + 100)	0.10	0.12	0.13	0.14	0.14
230 (100 + 80 + 50)	0.09	0.11	0.12	0.12	0.13
260 (100 + 80 + 80)	0.08	0.10	0.11	0.11	0.12
270 (150 + 120)	0.08	0.10	0.10	0.11	0.11
280 (100 + 100 + 80)	0.08	0.09	0.10	0.11	0.11
300 (100 + 100 + 100)	0.08	0.09	0.10	0.10	0.10
Kingspan GreenGuard® GG700*					
60	0.16	0.23	-	-	-
80	0.15	0.20	0.23	-	-
100 (50 + 50)	0.13	0.18	0.20	0.22	0.24
120 (60 + 60)	0.12	0.16	0.18	0.20	0.21
140 (80 + 60)	0.12	0.15	0.17	0.18	0.18
160 (80 + 80)	0.11	0.14	0.15	0.16	0.17
180 (80 + 50 + 50)	0.10	0.13	0.14	0.15	0.15

* The above table contains figures for Kingspan GreenGuard® GG500 and Kingspan GreenGuard® GG700 only. Please consult the Kingspan Insulation Technical Service Department (see rear cover) or U-value Calculator for calculations for other products in the range.

NB Where multiple layers of insulation of different thicknesses are used, the thickest layer should be installed as the outermost layer in the construction.

NB If the insulation is installed below the damp proof membrane then design thermal conductivty values should be used for the purposes of U-value calculations.

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

Typical constructions and U-values

Heat loss and linear thermal bridging

Basic principles

Linear thermal bridging describes the heat losses that occur at junctions between elements, which is additional to the losses occurring through roofs, walls and floors. This heat loss is represented by the junction's psi (ψ) value. The lower the ψ-value, the better the performance of a junction detail. The ψ-values and lengths of linear thermal bridges are accounted for in whole building energy and carbon dioxide emissions calculations.

In a typical wall-to-ground floor junction the heat will flow through the easiest path, for example in a masonry cavity wall the linear thermal bridge is primarily the inner leaf of masonry and in a timber frame wall the linear thermal bridge is primarily the sole plate and the construction below it. These linear thermal bridges can be reduced by increasing the distance that the heat has to travel.

Approved details, such as the Accredited Construction Details (England & Wales / Scotland / Northern Ireland) and Acceptable Construction Details (Republic of Ireland), collectively referred to here as ACDs, can uplift performance to provide a clear starting point towards achieving compliance, but they are limited in scope and applicability. The greatest opportunity for mitigating the impact of linear thermal bridges can come from following accurately 'modelled' details that take into account the following design considerations.

Reducing linear thermal bridging

Detailing at junctions to minimise the effects of thermal bridging and the associated risk of condensation or mould growth is important and there are some simple design considerations that can be adopted to help mitigate the risks and to reduce heat losses.

- Care is required to ensure continuation of insulation wherever possible between the wall for best thermal performance. Where this is not possible, the insulation should be overlapped and ideally, insulation material introduced between.
- In order to minimise cold bridging at the edge of the floor, the distance between the top surface of the floor insulation or perimeter insulation upstand, and the bottom of the wall insulation must be a minimum of 150 / 225* mm for a concrete floor (see Figures 1 & 2). The further down the wall insulation extends past the floor insulation, the better the thermal performance of the junction between the wall and the floor.

* 150 mm applies to the UK and 225 mm to the Republic of Ireland.

- Perimeter upstand insulation helps to reduce heat losses from the junction between the floor and external walls. The upstand insulation helps to increase the distance that the heat has to travel in order to escape through the junction, which therefore helps to reduce heat loss. Omitting this, or using a poorer performing insulation, can increase these losses.
- Using better thermally performing 'lightweight' aggregate blockwork for the inner leaf of cavity walls in adjacency to the junction with the floor can assist with lowering heat losses from the junction.
- An internal lining of insulation on the warm side of the construction can help to reduce the heat losses through the junction. The internal lining could be a wall lining for the whole wall area, such as Kingspan Kooltherm® K118 Insulated Plasterboard, or could be localised insulation behind the plasterboard to help reduce a junction's losses.
- One of the best approaches to minimising cold bridging is use external wall insulation, making the whole wall and any junctions warm, with suitable wall insulation at the junction with the ground floor extending past the level of the floor insulation below ground level.

For further advice on details to reduce linear thermal bridging please contact the Kingspan Insulation Technical Service Department (see rear cover for details).

Design considerations

Responsible sourcing

Kingspan GreenGuard® GG300 and GG500 produced at Kingspan Insulation's Selby (North Yorkshire) manufacturing facility is manufactured under a management system certified to ISO 14001: 2015.

NB The above information is correct at the time of writing. Please confirm at the point of need by visiting the Kingspan Insulation website from which copies of Kingspan Insulation's certificates can be obtained.

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 neighbouring communities.

A report covering the sustainability and responsibility of Kingspan Insulation Ltd's operations at its Pembridge (Herefordshire) and Selby (North Yorkshire) manufacturing facilities is available upon request from **literature@kingspaninsulation.co.uk**.

Specification clause

Kingspan GreenGuard® should be described in specification as:–

The floor insulation shall be Kingspan GreenGuard® GG300 / GG500 / GG700 (delete as appropriate) _____ mm thick: comprising rigid extruded polystyrene insulation. The product shall be manufactured under a management system certified to ISO 9001: 2015, ISO 14001: 2015, ISO 45001: 2018 and ISO 50001: 2018 and installed in accordance with the instructions issued by Kingspan Insulation Limited.

Product classifications

Uniclass UK

Pr_25_71_63_29 Extruded polystyrene (XPS) boards

CAWS

GG300, GG500 and GG700

E20/200, M10/290, M10/40, M13/260, M13/40

GG500

J42/12

GG700

K11/115, K11/125, K11/135, K11/145, K11/20 , K11/215, K11/225, K11/235, K11/25, K11/295, M10/290, M10/40, M13/260, M13/40

Details also available at the **NBS Source**.

Building Information Modelling (BIM)

BIM objects for Kingspan GreenGuard GG300, GG500 and GG700 can be downloaded using the Kingspan BIM Designer Software Tool available at: **www.kingspaninsulation.co.uk**.

Product selection

Un-reinforced floor screeds can be used in conjunction with Kingspan GreenGuard® in most applications. The high compressive strength of Kingspan GreenGuard® makes it particularly suitable for use where floor loads are to be severe.

Consideration must be given to which Kingspan GreenGuard® product is most appropriate for the required application. A table of the key distinguishing features is shown below.

Product	Thermal conductivity (W/mK)	Compressive strength (kPa)
Kingspan GreenGuard® GG300	0.033 W/mK (30 - 180 mm)	300
Kingspan GreenGuard® GG500	0.034 W/mK (50 mm) 0.036 W/mK (80 and 100 mm)	500
Kingspan GreenGuard® GG700	0.035 W/mK (50, 60 and 80 mm)	700

Design standards

Consideration should be given to the recommendations of BS 8102: 2022 (Code of practice for protection of structures against water from the ground), BS 8215: 1991 (Code of practice for design and installation of damp proof courses in masonry construction) and the information given in Building Research Establishment Digest 104 (Floor Screeds).

Compressive loads

Kingspan GreenGuard® GG300 is suitable for use in floors with low and medium service loads e.g. domestic and industrial flooring applications such as cold stores.

Kingspan GreenGuard® GG500 is particularly suited for use in industrial floor constructions with relatively high compressive service loads, such as car parks.

Kingspan GreenGuard® GG700 is particularly suited for use in floors with considerable service loads, such as aircraft hangers.

Sitework

Installation below a floor slab

- The site should be prepared and foundations, where appropriate, built to damp proof course (DPC) level.
- A thin sand blinding may be used to achieve a continuous level surface free from projections over rolled hardcore.
- The damp proof membrane (minimum 300 micron / 1200 gauge polythene) should be laid with joints well lapped and folded, to prevent the passage of ground water, either directly over the well compacted hardcore prior to laying the insulation boards, or over the insulation boards.
- The membrane should be brought up the surrounding foundation walls until it is sufficiently above the height of the wall DPC so that it will connect with or form the DPC.
- The insulation boards should always be loose-laid break-bonded, with joints lightly butted.
- If two or more layers of insulation are required, they should be horizontally offset relative to each other so that, as far as possible, the board joints in any two adjacent layers do not coincide with each other (see Figure 5).

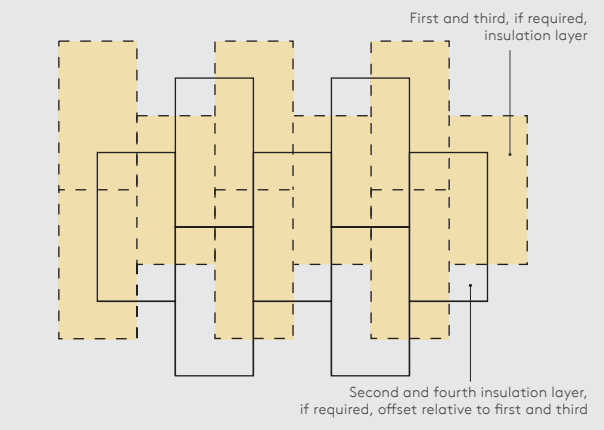


Figure 5 - Offsetting of multiple insulation layers

- A strip of rigid insulation board (minimum 20 mm thick) should be placed vertically around the perimeter of the floor slab in order to prevent cold bridging. The top of the strip of insulation board should be level with the top of the floor screed and the bottom should be level with the bottom of the horizontal floor insulation, and closely butted up to it.
- If the damp proof membrane is laid directly onto the hardcore below the insulation boards, the boards should be overlaid with a polythene sheet (not less than 125 micron / 500 gauge), to prevent the wet concrete penetrating the joints between the boards, and to act as a vapour control layer. Ensure the polythene sheet has 150 mm overlaps, taped at the joints, and is turned up 100 mm at the walls.
- The subsequent installation of the concrete slab and screed or other flooring material is carried out in a manner similar to that for an un-insulated floor. The concrete slab and screed should be allowed to dry out prior to the installation of the floor finish.

Installation below a floor screed

- Concrete slabs should be allowed to dry out fully prior to the installation of the insulation boards (average 1 day per mm of slab thickness).
- The surface of the slab should be smooth, flat and free from projections. Rough cast slabs should be levelled using a thin sand blinding to ensure boards are continuously supported.
- The damp proof membrane (minimum 300 micron / 1200 gauge polythene) should be laid with joints well lapped and folded, to prevent the passage of ground water, either directly over the floor slab prior to laying the insulation boards, or over the insulation boards.
- The membrane should be brought up the surrounding foundation walls until it is sufficiently above the height of the wall DPC so that it will connect with or form the DPC.
- The insulation boards should always be loose-laid break-bonded, with joints lightly butted.
- If two or more layers of insulation are required, they should be horizontally offset relative to each other so that, as far as possible, the board joints in any two adjacent layers do not coincide with each other (see Figure 5).
- A strip of rigid insulation board (minimum 20 mm thick) should be placed vertically around the perimeter of the floor slab in order to prevent cold bridging. The top of the strip of insulation board should be level with the top of the floor screed and the bottom should be level with the bottom of the horizontal floor insulation, and closely butted up to it.
- Insulation boards should be overlaid with a polythene sheet (not less than 125 micron / 500 gauge), to prevent the wet screed penetrating the joints between the boards, and to act as a vapour control layer. Ensure the polythene sheet has 150 mm overlaps, taped at the joints, and is turned up 100 mm at the walls.
- Use sand and cement screed laid to a minimum thickness of 75 mm.

Wheeled / foot traffic

- Ensure boards are protected during installation from wheeled / foot traffic by using scaffold planks or other protective measures.

Sitework

General

Cutting

- Cutting should be carried out either by using a fine toothed saw, a hot wire system or by scoring with a sharp knife and snapping the board over a straight edge.
- Ensure accurate trimming to achieve close-butting joints and continuity of insulation.

Availability

- Kingspan GreenGuard® is available through specialist insulation distributors and selected builders merchants throughout the UK and Ireland.

Packaging and storage

- Kingspan GreenGuard® may be delivered in packaging bearing alternative product branding.
- The polyethylene packaging of Kingspan Insulation products, which is recyclable, should not be considered adequate for outside protection.
- Ideally, boards should be stored inside a well ventilated building. If, however, outside storage cannot be avoided, then the boards should be stacked clear of the ground and covered with a pale pigmented polythene sheet or weatherproof tarpaulin.
- Kingspan GreenGuard® 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 Safety Information Data Sheet for this product is available from the Kingspan Insulation website **www.kingspaninsulation.co.uk/safety or www.kingspaninsulation.ie/safety**.

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

Product details

Composition

Kingspan GreenGuard® GG300, GG500 and GG700 are rigid extruded polystyrene insulants with a fibre-free core. They are manufactured with smooth, dense skins on both faces.

Standards and approvals

Kingspan GreenGuard® GG300 and GG500 are manufactured in accordance with the requirements of BS EN 13164: 2012 + A1: 2015 (Thermal insulation products for buildings. Factory made extruded polystyrene from (XPS) products. Specification).

Kingspan GreenGuard® GG300 and GG500 produced at Kingspan Insulation's Selby (North Yorkshire) manufacturing facility is manufactured to the highest standards under a management system certified to ISO 9001: 2015 (Quality management systems), ISO 14001: 2015 (Environmental Management Systems), ISO 45001: 2018 (Occupational Health and Safety Management Systems), ISO 50001: 2018 (Energy management systems) and ISO 37301: 2021 (Compliance management systems).

Standard dimensions

All products in the Kingspan GreenGuard® range are available in the following standard size:

Nominal dimension		Availability
Length	(mm)	1250 (and 2500 for GG300)
Width	(mm)	600
Insulant thickness	(mm)	Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.
Edge profile		Rebated (straight edge also available for GG300)

NB Please contact the Kingspan Insulation Technical Service Department (see rear cover) for information on rebated edge profiles.

Compressive strength

The compressive strength of Kingspan GreenGuard® products typically exceeds the following values:

Kingspan GreenGuard® GG300 - 300 kPa;

Kingspan GreenGuard® GG500 - 500 kPa; and

Kingspan GreenGuard® GG700 - 700 kPa,

when tested to EN 826: 2013 (Thermal insulating products for building applications. Determination of compression behaviour).

Water vapour resistivity

The products typically achieve a resistivity greater than 400 MNs/gm, when tested in accordance with BS EN 12086: 2013 (Thermal insulating products for building applications. Determination of water vapour transmission properties).

Absorption of moisture

Kingspan GreenGuard® is highly resistant to water absorption and the effects of freeze-thaw cycling.

Durability

If correctly installed, Kingspan GreenGuard® can have an indefinite life. Its durability depends on the supporting structure and the conditions of its use.

Resistance to solvents, fungi & rodents

Kingspan GreenGuard® is 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 GreenGuard®, resulting in softening, shrinkage and possible dissolution, with a consequent loss of performance.

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

Fire performance

Under System 4 AVCP, Kingspan GreenGuard® G300, GG500 and GG700 have a Euroclass rating of F.

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

Maximum service temperature

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

Product details

Thermal properties

The λ-values and R-values detailed below are determined in accordance with BS EN 13164: 2012: + A1: 2015 (Thermal insulation products for buildings. Factory made extruded polystyrene (XPS) products. Specification).

Thermal conductivity

The boards achieve a thermal conductivity (λ-value) of:

Kingspan GreenGuard® GG300 is:

0.033 W/mK (insulant thickness 30 - 180 mm).

Kingspan GreenGuard® GG500 is:

0.034 W/mK (insulant thickness 50 mm); and

0.036 W/mK (insulant thickness 80 and 100 mm).

Kingspan GreenGuard® GG700 is:

0.035 W/mK (insulant thickness 50, 60 and 80 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. The resulting number is rounded down to the nearest 0.05 (m^2K/W).

Insulant thickness (mm)	Thermal resistance (m^2K/W)		
	GG300	GG500	GG700
30	0.90	-	-
40	1.20	-	-
50	1.50	1.45	1.40
60	1.80	-	1.70
75	2.25	-	-
80	2.40	2.20	2.25
100	3.00	2.75	-
120	3.60	-	-
150	4.55	-	-
180	5.45	-	-

NB Multiple layers of insulation are required for higher thermal resistances.

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

NB Where a hyphen is shown the thickness is not available.

Contact details

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