Pitched roofs – ceiling level

Insulation at ceiling level design

Introduction

It is possible to achieve very high levels of insulation in pitched roofs where the insulation is positioned at ceiling level because the insulation thickness is largely unrestricted by construction considerations.

A major factor influencing the design of pitched roofs with insulation at ceiling level, is the type of roof tile underlay chosen. Traditionally, roofs with cold loft spaces were ventilated to allow for the removal of moisture-laden air from the roofspace.

The substitution of traditional roof tile underlays such as 1F sarking felt (which have high water vapour resistance and require ventilation) with modern roof tile underlays that have low water vapour resistance (and require no or low levels of ventilation), require the designer to incorporate various design features into the ceiling and pitched roof which are dictated by the type of roof tile underlay specified.

Ventilation and control of condensation

Where insulation is placed in roofs with insulation at ceiling joist level there is a risk that condensation will form on surfaces on the cold side of the insulation in the loft space. Condensation is most likely to occur where warm moisture laden air (laden with water vapour) is able to pass to the cold loft space but is prevented from dissipating to the atmosphere by the roof structure.

The key steps that need to be taken to prevent the formation of condensation are to restrict the passage of warm air and water vapour through the structure to the cold loft space and allow for its removal if it enters the cold loft space.
The former is achieved by ensuring that the ceiling is well sealed and has a high resistance to the diffusion of water vapour the latter by either ventilating the cold side of the insulation or ensuring that the roof construction will allow water vapour to disperse through its structure and dissipate to the atmosphere.

Reference should be made to BS5250: 2011.

BS 5250 : 2011 provides guidance for pitched roofs with two types of tiling underlay:

- Type HR (high water vapour resistance) such as traditional sarking felt
- Type LR (low water vapour resistance) – less than 0.25 MN s/g

Where an LR underlay which has third party certification by the British Board of Agrément, (for use as a tiling underlay for a pitched roof with a cold loft space and insulation at ceiling joist level) is used, any water vapour that does pass through the insulation layer can disperse through the tiling underlay to the outside air. This is known as a 'breathing' roof and is recommended by Knauf Insulation for new dwellings.

Where a HR underlay, such as traditional bitumen based sarking felt, is used as the tiling underlay, it is necessary to provide cross ventilation to the cold side of the insulation to enable water vapour to dissipate to the atmosphere and thus prevent condensation forming in the roof construction.

BS 5250: 2011 places great emphasis on the air tightness of the ceiling to prevent water vapour entering the loft space.

A BS 5250 'well sealed' ceiling

In BS 5250, a 'well sealed' ceiling requires the following:

- The design should avoid holes in the ceiling and constructional gaps, especially at the junction with dry lined external walls
- No access door or hatch or downlighters should be located in rooms where large amounts of moisture vapour are produced, such as kitchens or washrooms
- The access hatch should include draught seals that are compressed when the hatch is closed and have an air leakage rate no worse than specified
- Penetrations, such as those for services and rooflights, should be permanently sealed with suitable proprietary products
- The ceiling should be sealed to the external walls to limit any leakage through cracks
- Recessed light fittings should either comply with BS EN 60529 and be rated IP60 to IP65 (depending on room use), or incorporate an appropriate sealed hood or box
- The head of any cavity in any wall or partition should be sealed to prevent transfer of warm moist air into the roof space
- A well sealed ceiling is likely to be a prerequisite of achieving a satisfactory air leakage rate when a new building is tested

BS 9250 : 2007 Code of practice for the design of the airtightmess of ceilings in pitched roofs gives detailed advice

BS 5250: 2011, defines LR underlays as having a water vapour resistance of less than or equal to 0.25 MN.s/g and recommends that only LR underlays with technical approvals given by UKAS accredited technical approval bodies (e.g. BBA) for this type of application are used without ventilation.

If it is proposed to use a LR underlay without this type of technical approval then ventilation is required as set out in Table 1.

Note that if there is likely to be high initial moisture load in the building due to water introduced into the building during the construction phase, or the designer has any doubts about the viability of constructing a well sealed ceiling then consideration should be given to installing 5mm high level ventilation irrespective of whether the LR underlay has a technical approval or not.

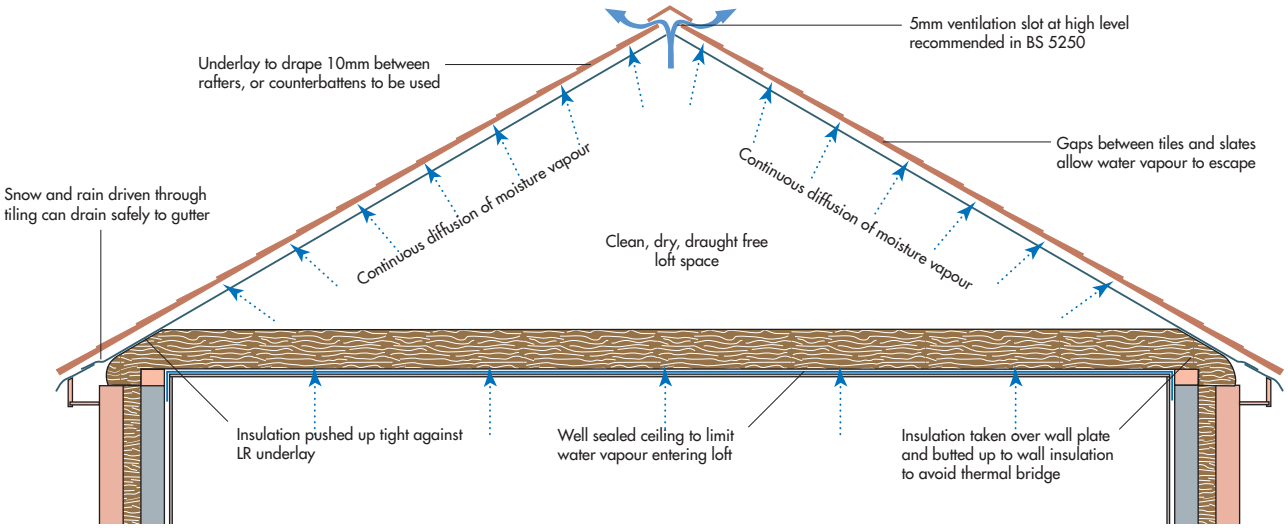
Where no eaves ventilation is provided, the ceiling level insulation is usually pushed up tight against the LR underlay to prevent air leakage into the loft at eaves level.

Table 1 - Ventilation requirements for LR underlays

	Type of ceiling	Size of ventilation openings at:	
		Eaves	High level
No technical approval	Normal	7mm	-
No technical approval	Well sealed	3mm	5mm
With technical approval	Normal	See relevant technical approval	See relevant technical approval
With technical approval	Well sealed	As above	As above

Ceiling level insulation with LR underlay

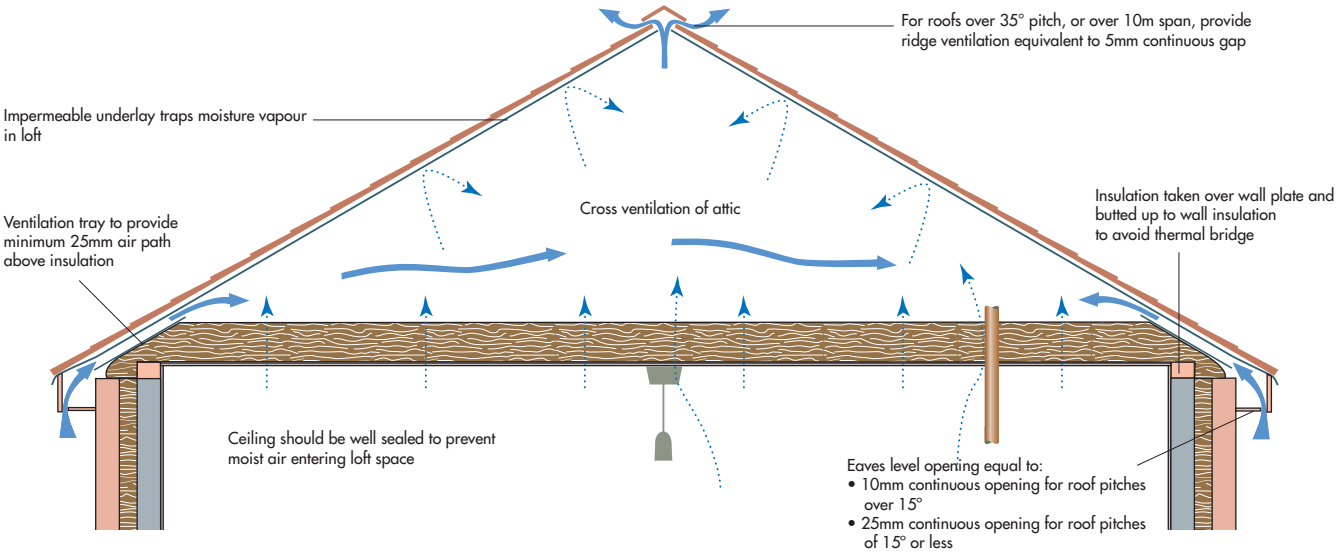
Using LR underlays can obviate the need for ventilation in a pitched roof.



Pitched roofs – ceiling level

Insulation at ceiling level design

Ceiling level insulation with HR underlay



Ventilated roof design

With a ventilated design, the insulation is placed at ceiling level and cross ventilation of the loft space is used to disperse moisture vapour.

It is important to allow a clear, unobstructed ventilation path at least 25mm wide between the insulation and the tiling underlay to allow outside air to enter the loft space and remove the water vapour.

The ventilation requirements for roofs with a duo pitch are shown above. Lean-to and mono-pitch roofs should have a continuous gap equivalent to 10mm at the eaves and high level or ridge ventilation equivalent to a continuous gap of 5mm.

Ventilation openings should prevent the entry of insects. A 3mm or 4mm mesh across the ventilation openings should be incorporated. Gaps and holes in the ceiling should be sealed to restrict the amount of water vapour that enters the loft space. Draft seal the loft hatch and provide catches or bolts to compress the draft seal and prevent air leakage from wind uplift.

Other precautions for ceiling level insulation

All tanks and pipes in the loft should be insulated to prevent freezing.

Refer to BS:5422 or the TIMSA guidance for achieving compliance with Part L of the Building Regulations for the type and thicknesses of insulation required.

Do not insulate directly under cold water tanks unless they are elevated. The loft hatch should also be insulated to a minimum depth of 100mm and draught stripped.

Construction Details

To avoid thermal bridging the roof insulation should butt up to or lap the wall insulation. The designer should consider at what stage this 'linking' insulation is installed, as this will affect the detailing of insulation at the eaves.

In cold roofs, one way of achieving this in practice is to place a short length of insulation quilt over the wall plate (and cavity closer, where applicable) immediately before the tiling underlay is fixed. This avoids having to push the insulation into place from inside the roof once the roof covering has been completed.

The gap between gable/separating walls and the first joist should be insulated to avoid thermal bridging. In cold roofs, the second layer of insulation should be butted up against the gable and separating walls to avoid thermal bridging. Knauf Insulation products are supplied in widths to suit standard joist spacings.

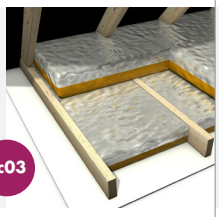
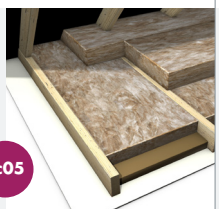
Recessed light fittings

Where recessed light fittings are to be used, specify LED compact fluorescent or low voltage tungsten lamps to minimise heat build up. Locate the fittings in enclosures that provide at least 75mm clearance around the fitting for air to circulate. Seal the enclosure to prevent air leakage into the loft and, if necessary, ventilate to the room.

Loft with storage deck

Where a boarded out storage deck is provided above the loft insulation, a check should be made to ensure that the ceiling joists are adequately sized to support the anticipated loadings.

Solution optimiser and pathfinder

Knauf Insulation solution	U-values	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.10	0.09	0.08
Between and above joists two layers **Product:** Earthwool Loft Roll 44/40 See page: 66	 Pc01										
Between and above joists two layers encapsulated **Product:** Space Blanket See page: 70	 Pc03										
Between and above joists – top up **Products:** Earthwool Loft Roll 44 and/or Earthwool Universal Roll See page: 74	 Pc05										

Key

Thermal insulation achievable by constructions within this document.

Pb01 Find online. Visit knaufinsulation.co.uk and key in construction code to find the most up to date information on your chosen solution.

Pitched roofs – ceiling level

Between and above joists two layers

Earthwool Loft Roll

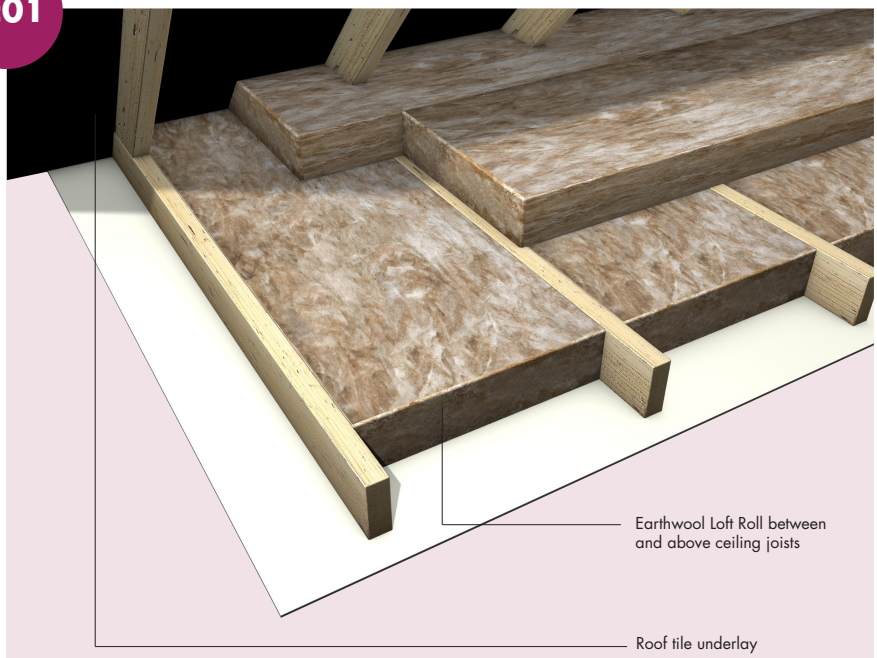
NEW BUILD REFURB

Pc01

- Insulating at ceiling level provides most cost effective insulation solution in terms of ratio of cost to energy saved
- Very low U-values can be easily and economically achieved
- Products are compression packed to reduce transport related CO_2 emissions

Earthwool Loft Roll

- Non-combustible with Euroclass A1 reaction to fire rating
- A+ Generic BRE Green Guide Rating
- Zero Ozone Depletion Potential (ODP)
- Zero Global Warming Potential (GWP)



Products

Earthwool Loft Roll 44 and Earthwool Loft Roll 40 are made from glass mineral wool and formed into rolls which are lightweight, flexible, resilient and non-combustible, their manufacture has a very low impact on the environment.

Typical construction

A pitched roof of timber trussed rafters with tiles or slates on battens and roof tile underlay optionally on sarking board. Plasterboard ceiling below.

Earthwool Loft Roll 44 or 40 is installed in two layers, the first layer between the joists and the second layer across the joists. This minimises thermal bridging through the ceiling joists.

Ventilation requirements

If using an accredited type LR roof tile underlay with a well sealed ceiling – no ventilation is required.

In all other circumstances ventilation at eaves and ridge is required.

Installation

The first layer of Earthwool Loft Roll 44 or 40, the same depth as the ceiling joists, is laid between the joists. The insulation should be taken over the wall plate to link up with the wall insulation. If the roof requires ventilation this is most easily done just before the eaves ventilator is fixed, during installation of the roof tile underlay.

The second layer of Earthwool Loft Roll 44 or 40 is laid at right angles to the ceiling joists, with all edges butt jointed. The insulation should be pushed up tight against the roof tile underlay, or tight against the eaves ventilator, if no ventilation is required, take care not to block the ventilation air path, if ventilation is required.

Electric cables should not be covered with insulation in case they overheat. Cables should be lifted up and ideally fixed to the structure above the insulation or laid on top of the loft insulation. If in any doubt consult with a suitably qualified person, such as an electrician.

Performance

Thermal performance

Earthwool Loft Roll 44 has a thermal conductivity of 0.044 W/mK. Earthwool Loft Roll 40 has a thermal conductivity of 0.040 W/mK.

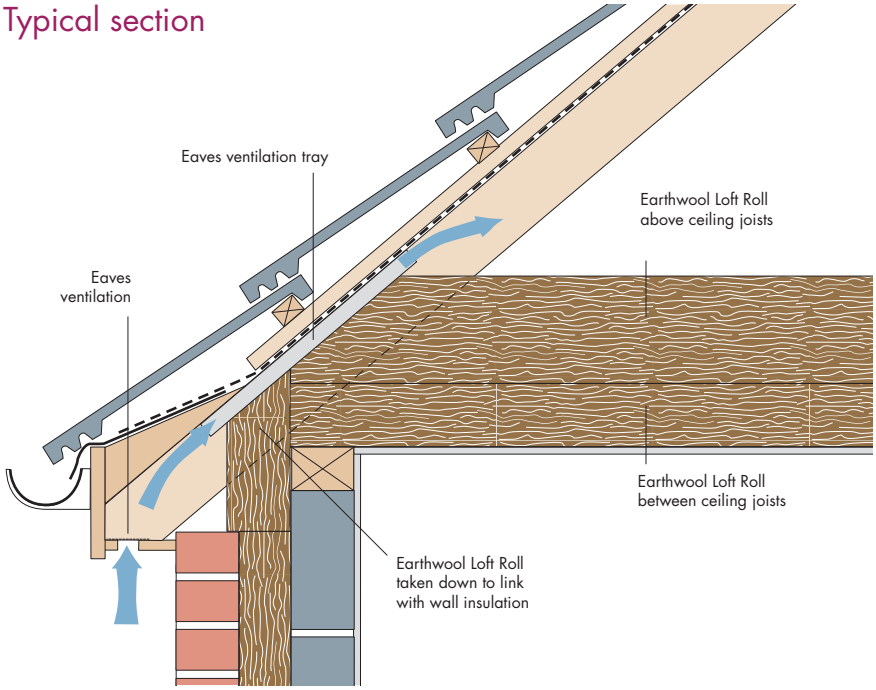
Fire performance

Earthwool Loft Roll 44 and Earthwool Loft Roll 40 are classified as Euroclass A1 to BS EN 13501-1.

Airtightness

Where enhanced airtightness performance is required the designer should consider the specification of a separate and fully sealed air leakage barrier to the underside of the ceiling joists, i.e. a polythene sheet.

Typical section



Typical U-values of pitched roofs with ceiling level insulation

Thickness (mm)			U-values
Between joists*	Over joists	Product	(W/m²K)
100	400 (2x200)	Earthwool Loft Roll 40	0.08
		Earthwool Loft Roll 44	0.09
100	350 (150+200)	Earthwool Loft Roll 40	0.09
		Earthwool Loft Roll 44	0.10
100	340 (2X170)	Earthwool Loft Roll 40	-
		Earthwool Loft Roll 44	0.10
100	300 (2x150)	Earthwool Loft Roll 40	0.10
		Earthwool Loft Roll 44	0.11
100	250 (100+150)	Earthwool Loft Roll 40	0.12
		Earthwool Loft Roll 44	0.12
100	200	Earthwool Loft Roll 40	0.13
		Earthwool Loft Roll 44	0.14
100	170	Earthwool Loft Roll 40	-
		Earthwool Loft Roll 44	0.16
100	150	Earthwool Loft Roll 40	0.16
		Earthwool Loft Roll 44	0.17

BBA CERTIFICATE CS/1001-2 U Value Competency Scheme

Note*: Joist sizes assumed to be 100 x 48mm at 600mm centres, 8% bridging plus 1% for cross noggings.

Typical specification

The whole area of the ceiling to be insulated with two layers of Earthwool Loft Roll 40*/44* of total thickness .....mm.

(*Delete as appropriate)

Width of first layer of insulation to be appropriate to the joist space and of a thickness equal to the joist depth. The insulation to be laid between the joists and over wall plate on external walls.

The second layer to be laid at right angles to the first layer. All joints between the rolls of insulation to be close butted.
If an HR roof tile underlay is installed maintain, a 25mm ventilated airspace between the insulation and the sarking felt/ sarking board at the eaves.

Do not insulate under cold water tanks unless they are elevated. Cold water tanks and pipes to be separately insulated.

Loft hatch to be insulated with a minimum 100mm depth of insulation.

NBS Plus

Alternatively, consult the National Building Specifications, Standard version clause/clauses... P10/125 and 135.....

Knauf Insulation specification clauses can be downloaded from knaufinsulation.co.uk/nbs

Pitched roofs – ceiling level

Between and above joists two layers encapsulated

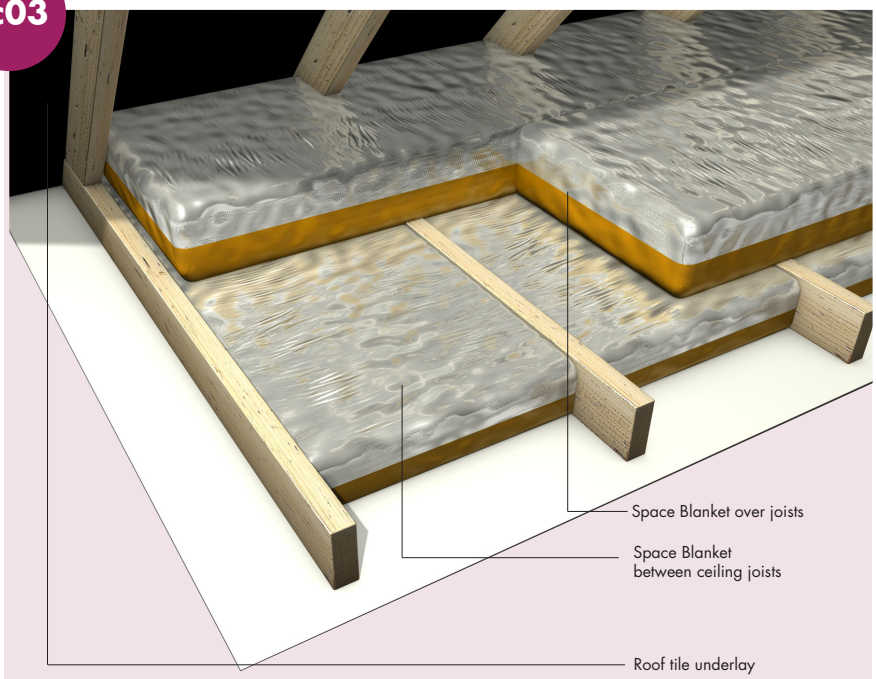
Space Blanket

Pc03

- Insulating at ceiling level provides most cost effective insulation solution in terms of ratio of cost to energy saved
- Encapsulated product for easier handling and installation
- Products are compression packed to reduce transport related CO_2 emissions

Space Blanket (insulation content)

- Non-combustible with Euroclass A1 reaction to fire rating
- A+ Generic BRE Green Guide Rating
- Zero Ozone Depletion Potential (ODP)
- Zero Global Warming Potential (GWP)



Products

Space Blanket is made from glass mineral wool and formed into rolls which are encapsulated in a lightweight part metalised polythene film.

It is lightweight, flexible, resilient and non-combustible, its manufacture has a very low impact on the environment.

Typical construction

A pitched roof of timber trussed rafters with tiles or slates on battens and roof tile underlay optionally on sarking board. Plasterboard ceiling below.

Space Blanket is installed in two layers, the first layer between the joists and the second layer across the joists. This minimises thermal bridging through the ceiling joists.

Ventilation requirements

If using an accredited type LR roof tile underlay with a well sealed ceiling – no ventilation is required.

In all other circumstances ventilation at eaves and ridge is required.

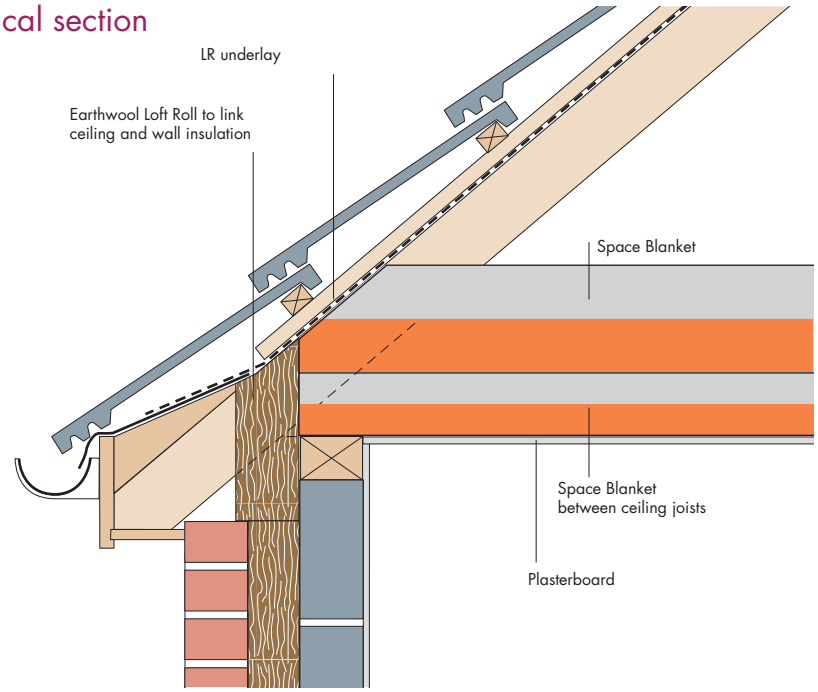
Installation

The first layer of Space Blanket, the same depth as the ceiling joists, is laid silver side up between the joists. The insulation should be taken over the wall plate to link up with the wall insulation. If the roof requires ventilation this is most easily done just before the eaves ventilator is fixed, during installation of the roof tile underlay.

The second layer of Space Blanket is laid at right angles to the ceiling joists, silver side up, with all edges butt jointed. The insulation should be pushed up tight against the roof tile underlay, or tight against the eaves ventilator, if no ventilation is required, take care not to block the ventilation air path, if ventilation is required.

Electric cables should not be covered with insulation in case they overheat. Cables should be lifted up and ideally fixed to the structure above the insulation or laid on top of the loft insulation. If in any doubt consult with a suitably qualified person, such as an electrician.

Typical section



Performance

Thermal performance

Space Blanket has a thermal conductivity of 0.044 W/mK.

Fire performance

The mineral wool content of Space Blanket is non-combustible, inorganic glass mineral wool, and is Euroclass A1 to BS EN 13501-1. Because the product is encapsulated in polythene the classification for Space Blanket is Euroclass F.

Airtightness

Where enhanced airtightness performance is required the designer should consider the specification of a separate and fully sealed air leakage barrier to the underside of the ceiling joists, i.e. a 500 gauge polyethylene sheet.

Typical U-values of pitched roofs with ceiling level insulation

Product	Thickness (mm)		U-values
	Between joists*	Over joists	(W/m²K)
Space Blanket	100	200	0.14
	100	150	0.17

BBA CERTIFICATE CS/1001-2 U Value Competency Scheme

Note*: Joist sizes assumed to be 100 x 48mm at 600mm centres, 8% bridging plus 1% for cross noggings.

Typical specification

The whole area of the ceiling to be insulated with two layers of Space Blanket of total thickness .....mm.

Width of first layer of insulation to be appropriate to the joist space and of a thickness equal to joist depth, laid between the joists.

The second layer to be laid at right angles to the first layer. All joints between the rolls of insulation to be close butted.

If an HR roof tile underlay is installed maintain, a 25mm ventilated airspace between the insulation and the sarking felt/ sarking board at the eaves.

Do not insulate under cold water tanks unless they are elevated. Cold water tanks and pipes to be separately insulated.

Loft hatch to be insulated with a minimum 100mm depth of insulation.

NBS Plus

Alternatively, consult the National Building Specifications, Standard version clause/clauses... P10/125 and 135.....

Knauf Insulation specification clauses can be downloaded from knaufinsulation.co.uk/nbs

Pitched roofs – ceiling level

Between and above joists – top up

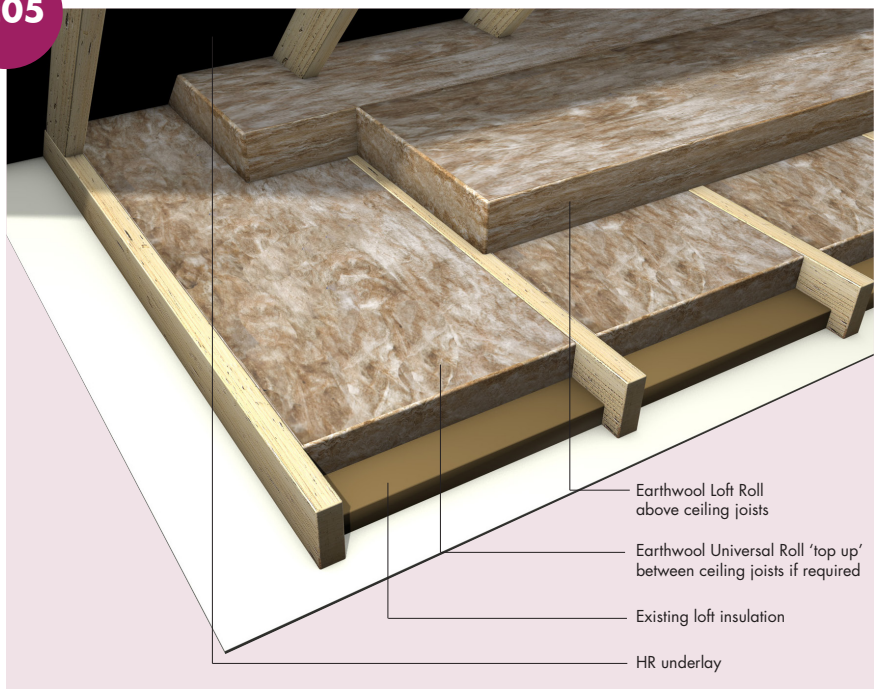
Earthwool Loft Roll and Earthwool Universal Roll

Pc05

- **Insulating at ceiling level provides most cost effective insulation solution in terms of ratio of cost to energy saved**
- **Flexible solution options to upgrade thermal performance of existing loft space**
- **Products are compression packed to reduce transport related CO_2 emissions**

Earthwool Loft Roll and Earthwool Universal Roll

- **Non-combustible with Euroclass A1 reaction to fire rating**
- **A+ generic BRE Green Guide Rating**
- **Zero Ozone Depletion Potential (ODP)**
- **Zero Global Warming Potential (GWP)**



Products

Earthwool Loft Roll 40 and **44** and **Earthwool Universal Roll** are made from glass mineral wool and formed into rolls which are lightweight, flexible, resilient and non-combustible, their manufacture has a very low impact on the environment.

Typical construction

A pitched roof with existing loft insulation and an HR underlay. Earlier Building Regulation requirements were achieved with 25, 50, 80, 100 and 150mm thickness of loft insulation. All these thicknesses may be found in existing properties.

An overall insulation thickness of at least 270mm is recommended when upgrading the thermal insulation of an existing roof.

If an HR roof tile underlay is installed maintain, a 25mm ventilated airspace between the insulation and the sarking felt/sarking board at the eaves.

Installation

In most pitched roofs, any existing insulation is likely to be between the ceiling joists. Where the existing insulation reaches the top of the joists, Earthwool Loft Roll 40 and 44 can simply be laid over the existing joists and insulation. Where the existing insulation is below the joist height, top-up the insulation so it reaches the top of the joists, and then add a further 170, 200 or 300mm thickness over the joists.

Take care not to block the eaves ventilation. If the new insulation covers the top of the eaves ventilators, install new extended ventilators before installing the insulation.

Seal any gaps or holes in the ceiling to the loft to limit air leakage into the loft from the internal environment. This is particularly important to the ceiling above areas where high levels of water vapour are generated such as bathrooms or wash rooms. Loft hatches should also have draught seals fitted.

Electric cables should not be covered with insulation in case they overheat. Cables should be lifted up and ideally fixed to the structure above the insulation or laid on top of the loft insulation. If in any doubt consult with a suitably qualified person, such as an electrician.

Performance

Thermal performance

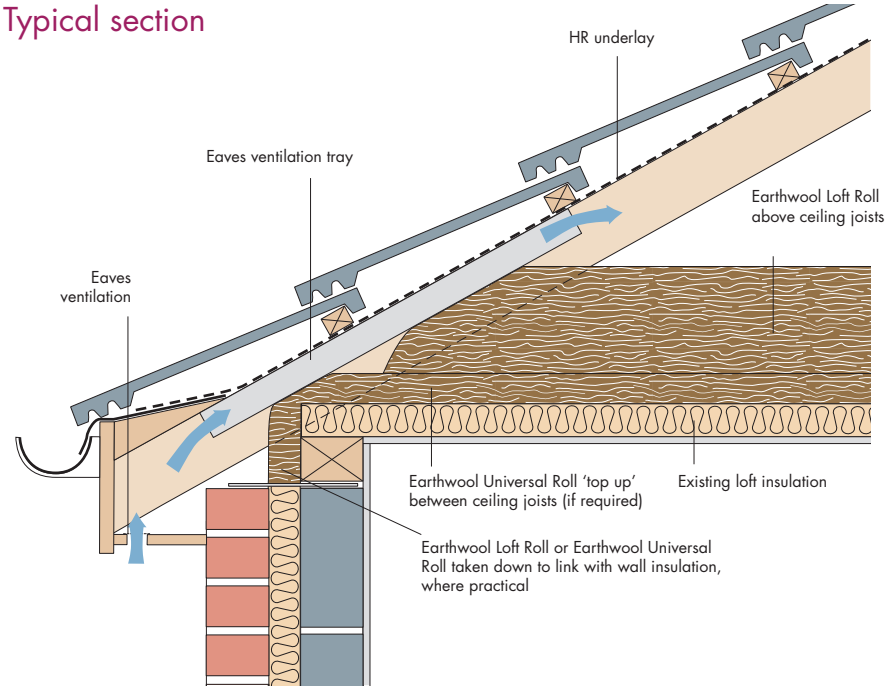
Earthwool Loft Roll 44 and Earthwool Universal Roll have a thermal conductivity of 0.044 W/mK.

Earthwool Loft Roll 40 has a thermal conductivity of 0.040 W/mK.

Fire performance

Earthwool Loft Roll 40 and 44 and Earthwool Universal Roll are classified as Euroclass A1 to BS EN 13501-1.

Typical section



Typical U-values for upgrading existing ceiling level insulation

	Additional Earthwool Loft Roll 44 insulation		U-values (W/m²K)
Existing insulation thickness (mm)	Between joists thickness (mm)	Over joists thickness (mm)	With or without sarking board
25	80*	170	0.16
50	60*	170	0.16
100	none	170	0.16
100	none	200	0.14
100	none	300 (2 x 150)	0.11

BBA CERTIFICATE CS/100112 U Value Competency Scheme

Note: Joist sizes assumed to be 100 x 48mm at 600mm centres, 8% bridging plus 1% for cross noggings.
*60mm and 80mm are Earthwool Universal Roll.

Typical specification

The two alternative specifications:

a) **Between joists (where applicable)**
The whole area of the existing ceiling to be insulated with Earthwool Loft Roll 40*/44*, thickness .....mm. Insulation of width appropriate to the joist space to be laid over the existing loft insulation and dressed over wall plate. Existing insulation to be topped up with Earthwool Universal Roll, thickness.....mm.
(*Delete as appropriate)

b) **Across the joists**
The whole area of the existing ceiling to be insulated with Earthwool Loft Roll 40*/44*, thickness .....mm. To be laid over the joists, with all joints close butted.
(*Delete as appropriate)

For both methods all joints to be close butted. If an HR roof tile underlay is installed, maintain a 25mm ventilated airspace between the insulation and the sarking felt/ sarking board at the eaves.

Do not insulate under cold water tanks. Cold water tanks and pipes to be separately insulated.

Loft hatch to be insulated with a minimum 100mm depth of insulation.

NBS Plus

Alternatively, consult the National Building Specifications, Standard version clause/clauses... P10/125 and 135.....

Knauf Insulation specification clauses can be downloaded from knaufinsulation.co.uk/nbs