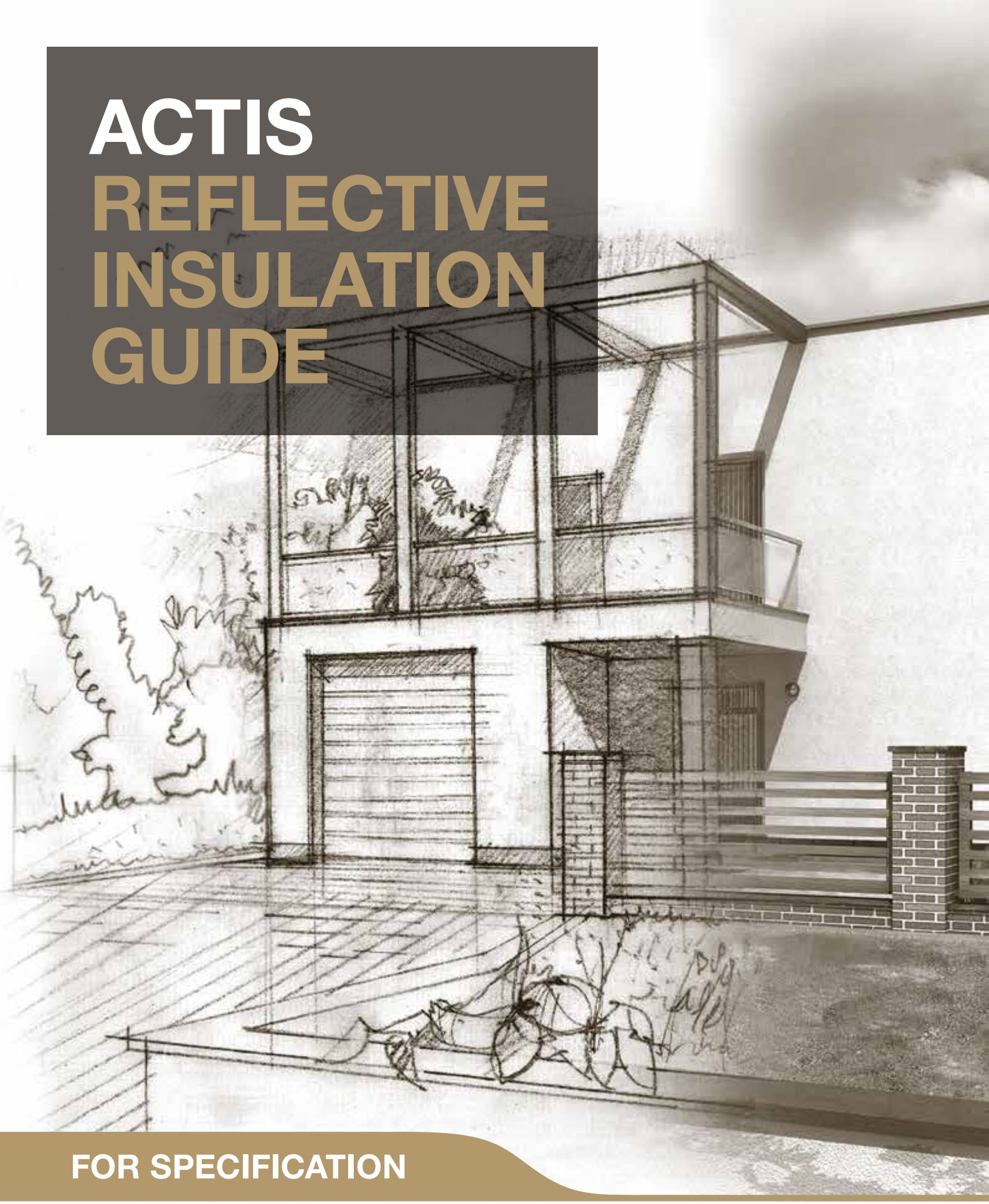
ACTIS REFLECTIVE INSULATION GUIDE



FOR SPECIFICATION

TOMORROW'S INSULATION TODAY

INTRODUCTION

This guide has been designed to offer assistance when selecting reflective insulation products for your project.

At Actis, we believe that the entire fabric of the building needs to be considered from design stage through to construction. This is to ensure that the real life thermal efficiency of a building achieves the predicted performance. Whilst U-value targets are very important, Actis goes much further than simply developing a product range with an excellent thermal performance. We also take into consideration the airtightness, moisture control and how to reduce the effects of thermal bridging, all of which contribute to the overall energy efficiency of the building.

If you have any queries that are not covered throughout this guide please do not hesitate to contact a member of our team. All contact details can be found on the back page.

The Actis UK team
February 2018

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REFLECTIVE INSULATION: PRINCIPLES

WHAT IS REFLECTIVE INSULATION?

Reflective insulation is a composite of an insulating core material with reflective faces. Reflective films act as a barrier to thermal transfer by radiation and the insulation core material acts against conduction. Reflective insulation products are typically airtight and if joints are taped during installation can avoid air infiltration and act against convection.

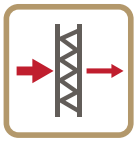
TYPES OF REFLECTIVE INSULATION

There are a number of reflective insulation products on the market including foil faced rigid board insulation and construction boards with foil faces. Traditionally, they are installed between timbers or inside cavities within a thermal element. There are also **flexible products with external faces and a specific insulating internal structure** (e.g. Actis Hybris).

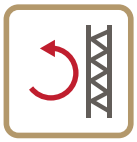
Reflective multifoil insulation is an airtight **multi-layered product composed of a series of reflective films interspersed with separators such as wadding and foam**. All the layers put together act as an insulating blanket. Products such as Boost'R Hybrid and HControl Hybrid are typically installed as a continuous layer across structural members.

HOW DO THEY WORK?

Generally, reflective insulation reduces heat transfer by counteracting all modes of heat transfer (radiation, convection and conduction).



The external reflective foils are extremely effective at reflecting infrared radiation back towards the source of heat (heating systems in the winter, and solar radiation in the summer). Each internal reflective foil acts as an additional barrier to thermal transfer by radiation.



The low density separators (wadding and foam) between the reflective foils of products create insulating air gaps, which are also barriers against conduction (same principle as double glazing).

Reflective insulation products remove cold air infiltration in the winter, and warm air infiltration in the summer.

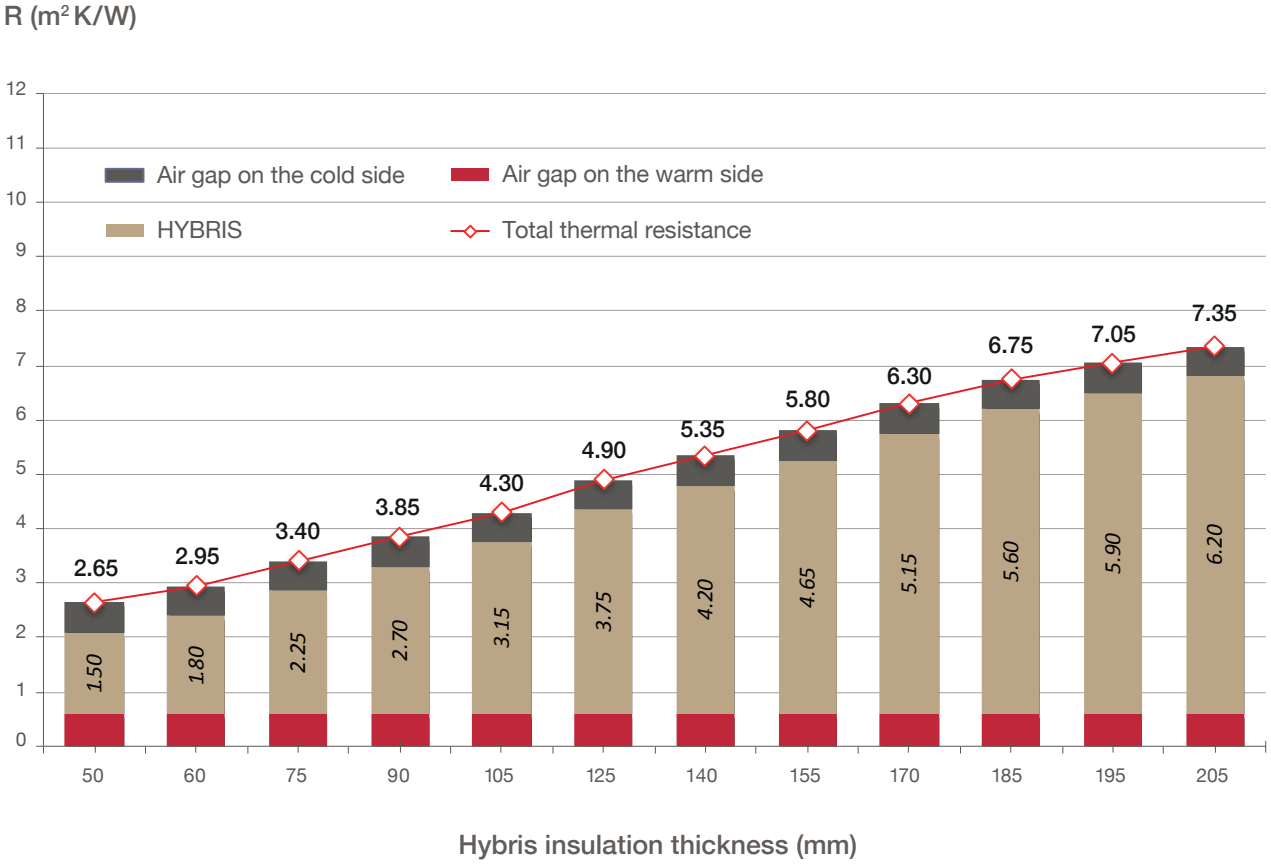
Reflective insulation is waterproof, providing protection if water penetrates the structure and avoids air leakage.

THERMAL PERFORMANCE

The thermal performance of reflective insulation materials is generally determined by:

- The core R-value of the material: Either the thermal resistance value (R-value) or the lambda value (λ) is declared.
- The R-value of the low emissivity air cavity associated with the product: The emissivity is declared alongside the R-value of the core material.

HYBRIS THERMAL PERFORMANCE IN WALL APPLICATIONS



TEST STANDARD FOR REFLECTIVE INSULATION PRODUCTS

European harmonized test standard EN 16012 recommends appropriate test methods for reflective insulation products, depending on product type.

According to the standard, the thermal performance of the core product and the emissivity value of the product faces are tested. The emissivity of the foil determines how much extra thermal performance can be gained from the associated air gap (the lower the emissivity the better the performance from the associated air gap). In accordance with EN 16012 the lowest possible emissivity to be declared is 0.05. Some types of reflective insulation products can also be tested as a system, together with adjacent airspaces, in which case the overall thermal resistance of the product and the air gaps are declared.

HControl Hybrid example

Declared thermal performance		
R-value of HCONTROL HYBRID + 2 air cavities after ageing	EN 16012	Horizontal heat flow 3.20 m² K/W Upward vertical heat flow 2.80 m² K/W
Core R-value of product		1.90 m² K/W
Emissivity after ageing		0.06

ENERGY EFFICIENCY IN BUILDINGS

ENERGY CONSUMPTION PRINCIPLE AND SAP

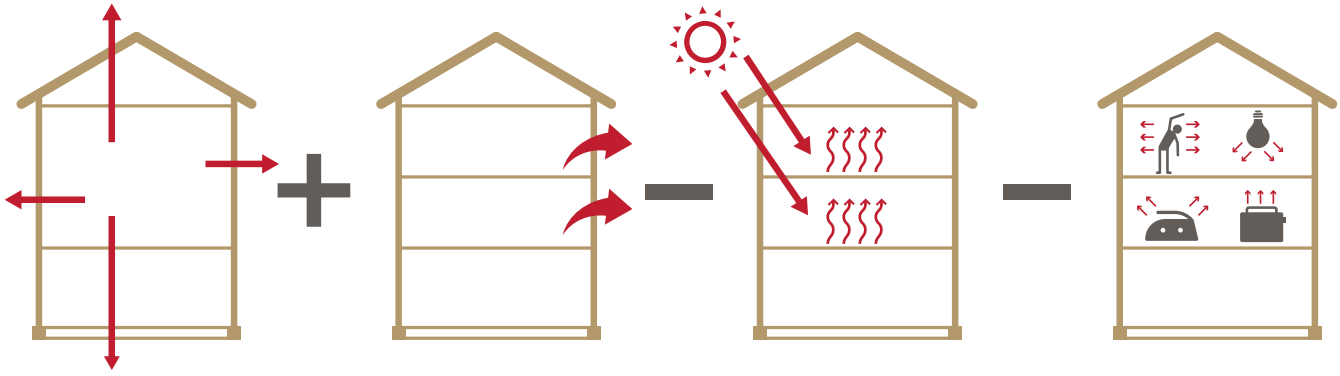
A building loses energy by thermal transmission through the building envelope or fabric as well as ventilation and gains energy from internal as well as external sources. The energy efficiency of buildings is quantified by offsetting heat losses against heat gains and energy efficiency calculations are based on this principle.

Loss by Transmission
U-values of Thermal Elements, Thermal Bridging, etc.

Loss by Ventilation
Ventilation, Airtightness, etc.

External Gains
Solar gains

Internal Gains
Lighting, People, etc.



'FABRIC FIRST' APPROACH

'Fabric First' focuses on reducing heat loss through the fabric elements of a building by increased levels of insulation, reduced thermal bridging and improved airtightness. The fabric should be dealt with first before looking at the use of more sophisticated building services such as ventilation systems and renewable energy systems. In simple terms the higher performance of the building fabric the lower reliance on home energy systems. The following paragraphs describe 'Fabric First' in more detail.

U-VALUES OF THERMAL ELEMENTS

The U-value is the thermal transmittance value of a thermal element (e.g. wall, roof, floor). U-values are expressed as W/m^2K – the rate in watts at which heat transfers through a square metre of the surface of an element when there is a temperature difference of one Kelvin between the inside and outside of the element.

For new builds, the U-value of a thermal element must be better (lower) than the limiting U-value and for existing buildings the U-value must meet the target U-value standards unless this is not technically or functionally feasible. Please refer to respective Building Regulations.

U-values are to be calculated according to BR 443. This convention for U-value calculations lays out guidelines including the use of robust thermal performance properties of products, appropriate fractions for repeating thermal bridges, correct surface resistance values, corrections for elements' adjacent unheated spaces, etc.

Reflective insulation products are to be tested in line with EN 16012 and such test results can be used in U-value calculations in accordance with BR 443. If the thermal performance of product associated low emissivity cavities is not covered by a test result, their R-value is calculated mathematically in accordance with EN 6946. The result depends on:

- Emissivity of faces: Emissivity values between 0.09 and 0.05 are typical for reflective products
- Air cavity thickness
- Temperature difference (5°K as per EN 6946)
- Heat flow direction: e.g. horizontal for walls, upward vertical for roof applications
- Ventilation: e.g. unventilated, ventilated, semi-ventilated, vented

Typical R-values of low emissivity air cavities for roof applications are around 0.45 m^2K/W and for walls 0.70 m^2K/W.

LINEAR THERMAL BRIDGING

A thermal bridge is where a penetration through the insulation layer occurs, and heat is transferred through a non-insulating material. The type of thermal bridging that happens at construction details (i.e. where two thermal elements meet) is defined as linear thermal bridging. The heat loss through this linear thermal bridge is quantified by the Ψ-value (psi-value). All Ψ-values (multiplied by the length of the bridge and divided by the building envelope area) make up the overall heat loss of the building through linear thermal bridging - the Y-value.

According to current convention, there are three possibilities for specifying thermal bridging for a new build dwelling:

1. Details conform with Approved Design Details
2. Linear thermal transmittance values are calculated according to BR 497
3. Using a global Y-value of 0.15 W/m^{2}K

In a building insulated to high energy efficiency standards thermal bridging can, in some cases, account for 20-30% of the overall heat loss.

AIRTIGHTNESS

Airtightness is the measure of air leakage of a building through gaps, cracks and holes in the building fabric. Under current Building Regulations in England and Wales, the minimum requirement for airtightness must be below 10m^3/(h.m^2) at 50Pa pressure differential. Airtightness testing is mandatory for new buildings.

For dwellings with air permeability rates below 5m^3/(h.m^2) at 50Pa, more background ventilation will be required to guarantee indoor air quality. Through good design and execution and alongside a ventilation strategy, dwellings can achieve an air permeability below 1m^3/(h.m^2) at 50Pa.

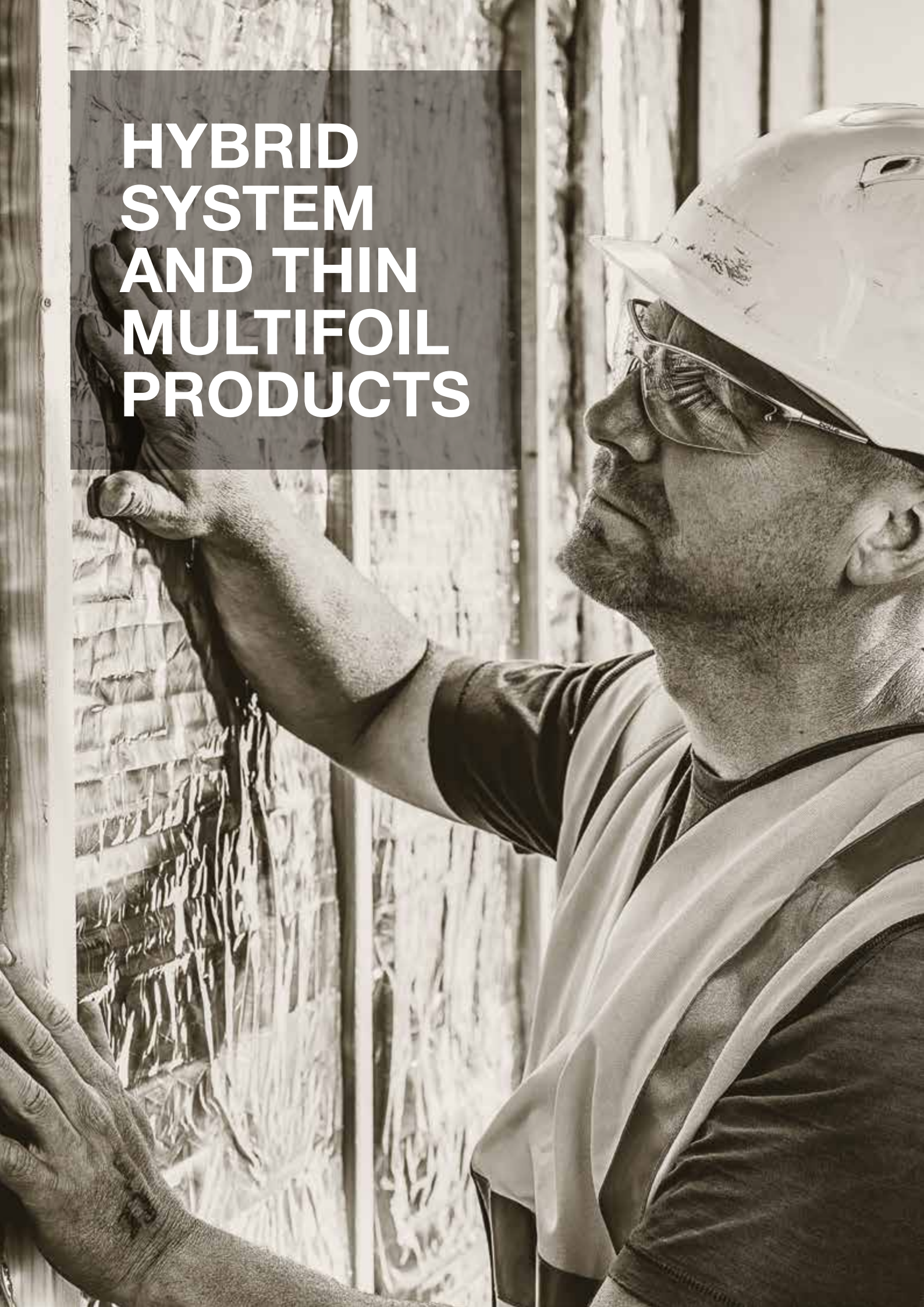
BUILDING REGULATIONS AND SAP

SAP is the Standard Assessment Procedure for the energy rating of dwellings and the indicators for energy performance are; Fabric Energy Efficiency (FEE), energy consumption per unit floor area, energy cost rating (the SAP rating), Environmental Impact rating based on CO_2 emissions and Dwelling CO_2 Emission Rate (DER).

Energy efficiency calculations are carried out using accredited software and DER must meet a given target i.e. the TER (Target CO_2 Emission Rate). In England and Wales the FEE must also meet a given target i.e. the TFEE (Target Fabric Energy Efficiency). These targets are calculated on a concurrent notional dwelling of the same size and shape as the proposed building and based on the notional dwelling specification in accordance with Building Regulations. Each country has individual notional dwelling specifications.

The following ‘Fabric First’ parameters refer to the notional dwelling specification for England:

Element / System	Values
External Walls	0.18 W/m^{2}K
Party Walls	0.00 W/m^{2}K
Floors	0.13 W/m^{2}K
Roofs	0.13 W/m^{2}K
Linear Thermal Transmittance	Standardised psi-values (see SAP 2012 Appendix R), or y=0.05 W/m^{2}K if the default value of y=0.15 W/m^{2}K is used in the actual dwelling
Airtightness	5.0 m^3/ (h.m^2)
Ventilation Type	Natural (with extractor fans)



HYBRID SYSTEM AND THIN MULTIFOIL PRODUCTS

HYBRID SYSTEM:

The Hybrid range consists of three innovative insulation products that are tested to European harmonised standard EN 16012 and easily recognised by a copper coloured external film.

One stop solution for all U-value requirements for walls, roofs and suspended floors.

Each Hybrid product is an insulation and membrane combined.

Hybrid products are resistant to air infiltration and create a barrier to thermal losses through convection.

Quick and easy to install, Hybrid products allow for faster construction.

Hybrid products are fully tested both under laboratory and real conditions of use.

Much less wastage than traditional forms of insulation.

Whatever the climatic conditions, the thermal performance of the Hybrid range makes homes more comfortable in both summer and winter.

Hybrid products have reflective faces with very low emissivities, as low as 0.05.

The 3 Hybrid products have been awarded LABC and LABSS Registered Details. They are also NHBC accepted when used in accordance with their certification.

HYBRIS

An innovative and unique insulation product providing an excellent thermal performance for use in timber frame or masonry walls, pitched roofs, ceilings and suspended floors.

CE ATE N° 13/0121

λ_D33 THERMAL PERFORMANCE

VAPOUR BARRIER

ACOUSTIC PERFORMANCE

FROM 50 TO 205MM

HIGH PERFORMANCE AIR GAP

LIGHT

2 in 1 DUAL PERFORMANCE

registered details LABC

LABSS

BMTRADA

VTT EXPERT SERVICES LTD

Applications in roofs, walls and suspended floors

Declared thermal performance:

Thermal conductivity:

λ_D = 0.033 W/m² K

Declared emissivity (inner/outer):
0.06 (inner layer) and 0.10 (outer layer)

DECLARED THERMAL PERFORMANCE

		ROOF	WALL
THICKNESSES	CORE THERMAL RESISTANCE	WITH TWO AIR GAPS	WITH ONE AIR GAP
50mm	**1.50**	1.90	2.10
60mm	**1.80**	2.20	2.40
75mm	**2.25**	2.85	2.85
90mm	**2.70**	3.10	3.30
105mm	**3.15**	3.55	3.75
125mm	**3.75**	4.15	4.35
140mm	**4.20**	4.60	4.80
155mm	**4.65**	5.05	5.25
170mm	**5.15**	5.55	5.75
185mm	**5.60**	6.00	6.20
195mm	**5.90**	6.30	6.50
205mm	**6.20**	6.60	6.80

HCONTROL HYBRID

A thin multifoil insulation product with a built-in vapour control function and an unrivalled thermal performance for use on the warm side of any insulation material, behind the internal finish in roofs, walls, ceilings and suspended floors.

CE COMPLIES WITH EN 13984

VAPOUR BARRIER

R=3.20 m².K/W 2 AIR VOIDS OF 20MM

45MM +/-5MM

AIRTIGHT

SPACE SAVING

10M² AREA PER ROLL

2 in 1 DUAL PERFORMANCE

registered details LABC

LABSS

BMTRADA

VTT EXPERT SERVICES LTD

Applications in roofs, walls and suspended floors

Declared thermal performance:

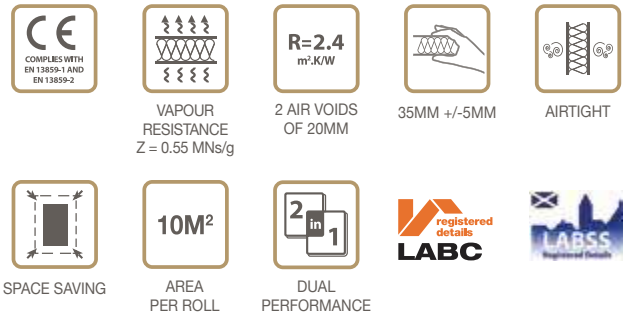
Core thermal resistance: 1.90 m² K/W

Thermal resistance with 2 air cavities of 20mm (horizontal heat flow):
3.20 m² K/W.

Declared emissivity: 0.06

BOOST'R HYBRID

A thin multifoil insulation product with a built-in breather membrane function and an exceptional thermal performance for use on the cold side of the building fabric.



Applications in roofs, walls and suspended floors

Declared thermal performance:

Core thermal resistance: 1.35 m² K/W

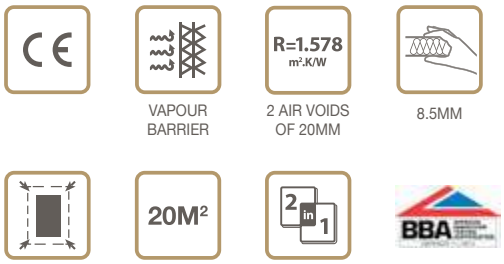
Thermal resistance with 2 air cavities of 20mm (horizontal heat flow): 2.4 m² K/W

Declared emissivity (inner/outer): 0.05 (inner layer) and 0.31 (outer layer)

OTHER THIN MULTIFOIL PRODUCTS:

HCONTROL REFLEX+

A reflective vapour control layer which also acts as a supplementary insulating material due to its thermal resistance value and high reflective properties.



Applications: warm side on roofs, walls and suspended floors

Declared thermal performance:

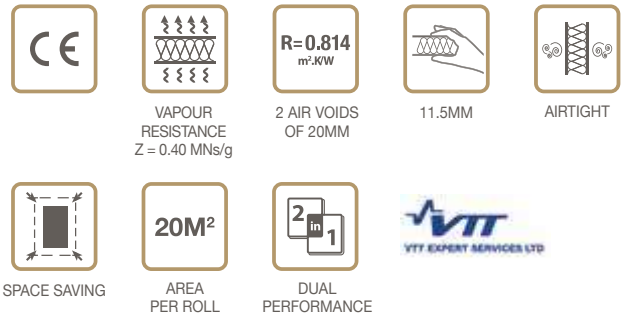
Core thermal resistance: 0.25 m² K/W

Thermal resistance with 2 air cavities of 20mm (horizontal heat flow): 1.578 m² K/W

Declared emissivity: 0.05

BOOST'R 10

A thin multifoil insulation product with a built-in breather membrane function for use on the cold side of the building fabric.



Applications: warm side on roofs, walls and suspended floors

Declared thermal performance:

Core thermal resistance: 0.303 m² K/W

Thermal resistance with 2 air cavities of 20mm (horizontal heat flow): 0.814 m² K/W

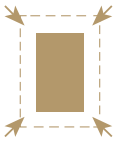
Declared emissivity (inner/outer): 0.05 (inner layer) and 0.14 (outer layer)

BENEFITS OF REFLECTIVE INSULATION

Reflective multi-layered insulation products simultaneously counteract all forms of heat loss (radiation, conduction, convection).

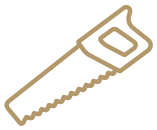
HIGHLY EFFECTIVE THERMAL INSULATION ALL YEAR ROUND: In summer the radiant heat is reflected outwards, which means a comfortable temperature even in the attic. In winter the heat is retained within the building and cold air is prevented from penetrating the building.

DURABLE INSULATION: Actis insulation does not weaken over time and does not support the nesting of rodents.



SPACE SAVING: Actis insulation products are particularly suited to new builds and renovation projects where space is limited.

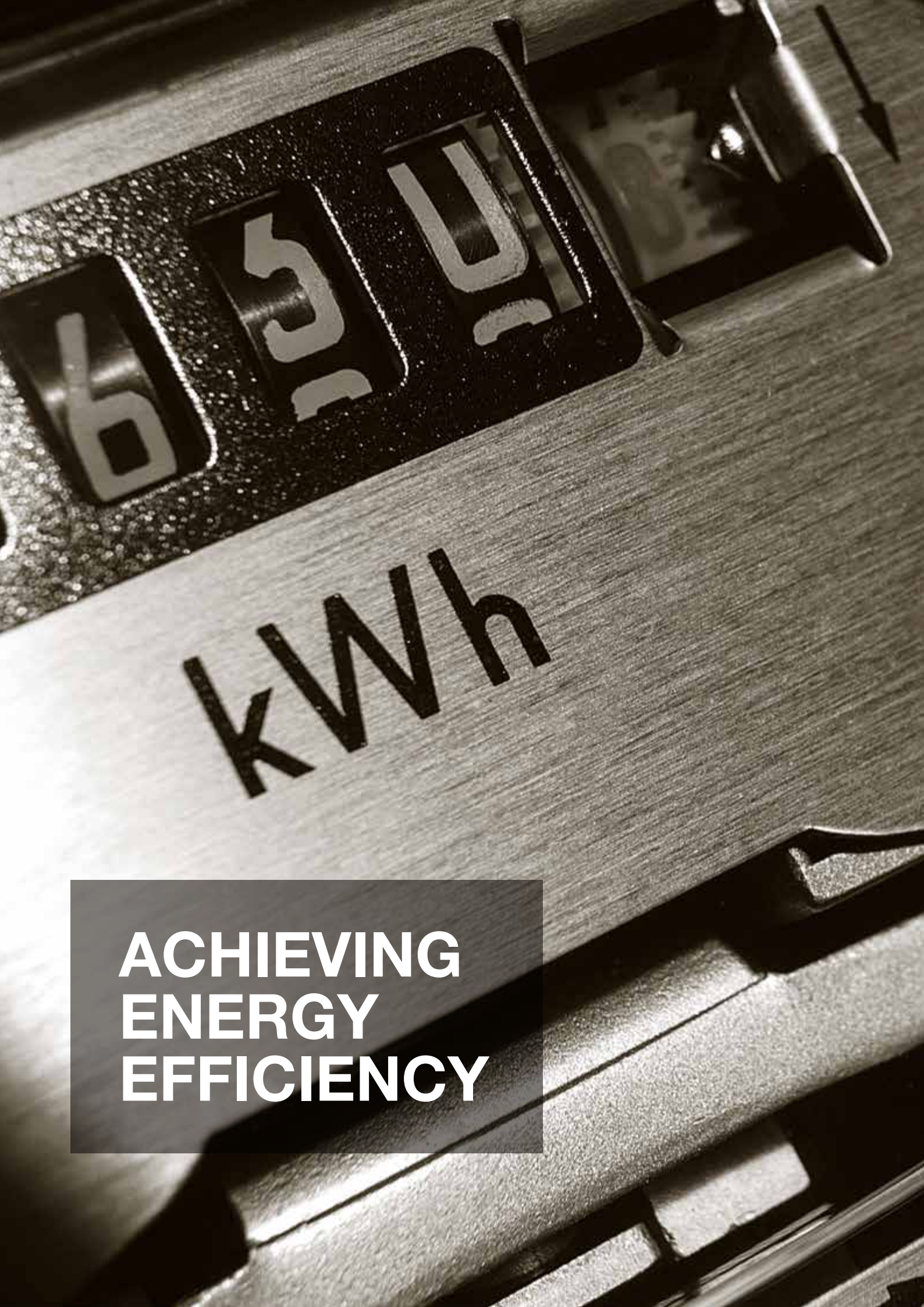
LIGHTWEIGHT: Actis products are flexible, light and easy to transport.



CUTTING: Actis products can be easily cut with knives (Actis cutter, stanley knife) or saws (standard, insulation or electric alligator saw).

ENERGY SAVING: As a result of using Actis insulation, energy consumption (heating and air-conditioning) is reduced, contributing to the energy efficiency of the building.

CLEAN AND NON-IRRITANT PRODUCTS: Actis products contain non-irritant fibres therefore no protective clothing or equipment is necessary.



ACHIEVING ENERGY EFFICIENCY

CONTRIBUTION TO THERMAL EFFICIENCY

The thermal efficiency of the building fabric is usually composed of:

45%
THERMAL TRANSMITTANCE (U-VALUE)

30%
AIRTIGHTNESS

25%
THERMAL BRIDGING

The fabric first approach suggests that the fabric should be dealt with first before looking at the use of more sophisticated building services. In simple terms the higher performance of the building fabric the lower reliance on home energy systems.

AIRTIGHTNESS

Actis Hybrid range of products are airtight. Whilst providing a continuous insulation layer with vapour control function they also give airtightness to the building.

The following data refers to a case study where Hybris is installed on the warm side of the masonry wall build-up in a continuous layer and with joints taped. Through good design and execution, dwellings can achieve an air permeability below 1 $m^3/(h.m^2)$ at 50Pa.

CASE STUDY

Semi-detached house

Floor area: 83 m^2
Envelope area: 250 m^2
Total heated volume: 215 m^2
Airtightness: 0.78 m^3 / ($h.m^2$) at 50Pa

Blower Door test result (EN 16829) prior to installation of plasterboard.

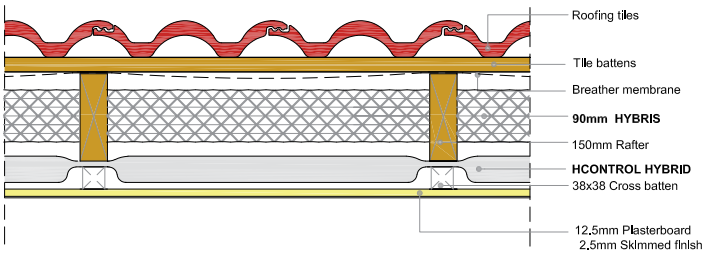
Construction:

Floor: Insulated concrete slab
Wall: Hybris insulation, joints taped
Roof: Mineral fibre insulation btw joists
Windows: uPVC

U-VALUES AND RISK OF CONDENSATION

Actis reflective insulation products perform best when they are used in conjunction with air cavities. The low emissivity of the outer face of Actis products increases the thermal performance of the associated air cavity and therefore it increases the overall performance of the thermal element.

According to standards BR 443 and EN 6946 the core R-value of products and the thermal resistance of the low emissivity air cavities are inserted in U-value calculations.

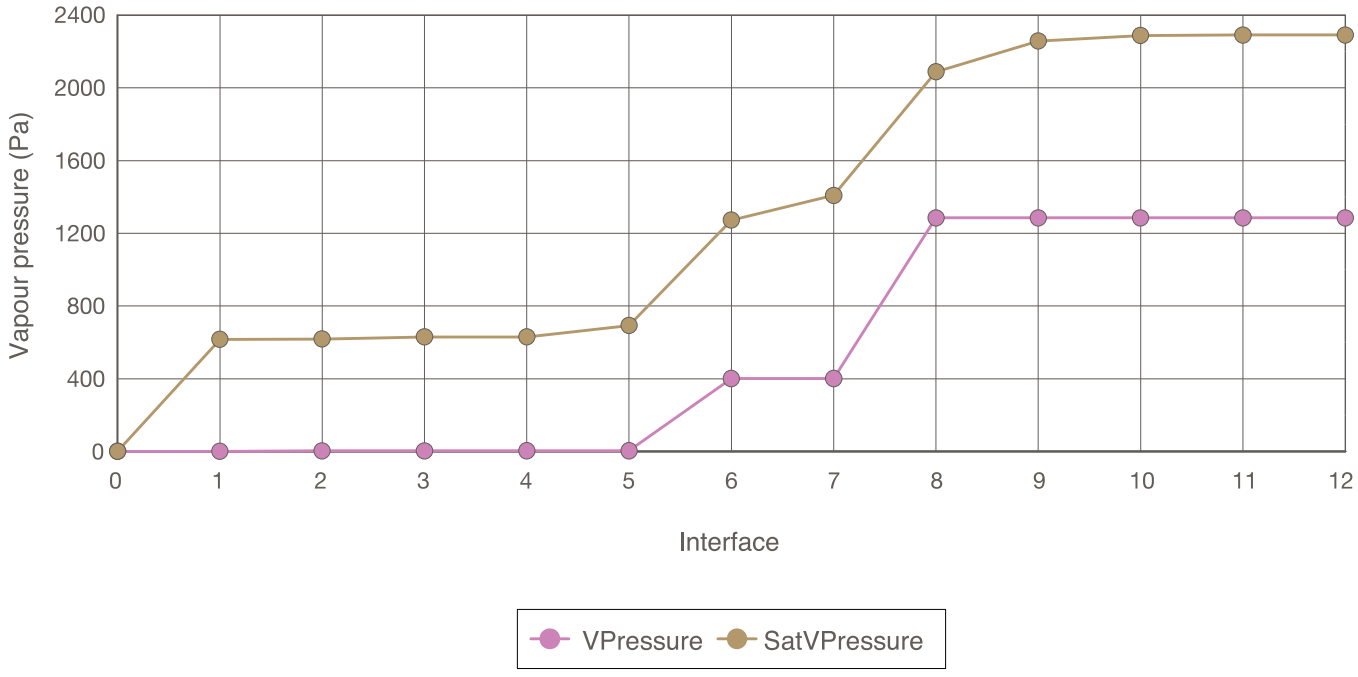


As shown overleaf in the extract of an example U-value calculation, the thermal resistance of the air cavities are included in the overall calculation as separate layers, alongside other layers of the build-up. Where the product is to be fixed by battens, the bridging effect of the battens needs to be considered.

CONDENSATION

Condensation is most likely to occur where warm moisture-laden air is able to pass to the cold side of the insulation and is then prevented from dissipating to the external ambiance.

BS 5250 suggests a condensation risk analysis in accordance with EN 13788 (Glaser method) for most build-ups. The following graph shows that the line of vapour pressure within different layers of the construction build-up remains below the saturation point and therefore the build-up is free from condensation risk.



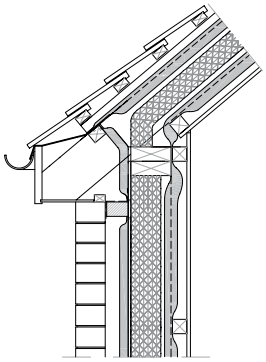
EXAMPLE U-VALUE CALCULATION

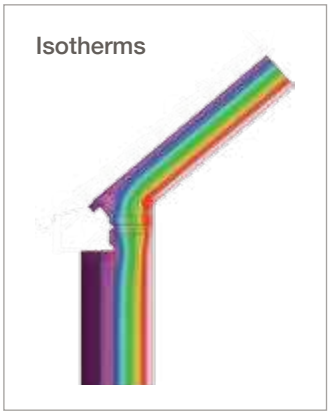
Building Element Roof PF31					
Roof Type: Pitched Roof, insulated sloping ceiling					
Layer	**Description**	**Thickness**	**λ**	**R**	**Fraction**
External surface				0.040	
Layer 1	**Tiling, clay** Main construction	15mm	1.000	0.015	100.00%
Layer 2	**Slightly ventilated air gap** Main construction	25mm	0.313	0.080	87.33%
	Bridging - Timber tile batten	25mm	0.130	0.000	12.67%
Layer 3	**Breather membrane** Main construction	0.4mm	0.500	0.001	100.00%
Layer 4	**Hybris - associated air gap** Main construction	15mm	0.037	0.407	92.17%
	Bridging - Timber rafter 140mm	15mm	0.130	0.000	7.83%
Layer 5	**Hybris** Main construction	90mm	0.033	2.727	92.17%
	Bridging - Timber rafter 140mm	90mm	0.130	0.000	7.83%
Layer 6	**Hybris - associated air gap** Main construction	15mm	0.032	0.474	92.17%
	Bridging - Timber rafter 140mm	15mm	0.130	0.000	7.83%
Layer 7	**HControl Hybrid** Main construction	45mm	0.024	1.900	93.67%
	Bridging - Timber batten 38mm	45mm	0.130	0.000	6.33%
Layer 8	**HControl Hybrid - associated air gap** Main construction	11mm	0.028	0.388	93.67%
	Bridging - Timber batten 38mm	11mm	0.130	0.000	6.33%
Layer 9	**Plasterboard** Main construction	13mm	0.190	0.066	100.00%
Layer 10	**Plaster, skim** Main construction	3mm	0.400	0.006	100.00%
Internal surface				0.100	
Total resistance: Upper limit = 5.780 m^2K/W, Lower limit = 5.048 m^2K/W, Average = 5.414 m^2K/W, U-value (unrounded) = 0.1847 W/m^2K					
U-value: 0.18 W/m^2K					

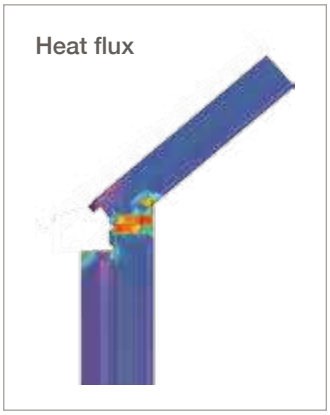
THERMAL BRIDGING

The type of thermal bridging that occurs at construction junctions is defined as linear thermal bridging (psi-value (Ψ)). All Ψ-values of the building envelope make up the overall thermal bridging heat loss – the Y-value.

Using thermal blankets, such as HControl Hybrid and/or Boost'^{R} Hybrid helps to counteract thermal bridging and Y-values below 0.022 W/m^{2}K can be achieved.





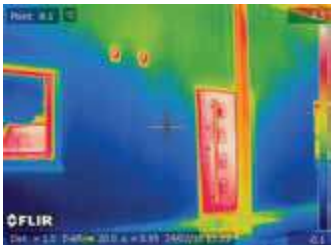


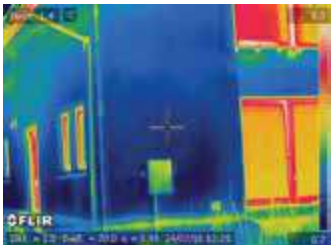
Typical eaves detail (E11) with all three Hybrid products

Hybrid CAD drawings and thermal details are available on request and can be downloaded from: **www.insulation-actis.com**

THERMAL IMAGING

The following are thermal images from a project with Actis' Hybris and HControl Hybrid used in both walls and roof.





Thermal imaging visualises variations in surface temperatures in different colours and therefore it is a good tool to identify thermal bridges in the building envelope as heat loss can be clearly identified across any thermal bridges such as structural timbers, door frames, window frames, etc.

What we can see from these images is that there is no thermal bridge or leakage on either of the analysed walls. Warmer points visible are doors and window frames as U-values of such elements are considerably higher than that of adjacent elements.

To conclude, the above thermal images prove that the building is very well insulated in a continuous manner and that reflective insulation products and multifoils in particular can overcome thermal bridging in-situ.

THERMAL DETAILS

Actis have commissioned an independent assessment of typical construction details utilising the Hybrid range of products. These thermal model junctions quantify the thermal performance of each specific thermal bridge, including temperature factors (fRsi) and thermal transmittance values ψ (psi-values) which can be applied in energy assessments (e.g. SAP calculations).

The thermal modelling assessment of junctions was carried out by BM Trada and Building Regulations Services Ltd (BRE approved).

The table below lists an extract of thermal model junctions available and compares different Hybrid product combinations with K1 default values:

Detail	Ref	Default value (SAP: table K1)	HControl Hybrid + Hybris + Boost'R Hybrid	HControl Hybrid + Hybris	Hybris + Boost'R Hybrid
		W/mK	W/mK	W/mK	W/mK
Window head	E2	1.000	0.037	0.046	0.053
Window sill	E3	0.080	0.068	0.075	0.075
Window jamb	E4	0.100	0.040	0.047	0.047
Wall - ground floor	E5	0.320	0.026	0.026	0.029
Wall - intermediate floor	E6	0.140	0.054	0.056	0.063
Wall - separating floor	E7	0.140	0.072	0.092	0.079
Eaves - cold roof	E10	0.120	*0.042	0.021	0.040
Eaves - warm roof	E11	0.080	0.045	0.052	0.043
Gable - cold roof	E12	0.480	*0.035	0.012	0.050
Gable - warm roof	E13	0.080	0.045	0.022	0.053
Wall - external corner 90°	E16	0.180	0.043	0.041	0.046
Wall - external corner 270°	E17	0.000	-0.060	-0.079	-0.064
Party wall - external wall	E18	0.120	0.054	0.043	0.079
Wall - exposed floor	E20	0.320	0.020	0.012	0.015
Party wall - ground floor	P1	0.160	/	0.040	/
Party wall - cold roof	P4	0.240	/	-0.016	/
Party wall - warm roof	P5	0.080	*0.061	*0.07	*0.101
			Elemental U-values:	**Elemental U-values:**	**Elemental U-values:**
			Wall: 0.14 W/m²K	Wall: 0.18 W/m²K	Wall: 0.18 W/m²K
			Warm roof: 0.16 W/m²K	Warm roof: 0.18 W/m²K	Warm roof: 0.20 W/m²K
			*Warm roof: 0.13 W/m²K	*Warm roof: 0.15 W/m²K	*Warm roof: 0.16 W/m²K
			Ceiling: 0.11 W/m²K	Ceiling: 0.13 W/m²K	Ceiling: 0.13 W/m²K
			*Ceiling: 0.13 W/m²K	Floor: 0.13 W/m²K	Floor: 0.12 W/m²K
			Floor: 0.11 W/m²K		

NB: Thermal details are also available for the above construction details substituting Hybris with rigid board insulation or mineral fibre insulation.

SAP COMPLIANCE EXAMPLE

Actis products combine airtightness and vapour control properties with insulation and therefore offer a complete solution against heat loss through the building fabric: low U-values, counteract thermal bridging and provide airtightness.

To review what impact low U-values, good airtightness and minimal thermal bridging can have on the overall energy efficiency of a building, a series of compliance scenarios have been modelled.

The building type analysed using SAP software 2012 is a semi-detached 1 and 1/2 storey family home with approximately 120m² floor area to comply with English/ Welsh Building Regulations Part L as well as the more stringent Scottish Building Regulations Section 6.

Actis' Hybrid solutions have been compared against industry standards and the advantages are shown via SAP compliance levels in conjunction with savings on photovoltaics / renewable energy systems.

			Specification compliant with England & Wales (Part L / 2016)			
			A) Timber Frame with mineral fibre insulation	A) Timber Frame with mineral fibre insulation and continuous rigid board	C) Timber Frame with Hybris insulation and HControl Hybrid	C) Timber Frame with full Hybrid system (Hybris, HControl Hybrid, Boost'R Hybrid)
Fabric Measures	U-values	Ext. Wall (W/m²K)	0.16	0.16	0.16	0.14
		Dormer Cheek (W/m²K)	0.20	0.20	0.20	0.14
		Pitched Roof (W/m²K)	0.17	0.17	0.17	0.13
		Floor (W/m²K)	0.12	0.12	0.12	0.12
	Airtightness (m³/hm²@50Pa)		5.0	5.0	5.0	5.0
	Thermal Bridging		default	(ACDs)	(Hybrid modelled)	(Hybrid modelled full system)
	Y-value (W/m²K)		0.15	0.06	0.021	0.023
	Thermal Mass		Low (100)	Low (100)	Low (100)	Low (100)
Heating & Ventilation	Ventilation (Efficiency)		Natural	Natural	Natural	Natural
	Heating System (Efficiency)		Gas Combi Boiler 90%	Gas Combi Boiler 90%	Gas Combi Boiler 90%	Gas Combi Boiler 90%
	Renewables (Amount)		Photovoltaics 5m²	n/a	n/a	n/a
Energy Efficiency	DER (kgCO²/m²)		14.6	14.07	13.05	12.83
	TFEE (kWh/m²/yr)		54.14	44.05	39.47	38.5
	SAP level		7%	1.19%	8.36%	9.9%
	(fail/pass)		pass	pass	pass	pass

			Specification compliant with Scotland (Section 6 / 2015)			
	Thermal Bridging		default	(ACDs Scotland)	(Hybrid modelled)	(Hybrid modelled full system)
	Y-value (W/m²K)		0.15	0.05	0.02	0.02
Additional Measures	Ventilation (Efficiency)		Natural	Natural	Natural	MVHR 93%
	Heating System (Efficiency)		Gas Combi Boiler 90%	Gas Combi Boiler 90%	Gas Combi Boiler 90%	Gas Combi Boiler 90%
	Renewables (Amount)		Photovoltaics 5m²	Photovoltaics 12.0m²	Photovoltaics 9m²	n/a
	Windows (W/m²K)		1.20	1.20	1.20	Triple glazing 0.90
Energy Efficiency	DER (kgCO²/m²)		9.96	9.98	9.97	9.92
	TFEE (kWh/m²/yr)		54.14	42.54	39.47	34.08
	SAP level		0.99%	0.8%	0.89%	1.39%
	(fail/pass)		pass	pass	pass	pass

BENEFITS OF HYBRID SPECIFICATION

The examples on the previous page show that compliance can be achieved by focusing mainly on the fabric of the building whilst maximising long-term savings. In England and Wales this can avoid the use of renewable energy systems and in Scotland, where regulations are more strict, these systems can be reduced to a minimum.

This also proves to be commercially interesting as the return from the investment in the building fabric is significant. In particular, limiting thermal bridging can have an impact on SAP as high as 15%. Using products that counteract thermal bridging such as HControl Hybrid and/or Boost'R Hybrid can achieve excellent Y-values and therefore a much better DER.

Using Actis Hybrid range offers a complete solution for thermal transmittance (U-values), thermal bridging (psi-values) and airtightness and can contribute to SAP improvements, such as:

COST SAVINGS

- Maximise return on investment by focussing on fabric improvement
- Reduced renewable energy costs
- Reduced construction costs (reduced timber sizes and subsequent savings on construction)

MAXIMISE SITE POTENTIAL

- Space saving (e.g. 89mm timber frame solutions could be feasible, allowing for larger rooms or even more units per development site)

MORE FLEXIBILITY

- Greater freedom with designing elemental specifications (e.g. standard instead of high performance windows could be used)

DESIGN CONSIDERATIONS

DETAILING

Building Regulations state that “Insulation should be reasonably continuous over the whole building envelope... Reduction in thermal performance can occur where the air barrier and the insulation layer are not continuous and the cavity between them is subject to air movement.” Attention to detail is therefore paramount from technical design through to construction stage to address any shortcomings that may lead to the building not performing as predicted.

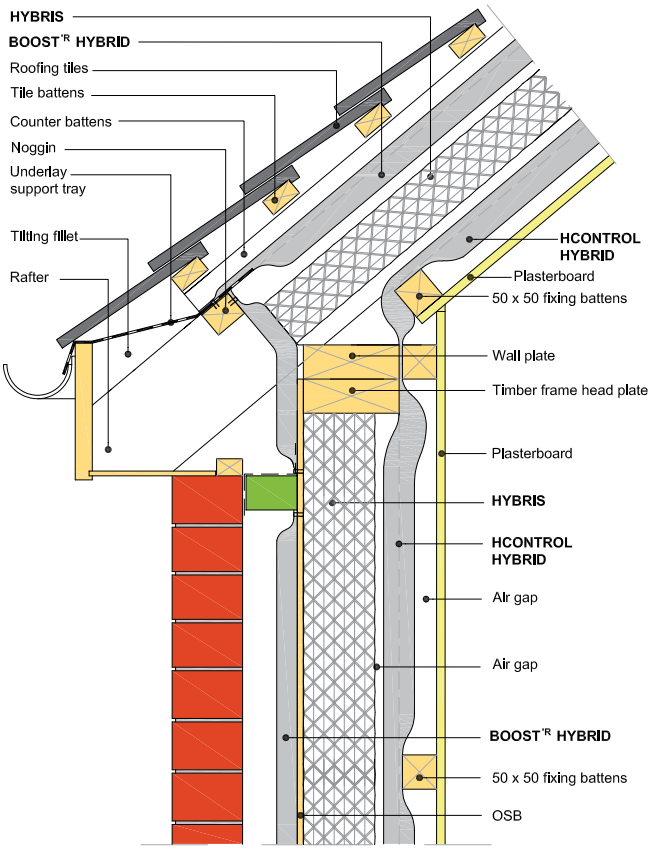
Using Actis Hybrid products offers a complete solution for thermal performance, thermal bridging and airtightness, which is easy to install thus guaranteeing a building that performs as expected.

Reflective insulation products are preferably installed with air cavities. This creates an integrated service void, undisturbed by follow up trades, which favours the continuity of the product within the building envelope. Multifoils could also be described as thermal blankets, which make it easy to create a continuous and airtight insulation layer.

Actis reflective insulation products are flexible, very forgiving and installation is not reliant on specialist workmanship. They can easily be cut with standard tools, stapled in place, fixed by battens or friction fit and sealed with tape if appropriate. Please refer to installation guides and online installation videos for each individual product.

Further construction details and installation guidelines are available at **www.insulation-actis.com**

TYPICAL EAVES DETAIL (WARM ROOF)



FIRE SOLUTIONS

ACTIS insulation products are organic compounds, based exclusively on carbon-hydrogen bonds. They must not be exposed to a direct heat source, sparks or a naked flame. ACTIS products will melt and shrink away from a heat source above 80°C, but will burn in the presence of a naked flame.

Whilst burning, the product may release hazardous breakdown products, such as carbon monoxide and dioxide. This is the case with all organic compounds, however, Actis insulation products do not produce any other toxic gasses.

FIRE RESISTANCE

In line with current regulatory guidance, ACTIS insulation products should always be covered with a fireproof lining board. When installed with an internal lining board, e.g. plasterboard, the insulation will be contained between the wall and internal lining board and the insulation will not contribute to the development stages of a fire. The performance of the chosen internal lining board is therefore paramount for the final in-use application.

With reference to bre report 128 'Guidelines for the construction of fire-resisting structural elements' one layer of 12.5mm plasterboard lining should achieve a fire resistance of 30 mins and two layers of 12.5mm plasterboard lining should achieve a fire resistance of 60 mins'.

COMPARTMENTATION

The spread of fire within a building can be restricted by sub-dividing it into segments separated from one another by walls and / or floors of fire resisting construction.

To ensure that compartment walls achieve the requisite levels of fire resistance, the insulation should not be carried over junctions with such walls and fire stops based on non-combustible materials are used to ensure that fire resistance requirements are met.

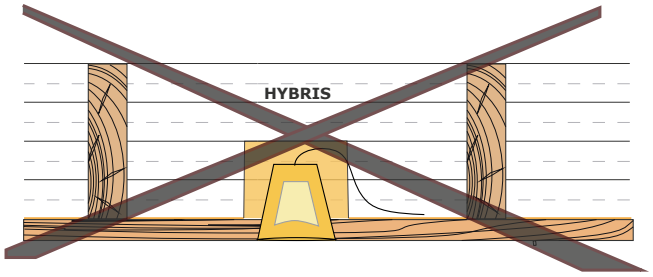
CAVITY BARRIERS – EXTERNAL FIRE SPREAD

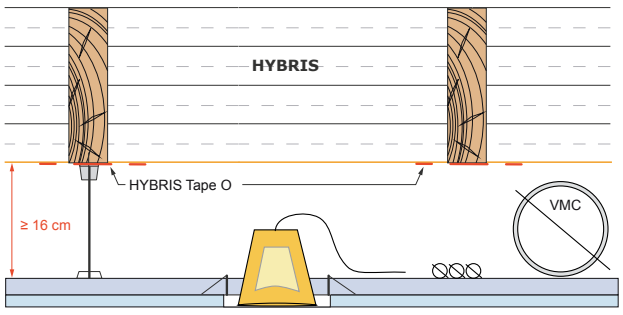
Cavity barriers are used within air cavities of cladding systems to prevent the spread of smoke and fire. They can be rigid (e.g. timber battens or non-combustible boards) or flexible (e.g. intumescent cavity carriers). Cavity barriers are usually required at eaves, around openings and at elements between compartments.

DOWNLIGHTERS AND RECESS LIGHTING

The use of down-lighters, recess lighting or any other source of localised heat (transformers, etc.) in direct contact with ACTIS insulation products is prohibited. However, if the use of recess lighting in conjunction with ACTIS insulation products is desired, specific precautions must be taken and ACTIS recommend the provision of a 'safety cavity' by creating a space between the insulation and the heat source in line with NHBC guidance.

This 'safety cavity' guarantees the installation of e.g. down-lighters without the risk of contact with the insulation. The minimum height of this 'safety cavity' depends on the safety distance recommended by the down-light manufacturer. Hoods and boxings can be used to maintain the safety cavity, however must be used with open down-lighters.





For further information, please contact ACTIS technical department, and follow fire safety provisions as set out in Building Regulations, NHBC and other relevant standards.

BIM (BUILDING INFORMATION MODELLING)

BIM is a process, managing the information produced during a construction project, in a common and open format - from feasibility study through to design and construction, operation and demolition, in order to make the best and most efficient use of that information.

In addition to enabling 3D 'real life' representations of the finished project and its intervening stages, the integrated system enables specifiers to anticipate errors, design issues and 'clashes' long before they would have occurred on site. BIM information of products is held within 'BIM objects'. 'BIM objects' have a unique number and contain all product characteristics, attributes etc. required for the BIM model of a construction project.

'BIM objects' for Actis Hybrid products are available at www.insulation-actis.com as well as on the following BIM portals:

NBS BIM Library
www.nationalbimlibrary.com

BIM Object
bimobject.com

SPECIFICATIONS

HYBRIS

Hybris is a reflective insulation product based on a honeycomb structure of shaped polyethylene foam layers and low emissivity films (aluminium coated polyethylene foils).

Hybris is an insulation material generally used for roof, wall, ceiling and suspended timber floor applications, especially suitable for timber/steel frame and masonry construction. The product should be installed in association with a suitable breather membrane or roofing felt. An independent and continuous vapour barrier may be required, however Hybris can act as a vapour control layer without the need for an independent vcl.

Product features:

- Thickness: 50mm to 205mm
- Weight: 9.5 kg/m³
- Declared thermal performance:

  Thermal conductivity: 0.033 W/mK

  Thermal resistance: 1.50 m²K/W (50mm Hybris) to 6.20 m²K/W (205mm Hybris)

  Thermal resistance with 2 air cavities of 20mm (heat flow horizontal): 2.65 m²K/W (50mm Hybris) to 7.35 m²K/W (205mm Hybris)

  Declared emissivity: 0.06 (inner layer) and 0.10 (outer layer)
- Water vapour resistance: >450 MNs/g
- Watertightness: W1
- Air permeability: Airtight
- Fire rating: Euroclass F
- Panel size: width: 1.145m, length: 1.200m
- Area: 1.374 m² / panel
- Non-hazardous with no special requirements for installation or disposal of waste
- Life expectancy: The product is expected to remain effective for the service life of the building provided that it is installed in accordance with the manufacturer's instructions and certification.

Hybris is CE-marked in accordance with ETA no 13/0121. Hybris has been designed for and fully tested in accordance with the EN 16012 standard for reflective insulation, including the application of 90/90. All testing of the product has been carried out by accredited independent test houses including VTT Expert Services Ltd.

The product has been tested in-situ according to ISO 9869 by Glasgow Caledonian University. Hybris has been awarded LABC and LABSS Registered Detail, is accepted by NHBC and holds BM Trada Q-mark certification.

Uniclass Code: Pr_25_57_06_57 Multifoil Blanket Insulation

HCONTROL HYBRID

HControl Hybrid is a thin multifoil insulation with built-in vapour control function. The product is composed of 20 layers; including coated metal reinforced polyolefin external films, coated metal polyolefin films, polyolefin foams and polyester wadding.

HControl Hybrid is typically installed on the warm side of roof, wall, ceiling or suspended floor constructions. The product should be installed in a continuous layer to guarantee contiguous insulation, airtightness and prevent any water vapour diffusion through the structure.

Product features:

- Thickness: 45mm
- Weight: 950 g/m²
- Declared thermal performance:

  Core thermal resistance: 1.9 m²K/W

  Thermal resistance with 2 air cavities of 20mm (heat flow horizontal): 3.2 m²K/W

  Declared emissivity: 0.06
- Water vapour resistance: >1000 MNs/g
- Watertightness: W1
- Air permeability: Airtight
- Fire rating: NPD
- Roll size: 1.6 x 6.25m
- Area: 10 m²/roll
- Non-hazardous with no special requirements for installation or disposal of waste
- Life expectancy: The product is expected to remain effective for the service life of the building provided that it is installed in accordance with the manufacturer's instructions and certification.

HControl Hybrid is CE-marked in accordance with EN 13984. HControl Hybrid has been designed for and fully tested in accordance with the EN 16012 standard for reflective insulation, including the application of 90/90. All testing of the product has been carried out by accredited independent test houses including VTT Expert Services Ltd. The product has been tested in-situ according to ISO 9869 by Glasgow Caledonian University.

HControl Hybrid has been awarded LABC and LABSS Registered Detail, is accepted by NHBC and holds BM Trada Q-mark certification.

Uniclass Code: Pr_25_57_06_57 Multifoil Blanket Insulation

BOOST'R HYBRID

Boost'R Hybrid is a thin multifoil insulation with built-in breather membrane function. The product is composed of 9 layers; including a watertight reflective breather membrane, polyester wadding layers and perforated coated metal polyolefin films.

Boost'R Hybrid is typically installed as a breathable membrane above rafters in a roof, on the outside face of walls and under suspended timber floor joists. The product should be installed in a continuous layer to guarantee contiguous insulation, airtightness and watertightness. Boost'R Hybrid is not intended to be used alone without weather protection (e.g. roof tiles).

Product features:

- Thickness: 35mm
- Weight: 650 g/m²
- Declared thermal performance:

  Core thermal resistance: 1.35 m²K/W

  Thermal resistance with 2 air cavities of 20mm (heat flow horizontal): 2.4 m²K/W

  Declared emissivity: 0.05 (inner layer) and 0.31 (outer layer)
- Water vapour resistance:

  0.55 MNs/g (overall product)

  0.25 MNs/g (breather membrane component)
- Water tightness: W1
- Air permeability: Airtight
- Fire rating: NPD
- Roll size: 1.5 x 6.70m
- Area: 10 m²/roll
- Non-hazardous with no special requirements for installation or disposal of waste
- Life expectancy: The product is expected to remain effective for the service life of the building provided that it is installed in accordance with the manufacturer's instructions and certification.

Boost'R Hybrid is CE-marked in accordance with EN 13859-1/2. Boost'R Hybrid has been designed for and fully tested in accordance with the EN 16012 standard for reflective insulation, including the application of 90/90. In accordance with BS 5534 Boost'R Hybrid is suitable for all wind zones (1-5) throughout the UK. All testing of the product has been carried out by accredited independent test houses including VTT Expert Services Ltd. The product has been tested in-situ according to ISO 9869 by Glasgow Caledonian University.

Boost'R Hybrid has been awarded LABC and LABSS Registered Detail, is accepted by NHBC and holds BM Trada Q-mark certification.

Uniclass Code: Pr_25_57_06_57 Multifoil Blanket Insulation

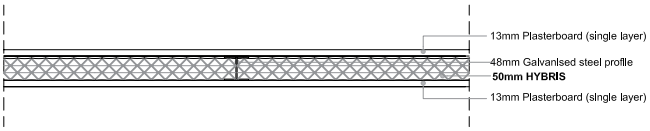
ACOUSTIC PERFORMANCE

SOUND INSULATION

Building Regulation Approved Document E requirements are performance based with a level of sound insulation specified, which must be achieved on site i.e. constructions need to be tested in situ.

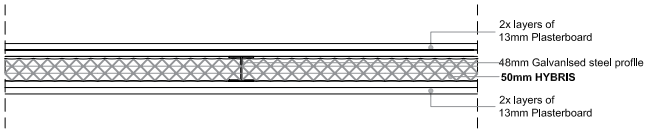
A series of wall build-ups were tested under laboratory conditions by an independent test body to evaluate airbourne sound properties of Actis Hybris insulation:

Example internal wall build-up



Build-up with 50mm Hybris and single layer of 12.5mm plasterboard:

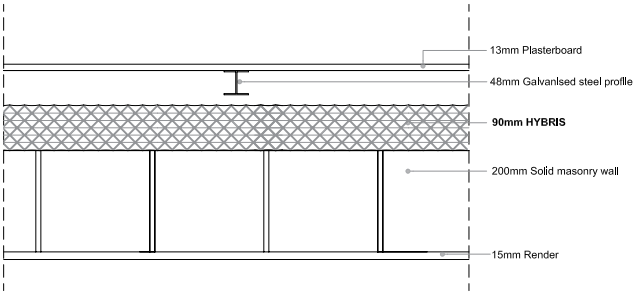
Rw (C;Ctr) 40.6 (-3:-8) dB



Build-up with 50mm Hybris and two layers of 12.5mm plasterboard:

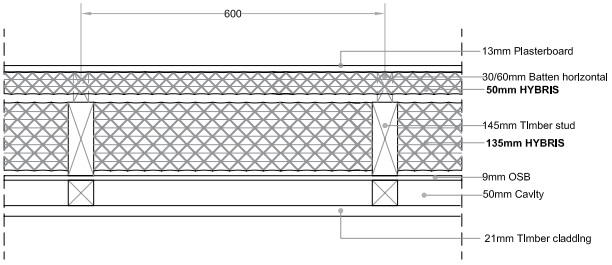
Rw (C;Ctr) 48.6 (-4;-10) dB

Example external wall build-ups



200mm Solid masonry wall with internal lining and 90mm Hybris:

Rw (C;Ctr) 67.3 (-2;-5) dB



145mm Timber frame wall with timber cladding and 135mm + 50mm Hybris:

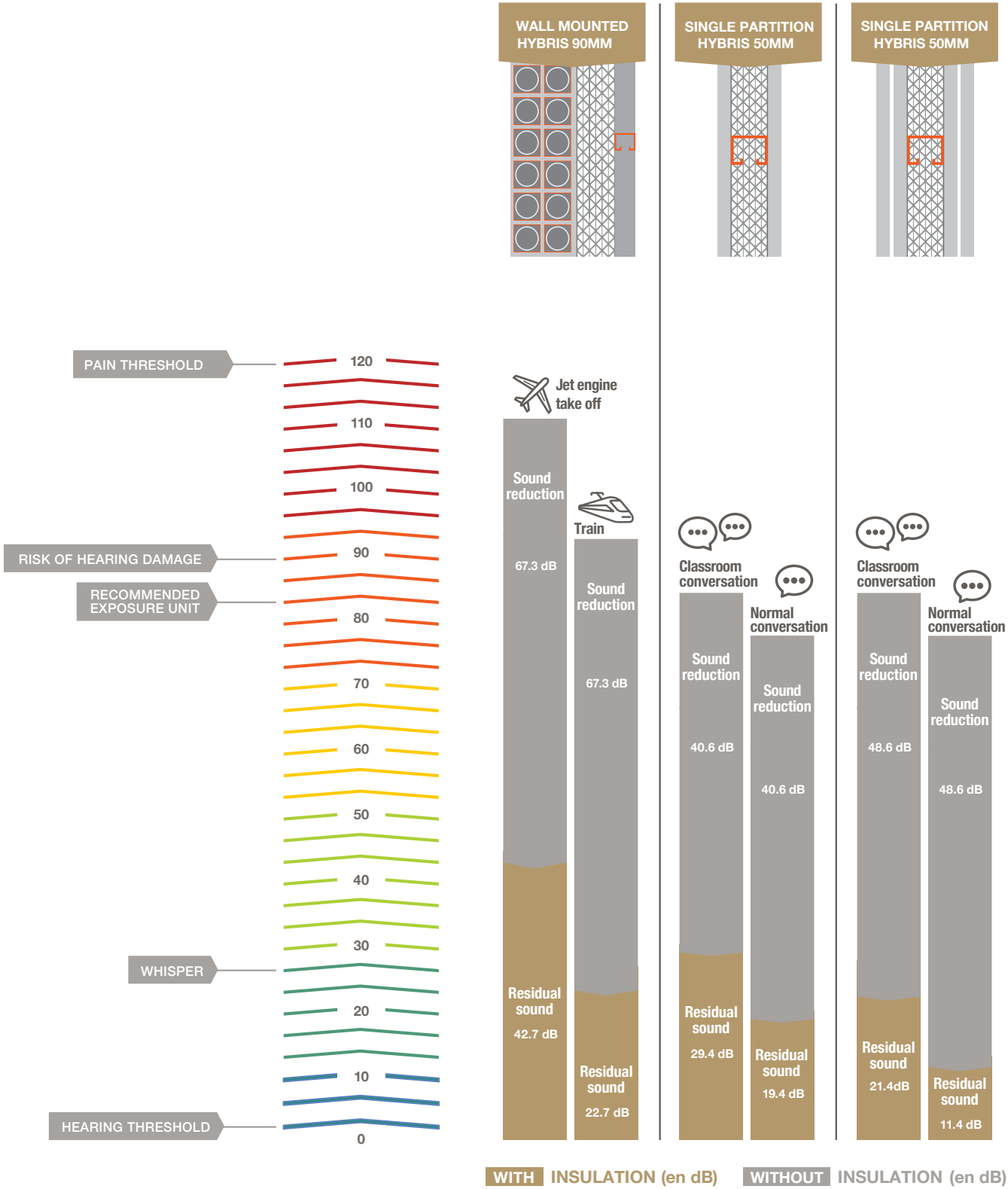
Rw (C;Ctr) 47.7 (-3;-9) dB

When looking at the difference between Rw + Ctr (laboratory performance) and predicted DnTw + Ctr (site performance) a minimum drop of 4dB is typical depending on the wall specification, assuming all flanking paths are appropriately detailed, site is ideally laid-out and perfect workmanship is applied.

Standard acoustic solutions are often based on mineral wool insulation. Acoustic tests show that the overall acoustic performance of Hybris is comparable with standard mineral wool.

For advanced acoustic performance requirements Actis recommends contacting an acoustic consultant.

EXAMPLE OF SOUND REDUCTION LEVELS



SUSTAINABLE DEVELOPMENT

RESEARCH & DEVELOPMENT

Actis' vision of innovation is to develop even more effective and environmentally friendly solutions to reduce the energy consumption of buildings. Actis is certified to ISO 9001 for its quality management system with more than 40,000 internal quality control tests being implemented annually. Each year Actis invests 5% of the company's turnover back into Research and Development.

PRODUCTS FROM SCIENTIFIC RESEARCH

Fundamental research, applied research, advanced research and technical support are the four strategies explored by R&D. Actis has a research laboratory equipped with calibrated measuring tools and specialised equipment (guarded hot box, guarded hot plate, climatic chamber etc.) to test the products as described by the current standards for building insulation.

The Hybrid range is the result of 10 years of research in collaboration with several laboratories and European certification agencies including the Scientific Centre for Technical Building (CSTB), the National Testing Laboratory (ESA), the certification body VTT Expert Services Ltd and University of Building Physics Kaunas Technology (KTU).

TRACEABILITY SYSTEM

Since January 2008, each Actis insulation product carries a traceability number identifying the batch from which it came. This traceability procedure enables the tracking of Actis' insulation products back to date of manufacture. Furthermore the external film of each roll is printed with the company name.

A HIGH-PERFORMANCE INDUSTRIAL TOOL

Since 2003 Actis has invested €25 million into four production sites in the Languedoc-Roussillon region and has a total production surface area of 45,000m^2. The manufacturing process benefits from a computer-aided management and manufacturing system, which optimises team operations and allows for a direct flow of operations and logistics.

PRODUCTION QUALITY CONTROL

In the interest of quality, all the components of Actis' insulation products are now manufactured in-house.

Thin reflective multifoil insulation products: reflective film extrusion and metallization, wadding manufacture, foam extrusion and assembly of the multilayer insulation product by hot-melt lamination or sewing.

Reflective underlays: reflective film extrusion and metallization, wadding manufacture and assembly of the underlay by hot-melt lamination.

Actis controls the quality of its products throughout the manufacturing process, from raw materials to finished products, including production and measurement equipment, packaging and distribution. Audits are carried out annually by Bureau Veritas to verify conformity with ISO 9001.

RESPECT FOR THE ENVIRONMENT AND FOR THE HEALTH AND SAFETY OF THE END-USERS

Since 2003 Actis has been committed to a strict 'Quality, Safety and Environmental' policy which forms the basis of the company's approach towards innovation.

Actis is certified to the Environmental Management Standard ISO 14001; Actis has identified the impact of its activities on the environment and put in place strategies to reduce these impacts as part of a continuous environmental improvement plan.

Further examples of environmental achievements:

- Implementation of waste sorting and re-use of packaging between the Group's production sites.
- Lean production process avoids the need for stopping and restarting machinery and thereby reduces energy consumption.
- Recycling machinery enables production offcuts to be reused, giving a wastage rate of almost zero.
- Products designed to preserve internal air quality.

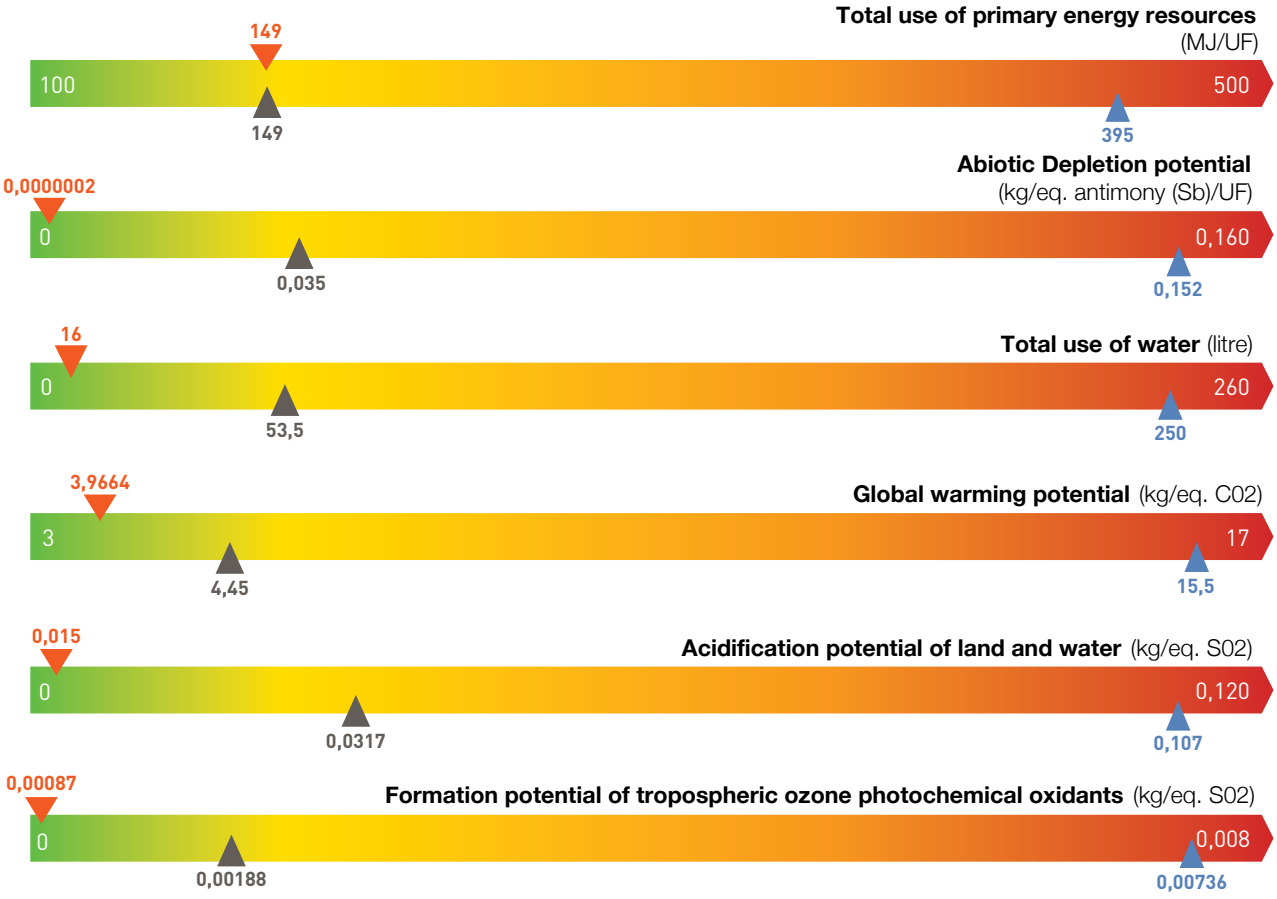
Information about VOC emission levels in indoor air, showing the risk of toxicity if inhaled, on a scale from A+ (very low emissions) to C (high emissions).

PRODUCT LIFE CYCLE ANALYSIS

For environmental assessments of buildings, the Global Warming Potential of products is usually required. This, as well as more detailed environmental data, are independently assessed via Environmental Product Declarations (EPDs).

EPD documents can be found at **www.insulation-actis.com**

Extracts and comparison of environmental product declarations (EN 15804)



HYBRIS $\lambda = 0.032$ W/mK
R=4.40 m²K/W
with 1 wall air cavity

GLASS WOOL $\lambda = 0.032$ W/mK
R=4.35 m²K/W

POLYURETHANE $\lambda = 0.024$ W/mK
R=4.25 m²K/W

SAFETY

ACTIS insulation products are organic compounds, based exclusively on carbon-hydrogen bonds. They are free from asbestos or irritant fibres and are CFC and HCFC free. Products are resistant to decay, no fungicide treatment necessary.

ACTIS insulation products are lightweight and non-load bearing. They will resist normal loads associated with installation and use, although cannot be walked on.

Installation does not require special protection equipment. However, where the products are being installed in bright or sunny weather conditions, appropriate eyewear should be worn and protection against sunburn. During installation extra care should be taken when working in wet conditions due to the increased risk of slipping.

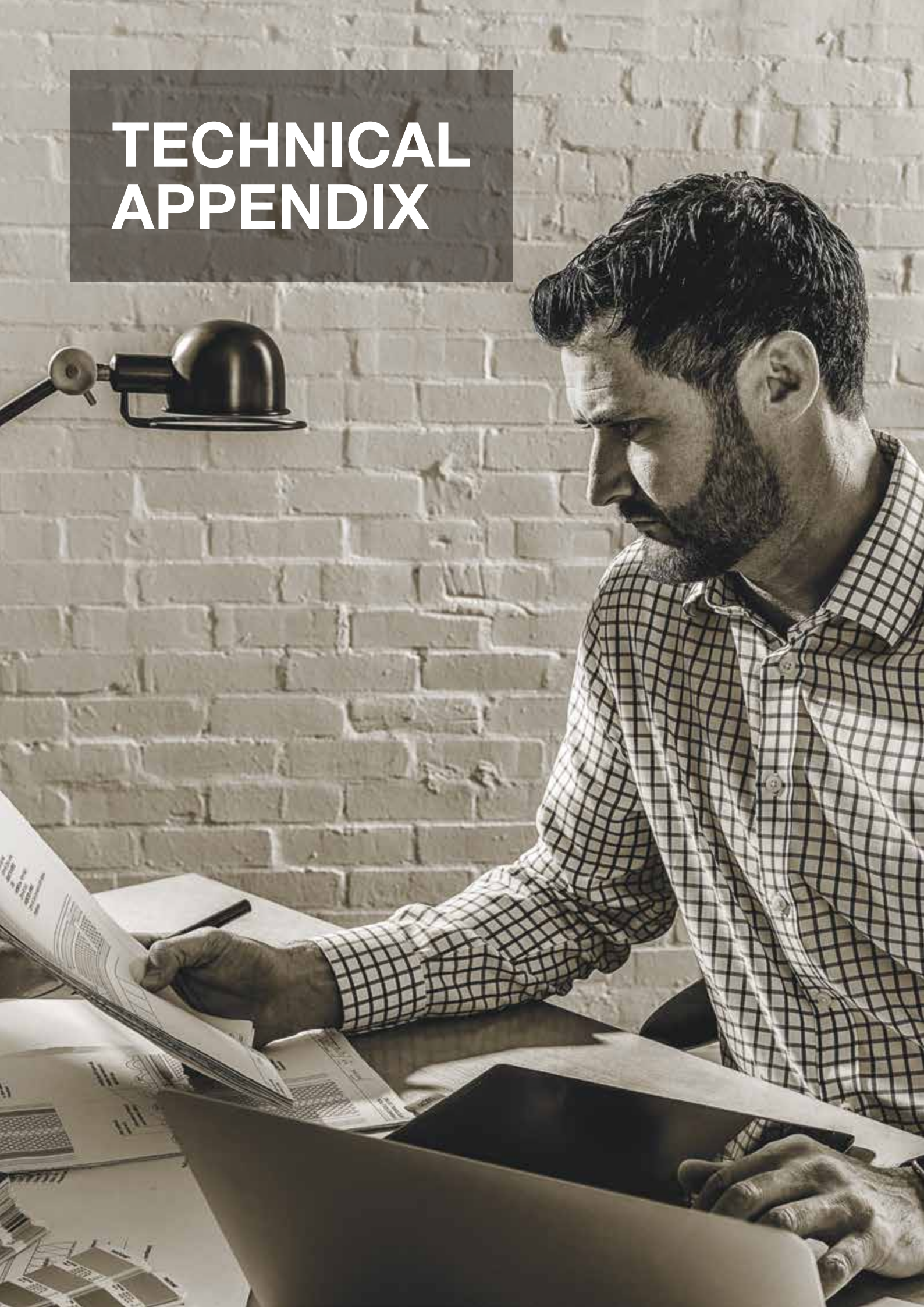
For fire safety please refer to section ‘fire solutions’.

Products should be stored in clean, dry conditions, not exposed to sunlight and in such a way that dirt and dust does not adhere to the product surfaces. The products must be protected from being dropped or crushed by objects and must be stored away from flammable material such as solvents.

In addition to the specific recommendations given above, ACTIS products should be used in compliance with good building practice, the most recent editions of any applicable regulations or relevant guidance and any British or European Standards relating to the installation and use of insulation products, particularly in relation to safety precautions.

All Actis products have COSHH certificates available on request.

TECHNICAL APPENDIX



GLOSSARY

THERMAL TRANSMITTANCE: U-VALUE

U-values are expressed as W/m^{2}K - the rate in watts at which heat transfers through a square metre of the surface of an element when there is a temperature difference of one Kelvin between the inside and outside of the element (i.e. a wall, floor or roof).

A U-value doesn't apply to any individual material used in the build-up, but to a thermal element as a whole. So a brick won't have a U-value, but a build-up consisting of brick, block, mortar, insulation and so forth does have a U-value.

THERMAL CONDUCTIVITY: λ-VALUE (LAMBDA)

The lambda value is the thermal conductivity of each of the materials used in the build-up. Each building material has a defined thermal conductivity: how much heat is conducted through a cubic metre of material with a one Kelvin temperature difference between side A and side B. The more easily a material conducts heat the higher its lambda value.

For example, aluminium, which conducts heat very easily, has a lambda value of 160 W/mK, whereas steel is 50 W/mK and brick is 0.72 W/mK.

THERMAL RESISTANCE: R-VALUE

Each material component has an R-value (thermal resistance, shown as m^{2}K/W.), which is the resistance to the transfer of heat across the material, in relation to its thickness.

The thermal resistance is then calculated by dividing the thickness of a material (in metres) by its thermal conductivity (lambda value - λ). For non-standard products verified lab tests are carried out to test the lambda or R-values enabling specifiers to declare values (λD or RD) which can be included within their calculations.

While λ-values need to be as low as possible for maximum efficiency, R-values need to be as high as possible.

LINEAR THERMAL TRANSMITTANCE: ψ VALUE (PSI)

A thermal bridge is when an insulation layer is interrupted, and heat is transferred through a non-insulating material. The type of thermal bridging that happens at construction details (i.e. where two thermal elements meet) is defined as linear thermal bridging. The heat loss through this linear thermal bridge is quantified by the Ψ-value (psi-value) expressed in W/mK.

All Ψ-values multiplied by the length of the bridge and divided by the building envelope area make up the overall heat loss of the building through linear thermal bridging - the Y-value expressed as W/m^{2}K.

STANDARDS REFERENCE

EN 16012: Thermal insulation: Reflective insulation products. Determination of declared thermal performance.

EN 8990: Thermal insulation: Determination of steady-state thermal transmission properties. Calibrated and guarded hot box.

EN 12667: Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance.

EN 6946: Building components and building elements. Thermal resistance and thermal transmittance. Calculation method.

ISO 9869: Thermal insulation. Building elements. In-situ measurement of thermal resistance and thermal transmittance. Heat flow meter method.

EN 13984: Flexible sheets for waterproofing. Plastic and rubber vapour control layers. Definitions and characteristics.

EN 13829: Thermal performance of buildings. Determination of air permeability of buildings. Fan pressurization method.

BS 5250: Code of practice for control of condensation in buildings.

EN 10211: Thermal bridges in building construction. Heat flows and surface temperatures. Detailed calculations.

BR 443: U-value conventions in practice: Worked examples using BR 443.

BR 497: Conventions for calculating linear thermal transmittance and temperature factors.

BS 5534: Slating and tiling for pitched roofs and vertical cladding. Code of practice.

BBA IB3: Reflective foil insulation - Conventions for U-value calculations.

ADDITIONAL HELP AND ADVICE

U-VALUE SIMULATOR

Discover a unique tool to get a quick simulation of your project by visiting **hybrid.insulation-actis.com**.

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Actis BIM content is available on the NBS BIM library and BIM object library.

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HELPFUL GUIDES

We have a range of useful guides to assist you with your project. Please contact us if you would like to receive a copy of any of the following:

- Timber Frame Brochure
- Solutions and Systems Brochure
- Hybrid Range Brochure
- Installation Guidelines
- Park Homes Brochure

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