Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946
Source: **own catalogue - Pitched roofs**
Component: **Icotherm Metro Vented**

OUTSIDE

This illustration of inhomogeneous layers is provided only to assist in visualising the arrangement.

On the basis of the given information about the inhomogeneous layers, it is not possible to estimate how and where bearing elements intersect each other. It was assumed that the layers intersect crosswise. The size of the areas was calculated corresponding to their percentage of the whole area.

INSIDE

Assignment: Pitched roof < 70°, with insulation between rafters

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m²K/W]
		Rse					0.0400
☑	1	BS EN 12524	Steel	0.0020	50.000	D	0.0000
☑	2	BS EN 12524	Breather membrane	0.0001	0.170	D	0.0006
☑	3	BS EN 12524	Plywood [500 kg/m³]	0.0120	0.130	D	0.0923
☑	4	Inhomogeneous material layer	consisting of:	0.0250	ø 0.300		0.0834
	4a	BS EN ISO 6946	Slightly vent. air layer: 25 mm, upwards heat flow	92.67 %	0.313	D	-
	4b	BS EN 12524	Softwood Timber [500 kg/m³]	07.33 %	0.130	D	-
☑	5	Inhomogeneous material layer	consisting of:	0.1500	ø 0.030		5.0140
	5a	Quinn Therm	Quinn Therm	92.67 %	0.022	E	-
	5b	BS EN 12524	Softwood Timber [500 kg/m³]	07.33 %	0.130	D	-
☑	6	British Gypsum Limited	Gyproc Wallboard DUPLEX 12.5mm	0.0125	0.190	D	0.0658
☑	7	BS EN 12524	Gypsum plastering	0.0025	0.570	D	0.0044
		Rsi					0.1000
				0.2041			

$R_T = (R_T' + R_T'')/2 = 5.59\ m^2K/W$

$U = 1/R_T = 0.18\ W/(m^2K)$

Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
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B .. B: Data is entered and validated by the manufacturer or supplier. Data is certified by 3rd party
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U_{max} = 0.18 W/(m²K)   U = 0.18 W/(m²K) R_T = 5.59 m²K/W

Source of Umax value: England and Wales Approved Document L1B 2010 Tab 1 Dwellings Existing New Thermal Elements

Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946
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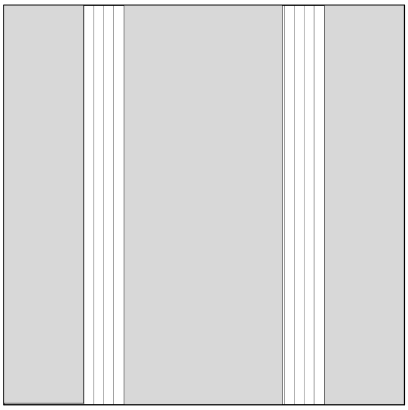
Component: **Icotherm Metro Vented**

Draft of the component (portion in %):

23.17 3.66 46.34 3.66 23.17



The inhomogeneous layer consists of two zones (A, B).
The portion is given in %.

A	23.17 + 46.34 + 23.17 consisting of material layers: 1, 2, 3, 4a, 5a, 6, 7	= 92.67%
B	3.67 + 3.67 consisting of material layers: 1, 2, 3, 4b, 5b, 6, 7	= 7.33%

Upper limit of the thermal transfer resistance R

U_A [W/(m²K)] = $\frac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}} = \frac{1}{7.06 + 0.1 + 0.04}$ = 0.14

U_B [W/(m²K)] = $\frac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}} = \frac{1}{1.51 + 0.1 + 0.04}$ = 0.61

$$R_T' = \frac{1}{A * U_A + B * U_B} = 5.78 \text{ m}^2\text{K/W}$$

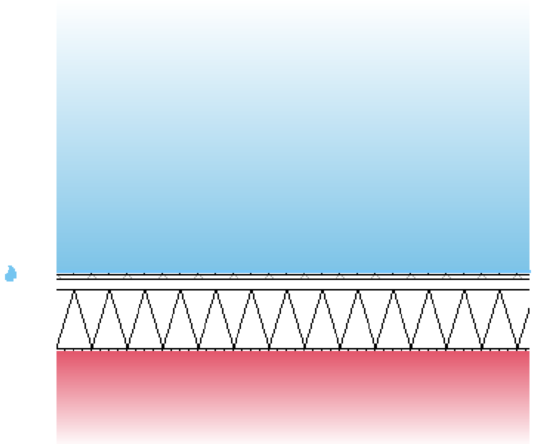
Lower limit of the thermal transfer resistance R

R_{se} [m²K/W]			= 0.04
R_1 " [m²K/W]	= d_1 / λ_1 =	0.0020 / 50.000	= 0.00
R_2 " [m²K/W]	= d_2 / λ_2 =	0.0001 / 0.170	= 0.00
R_3 " [m²K/W]	= d_3 / λ_3 =	0.0120 / 0.130	= 0.09
R_4 " [m²K/W]	= $d_4 / (\lambda_{4a} * A + \lambda_{4b} * B)$ =	0.0250 /(0.313 * 92.67% + 0.130 * 7.33%)	= 0.08
R_5 " [m²K/W]	= $d_5 / (\lambda_{5a} * A + \lambda_{5b} * B)$ =	0.1500 /(0.022 * 92.67% + 0.130 * 7.33%)	= 5.01
R_6 " [m²K/W]	= d_6 / λ_6 =	0.0125 / 0.190	= 0.07
R_7 " [m²K/W]	= d_7 / λ_7 =	0.0025 / 0.570	= 0.00
R_{si} [m²K/W]			= 0.1

$$R_T'' = \Sigma R_i'' + R_{si} + R_{se} = 5.40 \text{ m}^2\text{K/W}$$

Documentation of the component
Calculation according BS EN ISO 13788
Source: **own catalogue - Pitched roofs**
Component: **Icotherm Metro Vented**

OUTSIDE



INSIDE

The list of material layers shown below may differ from those in the U-value calculation printout. Only material layers which are used in the Condensation Risk Analysis are listed.

This calculation of the Condensation risk analysis according to BS EN ISO 13788:2002 has been performed on a construction containing inhomogeneous layers. This calculation is only valid through the selected section. It is advisable that you should also select the alternative position and recalculate the Condensation Risk Analysis for a more complete assessment of the construction.

The CRA calculation for pitched roofs can be very unreliable and caution should be used when interpreting these results. For further guidance the user is advised to follow the recommendation of BS 5250:202 (currently under review).

Assignment: Pitched roof < 70°, with insulation between rafters

Name	Thickn. [m]	lambda [W/(mK)]	Q	μ [-]	Q	sd [m]	R [m²K/W]
Steel	0.0020	50.000	D	999999.00	D	2000.00	0.0000
Breather membrane	0.0001	0.170	D	2000.00	D	0.20	0.0006
Plywood [500 kg/m³]	0.0120	0.130	D	70.00	D	0.84	0.0923
Slightly vent. air layer: 25 mm, upwards heat flow	0.0250	0.313	D	1.00	D	0.03	0.0799
Quinn Therm	0.1500	0.022	E	8340.00	E	1251.00	6.8182
Gyproc Wallboard DUPLEX 12.5mm	0.0125	0.190	D	970.00	D	12.13	0.0658
Gypsum plastering	0.0025	0.570	D	6.00	D	0.02	0.0044

Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
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Documentation of the component
Calculation according BS EN ISO 13788
Source: **own catalogue - Pitched roofs**
Component: **Icotherm Metro Vented**

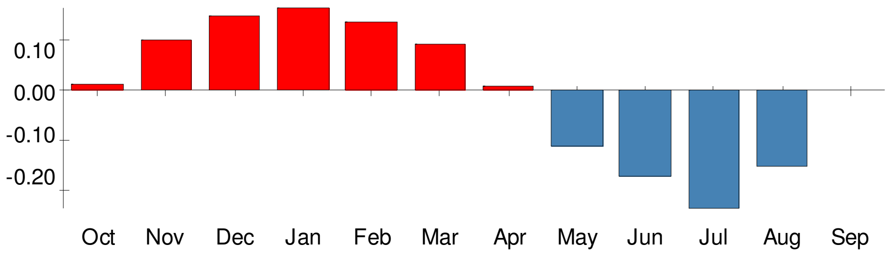
Condensation risk analysis - summary of main results
Calculation according BS EN ISO 13788

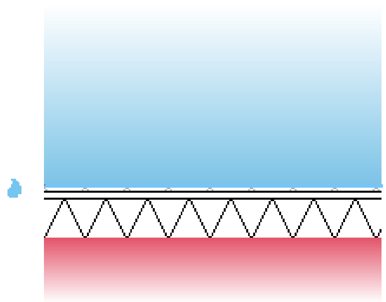
Surface temperature to avoid critical surface moisture:
No danger of mould growth is expected.

Interstitial condensation occurs, but all the condensate is predicted to evaporate during the summer months.

The risk of degradation of building materials and deterioration of thermal performance as a consequence of the calculated maximum amount of moisture shall be considered according to regulatory requirements and other guidance in product standards.

Interstitial condensation and evaporation per month gc [g/m²]





Component, condensation range

CRA calculations according to BS EN ISO 13788:2002 are used as a guide in predicting interstitial condensation. This methodology uses some simplifications of the dynamic processes involved and subsequently does have some limitations. Further information can be found in Information Paper IP 2/05 'Modelling and controlling interstitial condensation in buildings'' Feb 2005.

The CRA calculation for pitched roofs can be very unreliable and caution should be used when interpreting these results. For further guidance the user is advised to follow the recommendation of BS 5250:202 (currently under review).

Surface temperature to avoid critical surface humidity
Calculation according BS EN ISO 13788

Location: Manchester Airport; Humidity class according BS EN ISO 13788 annex A: Dwellings with low occupancy

		1	2	3	4	5	6	7	8	9	10	11	12
	Month	Te	phi_e	Ti	phi_i	pe	delta p	pi	ps(Tsi)	Tsi,min	fRsi	Tsi	Tse
		[°C]	---	[°C]	---	[Pa]	[Pa]	[Pa]	[Pa]	[°C]	---	[°C]	[°C]
●	January	4.2	0.830	20.0	0.594	684	704	1388	1735	15.3	0.701	19.5	4.3
	February	4.1	0.800	20.0	0.583	655	708	1363	1704	15.0	0.685	19.5	4.2
	March	5.8	0.760	20.0	0.570	701	633	1333	1666	14.7	0.623	19.5	5.9
	April	7.8	0.710	20.0	0.554	751	544	1294	1618	14.2	0.524	19.6	7.9
	May	11.3	0.680	20.0	0.555	910	388	1298	1622	14.2	0.337	19.7	11.3
	June	14.1	0.710	20.0	0.601	1142	263	1405	1756	15.5	0.231	19.8	14.1
	July	16.1	0.720	20.0	0.638	1317	174	1491	1863	16.4	0.075	19.9	16.1
	August	15.8	0.740	20.0	0.648	1328	187	1515	1894	16.6	0.201	19.9	15.8
	September	13.3	0.770	20.0	0.631	1175	298	1474	1842	16.2	0.435	19.8	13.3
	October	10.3	0.810	20.0	0.619	1014	432	1446	1808	15.9	0.579	19.7	10.4
	November	6.7	0.820	20.0	0.598	804	593	1397	1746	15.4	0.652	19.5	6.8
	December	5.2	0.840	20.0	0.600	743	659	1402	1752	15.4	0.691	19.5	5.3

● The critical month is January with $f_{Rsi,max}$ = 0.701
f_{Rsi} = 0.966

$f_{Rsi} > f_{Rsi,max}$, the component complies.

Nr	Explanation
1	External temperature
2	External rel. humidity
3	Internal temperature
4	Internal relative humidity
5	External partial pressure $p_e = \phi_e * p_{sat}(T_e)$; $p_{sat}(T_e)$ according formula E.7 and E.8 of BS EN ISO 13788
6	Partial pressure difference. The security factor of 1.10 according to BS EN ISO 13788, ch.4.2.4 is already included.
7	Internal partial pressure $p_i = \phi_i * p_{sat}(T_i)$; $p_{sat}(T_i)$ according formula E.7 and E.8 of BS EN ISO 13788
8	Minimum saturation pressure on the surface obtained by $p_{sat}(T_{si}) = p_i / \phi_{si}$, where ϕ_{si} = 0.8 (critical surface humidity)
9	Minimum surface temperature as function of $p_{sat}(T_{si})$, formula E.9 and E.10 of BS EN ISO 13788
10	Design temperature factor according 3.1.2 of BS EN ISO 13788
11	Internal surface temperature, obtained from $T_{si} = T_i - R_{si} * U * (T_i - T_e)$
12	External surface temperature, obtained from $T_{se} = T_e + R_{se} * U * (T_i - T_e)$

Interstitial condensation - main results
Calculation according BS EN ISO 13788

Interstitial condensation occurs but all the condensate is predicted to evaporate during the summer months.

The risk of degradation of building materials and deterioration of thermal performance as a consequence of the calculated maximum amount of moisture shall be considered according requirements and other guidance in product standards.

Climcatic conditions
Location: Manchester Airport; Humidity class according BS EN ISO 13788 annex A: Dwellings with low occupancy

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Internal temperature [°C]	Ti	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Internal rel. humidity [%]	phi_i	59.4	58.3	57.0	55.4	55.5	60.1	63.8	64.8	63.1	61.9	59.8	60.0
External temperature [°C]	Te	4.2	4.1	5.8	7.8	11.3	14.1	16.1	15.8	13.3	10.3	6.7	5.2
External rel. humidity [%]	phi_e	83.0	80.0	76.0	71.0	68.0	71.0	72.0	74.0	77.0	81.0	82.0	84.0

Monthly moisture content per area gc [g/m²]
Accumulated moisture content per area Ma [g/m²]

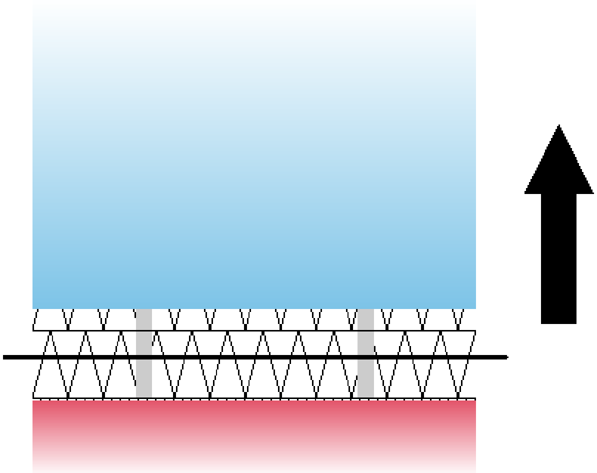
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Steel / Breather membrane	gc	0	0	0	0	0	0	0	0	0	0	0	---
	Ma	0	0	0	0	1	1	1	1	0	0	---	---
Breather membrane / Plywood [500 kg/m³]	gc	---	---	0	0	0	0	0	---	---	---	---	---
	Ma	---	---	0	0	0	0	---	---	---	---	---	---

icotherm solid roof

Iconservatories Ltd
T/A Icotherm Solid Roof

Documentation of the component
Heat capacity
Source: **own catalogue - Pitched roofs**
Component: **Icotherm Metro Vented**

OUTSIDE



INSIDE

The list of materials shown below may differ from those in the U-value calculation printout. Only material layers which are used in the heat capacity calculation are listed.

Single material layers shown in the U-value calculation printout may be separated to meet the exclusion criteria:

A .. The total thickness of the layers exceed 0.1 m.
B .. The mid point in the construction is reached.

For insulation layers the following criteria applies:

C .. An insulating layer is reached (defined as lambda <= 0.08 W/(mK)).

	Name	Thickness [m]	lambda [W/(mK)]	Q	Thermal capacity [kJ/(kgK)]	Q	Density [kg/m^3]	Q	Thermal mass kJ/(m^{2}K)	Criteria Exclusion
	End of calculation - Cold									
1	Steel	0.0020	50.000	D	0.45	D	7800.0	D	~~7.0~~	A, -, C
2	Breather membrane	0.0001	0.170	D	1.80	D	350.0	D	~~0.1~~	A, -, C
3	Plywood [500 kg/m^3]	0.0120	0.130	D	1.60	D	500.0	D	~~9.6~~	A, -, C
4	Inhomogeneous material layer consisting of:	0.0250							~~1.5~~	A, -, C
4a	Slightly vent. air layer: 25 mm, upwards heat flow	92.67%	0.313	D	1.01	D	1.2	D	~~0.0~~	A, -, C
4b	Softwood Timber [500 kg/m^3]	07.33%	0.130	D	1.60	D	500.0	D	~~1.5~~	A, -, C
5	Inhomogeneous material layer consisting of:	0.0650							~~3.8~~	A, -, C
5a	Quinn Therm	92.67%	0.022	E	1.40	E	29.0	E	~~2.4~~	A, -, C
5b	Softwood Timber [500 kg/m^3]	07.33%	0.130	D	1.60	D	500.0	D	~~3.8~~	A, -, C
5	Inhomogeneous material layer consisting of:	0.0850							5.0	-, -, -
5a	Quinn Therm	92.67%	0.022	E	1.40	E	29.0	E	~~3.2~~	-, -, C
5b	Softwood Timber [500 kg/m^3]	07.33%	0.130	D	1.60	D	500.0	D	5.0	-, -, -
6	Gyproc Wallboard DUPLEX 12.5mm	0.0125	0.190	D	1.00	D	684.0	D	8.6	-, -, -
7	Gypsum plastering	0.0025	0.570	D	1.00	D	1300.0	D	3.3	-, -, -
	Start of calculation - Warm									
		0.2041							**16.8**	

Heat capacity = 16.8 kJ/(m^{2}K)

The following exclusion criteria apply:
A .. The total thickness of the layers exceed 0.1 m.
C .. An insulating layer is reached (defined as lambda <= 0.08 W/(mK)).

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