INSULATION FOR COMPOSITE PANEL ROOFS AND ENCLOSURES

For composite panel roofs, there are several thermal and acoustic insulation options available on the mar- ket that can be fitted between two roofing panels.

A particular condition of this solution is that the thickness of the insulation material must not be less than the height of the standing seam, as the air gaps reduce the insulation capabilities of the panel.

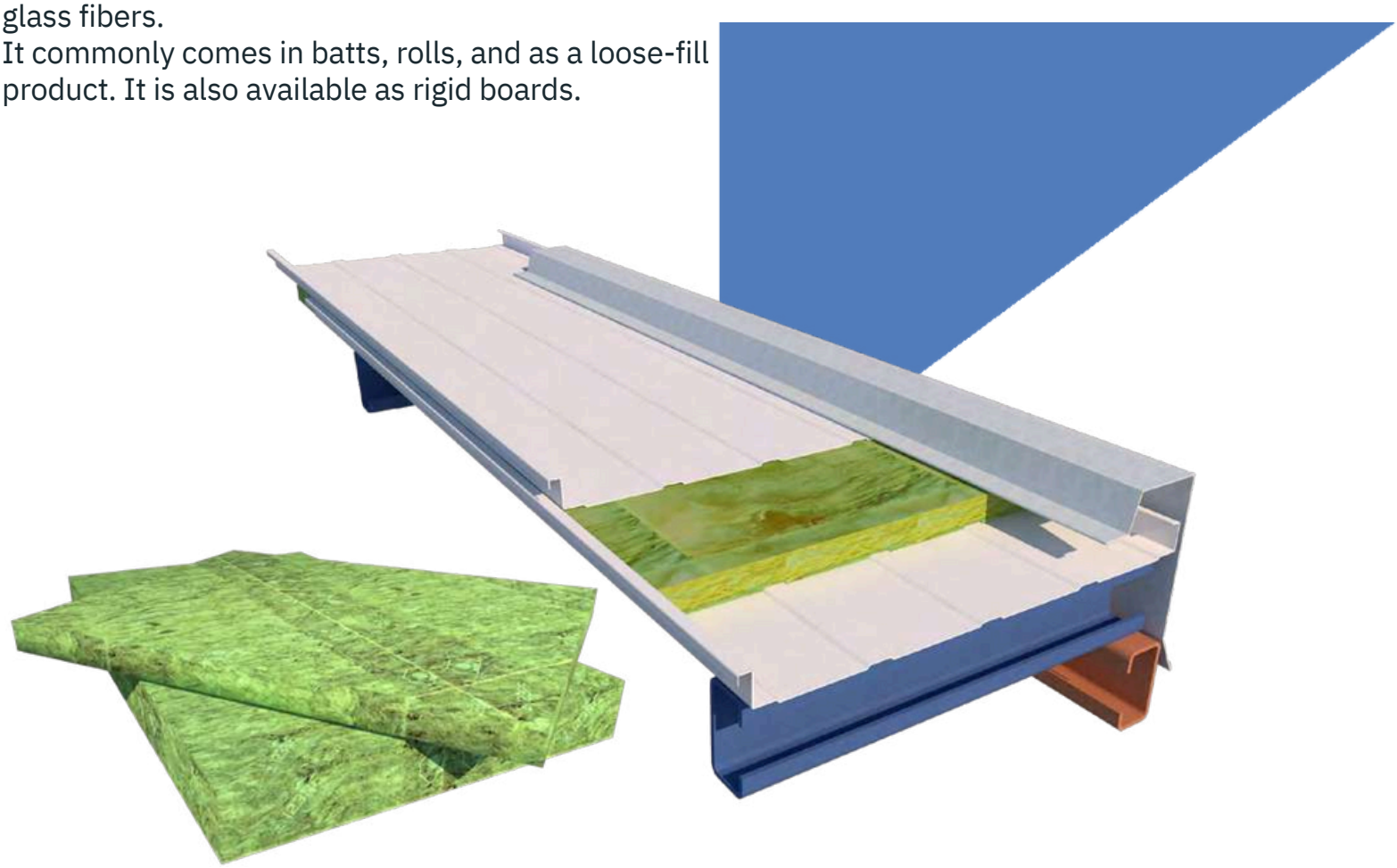
The type of insulation used in these panels is known as bulk insulation. Conventional bulk insulation materials can break up. the path of conductive heat flow (e.g., 25% of the total heat flowing into a building), slowing down or resisting the transmission of heat from one side of the material to the other.

Bulk insulation materials are generally evaluated in terms of their heat transfer (or thermal) resistance by assigning them a rating known as R-value.

Below are the most common types of bulk insulation we use at Cielo Vivo.

FIBERGLASS INSULATION

Fiberglass insulation is composed of extremely fine glass fibers.
It commonly comes in batts, rolls, and as a loose-fill product. It is also available as rigid boards.



ACOUSTIC PERFORMANCE IN OCTAVE BAND FREQUENCIES

3 ½" unfaced insulation*	Typical mounting	125	250	500	1000	2000	4000	NRC***
	Type-A**	0.34	0.85	1.09	0.97	0.97	1.12	0.95

*Material exposed to sound.
**Type-A mounting: Material installed near a solid partition, such as a brick wall.
***NRC=Noise Reduction Coefficient. Typical expected value according to comparable product ratings.

	UNFACED	PAPER-FACED	FOIL-FACED
DIMENSIONS	15.24 m (600") L x 1.22 m (48") W x 3.5" and 2.5" thick R	15.24 m (600") L x 1.22 m (48") W x 3.5" and 2.5" thick R 11	15.24 m (600") L x 1.22 m (48") W x 3.5" and 2.5" thick
THERMAL RESISTANCE (°F•ft²•h/BTU)	11(3.5") R 8 (2.5")	0,8 Type-A	R 11
NOISE REDUCTION COEFFICIENT (NRC)	0.85 (2.5") 1.05 (3.5") Type-A mounting	mounting	0,8 Type-A mounting
SURFACE BURNING CHARACTERISTICS	ASTM E84 – FS/SD 25/50		
PACKAGING	Compression-packaged rolls in poly bags		

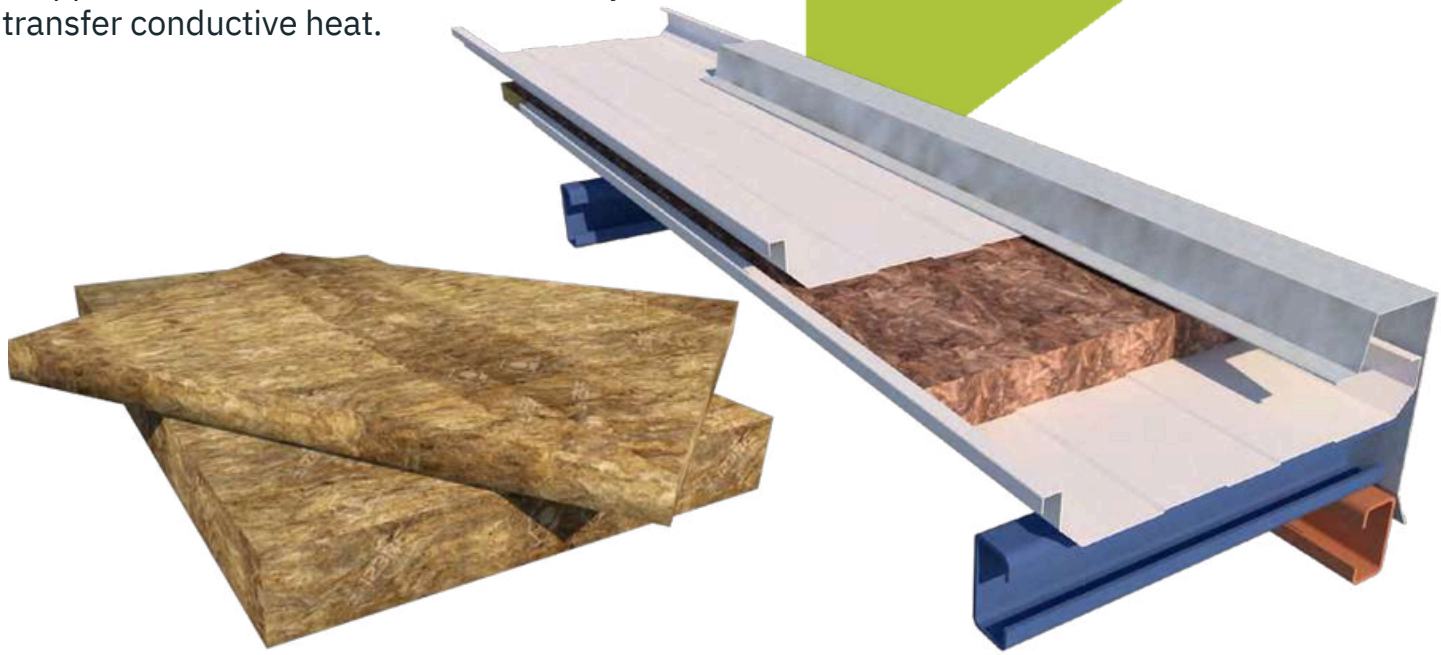
MINERAL WOOL INSULATION

Mineral wool insulation is composed primarily of natural rock.

As such, it is considered a sustainable material and it can also be recycled.

During the production process of the insulation mats, fibers are compressed, and air is trapped between them.

Trapped air reduces the material's ability to transfer conductive heat.



ASTM C518 TEST METHOD

Density	Thermal conductivity (k) @ 75 °F (24 °C) BTU•in/ft²•h•°F	R-value per inch of thickness*
2.5pcf	0.27	3.7
4.0 pcf	0.23	4.3

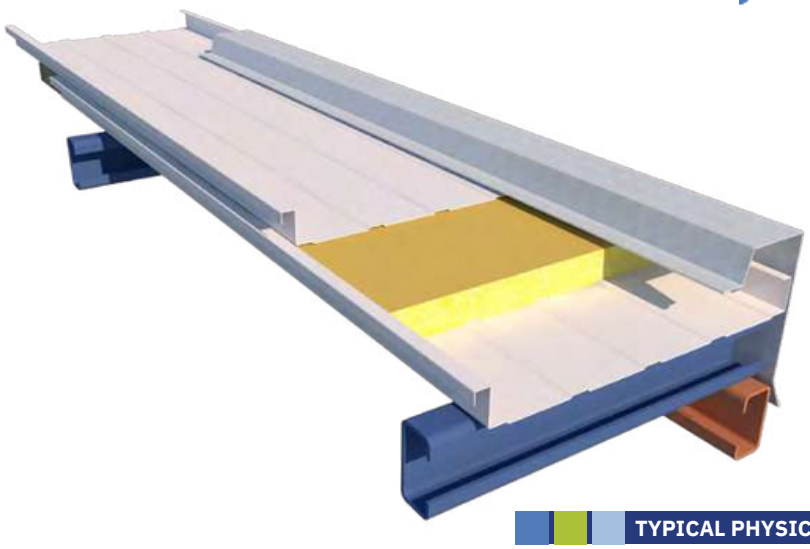
*R = thickness divided by "k"

ACOUSTIC BEHAVIOR

FREQUENCY COEFFICIENTS PER ASTM C423								
	THICKNESS	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
DENSITY 2.5 pcf	2"	0.34	0.61	1.07	1.09	1.07	1.1	0.95
	3"	0.51	0.99	1.18	1.03	0.99	0.96	1.05
	4"	0.83	1.19	1.27	1.12	1.12	1.13	1.20
	6"	1.37	1.32	1.23	1.16	1.12	1.12	1.20

POLYURETHANE AND POLYISOCYANURATE INSULATION

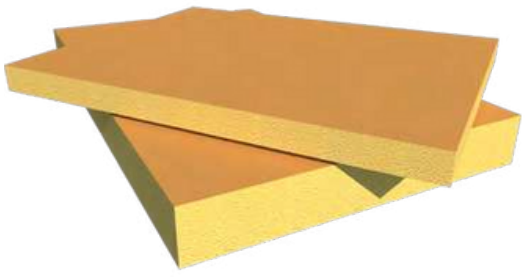
The main properties of these types of insulation include high thermal resistance —allowing for thinner insulating panels—, rigidity and lightness, which facil- itate handling and installation. Rigid polyurethane foam (PUR) is an excellent thermal insulator with low thermal conductivity, light weight, high durability and optimal chemical and organic sta- bility. Rigid polyisocyanurate (PIR) is a variant of PUR foam with similar appearance and mechanical and thermal properties but offering greater fire and temperature resistance.



THERMAL AND PHYSICAL PROPERTIES

THICKNESS		LTTR	Max. Flute-Span Capability	
in	mm	(R-Value**)	in	mm
1.0	25.4	5.7	2 5/8	66.7
1.5	38.1	8.6	4 3/8	111
2.0	51	11.4	4 3/8	111
2.5	64	14.4	4 3/8	111
3.0	76	17.4	4 3/8	111
3.5	89	20.5	4 3/8	111
4.0	102	23.6	4 3/8	111
4.5	114	26.8	4 3/8	111

*Long Term Thermal Resistance (LTTR) values provide a 15-year time weighted average in accordance with CAN/ULC S770.
Note: Physical and thermal properties shown are based on data obtained under controlled laboratory conditions and are subject to normal manufacturing tolerances.



TYPICAL PHYSICAL PROPERTIES

PROPERTY	VALUE	MÉTODO DE PRUEBA
Water absorption, % by volume – 2 hrs. (under 1" [25.4 mm] of water)	1.5 max.	ASTM C209
Dimensional stability change, 7 days @ 158 °F (70 °C), 97% RH • Length + Width	<2%	ASTM D2126
Compressive strength – psi (kPa)	25 (172) nom. Grade 3 20 (138) nom. Grade 2	ASTM D1621
Tensile strength – psf (kPa)	≥ 500 (23.9)	ASTM C209
Moisture vapor transmission	<1.5 perm (85.8 ng/Pa s m2)	ASTM E96 (Procedure A)
Flame spread index1, 2	<75	ASTM E84
Service temperature	-100–200 °F (-73.3–93.3 °C)	

[1] Foam core only.
[2] These numerical ratings are not intended to reflect hazards presented by these or any other material under actual fire conditions.

POLYSTYRENE INSULATION

Polystyrene is a plastic derivative that is made from various petroleum-based products.

Expanded polystyrene (EPS) is marketed as an insulation material in the form of EPS rigid foam.

It is one of the most common materials used in roofing because in addition to having good thermo-acoustic properties, it is affordable and easy to transport and install, creating significant saving for composite panel roofing projects.

BOARD THICKNESS		R-VALUE		
mm	in	Dens. 12 kg/m³	Dens. 15 kg/m³	Dens. 20 kg/m³
25	1″	3.59	3.84	4.06
32	1.25″	4.6	4.91	5.19
38	1.5″	5.46	5.83	6.16
50	2″	7.19	7.67	8.11
63	2.5″	9.06	9.67	10.22
75	3″	10.78	11.51	12.17
95	3.5″	13.66	14.58	15.41
100	4″	14.38	15.35	16.22
125	5″	17.97	19.18	20.28
150	6″	21.56	23.02	24.34
175	7″	25.16	26.86	28.39
200	8″	28.75	30.69	32.45
Fire resistance Flame spread index	Complies with: DIN 4102 Class B1, ASTM E84 and IBC 2009 Section 2603, NBC 3.1.14.2.1 and CAN/ULC-S126			
Smoke spread index	10, according to ASTM E84			
Temperature range	Between 15 and 40, depending on thickness, according to ASTM E84			
Production standard	-100 °C–75 °C, ASTM C1258, up to 85 °C for short periods			
Water absorption	According to ASTM C578			
Mold resistance	After being submerged for 1 month, less than 4% by volume			
	Resistant			