Product data sheet

ECOCOOL

THERMOCOVER ECO-SAFE+

WATER-BLANKETS (to be used in conjunction with Thermocover Eco-Safe)

Specification

Water-Blankets for extended temperature control for shipments of palletized, temperature sensitive goods. Five Water-Blankets are to be used in conjunction with one ECOCOOL thermal blanket ECO-SAFE.

Construction

ISOHOOD-WATER-BLANKETS consist of water-based gel (polyacrylate, cross-linked superabsorber granulate in waterous solution), vacuum-sealed in PE/PA compound foil. The foil and superabsorber granulate comply with EC regulations for packaging materials in direct contact with foodstuffs.

Thermoforming foil			
Composition	Thickness (µm)	Weight (g/m²)	Tolerance
PE/PA	120	83,5	+-15 %

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Dimensions

ECOCOOL Water-Blankets consist of sleeves of gel-filled chambers, eight of which form one panel. The total length of one Water-Blanket has to be an integer-multiple of these panels and solely depends on the dimensions of the pallet to be covered.

- Length: 280 mm (+-5 mm)
- Width: 380mm (+-5 mm)
- Thickness: 10mm (average)
- Each panel contains eight gel-filled chambers of dimensions 175x60x10mm.

One Panel of Water-Blankets

THERMAL QUALIFICATION SUMMARY

Qualification results

Important note: Results of tests of thermocovers are always specific to the chosen test setup. In particular, the respective thermal mass on the covered pallet, incidence and strength of solar irradiation, ambient temperatures as well as prevalent wind conditions may lead to different test results. Hence, the following results are indicative of relative levels of performance rather than defining absolute levels of performance during real shipments.

Qualification strategy

In order to test a broad range of ambient conditions, three particular test scenarios are conducted.

- Climate chamber summer test, medium mass
- Climate chamber winter test, medium mass
- Outdoor summer test, zero mass (worst case scenario)

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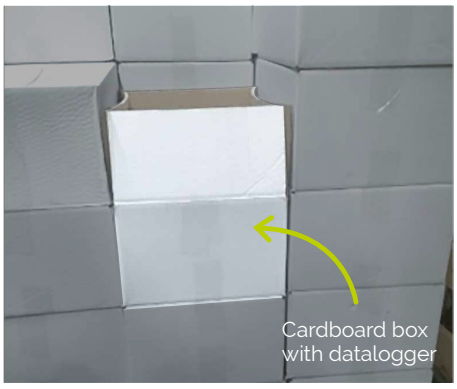
Climate Chamber Summer Test

Climate chamber summer tests are indicative of the insulating properties of the tested packaging, disregarding the potential impact of solar irradiation. This is particularly relevant to understand the impact of hot ambient temperatures without direct solar irradiation, such as during loading processes in cloudy tropical locations, in non-ininsulated warehouses or during non temperature controlled road- or sea-shipments.

Test setup:

- EUR pallet (80x120x100) loaded with 40 single fluted cardboard boxes
- Each cardboard box contains 4.5L water
- Total load 180L or 19% loading volume
- 40°C ambient temperature
- 15°C start temperature
- Test duration: 96 hours

Positioning of inside logger inside the cardboard box



Positioning of inside logger on pallet

Positioning of outside loggers on the pallet

Pallet prepared with thermocover ECO-SAFE+

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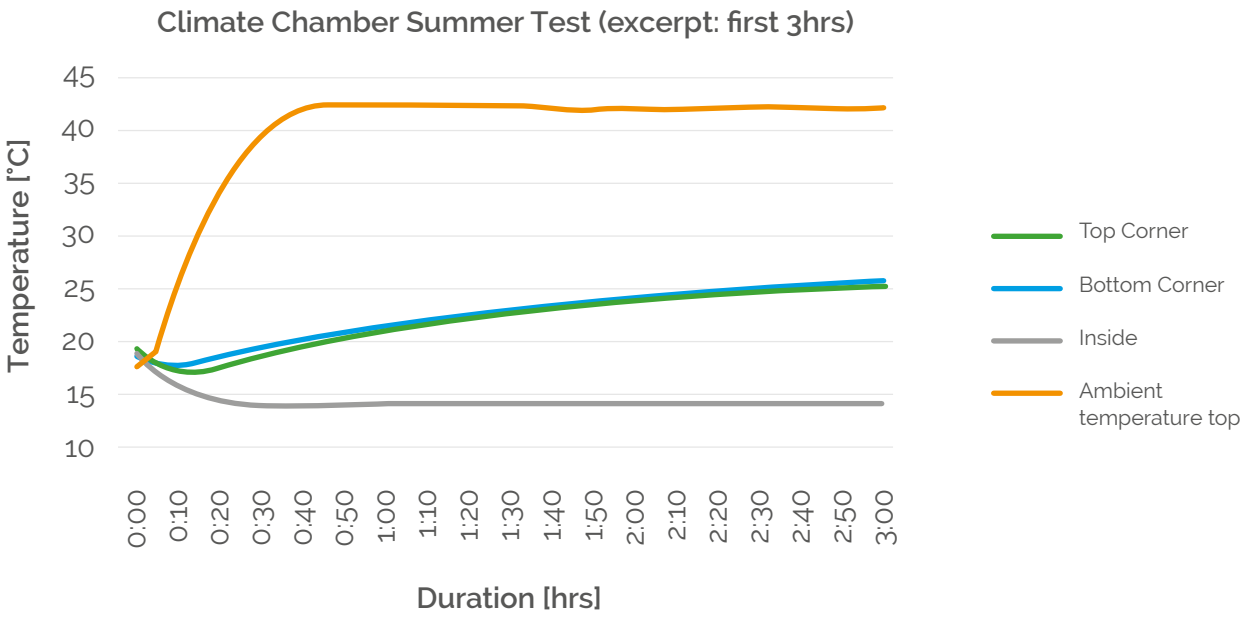
Results

Test results are depicted in Graph 1 and tabulated in Table 1 below. The results document the ability of the thermocover ECO-SAFE+ to significantly slow down the process of temperature equilibration between the temperature underneath the thermocover or at the dummyload and the ambient temperature. Compared with the standard thermocover ECO-SAFE, the ECO-SAFE+ solution increases the time to reach 25°C (30°C) at the outside of the pallet by at least 100 (425) minutes, thus drastically minimizes the potential for potentially harmful temperature excursions under summer conditions.

All other things being equal (i.e. same ambient temperature), the test outcome will improve (slow-down of temperature increase) if the thermal mass on the pallet is increased and vice versa.



Graph 1: Climate chamber summer test, (excerpt first 3hrs)

Time to temperature change

	+Δ5°C	+Δ10°	+Δ15°
Outside top logger	1:25 h	5:00 h	21:55 h
Outside bottom logger	1:10 h	4:30 h	19:25 h
Inside logger	16:50 h	32:25 h	52:45 h

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Temperature change over time (compared to starting value)			
	1 hour	3 hours	6 hours
Outside top logger	3.7 °C	8.3 °C	10.6 °C
Outside bottom logger	4.6 °C	8.6 °C	10.9 °C
Inside logger	0.0 °C	0.4 °C	1.3 °C

Time to reach			
	25 °C	30 °C	35 °C
Outside top logger	2:10 h	9:25 h	33:40 h
Outside bottom logger	2:00 h	8:25 h	33:25 h
Inside logger	38:40 h	61:35 h	> 96:00 h

Table 1: Tabulated results of climate chamber summer test

Winter test setup:

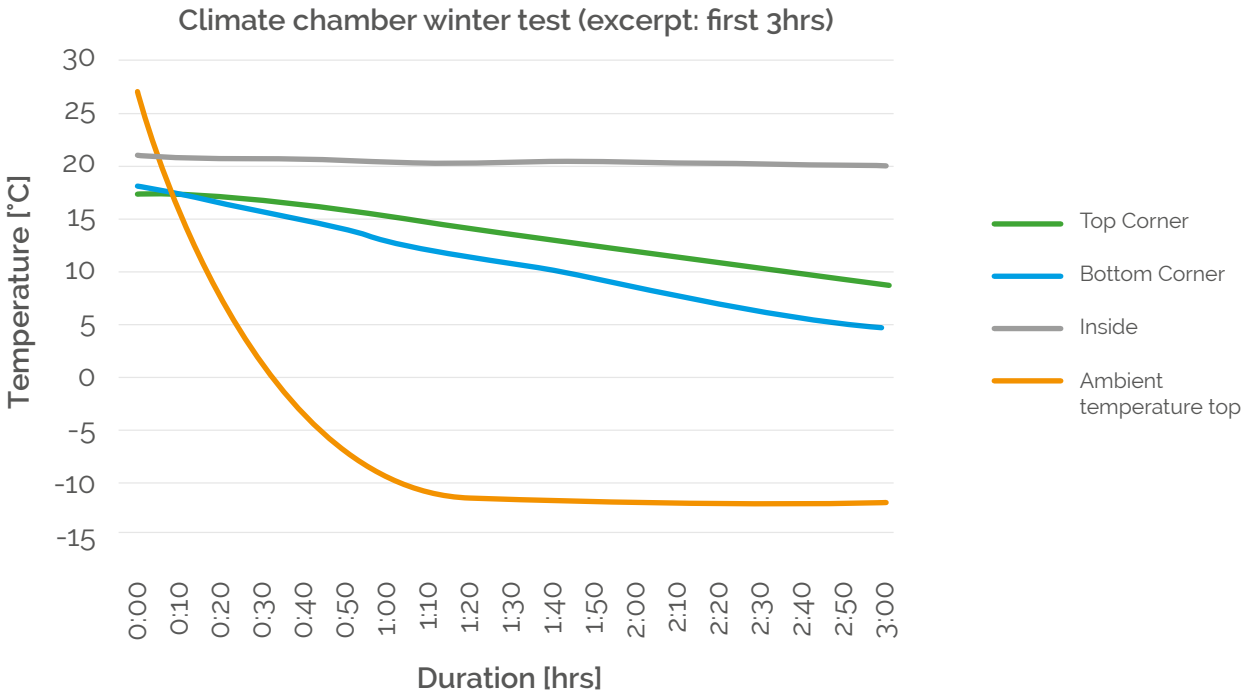
Climate chamber winter tests are indicative of the insulating properties of the tested packaging under cold ambient conditions. This is particularly relevant to understand the impact of cold ambient temperatures, as encountered during loading processes in winter conditions or during non temperature controlled road- or sea-shipments.

- EUR pallet (80x120x100) loaded with 40 single fluted cardboard boxes
- Each cardboard box contains 4.5L water
- Total load 180L or 19% loading volume
- -10°C ambient temperature
- 15°C start temperature

Results

Test results are depicted in Graph 2 and tabulated in Table 2 below. The results document the ability of the thermocover ECO-SAFE+ to significantly slow down the process of temperature equilibration between the temperature underneath the thermocover or at the dummyload and the ambient temperature. Compared with the standard thermocover ECO-SAFE, the ECO-SAFE+ solution increases the time to reach 10°C (5°C) at the outside of the pallet by at least 30 (95) minutes, thus minimizing the potential for potentially harmful temperature excursions under winter conditions.

All other things being equal (i.e. same ambient temperature), the test outcome will improve (slow-down temperature decrease) if the thermal mass on the pallet is increased and vice versa.



Graph 2: Climate chamber winter test, (excerpt first 3hrs)

Time to temperature change

	-Δ5°C	-Δ10°	-Δ15°
Outside top logger	1:35 h	3:45 h	10:15 h
Outside bottom logger	1:00 h	1:55 h	4:50 h
Inside logger	13:15 h	25:50 h	40:10 h

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Temperature change over time (compared to starting value)			
	1 hour	3 hours	6 hours
Outside top logger	2.5 °C	8.7 °C	12.2 °C
Outside bottom logger	5.4 °C	12.7 °C	15.9 °C
Inside logger	0.2 °C	1.1 °C	2.6 °C

Time to reach			
	10°C	5°C	0°C
Outside top logger	02:15 h	5:35 h	16:55 h
Outside bottom logger	1:20 h	2:45 h	8:15 h
Inside logger	29:30 h	44:35 h	69:10 h

Table 2: Tabulated results of climate chamber winter test

Outdoor stress test

A stress-test, based on a zero mass pallet (40 empty cardboard boxes) was conducted to account for conditions encountered in air-cargo shipments of low-mass pharmaceutical products. Covered pallets were exposed to direct sunlight for approximately 4 hours. One data logger was positioned on top of the pallet, directly underneath the Water-Blankets and the thermocover, recording the temperature development at the most vulnerable spot. Ambient conditions were calm and sunny. Ambient shadow temperatures peaked at 30.7°C (average ambient temperatures over 4 hours: 30.2°C), ambient temperatures under direct exposure to sunlight peaked at 49.2°C (average over 4 hours: 41.8°C).

Test date: 2015/07/01, test location: Bremerhaven, Germany.

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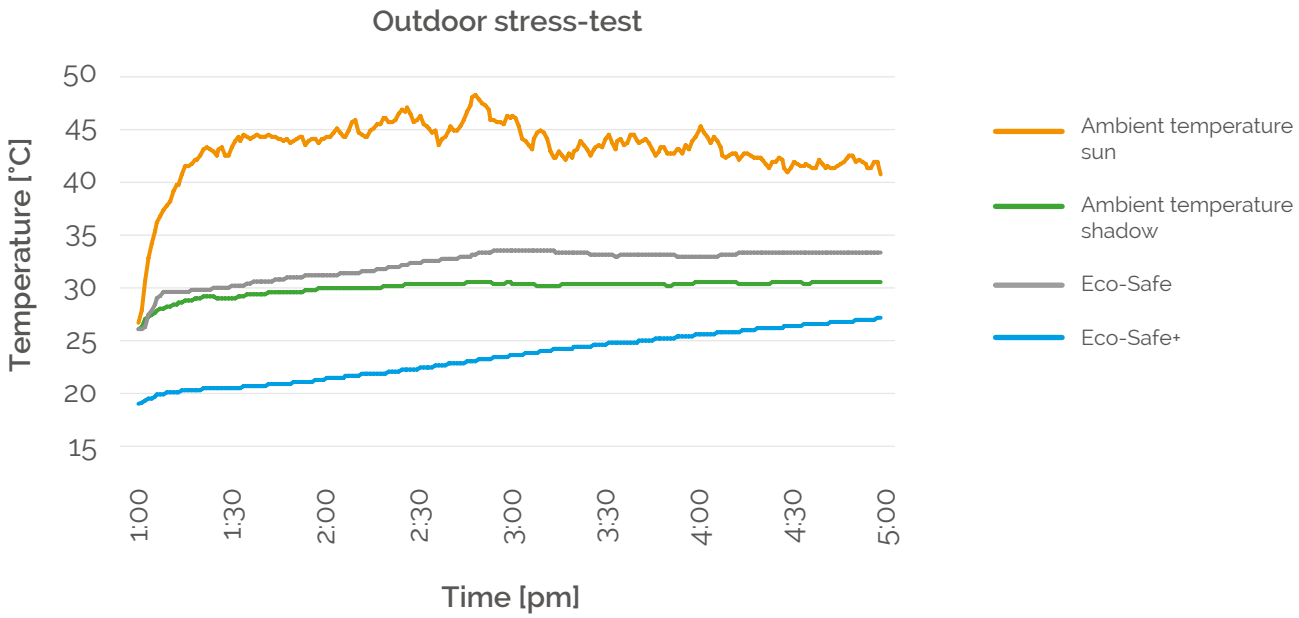
Results

Test results are depicted in Graph 3 below. The results obtained with the thermocover ECO-SAFE are included for comparative purposes, The results obtained for the ECO-SAFE+ solution document its ability to keep temperatures at the pallet significantly below the ambient shadow temperature for extended periods of time. Moreover, it takes inside temperatures over 150 minutes to reach 25°C and the critical 30°C boundary was not exceeded during the test period. The temperature differential obtained via the ECO-SAFE+ solution compared with the ambient temperature with direct sun exposure amounted to 18.7°C over the test period. The respective differential compared with a pallet coved by the ECO-SAFE thermocover averaged 7.4°C. These results confirm the prior lab tests that the ECO-SAFE+ thermocover with Water-Blankets consitutes an extremely efficient means to protect temperature sensitive loads from temperature excursions under extreme conditions.



Graph 3: Outdoor stress-test