

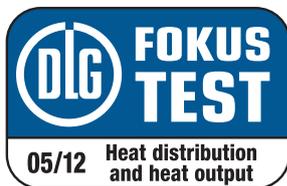
REVENTA Kunststoffverarbeitung GmbH & Co. KG

“Thermo-Plus”[®]

Electric Piglet-Nest Heating Plates

Heat distribution and heat output

DLG Test Report 6080F



Applicant

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DLG e.V.
Test Center Technology
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Brief description

The tested “Thermo-Plus”[®] Elektro universal piglet-nest heating plates are electrical heating plates made of polyethylene in two different widths.

The plate’s interior is completely filled with water and is heated by an immersion heater. The immersion heater and a thermowell for the temperature sensor are screwed onto the plate at the side and

connected to the Reventa TR 2A controller (controlling range: stepless from 0 to 60 °C). On the underside of the plate, there is thermal insulation with a thickness of approx. 15 mm.

The test included the following plate models:

- Model 500x1,200 mm universal
- Model 400x1,200 mm universal

Technical Data (Measured Values)

	“Thermo-Plus” electric piglet-nest heating plates	
	400 x 1,200 universal	500 x 1,200 universal
Material	Plastic, rigid (HDPE)	Plastic, rigid (HDPE)
Plate length [mm]	1,190	1,190
Plate width [mm]	370	470
Plate thickness [mm]	55	55
Insulating material [mm]	15	15
Unladen weight (with cables/thermowell) [kg]	6.7	7.6
Water filling [litres]	approx. 14	approx. 18.5

Test Results and Individual Evaluations

	"Thermo-Plus" electric piglet-nest heating plates			
	400 x 1,200 universal		500 x 1,200 universal	
	Test result	Evaluation*	Test result	Evaluation*
Optimum controller setting:				
Maximum proportion of area with advantageous/optimum temperatures on the plate	45		42.5	
Heat distribution at optimum controller setting				
Proportion of area with advantageous temperatures (37–43 °C) [%]	86.2	+	86.4	+
Proportion of area with optimum temperatures (39–41 °C) [%]	40.2	○	42.6	○
Mean temperature on the plate [°C]	40.6	++	39.6	++
Coefficient of variation (CV) [%]	4.0	+	4.6	+
Energy demand at optimum controller setting				
Energy demand per hour per plate	0.18 kWh		0.19 kWh	
Energy demand per hour per m ²	0.37 kWh/m ²	+	0.32 kWh/m ²	+

* Ambient conditions: 20 °C / plate with insulation on the underside

Evaluation range: ++ / + / ○ / - / -- (○ = standard); for CV: + / ○ / - (○ = standard)

Test – Heat Distribution and Energy Demand

The heat distribution and energy demand were tested in the laboratory without animals at a room air temperature of 20 °C ± 2K without exposure to direct sunlight. The measurements were performed on individual plates.

The determined values relate exclusively to the stable state of the plate following the respective heating phase. Various controller settings were investigated in order to determine the optimum set-point setting that gives the maximum proportion of lying area with optimum surface temperatures. Each setting was repeated on three identical plates.

Heat distribution (individual plate)

The heat distribution was recorded using thermograms from a thermal imaging camera and analysed using software. Each thermogram records between 5,000 and 8,000 surface temperatures, from which it is easy to derive a mean value over the plate. Before the measurements were taken, a value of $\varepsilon = 0.94$ was determined for the emission factor applicable to the plate and a value of $RTC = 20\text{ °C}$ was determined for

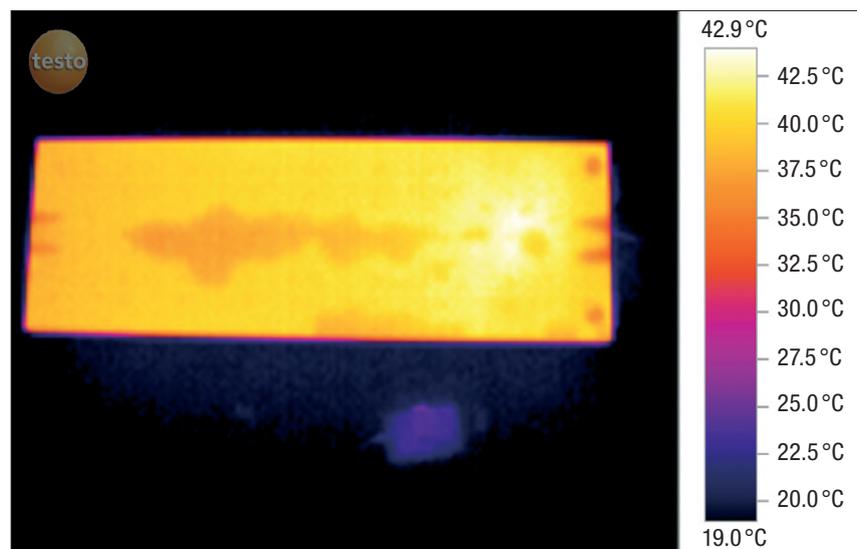


Figure 2:
Thermogram of the Thermo-Plus® Elektro 400x1,200 mm at a controller setting of 45

the corresponding reflected ambient temperature. Various controller settings were tested in order to determine the optimum value applicable to the plate under the specified test conditions (Table 1). With the "Thermo-Plus"® Elektro 400 x 1,200 mm, the proportions of lying area with advantageous and optimum temperatures were at their maximum when the controller

setting was set to 45 as a set point. With the wider plates, measuring 500 x 1,200 mm, the controller's ideal setting in the test was 42.5. At these settings, it was possible to achieve the desired average surface temperature of 40 °C in both plate sizes. Temperatures of around 40 °C on the piglet-nest plate are considered the ideal ambient temperature for piglets in the first days of life.

Figure 3 shows the surface temperatures that result from the different controller settings.

With a coefficient of variation of less than 5%, the scattering of the surface temperatures remained within a favourable range. A good 86% of all temperatures were between the required values of 37 and 43 °C. Excess scattering of the values is to be avoided so that an optimum lying area can be provided even for lower-ranking animals.

As in most commercially available water-filled plates, a certain proportion of air in the plate is unavoidable. However, all users should ensure that the plate is filled with water as completely as possible, as this strongly influences the heat distribution. Air is known to be a considerably poorer conductor of heat than water. Air bubbles can be identified in the thermogram (Figure 2).

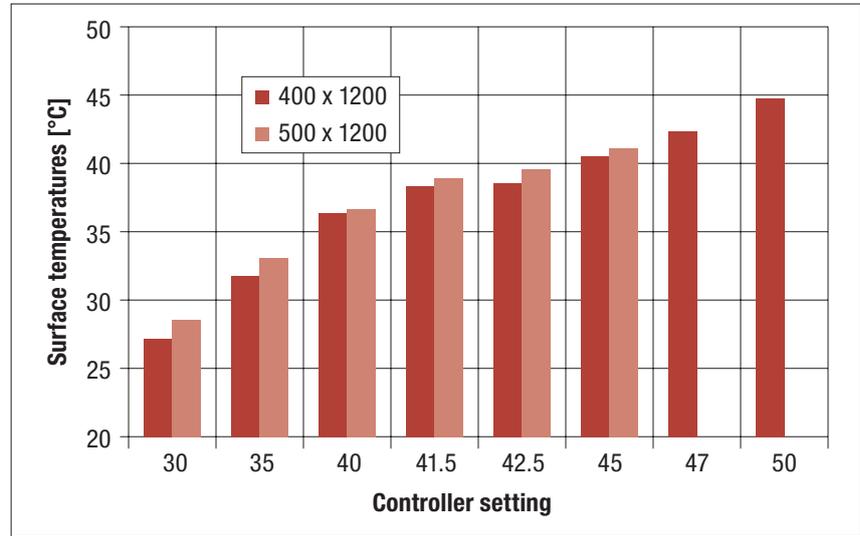


Figure 3: Surface temperatures as a function of controller setting

Evaluation of heat distribution**

for 400x1,200: controller setting = 45 / for 500x1,200: controller setting = 42.5

- Lying area with advantageous temperatures +
- Lying area with optimum temperatures ○
- Mean temperature on the plate ++
- Coefficient of variation = uniform temperature distribution +

Table 1: Heat distribution of "Thermo-Plus"® Elektro – individual results at various controller settings

Size	Inlet temperature [°C]	Surface T, mean [°C]	Standard deviation s	Coefficient of variation CV* [%]	Surface T, max. [°C]	Proportion of lying area with optimum temperatures 39–41 °C [%]	Proportion of lying area with advantageous temperatures 37–43 °C [%]
"Thermo-Plus"® Elektro 400x1,200							
400x1,200	30	27.2	0.92	3.4%	29.9	0.0	0.0
400x1,200	35	31.8	1.67	5.2%	36.5	0.0	0.1
400x1,200	40	36.4	1.53	4.2%	40.2	6.5	32.5
400x1,200	41.5	38.4	2.04	5.3%	43.7	32.4	69.6
400x1,200	42.5	38.6	1.93	5.0%	44.0	32.6	73.5
400x1,200	45	40.6	1.63	4.0%	44.7	40.2	86.2
Evaluation		++		+		○	+
400x1,200	47	42.4	2.02	4.8%	46.8	18.4	55.5
400x1,200	50	44.9	2.05	4.6%	50.4	1.1	14.6
"Thermo-Plus"® Elektro 500x1,200							
500x1,200	30	28.6	1.83	6.4%	34.53	0.0	0.0
500x1,200	35	33.2	1.49	4.5%	37.08	0.0	0.9
500x1,200	40	36.7	1.73	4.7%	42.20	8.6	40.3
500x1,200	41.5	39.0	1.95	5.0%	44.36	39.5	83.1
500x1,200	42.5	39.6	1.84	4.6%	44.88	42.6	86.4
Evaluation		++		+		○	+
500x1,200	45	41.2	1.83	4.4%	46.28	33.8	73.7

* CV = coefficient of variation [%] = (standard deviation / mean temperature) * 100

** Evaluation range: ++ / + / ○ / - / -- (○ = standard)

Energy demand

To determine the energy demand, the electrical power consumption was determined through continual measurements. In this process, the measured power value was recorded at a frequency of 1 Hz. As with the heat distribution, different controller settings were tested.

Evaluation of energy demand*

+

With an electrical power consumption of 0.18 kW, which corresponds to 0.37 kWh/m², at the optimum controller setting, the Thermo-Plus® Elektro 400 x 1,200 mm exhibited a reasonably low energy demand. The wider 500 x 1,200 mm plate gave a similar result of 0.19 kW, or 0.32 kWh/m².

The analysed time periods relate exclusively to the respective stable state following the heating phase.

* Evaluation range:

++ / + / o / - / -- (o = standard)

Table 2:

Results – energy demand as a function of controller setting

Controller setting	30	35	40	41.5	42.5	45	47	50
“Thermo-Plus”® Elektro 400 x 1,200								
Energy demand in 1 h [Wh]	67	99	138	151	159	176	193	216
Energy demand in 1 h per m ² [kWh/m ²]	0.14	0.21	0.29	0.31	0.33	0.37	0.40	0.45
Evaluation	+							
% proportion of the heating phase during the stationary phase in the test	31 %	42 %	64 %	69 %	66 %	77 %	87 %	99 %
“Thermo-Plus”® Elektro 500 x 1,200								
Energy demand in 1 h [Wh]	79	123	168	186	194	212		
Energy demand in 1 h per m ² [kWh/m ²]	0.13	0.21	0.28	0.31	0.32	0.35		
Evaluation	+							
% proportion of the heating phase during the stationary phase in the test	37 %	54 %	75 %	81 %	92 %	99 %		

Prüfung

The DLG FokusTest included measurements on test rigs at the DLG Test Center.

The heat output and heat distribution were investigated. Other criteria were not tested.

Test execution

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