



JouleTherm CeP Performance Tests

BSRIA Final Report 60610/1

Carried out for
Ecovolt

By Philip Stonard

13 March 2018



JouleTherm CeP Performance Tests

Carried out for:

Ecovolt

142A Slaney Close
Glasnevin Industrial Estate
Dublin 11
Ireland

Contract: **Final Report 60610/1**

Date: **13 March 2018**

Issued by: **BSRIA Limited**
Old Bracknell Lane West,
Bracknell,
Berkshire RG12 7AH UK

Telephone: +44 (0)1344 465600

Fax: +44 (0)1344 465626

E: bsria@bsria.co.uk W: www.bsria.co.uk

Compiled by: Name: P. Stonard Title: Senior Test Engineer BSRIA Test	Approved by: Name: Tom Garrigan Title: Business Manager BSRIA Test
---	---

DISCLAIMER

This report must not be reproduced except in full without the written approval of an executive director of BSRIA. It is only intended to be used within the context described in the text.

This report has been prepared by BSRIA Limited, with reasonable skill, care and diligence in accordance with BSRIA's Quality Assurance and within the scope of our Terms and Conditions of Business.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at its own risk.

SUMMARY

This report details tests conducted on a novel electric heating product.

The product supplied was called JouleTherm CeP and items submitted consisted of two plasterboard panels, each 2.4m x 1.2m. One was uninsulated while the other incorporated 50mm bonded blown foam insulation on the rear.

Panels had been prepared by Ecovolt with a central area 1.5m x 0.78m painted with their electrically conductive low voltage carbon/graphite paint. This had been overpainted with a moisture proof sealer.

Tests were conducted in September 2017 using a new 24V/400W HCU with adjustable output.

The uninsulated panel drew 355W.

The pre-insulated panel drew 354W.

Full details are shown within the main body of this report.

Thermal images showing panel heat up and temperature distributions are included in Appendix B.

CONTENTS

1	INTRODUCTION.....	6
2	OBJECTIVE	6
3	ITEMS SUPPLIED FOR TEST	6
4	INSTRUMENTATION.....	6
5	TEST METHOD	7
6	RESULTS.....	7
6.1	60610A1PS Plasterboard (with 400W HCU)	8
6.2	60610A2PS Pre insulated Plasterboard (with 400W HCU).....	9
6.3	Thermal image data.....	10
6.4	Example load Calculations	11
6.5	Conclusions	12

APPENDICES

APPENDIX: A	PHOTOS	13
APPENDIX: B	THERMAL IMAGES	14

FIGURES

Figure 1	Panel installation in the chamber	13
Figure 2	Rear of pre insulated panel	13
Figure 3	Side view pre insulated panel	13
Figure 4	400W power supply unit.....	13

1 INTRODUCTION

This report details tests conducted on a novel electric heating product, designated JouleTherm CeP. The work was requested and product supplied by Ecovolt. Tests were conducted in the BSRIA laboratories during the period 21st-22nd September 2017.

2 OBJECTIVE

The objective was to measure the power consumption and determine surface temperature of the panel. Additionally observations of response time and heat distribution on the panels were made.

3 ITEMS SUPPLIED FOR TEST

The product supplied was called JouleTherm CeP and items submitted consisted of two plasterboard panels, each 2.4m x 1.2m. One was uninsulated, designated Cep350/FB with a thermal conductivity of 0.19W/mK, while the other incorporated 50mm bonded thermoset foam insulation on the rear, designated Cep350/WB50 with a thermal conductivity 0.19W/mK for the plasterboard and 0.02W/mK for the insulation.

Panels had been prepared by Ecovolt with a central area 1.5m x 0.78m painted with their electrically conductive low voltage carbon/graphite paint. This had been overpainted with a moisture proof sealer.

Tests conducted in September used a 24V/400W HCU with adjustable output.

Photographs of the panels and controls are shown in Appendix A.

4 INSTRUMENTATION

Description	Identifier	Calibration expiry
Agilent logger	266	05/09/18
PT100 resistance thermometers	329, 1512	05/09/18
Agilent logger & type T thermocouples	2022	12/01/18
Yokogawa WT210 Power meter	988	07/12/17
Timer within PC	526	20/10/17
FLIR T460 Thermal camera	202565	25/05/18
Yokogawa WT210 Power meter	130	22/11/17

5 TEST METHOD

The test method consisted of installing each panel in turn, vertically, within the BSRIA radiator test chamber. This facility was 4m x 4m x 3m and had five water cooled surfaces, used to balance the test load and maintain a stable air temperature. One wall was not cooled, this being the surface against which the test panel was fixed. The panel was held in position by a mechanical fixing at the top edge.

A three term (PID) controller was used to modulate the cooling based on a manual setpoint. This was measured air temperature in the centre of the chamber, 0.75m above floor level. Additionally the standard air probe, with radiant shield, at the same position was logged as was an additional probe installed in a black globe to measure radiant temperature.

Chilled water thermocouples at the inlet and outlet of each chamber surface were recorded and a thermocouple embedded in the non-cooled wall, behind the test panel at 1.5m above the floor.

Temperatures were logged at 100 second intervals, using the standard chamber instrumentation and time base.

Electrical power input was logged separately, on the same time base.

Additionally, an infra-red camera was positioned within the chamber to view the heated area of the test panels, programmed in time lapse mode to take images every 100seconds for at least one hour. Snapshot images were then taken after two hours.

The IR temperature range was switched from 'auto' to fixed range 20°C-55°C, enabling a broader colour range to be seen as the panel warmed up.

Where the panel thermostat was used, this was set to a temperature of 26°C to prevent cycling of the test panel output.

6 RESULTS

The results are displayed in 3 parts:

1. Excel sheets of logged data showing reference air temperatures, chamber surface temperatures and power consumed.
2. Panel temperature into the space using IR images and mean panel temperature based on five spot readings in the IR images at 1hr, 2hr and, where logged, 3 hrs run time.
3. IR images at 100second time lapse for 1hr, plus snapshots at longer periods of 2 and 3 hours (shown in Appendix B)

Note that the chamber surface temperatures are determined from flow and return chilled water to each surface, except Wall 4, which is the non-cooled wall that has a thermocouple embedded in the centre, behind the test panel.

Power draw log interval was 100sec up to at least 1 hour. Where no data is shown variations remained within values shown at the start and finish of those periods.

All chamber panels with the exception of wall 4 are controlled to maintain a stable room air temperature with changing heat load.

Test reference 60372A1PS was run to trial the IR range, available colour palettes and time lapse configurations and is therefore not reported.

Where additional IR snapshots were taken beyond a 1hr or 2hr run time, two images are present - at 0 and +100seconds.

6.1 60610A1PS PLASTERBOARD (WITH 400W HCU)

Time	Globe room air	Shielded room air	Wall 1	Wall 2	Wall 3	Wall 4	Roof	Floor	Power draw kW	Power draw W/m2
22/Sep/2017 11:00:00	20.5	20.3	19.3	19.3	19.3	26.9	19.5	19.5	0.355	311.1
22/Sep/2017 11:01:40	20.5	20.3	19.2	19.2	19.3	27.0	19.4	19.5	0.353	310.0
22/Sep/2017 11:03:20	20.5	20.3	19.2	19.2	19.3	27.0	19.4	19.4	0.353	310.0
22/Sep/2017 11:05:00	20.5	20.3	19.2	19.2	19.2	27.0	19.3	19.4	0.354	310.1
22/Sep/2017 11:06:40	20.5	20.2	19.1	19.1	19.2	27.1	19.3	19.4	0.355	311.1
22/Sep/2017 11:08:20	20.4	20.2	19.1	19.1	19.2	27.1	19.3	19.4	0.355	311.3
22/Sep/2017 11:10:00	20.4	20.2	19.1	19.1	19.2	27.1	19.3	19.3	0.354	310.5
22/Sep/2017 11:11:40	20.4	20.2	19.1	19.1	19.1	27.1	19.2	19.3	0.353	310.0
22/Sep/2017 11:13:20	20.4	20.2	19.0	19.0	19.1	27.2	19.2	19.3	0.354	310.4
22/Sep/2017 11:15:00	20.4	20.1	19.0	19.0	19.1	27.2	19.2	19.3	0.355	311.5
22/Sep/2017 11:16:40	20.4	20.1	19.0	19.0	19.1	27.3	19.2	19.3	0.355	311.8
22/Sep/2017 11:18:20	20.3	20.1	19.0	19.0	19.1	27.3	19.2	19.3	0.354	310.5
22/Sep/2017 11:20:00	20.3	20.1	19.0	19.0	19.1	27.3	19.2	19.3	0.354	310.5
22/Sep/2017 11:21:40	20.3	20.1	19.0	19.0	19.1	27.3	19.2	19.2	0.354	310.6
22/Sep/2017 11:23:20	20.3	20.1	19.0	19.0	19.1	27.3	19.2	19.2	0.356	311.8
22/Sep/2017 11:25:00	20.3	20.1	19.0	19.0	19.1	27.3	19.2	19.2	0.356	312.0
22/Sep/2017 11:26:40	20.3	20.1	19.0	19.0	19.1	27.3	19.2	19.2	0.354	310.8
22/Sep/2017 11:28:20	20.3	20.0	19.0	19.0	19.1	27.3	19.2	19.2	0.355	311.0
22/Sep/2017 11:30:00	20.3	20.0	19.0	19.0	19.1	27.4	19.2	19.2	0.354	310.8
22/Sep/2017 11:31:40	20.3	20.0	19.0	19.0	19.1	27.4	19.2	19.2	0.356	312.0
22/Sep/2017 11:33:20	20.2	20.0	19.0	19.0	19.1	27.4	19.2	19.3	0.356	312.2
22/Sep/2017 11:35:00	20.2	20.0	19.0	19.0	19.1	27.4	19.2	19.2	0.355	311.1
22/Sep/2017 11:36:40	20.3	20.0	19.0	19.0	19.1	27.4	19.2	19.3	0.355	311.0
22/Sep/2017 11:38:20	20.2	20.0	19.1	19.1	19.1	27.5	19.3	19.3	0.355	311.1
22/Sep/2017 11:40:00	20.2	20.0	19.1	19.1	19.2	27.5	19.3	19.3	0.356	312.4
22/Sep/2017 11:41:40	20.3	20.0	19.1	19.1	19.2	27.5	19.3	19.3	0.356	312.5
22/Sep/2017 11:43:20	20.3	20.0	19.1	19.1	19.2	27.5	19.3	19.3	0.355	311.5
22/Sep/2017 11:45:00	20.3	20.0	19.1	19.2	19.2	27.6	19.3	19.3	0.355	311.3
22/Sep/2017 11:46:40	20.3	20.0	19.2	19.2	19.2	27.6	19.3	19.4	0.355	311.3
22/Sep/2017 11:48:20	20.3	20.1	19.2	19.2	19.3	27.6	19.4	19.4	0.357	312.8
22/Sep/2017 11:50:00	20.3	20.1	19.2	19.2	19.3	27.6	19.4	19.4	0.357	313.1
22/Sep/2017 11:51:40	20.3	20.1	19.2	19.2	19.3	27.6	19.4	19.4	0.355	311.5
22/Sep/2017 11:53:20	20.3	20.1	19.2	19.2	19.3	27.6	19.4	19.5	0.355	311.6
22/Sep/2017 11:55:00	20.3	20.1	19.3	19.3	19.3	27.7	19.4	19.5	0.355	311.4
22/Sep/2017 11:56:40	20.3	20.1	19.3	19.3	19.4	27.7	19.5	19.5	0.357	312.7
22/Sep/2017 11:58:20	20.3	20.1	19.3	19.3	19.3	27.7	19.4	19.5	0.356	312.1
22/Sep/2017 12:00:00	20.4	20.2	19.3	19.3	19.3	27.7	19.4	19.5	0.355	311.8
Min (over 1hr)	20.2	20.0	19.0	19.0	19.1	26.9	19.2	19.2	0.353	310.0
Max (over 1 hr)	20.5	20.3	19.3	19.3	19.4	27.7	19.5	19.5	0.357	313.1
Average (over 1 hr)	20.3	20.1	19.1	19.1	19.2	27.4	19.3	19.3	0.355	311.3

6.2 60610A2PS PRE INSULATED PLASTERBOARD (WITH 400W HCU)

Time	Globe room air	Shielded room air	Wall 1	Wall 2	Wall 3	Wall 4	Roof	Floor	Power draw kW	Power draw W/m ²
22/Sep/2017 13:10:00	20.3	20.1	18.9	18.9	19.0	22.8	19.1	19.2	0.355	311.8
22/Sep/2017 13:11:40	20.3	20.1	18.9	18.9	19.0	22.8	19.1	19.2	0.355	311.8
22/Sep/2017 13:13:20	20.3	20.1	19.0	19.0	19.0	22.8	19.2	19.2	0.356	312.0
22/Sep/2017 13:15:00	20.3	20.1	19.0	19.0	19.0	22.7	19.2	19.2	0.356	312.2
22/Sep/2017 13:16:40	20.3	20.1	19.0	19.0	19.1	22.7	19.2	19.2	0.356	312.3
22/Sep/2017 13:18:20	20.3	20.1	19.0	19.0	19.1	22.7	19.2	19.2	0.356	312.4
22/Sep/2017 13:20:00	20.3	20.1	19.0	19.0	19.1	22.6	19.2	19.2	0.356	312.5
22/Sep/2017 13:21:40	20.3	20.1	19.0	19.0	19.1	22.6	19.2	19.2	0.356	312.5
22/Sep/2017 13:23:20	20.3	20.1	19.0	19.0	19.1	22.6	19.2	19.2	0.356	312.6
22/Sep/2017 13:25:00	20.3	20.1	19.0	19.0	19.1	22.6	19.2	19.2	0.357	312.8
22/Sep/2017 13:26:40	20.3	20.1	19.0	19.0	19.1	22.6	19.2	19.3	0.357	312.8
22/Sep/2017 13:28:20	20.3	20.1	19.1	19.0	19.1	22.5	19.2	19.3	0.357	313.0
22/Sep/2017 13:30:00	20.3	20.1	19.1	19.1	19.2	22.5	19.2	19.3	0.357	313.0
22/Sep/2017 13:31:40	20.3	20.1	19.1	19.1	19.1	22.5	19.2	19.3	0.357	313.0
22/Sep/2017 13:33:20	20.3	20.1	19.1	19.1	19.1	22.5	19.2	19.3	0.357	313.2
22/Sep/2017 13:35:00	20.3	20.1	19.1	19.1	19.2	22.5	19.3	19.3	0.357	313.2
22/Sep/2017 13:36:40	20.3	20.1	19.1	19.1	19.2	22.4	19.3	19.3	0.357	313.4
22/Sep/2017 13:38:20	20.3	20.1	19.1	19.1	19.2	22.4	19.3	19.3	0.357	313.2
22/Sep/2017 13:40:00	20.3	20.1	19.1	19.1	19.2	22.4	19.3	19.3	0.357	313.3
22/Sep/2017 13:41:40	20.3	20.1	19.1	19.1	19.2	22.4	19.3	19.3	0.358	313.7
22/Sep/2017 13:43:20	20.3	20.1	19.1	19.1	19.2	22.4	19.3	19.3	0.358	313.8
22/Sep/2017 13:45:00	20.3	20.1	19.1	19.1	19.2	22.3	19.3	19.3	0.348	304.9
22/Sep/2017 13:46:40	20.3	20.1	19.1	19.1	19.2	22.3	19.3	19.4	0.351	308.1
22/Sep/2017 13:48:20	20.4	20.1	19.1	19.1	19.2	22.3	19.3	19.4	0.351	308.2
22/Sep/2017 13:50:00	20.4	20.1	19.2	19.2	19.2	22.3	19.3	19.4	0.352	308.4
22/Sep/2017 13:51:40	20.4	20.1	19.1	19.2	19.2	22.3	19.3	19.4	0.352	308.8
22/Sep/2017 13:53:20	20.4	20.2	19.2	19.2	19.3	22.3	19.3	19.4	0.352	308.8
22/Sep/2017 13:55:00	20.4	20.2	19.2	19.2	19.3	22.3	19.4	19.4	0.352	308.7
22/Sep/2017 13:56:40	20.4	20.2	19.2	19.2	19.3	22.3	19.4	19.4	0.352	308.6
22/Sep/2017 13:58:20	20.4	20.2	19.2	19.2	19.3	22.2	19.4	19.4	0.352	308.9
22/Sep/2017 14:00:00	20.4	20.2	19.2	19.2	19.3	22.2	19.4	19.4	0.352	308.9
22/Sep/2017 14:01:40	20.4	20.2	19.2	19.2	19.3	22.2	19.4	19.4	0.352	308.9
22/Sep/2017 14:03:20	20.4	20.2	19.2	19.2	19.3	22.2	19.4	19.4	0.352	309.0
22/Sep/2017 14:05:00	20.4	20.2	19.2	19.2	19.3	22.2	19.4	19.4	0.352	309.0
22/Sep/2017 14:06:40	20.4	20.2	19.2	19.2	19.3	22.2	19.4	19.4	0.353	309.2
22/Sep/2017 14:08:20	20.4	20.2	19.2	19.2	19.3	22.2	19.4	19.5	0.353	309.2
22/Sep/2017 14:10:00	20.4	20.2	19.2	19.2	19.3	22.2	19.4	19.5	0.353	309.2
Min (over 1hr)	20.3	20.1	18.9	18.9	19.0	22.2	19.1	19.2	0.348	304.9
Max (over 1 hr)	20.4	20.2	19.2	19.2	19.3	22.8	19.4	19.5	0.358	313.8
Average (over 1 hr)	20.4	20.1	19.1	19.1	19.2	22.4	19.3	19.3	0.354	311.0

6.3 THERMAL IMAGE DATA

Thermal images were taken during tests in July and surface temperature determined using the average of five spot readings on each panel taken at elapsed times of one hour, two hours and where taken, three hours from start up at ambient conditions.

6.3.1 Table of data from IR images

Test type	Time	Sp1 (°C)	Sp2 (°C)	Sp3 (°C)	Sp4 (°C)	Sp5 (°C)	Mean (°C)	Air (°C)	DT (°C)
Plasterboard	1hr	46.0	47.5	46.0	45.2	45.7	46.1	20.4	25.7
Plasterboard	2hr	49.4	50.6	49.6	47.2	47.7	48.9	20.4	28.5
Plasterboard	3hr	51.0	52.6	51.8	48.9	48.9	50.6	20.5	30.1
Plasterboard (pre-insulated)	1hr	44.3	47.0	45.1	45.7	44.5	45.3	20.1	25.2
Plasterboard (pre-insulated)	2hr	47.4	50.0	48.4	48.2	46.9	48.2	20.1	28.1

6.4 EXAMPLE LOAD CALCULATIONS

Calculations are provided here at the client request to illustrate the approximate power required to heat two buildings when using an example of a theoretical operating profile installed in a particular building type and construction.

This is not test data and does not take account of ventilation rates, thermal bridging (such as pipe penetrations), weather or thermal comfort achieved within the space and thus would be considered a minimum heat requirement.

The theoretical operating profile is a daytime condition of inside air at 21°C, outside at 10°C for 16hours, with a night condition of inside at 16°C and outside at -1°C for 8 hours.

The first example building is a brick built end of terrace house with dimensions of 6m x 8m x 5m and component U values below.

The adjoining building is considered to be at the same conditions and thus no heat loss is considered through the party wall.

Theoretical transmission heat loss-

Daytime						
		Area	U	ΔT	Power	Power 16hr
		m ²	W/m ² K	C	W	kWh
	Walls	80	0.35	11	308.0	
	Ceiling	48	0.16	11	84.5	
	Floor	48	0.25	11	132.0	
	Doors & windows	20	2	11	440.0	
					964.5	15.43
Night						
		Area	U	ΔT	Power	Power 8hr
		m ²	W/m ² K	C	W	kWh
	Wall 1	80	0.35	17	476.0	
	Ceiling	48	0.16	17	130.6	
	Floor	48	0.25	17	204.0	
	Doors & windows	20	2	17	680.0	
					1490.6	11.92
				Total kWh		27.36

The second example below is using the same size building but with U values taken from the Irish NZEB (near zero energy building) regulations to show the difference in heat loss.

Theoretical transmission heat loss- using Irish NZEB values

Daytime						
		Area	U	ΔT	Power	Power 16hr
		m ²	W/m ² K	C	W	kWh
	Walls	80	0.13	11	114.4	
	Ceiling	48	0.11	11	58.1	
	Floor	48	0.14	11	73.9	
	Doors & windows	20	1.3	11	286.0	
					532.4	8.52
Night						
		Area	U	ΔT	Power	Power 8hr
		m ²	W/m ² K	C	W	kWh
	Wall 1	80	0.13	17	176.8	
	Ceiling	48	0.11	17	89.8	
	Floor	48	0.14	17	114.2	
	Doors & windows	20	1.3	17	442.0	
					822.8	6.58
				Total kWh		15.10

To determine the amount of heat required in each room the same form of equation would apply with the relevant areas and U values.

6.5 CONCLUSIONS

Tests were conducted in September used a new 24V/400W HCU with adjustable output.

The uninsulated panel drew 355W.

The pre-insulated panel drew 354W

Maximum surface temperatures observed during tests were:

Plasterboard 52.6°C

Plasterboard (pre-insulated) 50.0°C

APPENDIX: A PHOTOS

Figure 1 Panel installation in the chamber



Figure 2 Rear of pre insulated panel



Figure 3 Side view pre insulated panel

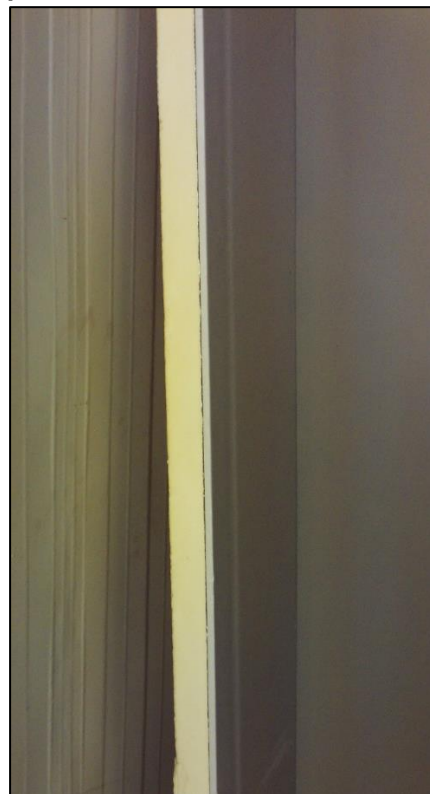


Figure 4 400W power supply unit



APPENDIX: B THERMAL IMAGES

Images are taken at 100sec intervals up to at least 1 hour run time. Images at 1, 2 and 3 hours (where run) have 5 spot readings visible. All other images have single centre spot.

Images are in three large groups, with page break between each group.

These correspond to tests in July: 60372A2PS (un-insulated plasterboard, 60372A3PS (pre insulated plasterboard)

