Engineered Packaging and Distribution Research Group

PERFORMANCE EVALUATION OF THERMALLY-INSULATED PACKAGING

For Woolcool Australia

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1 INTRODUCTION

At the request of Woolcool Australia, the Engineered Packaging and Distribution Research Group at Victoria University undertook an evaluation of the Woolcool thermally insulated containers. The main objective of the investigation was to evaluate the effectiveness of Woolcool thermally insulated containers and compare the results with a number of alternative insulated containers under the same conditions.

2 METHODOLOGY

Each container sample was packed with refrigerated product and gel packs and placed in a hot room while the variation in the temperature of the product was monitored.

3 SAMPLES DESCRIPTION

A total of six samples were supplied for evaluation:

- ***Fibreboard box with Woolcool liner - 1000 GSM***

  Paperboard box (C flute, manufactured by Austcor with internal dimensions of 326 x 220 x 234 mm) lined internally on all sides with Woolcool 1000 GSM liner.

- ***Fibreboard container with Woolcool liner – 800 GSM***

  Paperboard box (C flute, manufactured by Austcor with internal dimensions of 326 x 220 x 234 mm) lined internally on all sides with Woolcool 800 GSM liner.

- ***Fibreboard container with bubble wrap liner***

  Paperboard box (C flute, manufactured by Austcor with internal dimensions of 326 x 220 x 234 mm) lined internally on all sides with bubble wrap liner.

- ***Insulated cool bag***

  Insulated bag with zip with two compartments with internal dimensions of 450 x 280 x 260 mm.

- ***Large polystyrene container***

  Air freight rated expanded polystyrene container (Grade M) with internal dimensions of 520 x 330 x 210 mm.

- ***Small polystyrene container***

  Small expanded polystyrene container (Grade M) with internal dimensions of 450 x 295 x 130 mm.

4 TEST PROCEDURE

Each container sample was to be packed with a number of packaged meat products supplied by Woolcool and two gel packs then sealed with packaging tape (except for the cool box). The meat products in each contained sample consisted of:

- 1 x large steak pack
- 2 x small steak packs
- 2 x minced meat packs
- 1 x bacon packs
- 1 x large salmon pack

The container samples, meat packs and gel packs were conditioned separately prior to testing to the conditions specified in Table 4.1.

Table 4.1: Sample and contents pre-conditioning specifiactions.

Items	Temperature [°C]	Time [hrs]
Meat packs	1 ± 1	72
Gel packs	-20 ± 1	72
Containers	4 ± 1	4

On completion of the pre-conditioning phase, the container samples were transported to another lab (duration: 3 minutes) and packed with the meat and gel packs in the configuration shown in Figure 4.1. Temperature probes connected to Tinytag Plus® temperature recorders were inserted to the centre of the central minced meat pack prior to placing in the respective containers. Note that all temperature recorders were submitted to a calibration check against a calibrated temperature indicator (Model 615 by Testo®) – see Appendix B for calibration certificate.

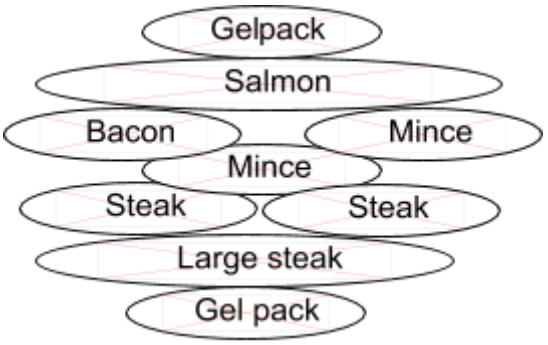


Figure 4.1. Content arrangement.

As the depth of the small polystyrene box was too small, the assembly was placed on its side. Packing was undertaken by three people in a hastily manner and each packed container was transported to the pre-heated (30 ± 2 °C) walk-in environmental chamber within three minutes. The internal temperature of the samples and the room temperature were logged at an interval of 1 minute for 72 hours while the hot room temperature was measured with two Tyniview Plus® temperature recorders set at 5 minutes interval.

5 RESULTS

The entire temperature records from the test are given in Appendix A. A summary of the internal temperatures at 12 hour intervals are in Table 5.1. The mean room temperature during the test was recorded at 31 ^{o}C with a standard deviation of ± 1.6 ^{o}C. Note that the temperature logger placed in the Cool bad failed during the test and no data was available.

Table 5.1 Internal product temperature at 12 hour intervals.

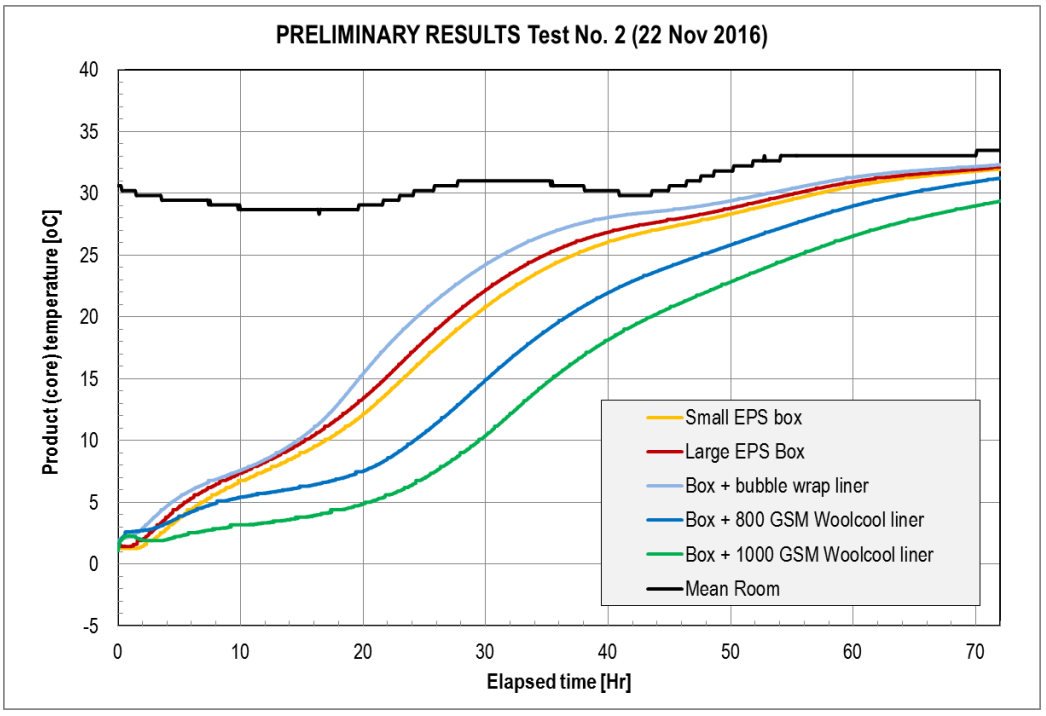
Elapsed time [Hr]	Small EPS box	Large EPS Box	Cool Bag	Box + bubble wrap liner	Box + 800 GSM Woolcool	Box + 1000 GSM Woolcool
0	1.3 °C	1.5 °C	0.0 °C	1.9 °C	1.6**li** °C	1.3**li** °C
12	7.5 °C	8.3 °C	0.0 °C	8.5 °C	5.8 °C	3.3 °C
24	15.7 °C	17.1 °C	0.0 °C	19.6 °C	9.9 °C	6.4 °C
36	24.5 °C	25.5 °C	0.0 °C	27.1 °C	19.7 °C	15.5 °C
48	27.9 °C	28.4 °C	0.0 °C	29.1 °C	25.2 °C	22.0 °C

Comparing the above data with the best performing configuration (namely Box + 1000 GSM Woolcool liner), the temperature differences at the selected time interval were calculated and are shown in Table 5.2.

Table 5.1 Differences in internal product temperature at 12 hour intervals compared with that of Box + 1000 GSM Woolcool liner.

Elapsed time [Hr]	Small EPS box	Large EPS Box	Cool bag	Box + bubble wrap liner	Box + 800 GSM Woolcool liner	Box + 1000 GSM Woolcool liner
12	4.2 °C	4.9 °C	-3.3 °C	5.1 °C	2.4 °C	0.0 °C
24	9.3 °C	10.7 °C	-6.4 °C	13.2 °C	3.4 °C	0.0 °C
36	9.0 °C	10.1 °C	-15.5 °C	11.6 °C	4.3 °C	0.0 °C
48	5.9 °C	6.3 °C	-22.0 °C	7.0 °C	3.1 °C	0.0 °C

APPENDIX A


PRELIMINARY RESULTS Test No. 2 (22 Nov 2016)
Product (core) temperature [oC]
Elapsed time [Hr]
40
35
30
25
20
15
10
5
0
-5
0
10
20
30
40
50
60
70
Small EPS box
Large EPS Box
Box + bubble wrap liner
Box + 800 GSM Woolcool liner
Box + 1000 GSM Woolcool liner
Mean Room

APPENDIX B

AUSTRALIAN
CALIBRATING
SERVICES (A'SIA) PTY. LTD.
A.B.N. 33 623 153 736

126 Oxford Street, Collingwood
P.O. Box 1174, Collingwood, Vic. 3066, Australia
Phone: +61 3 9417 5688, Fax: +61 3 9417 1578

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SCN561v8.30

CALIBRATION REPORT
TEMPERATURE & HUMIDITY INDICATOR

FOR: VICTORIA UNIVERSITY
MECHANICS LABORATORY FOOTSCRAY CAMPUS
BALLARAT ROAD
FOOTSCRAY VIC 3011

LOCATION: ACS Melbourne - Site No. 1232

DATE OF TEST: 1-Aug-2016

EQUIPMENT DETAILS:

Maker:	Testo
Model:	615
Serial Number:	6096410063GB
Plant Number:	Nil
Type:	Digital
Calibrated Range:	-10°C to 50°C & 50%RH
Resolution:	0.1°C & 0.1% RH

TEST DETAILS:

- The equipment under test was calibrated by direct comparison with the reference equipment.
- Prior to testing the system was stabilised for 30 minutes.
- 5 readings were taken every 60 seconds over a 5.0 minute period.
- Ambient temperature: 21.1°C ±1°C and 44% RH
- Temperature expressed in terms of the International Temperature Scale (ITS90).
- Reference equipment:
  V.AC/100-10P, V.AC/100-17N.
- Test procedure: ACS Procedure H005 & H001 for temperature & H004 for humidity.
- Uncertainty: confidence level ≈ 95%, coverage factor (k) = 2.0

COMMENTS:

The equipment was found to be operational before testing.

REQUIREMENTS:

-10°C, 50°C & 50% RH.

Signed .....
A. Csendes
Approved Signatory
AUSTRALIAN CALIBRATING SERVICES (A'SIA) PTY LIMITED

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 1239. Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National Standards.

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126 Oxford Street, Collingwood
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RESULTS:

Instrument Display °C	Ref. Temperature °C	Correction °C	Uncertainty °C
-9.6	-10.0	-0.4	±0.31
+49.6	+50.1	+0.5	±0.30

Nominal Test Temperature: 40°C

Instrument Display (RH%)	Ref. Humidity (RH%)	Correction (RH%)	Uncertainty (RH%)
53.0	49.5	-3.5	±3.3

RECOMMENDED DATE OF NEXT TEST: 1-Aug-2017

Signed .....
A. Csendes
Approved Signatory
AUSTRALIAN CALIBRATING SERVICES (A'SIA) PTY LIMITED

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Notes