



Test Numbers: T2258-1,2,3,7,8 & 9	Creation Date: 18-Apr-2012
Comparison Report	Issue No.: 1.1
Customer: BPF EPS Group	Issue Date: 01-May-2012
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# Comparison of the EPS, Waxed-Corrugate & Corrugated Twin-Wall Polypropylene Small Shipping Systems for Temperature Sensitive Products by SCA Cool Logistics

## BPF EPS Group

Associated Test Number(s): T2258-1,2,3,7,8 & 9  
Test Description: Flat +5.0°C Profile  
Flat +15.0°C Profile

01-May-2012

Prepared by: Matt Carroll

Position: Packaging Engineer

Signature:

Approved by: Richard Wood

Position: Design Manager

Signature:



## 1 Executive Summary

The EPS, Waxed-Corrugate & Corrugated Twin-Wall Polypropylene Small systems were tested to the predetermined criteria to confirm their comparability of maintaining a product temperature range of below +5.0°C for the required duration as outlined in Appendix A.

## 2 Results Summary

Shipper Type	Ambient Profile	Time to >+5.0°C	Test Iteration
EPS	Cold	>72:00hrs	T2258-1
	Warm	18:15hrs	T2258-7
Waxed-Corrugate	Cold	49:00hrs	T2258-2
	Warm	04:15hrs	T2258-8
Corrugated Twin-Wall Polypropylene	Cold	37:00hrs	T2258-3
	Warm	07:30hrs	T2258-9

EPS Shipper

Corrugated Twin-Wall Polypropylene Shipper

Waxed-Corrugate Shipper





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### 4 Revision Control

Issue	Date	Amendments	By
1.0	18-Apr-2012	Initial Issue	Matt Carroll
1.1	01-May-2012	Minor Cosmetic Changes	Matt Carroll



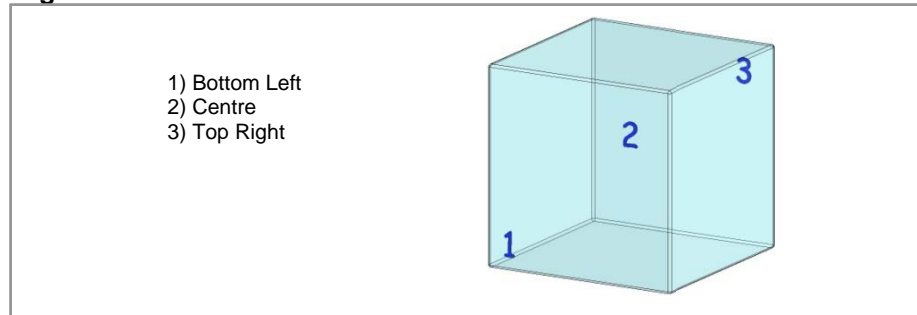
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## 5 Methodology

### 5.1 Product Preparation

Calibrated T type thermocouple probes were attached to the test product load in the locations referenced in figure A. This was done by taping the thermocouple wire to the individual product.

Figure A



### 5.2 Product Conditioning

The product load was placed into 0.0°C (±3.0°C) storage for a minimum period of 24 hours prior to the test start to allow its temperature to stabilise.

### 5.3 -18.0°C Component Conditioning

As referenced on the System Diagram, all components marked as -18.0°C were placed into -18.0°C (±3.0°C) storage for a minimum period of 24 hours prior to the test start to allow their temperature to stabilise. Conditioning times quoted are for individual components only, placed individually, allowing contact with air on a minimum of five faces (e.g. not stacked).

Prior to test initiation, these components were removed from storage and allowed to precondition at warehouse temperature (+20.0°C [±5.0°C]) until they had reached -4.0°C. At this temperature point they were added to the system packout. The temperatures were monitored using an infrared thermometer.

### 5.4 Other Component Conditioning

All other materials were maintained at warehouse temperature (+20.0°C [±5.0°C]) prior to testing.

### 5.5 Test Initiation

One hour prior to the start of testing, the environmental test chamber was programmed with the required ambient temperature profile and set to the starting temperature to stabilise.

All components were then assembled as illustrated on the system diagram.

With the shipper assembled and the lid secure, at least one (1) additional thermocouple was attached to the system exterior to measure the ambient temperature of the environmental chamber. All thermocouples were connected to a calibrated data logger and set to record at fifteen minute intervals. The tests were run for the required duration before the data logger was downloaded and a graph and table of readings produced.

### 5.6 Coolant

The coolant ice packs used contained a solution of 3% salt to 97% water.



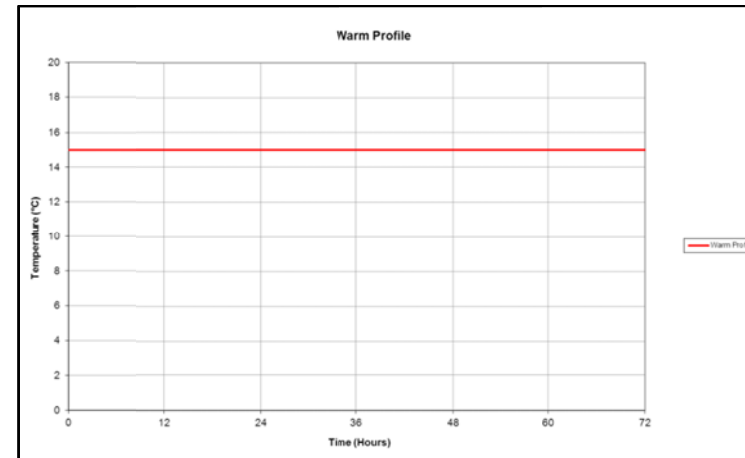
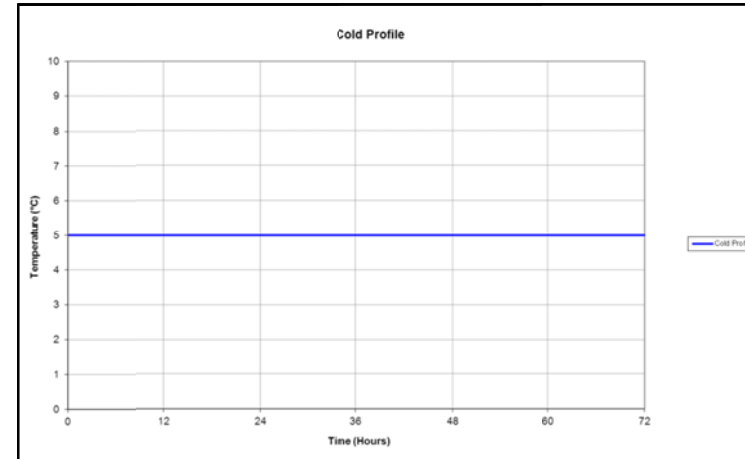
## 6 Ambient Temperature Profiles

### Cold Profile

Set Temperature	Duration
+5.0°C	72:00hrs

### Warm Profile

Set Temperature	Duration
+15.0°C	72:00hrs





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## 7 System Diagram and Specification

### 7.1 T2258-1 & 7 BPF EPS Group EPS Small Shipper

Small EPS Lid



Small EPS Base

External Dimensions: 500x300x140mm  
Internal Dimensions: 460x260x100mm  
Internal Volume: 12.0L  
Shipper Weight: 0.2kg  
Volumetric Weight: 3.5kg



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## 7.2 T2258-2 & 8 Competitor Waxed-Corrugate Small Shipper

Small Waxed-Corrugate Lid



Small Waxed-Corrugate Base

External Dimensions: 380x240x95mm  
Internal Dimensions: 370x230x90mm  
Internal Volume: 7.7L  
Shipper Weight: 0.4kg  
Volumetric Weight: 1.4kg



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### 7.3 T2258-3 & 9 Competitor Corrugated Twin-Wall Polypropylene Small Shipper

Small Corrugated Twin-Wall Polypropylene Lid



Small Corrugated Twin-Wall Polypropylene Base

External Dimensions: 375x250x120mm  
Internal Dimensions: 355x230x115mm  
Internal Volume: 9.4L  
Shipper Weight: 0.2kg  
Volumetric Weight: 1.9kg





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## 8 Packing Procedure

### 8.1 First Product Layer





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## 8.2 First Coolant Layer and Final Product Layer





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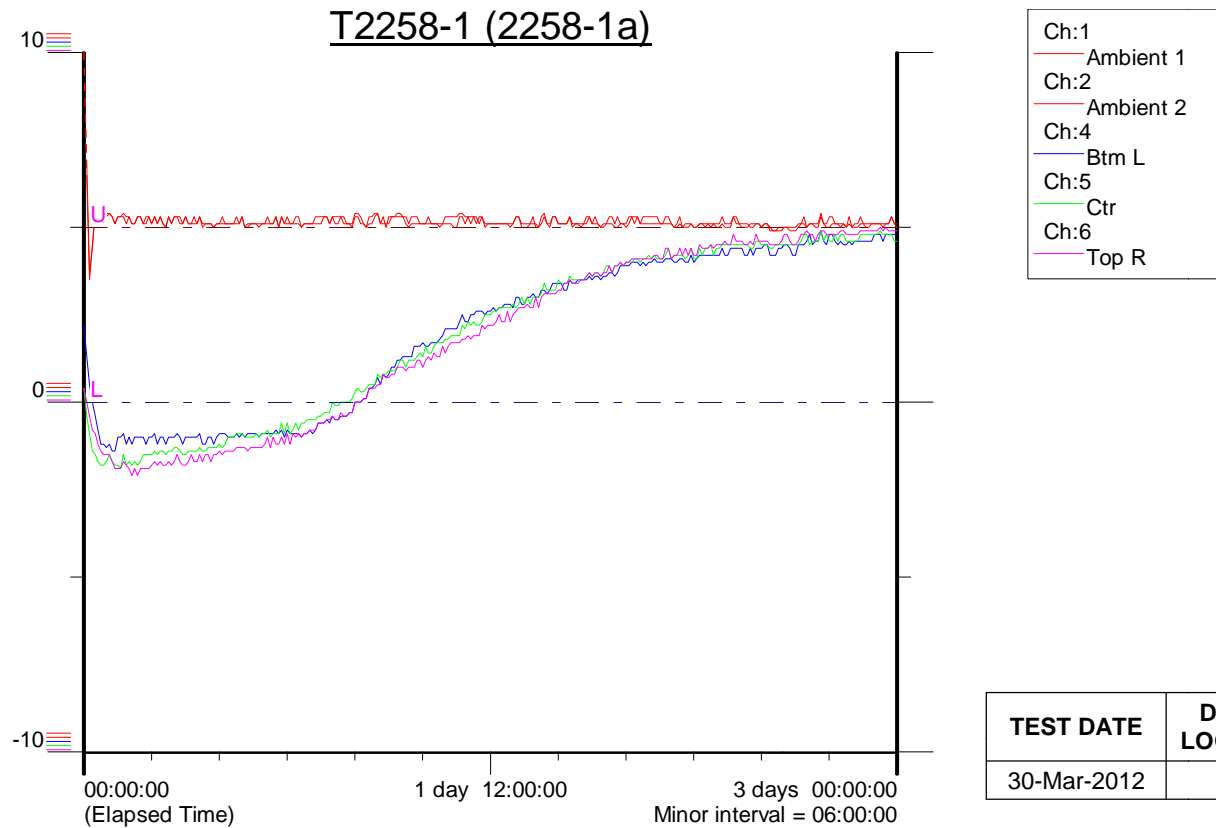
### 8.3 Final Coolant Layer





## 9 Test Result

### 9.1 T2258-1: Cold Profile, EPS Small Shipper (3.3kg of product, 1.8kg of coolant)



#### Results

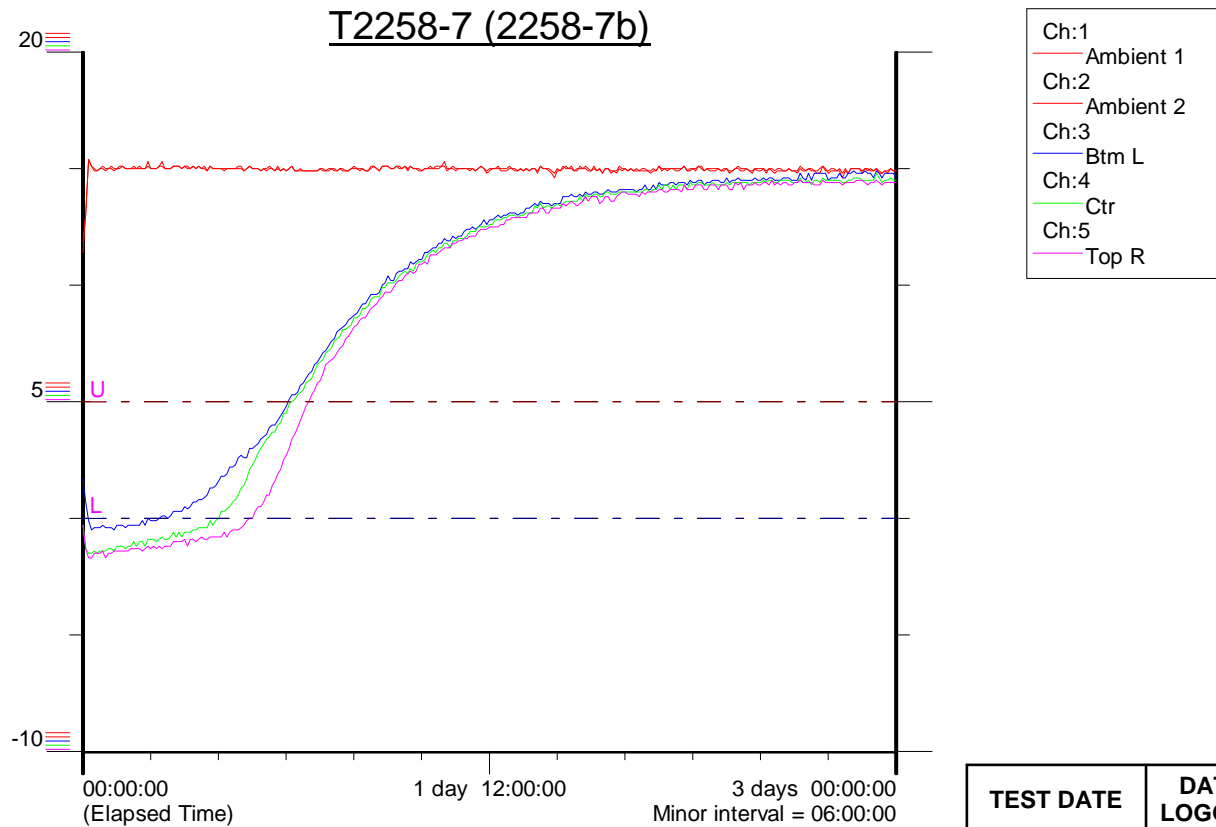
	TIME / TEMPERATURE	CHANNEL
>+5.0°C @	N/A	N/A
<b>Maximum Temperature</b>	+5.0°C 70:30hrs	6
<b>Minimum Temperature</b>	-2.1°C 04:15hrs	6

#### Equipment

TEST DATE	DATA LOGGER	PROBE SET	PROBE EXTENSION	ENVIRONMENTAL CHAMBER
30-Mar-2012	Z	Z	Z	17



**9.2 T2258-7: Warm Profile, EPS Small Shipper**  
 (3.3kg of product, 1.8kg of coolant)



**Results**

	TIME / TEMPERATURE	CHANNEL
<b>&gt;+5.0°C @</b>	18:15hrs	3
<b>Maximum Temperature</b>	+14.9°C 68:15hrs	3
<b>Minimum Temperature</b>	-1.7°C 00:30hrs	5

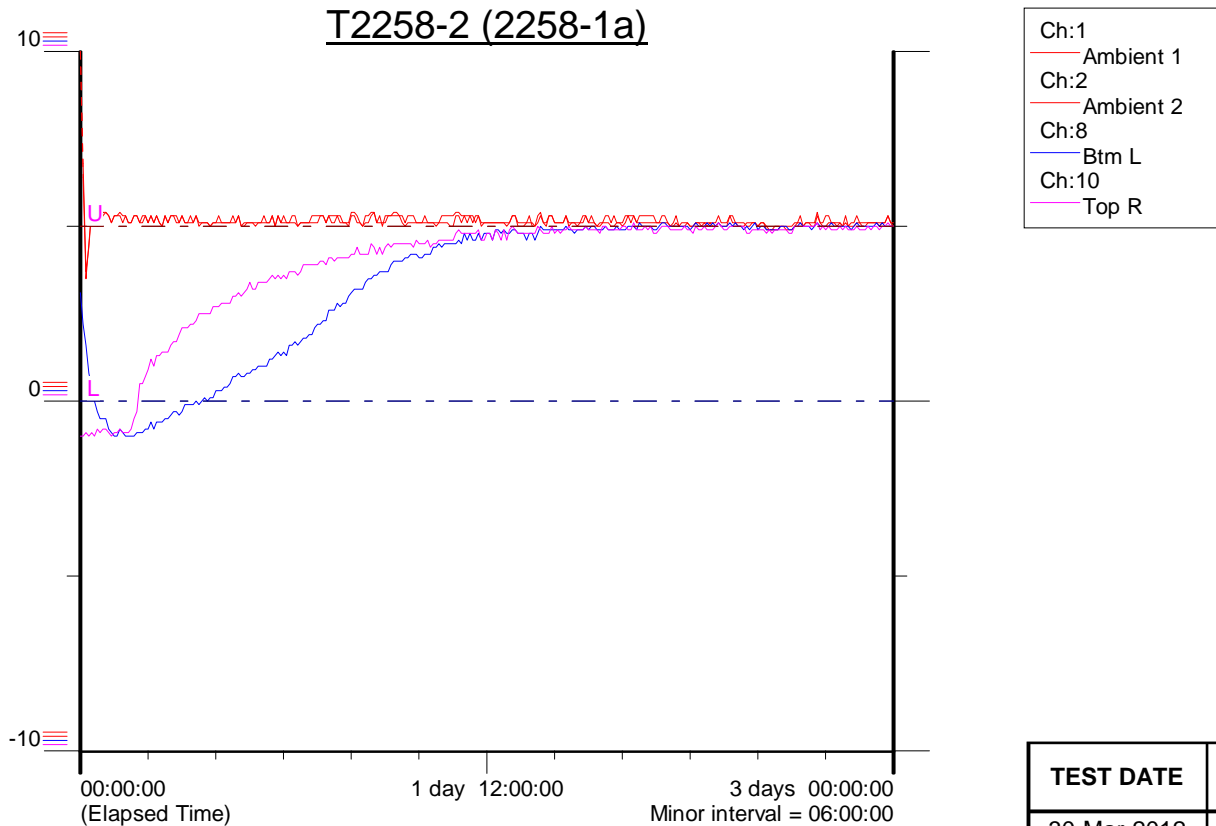
**Equipment**

TEST DATE	DATA LOGGER	PROBE SET	PROBE EXTENSION	ENVIRONMENTAL CHAMBER
12-Apr-2012	Z	Z	Z	17



Test Numbers: T2258-1,2,3,7,8 & 9	Creation Date: 18-Apr-2012
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Customer: BPF EPS Group	Issue Date: 01-May-2012
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### 9.3 T2258-2: Cold Profile, Waxed-Corrugate Small Shipper (3.3kg of product, 1.8kg of coolant)



#### Results

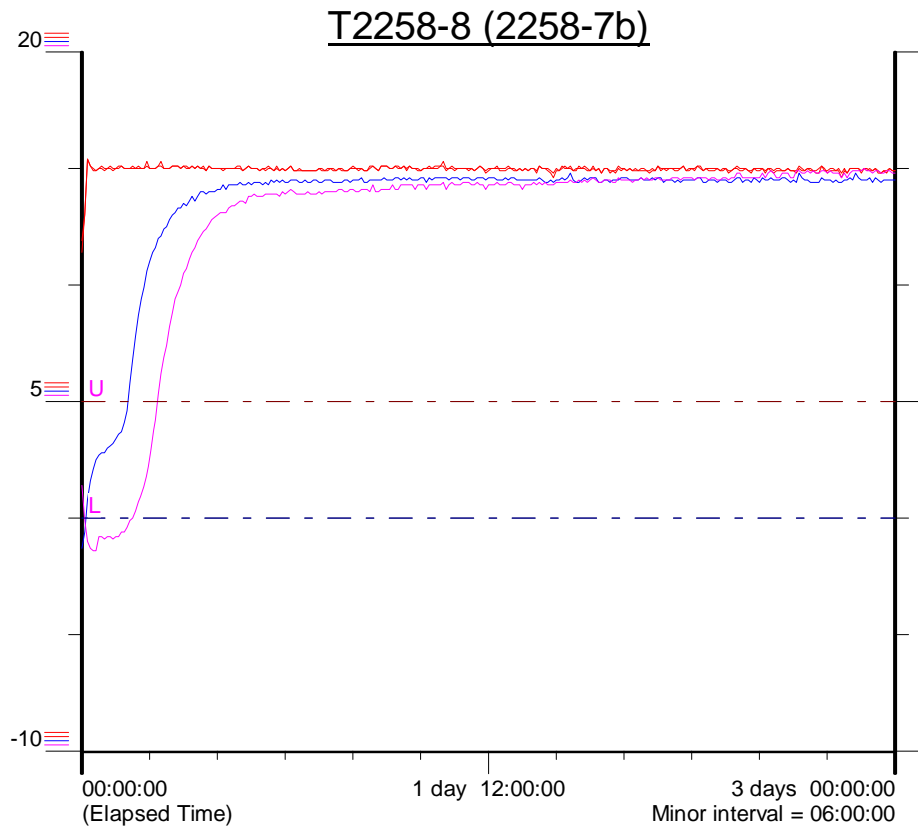
	TIME / TEMPERATURE	CHANNEL
>+5.0°C @	49:00hrs	10
Maximum Temperature	+5.1°C 49:00hrs	10
Minimum Temperature	-1.0°C 00:00hrs	10

#### Equipment

TEST DATE	DATA LOGGER	PROBE SET	PROBE EXTENSION	ENVIRONMENTAL CHAMBER
30-Mar-2012	Z	Z	Z	17



**9.4 T2258-8: Warm Profile, Waxed-Corrugate Small Shipper**  
 (3.3kg of product, 1.8kg of coolant)



- Ch:1 Ambient 1
- Ch:2 Ambient 2
- Ch:7 Btm L
- Ch:10 Top R

**Results**

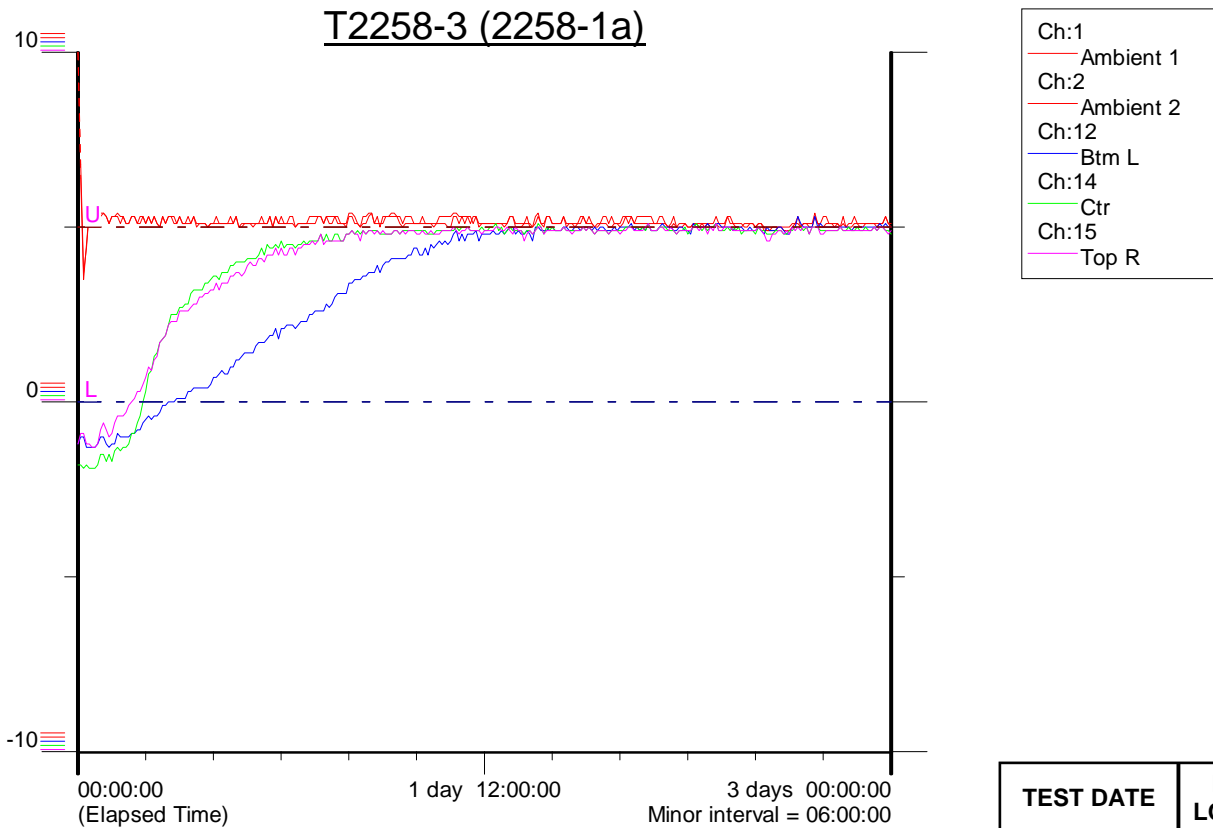
	TIME / TEMPERATURE	CHANNEL
>+5.0°C @	04:15hrs	7
Maximum Temperature	+15.0°C 69:15hrs	10
Minimum Temperature	-1.4°C 01:00hrs	10

**Equipment**

TEST DATE	DATA LOGGER	PROBE SET	PROBE EXTENSION	ENVIRONMENTAL CHAMBER
12-Apr-2012	Z	Z	Z	17



**9.5 T2258-8: Cold Profile, Corrugated Twin-Wall Polypropylene Small Shipper**  
 (3.3kg of product, 1.8kg of coolant)



**Results**

	TIME / TEMPERATURE	CHANNEL
<b>&gt;+5.0°C @</b>	37:00hrs	14
<b>Maximum Temperature</b>	+5.3°C 63:45hrs	12
<b>Minimum Temperature</b>	-1.9°C 00:30hrs	14

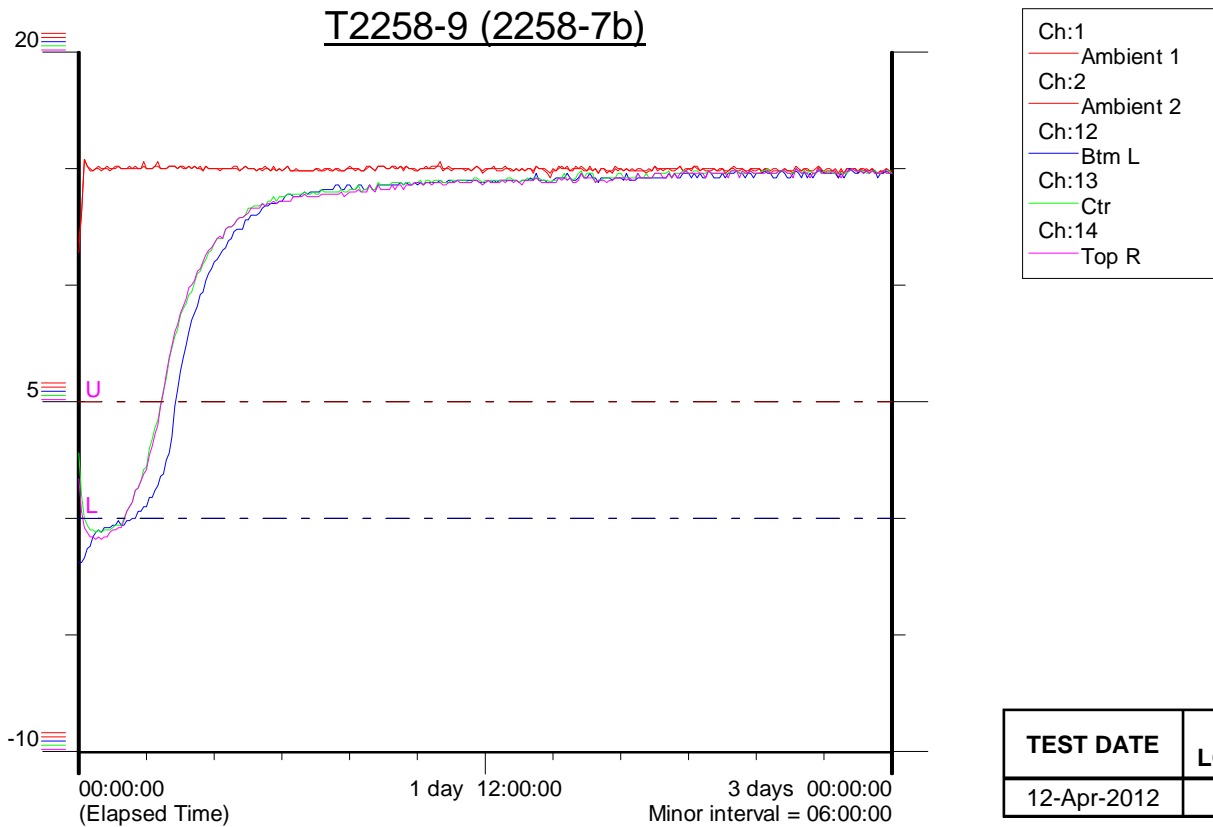
**Equipment**

TEST DATE	DATA LOGGER	PROBE SET	PROBE EXTENSION	ENVIRONMENTAL CHAMBER
30-Mar-2012	Z	Z	Z	17





**9.6 T2258-9: Warm Profile, Corrugated Twin-Wall Polypropylene Small Shipper**  
 (3.3kg of product, 1.8kg of coolant)



**Results**

	TIME / TEMPERATURE	CHANNEL
>+5.0°C @	37:00hrs	14
<b>Maximum Temperature</b>	+5.3°C 63:45hrs	12
<b>Minimum Temperature</b>	-1.9°C 00:30hrs	14

**Equipment**

TEST DATE	DATA LOGGER	PROBE SET	PROBE EXTENSION	ENVIRONMENTAL CHAMBER
12-Apr-2012	Z	Z	Z	17



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## 10 Deviations and Discussion

Shipper Type	Ambient Profile	Time to >+5.0°C	Test Iteration
EPS	Cold	>72:00hrs	T2258-1
	Warm	18:15hrs	T2258-7
Waxed-Corrugate	Cold	49:00hrs	T2258-2
	Warm	04:15hrs	T2258-8
Corrugated Twin-Wall Polypropylene	Cold	37:00hrs	T2258-3
	Warm	07:30hrs	T2258-9

The EPS Small shipper maintained a product temperature of below +5.0°C for the full 72:00hrs duration when tested to the Cold Profile, significantly outperforming the Waxed-Corrugate and Corrugated Twin-Wall Polypropylene Small shippers. While the EPS Small shipper did not pass the full required duration when tested to the Warm Profile it still managed to outperform both the Waxed-Corrugate and Corrugated Twin-Wall Polypropylene Small shippers by more than 12:00hrs. The EPS Small shipper can be considered a more effective choice for shipping fish products through cold and warm ambient conditions than either the Waxed-Corrugate or Corrugated Twin-Wall Polypropylene Small shippers. It is worth noting that during the T2258-2 (Waxed-Corrugate Small, Cold Profile) and the T2258-8 (Waxed-Corrugate Small, Warm Profile) tests one probe failed to record and as such is not included in the results displayed above. According to ASTM D3103 guidelines the failure of a single probe to read during a test is considered acceptable.

## 11 Conclusion

The tests have shown that the EPS Small system outperforms the Waxed-Corrugate and Corrugated Twin-Wall Polypropylene Small systems in terms of thermal performance.

## 12 Liability Restriction

It should be noted that this report represents test results carried out by SCA Cool Logistics in good faith. As such we cannot be responsible for the handling and usage of the systems tested; we restrict our liability to the replacement of any components supplied which are not to agreed specification. Customers are advised to check the appropriateness of the testing parameters for their shipping conditions.



### 13 Appendix A: Test Criteria

<b>Product</b>	<b>Name</b>	<b>Rainbow Trout</b>
	<b>Temperature Range</b>	<b>Below +5.0°C</b>
	<b>Primary Packaging</b>	<b>Vacuum Sealed Bag</b>
	<b>Weight</b>	<b>550g</b>
	<b>Quantity Within Presentation Packaging</b>	<b>2</b>
<b>Product Load</b>	<b>EPS Shipper Load Quantity</b>	<b>6</b>
	<b>EPS Shipper Load Weight</b>	<b>3.3kg</b>
	<b>Waxed-Corrugate Shipper Load Quantity</b>	<b>6</b>
	<b>Waxed-Corrugate Shipper Load Weight</b>	<b>3.3kg</b>
	<b>Corrugated Twin-Wall Polypropylene Shipper Load Quantity</b>	<b>6</b>
	<b>Corrugated Twin Wall Polypropylene Shipper Load Weight</b>	<b>3.3kg</b>
<b>Shipping</b>	<b>Required Minimum Pass Duration</b>	<b>72:00hrs</b>
	<b>Test Run Duration</b>	<b>72:00hrs</b>
	<b>Ambient Profile A</b>	<b>Cold Profile</b>
	<b>Ambient Profile B</b>	<b>Warm Profile</b>
<b>Other</b>		



# 14 Appendix B: Calibration Documents

## 14.1 Environmental Chamber

### Calibration Report of Environmental Test Chambers

Test Chamber Reference: 17      Serial Number: 522/83142      Model Number: 561898/1  
 Logger Reference: AN      Probe Set Reference: AN      Extension Lead Reference: AN

#### Ambient Temperature Profile

Temperature (°C)	Duration (hours)
+20	4
+50	4
-20	4
+50	4
+5	4
+20	4

#### Results

#### Thermocouple Positioning

Calibration performed by: Matt Carroll

Date: 21-Dec-2011



### 14.2 Data Logger

**CALIBRATION REPORT**  
Squirrel Data Logger and T-Type Thermocouple Probes  
Revision 5 19/12/2009

**RESULTS**  
All of the following equipment has been calibrated against the NIST traceable standard

DATA LOGGER REFERENCE	PROBE SET REFERENCE	EXTENSION PROBE REFERENCE	LOGGER SERIAL NUMBER
<b>AN</b>	<b>AN</b>	<b>AN</b>	<b>EL-9317</b>

Reference Dotsmann Serial Number: 65505020361      Reference Calibrated Probe Serial No: 60997

**Calibration at +65°C**

Initial Calibrator Reading: **65.10°C**      Average Calibrator Reading: **65.100°C**  
Final Calibrator Reading: **65.10°C**      (Channels must read +/- 0.9°C of average calibrator reading)

**Thermocouple Readings**

Channel 1	<b>65.1°C</b>	Channel 5	<b>65.3°C</b>	Channel 9	<b>65.1°C</b>	Channel 13	<b>65.2°C</b>
Channel 2	<b>65.1°C</b>	Channel 6	<b>65.2°C</b>	Channel 10	<b>65.2°C</b>	Channel 14	<b>65.2°C</b>
Channel 3	<b>65.1°C</b>	Channel 7	<b>65.1°C</b>	Channel 11	<b>65.1°C</b>	Channel 15	<b>65.2°C</b>
Channel 4	<b>65.2°C</b>	Channel 8	<b>65.1°C</b>	Channel 12	<b>65.2°C</b>	Channel 16	<b>65.3°C</b>

**Calibration at +5°C**

Initial Calibrator Reading: **5.30°C**      Average Calibrator Reading: **5.300°C**  
Final Calibrator Reading: **5.30°C**      (Channels must read +/- 0.9°C of average calibrator reading)

**Thermocouple Readings**

Channel 1	<b>5.0°C</b>	Channel 5	<b>5.0°C</b>	Channel 9	<b>5.0°C</b>	Channel 13	<b>5.1°C</b>
Channel 2	<b>5.0°C</b>	Channel 6	<b>5.8°C</b>	Channel 10	<b>5.0°C</b>	Channel 14	<b>5.0°C</b>
Channel 3	<b>4.9°C</b>	Channel 7	<b>5.0°C</b>	Channel 11	<b>5.0°C</b>	Channel 15	<b>5.0°C</b>
Channel 4	<b>4.9°C</b>	Channel 8	<b>5.0°C</b>	Channel 12	<b>5.0°C</b>	Channel 16	<b>5.0°C</b>

**Calibration at <-30°C**

Initial Calibrator Reading: **-35.40°C**      Average Calibrator Reading: **-35.400°C**  
Final Calibrator Reading: **-35.40°C**      (Channels must read +/- 0.9°C of average calibrator reading)

**Thermocouple Readings**

Channel 1	<b>-35.6°C</b>	Channel 5	<b>-35.4°C</b>	Channel 9	<b>-35.4°C</b>	Channel 13	<b>-35.6°C</b>
Channel 2	<b>-35.4°C</b>	Channel 6	<b>-35.6°C</b>	Channel 10	<b>-35.6°C</b>	Channel 14	<b>-35.6°C</b>
Channel 3	<b>-35.4°C</b>	Channel 7	<b>-35.4°C</b>	Channel 11	<b>-35.6°C</b>	Channel 15	<b>-35.6°C</b>
Channel 4	<b>-35.4°C</b>	Channel 8	<b>-35.6°C</b>	Channel 12	<b>-35.4°C</b>	Channel 16	<b>-35.6°C</b>

CALIBRATION PERFORMED BY: **Matt Carroll**  
NAME: \_\_\_\_\_ SIGNATURE: \_\_\_\_\_  
DATE: **12 December 2011**

**CALIBRATION REPORT**  
Squirrel Data Logger and T-Type Thermocouple Probes  
Revision 5 19/12/2009

**RESULTS**  
All of the following equipment has been calibrated against the NIST traceable standard

DATA LOGGER REFERENCE	PROBE SET REFERENCE	EXTENSION PROBE REFERENCE	LOGGER SERIAL NUMBER
<b>Z</b>	<b>Z</b>	<b>Z</b>	<b>EL-8190</b>

Reference Dotsmann Serial Number: 65505020361      Reference Calibrated Probe Serial No: 60997

**Calibration at +65°C**

Initial Calibrator Reading: **65.20°C**      Average Calibrator Reading: **65.200°C**  
Final Calibrator Reading: **65.20°C**      (Channels must read +/- 0.9°C of average calibrator reading)

**Thermocouple Readings**

Channel 1	<b>65.2°C</b>	Channel 5	<b>65.3°C</b>	Channel 9	<b>65.2°C</b>	Channel 13	<b>65.3°C</b>
Channel 2	<b>65.0°C</b>	Channel 6	<b>65.2°C</b>	Channel 10	<b>65.3°C</b>	Channel 14	<b>65.2°C</b>
Channel 3	<b>65.2°C</b>	Channel 7	<b>65.3°C</b>	Channel 11	<b>65.2°C</b>	Channel 15	<b>65.1°C</b>
Channel 4	<b>65.0°C</b>	Channel 8	<b>65.3°C</b>	Channel 12	<b>65.2°C</b>	Channel 16	<b>65.2°C</b>

**Calibration at +5°C**

Initial Calibrator Reading: **5.30°C**      Average Calibrator Reading: **5.300°C**  
Final Calibrator Reading: **5.30°C**      (Channels must read +/- 0.9°C of average calibrator reading)

**Thermocouple Readings**

Channel 1	<b>5.4°C</b>	Channel 5	<b>5.7°C</b>	Channel 9	<b>5.6°C</b>	Channel 13	<b>5.5°C</b>
Channel 2	<b>5.5°C</b>	Channel 6	<b>5.5°C</b>	Channel 10	<b>5.4°C</b>	Channel 14	<b>5.5°C</b>
Channel 3	<b>5.4°C</b>	Channel 7	<b>5.5°C</b>	Channel 11	<b>5.4°C</b>	Channel 15	<b>5.5°C</b>
Channel 4	<b>5.5°C</b>	Channel 8	<b>5.7°C</b>	Channel 12	<b>5.4°C</b>	Channel 16	<b>5.5°C</b>

**Calibration at <-30°C**

Initial Calibrator Reading: **-35.60°C**      Average Calibrator Reading: **-35.600°C**  
Final Calibrator Reading: **-35.60°C**      (Channels must read +/- 0.9°C of average calibrator reading)

**Thermocouple Readings**

Channel 1	<b>-35.2°C</b>	Channel 5	<b>-35.1°C</b>	Channel 9	<b>-35.1°C</b>	Channel 13	<b>-35.2°C</b>
Channel 2	<b>-35.1°C</b>	Channel 6	<b>-35.1°C</b>	Channel 10	<b>-35.1°C</b>	Channel 14	<b>-35.2°C</b>
Channel 3	<b>-35.3°C</b>	Channel 7	<b>-35.1°C</b>	Channel 11	<b>-35.2°C</b>	Channel 15	<b>-35.3°C</b>
Channel 4	<b>-35.2°C</b>	Channel 8	<b>-35.1°C</b>	Channel 12	<b>-35.2°C</b>	Channel 16	<b>-35.2°C</b>

CALIBRATION PERFORMED BY: **Matt Carroll**  
NAME: \_\_\_\_\_ SIGNATURE: \_\_\_\_\_  
DATE: **12 December 2011**





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## 15 Appendix C: Glossary of Terms

**Conditioning:** The period (minimum of 48 hours) in which product or components are stored in order for them to stabilise at their relevant temperature.

**Deviation:** Any unexpected outcomes during testing are included in 'Deviations and Discussion', and can include things such as failed probes, temperature excursions or any changes made to the system or test process which differs from the original protocol.

**Excursion:** Refers only to temperatures recorded above or below threshold during testing.

**Preconditioning:** It is sometimes recommended that frozen components are left at factory ambient for a specified duration prior to their use within a system in order to avoid cold shock. This never applies to chilled or warm components and differs from standard conditioning which is required for all components. Preconditioning times are stated on the Methodology and System Diagram pages.

**System Name:** As a system configuration may require multiple tests to prove suitability, a single system name is used for identification for reporting, traceability and ordering purposes. The system name applied will always relate to the earliest approved test number. For example, a report contains results from two tests, T1111-11 and T1111-12, and so would be named the T1111-11 system.

**Temperature Readings:** All temperature readings throughout the report are presented in °C (degrees Celsius).

**Test Number:** Each Technical project is given a unique project number e.g. T1111. Each individual test is given a different identification number, which is the suffix to the unique project number e.g. T1111-13.