

Customer: FedEx Corporation  
Document Type: Qualification Report  
Product: 2-153852C-S  
Document Date: 29 April 2016  
Document Number: CQR -003-16

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# Qualification Report For the 2-153852C-S NanoCool Shipping System

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## Purpose

This report outlines testing for the qualification of the 2-153852C-S NanoCool shipping system. Three 2-153852C-S systems were tested against the ISTA-7D Summer forty-eight hour profile (Chart 1) and drop tested against a modified ISTA-3A drop procedure (Chart 2).

## Summary

Testing was conducted in triplicate using the 2-153852C-S NanoCool shipping system. In addition, three 2-153852C-S systems were drop tested against a modified ISTA-3A drop procedure (Chart 2) and then tested against the ISTA-7D Summer forty-eight hour profile (Chart 1). The systems tested against ISTA-7D summer had a product temperature range from 2.7 to 6.8°C over forty-eight hours. The systems drop tested passed with no significant damage to the outer box, foam, VIP, or cooler engine.

Chart 1 - ISTA-7D 48 Hour Summer Profile

Summer		
Temperature °C	Hours	Elapsed Time
22	4	4
35	2	6
30	36	42
35	6	48

## Thermal Test Procedures

Testing was conducted using one 60mL Nalgene bottle as the test product. All test products contain deionized water. A single 60mL Nalgene bottle was probed with a thermocouple to monitor the product temperature during testing.

Prepare for testing:

- Precondition the 60mL Nalgene bottles at 3-5°C for 24 hours
- Prepare TIS (test information sheets), assign logger and chamber
- Prepare NanoCool shipping systems according to TIS sheet
- Obtain appropriate coolers for testing
- Assign coolers to boxes, documenting cooler numbers and box numbers on TIS

When coolers, boxes, products, and chambers are prepared start hook-up procedures.

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## Hook-Up Procedure

- Open box and remove cooler
- Place cooler upside down, dome up, and activate
- Tape the assigned thermocouple to the side of the triangle with the thermocouple end on the marked line (30mm from the base of the triangle) and the rest of the thermocouple running up the long side of the triangle.
- Insert the triangle into the chipboard box ensuring that the thermocouple is facing the product, and then insert the product base first
- Obtain 60mL Nalgene bottle and place bottle in the payload cavity with the thermocouple to the center of the box
- Place cooler onto the box and close the outer box
- Place systems in the chamber, ensuring that boxes are not touching
- Close chamber
- Turn on logger
- Turn on chamber with correct testing profile

## Down-loading and Autopsy Procedure

- Download loggers according to download procedures
- Graph experiments according to graphing procedures and information on the test information sheet
- Analyze data to determine if the units passed or failed the 2-8°C product temperature specifications over the forty-eight hours.
- Chamber used for test FG85201-#53 was: ZP0453562 Logger: EL-8174

## Drop Test Procedures

The purpose of this test is to evaluate the durability of the 2-153852C-S NanoCool shipping system. Three 2-153852C-S NanoCool shipping systems were drop tested against the ISTA-3A protocol (see Chart 2) with the addition of two 60" face one drops during the procedure. The two 60" drops on face one are to test the integrity of the NanoCool shipping system's engine. The three systems were tested thermally after drop testing and the results are used in this qualification report.

After the completion of the ISTA test sequence, the NanoCool shipping system is opened and inspected to see if it passes the acceptance criteria (see below). If the system passes the acceptance criteria guidelines the units are inspected again after twenty-four hours.

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Chart 2: Drop Sequence

ISTA-3A Drop Sequence		
Drop Number	Drop Height (in)	Orientation
1	18"	Edge 3-4
2	18"	Edge 3-6
3	18"	Edge 4-6
4	18"	Corner 3-4-6
5	18"	Corner 2-3-5
6	18"	Edge 2-3
7	18"	Edge 1-2
8	36"	Face 3
9	18"	Face 3
10	60"	Face 1 on Hazard
11	18"	Edge 3-4
12	18"	Edge 3-6
13	18"	Edge 1-5
14	18"	Corner 3-4-6
15	18"	Corner 1-2-6
16	18"	Corner 1-4-5
17	36"	Face 1
18	60"	Face 1

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## Set-up

Each unit will be assembled in the following manner prior to the initiation of ISTA-3A.

- Obtain correct systems
- Ensure package component integrity prior to testing
- Remove cooler and activate
- Place product in payload
- Replace cooler engine and close NanoCool shipping unit
- Using packing-style adhesive tape, seal the shipping units in the manner indicated by the shipping unit graphics, sealing face 2 to face 5, face 2 to face 6, and face 2 to face 3
- Number outer shipping box according to ISTA-3A drop testing procedures
- Establish 18", 36" and 60" drop testing height

## Inspection and Acceptance Criteria

Visually inspect the NanoCool shipping systems for the following:

- Rips in the corrugate shipping case material
- Adhesion of the foam pad to the inside of Face 1
- Cooler engine integrity
  - Burst bladder
  - Loss of vacuum
- Integrity of the vacuum insulation panel (VIP)
  - Loss of vacuum
  - Structure maintained
- Integrity of the foam sleeve
  - Structure maintained

Failure: loss of cooler and/or VIP integrity or damage to insulated box as listed above. Document all other observations related to above criteria.

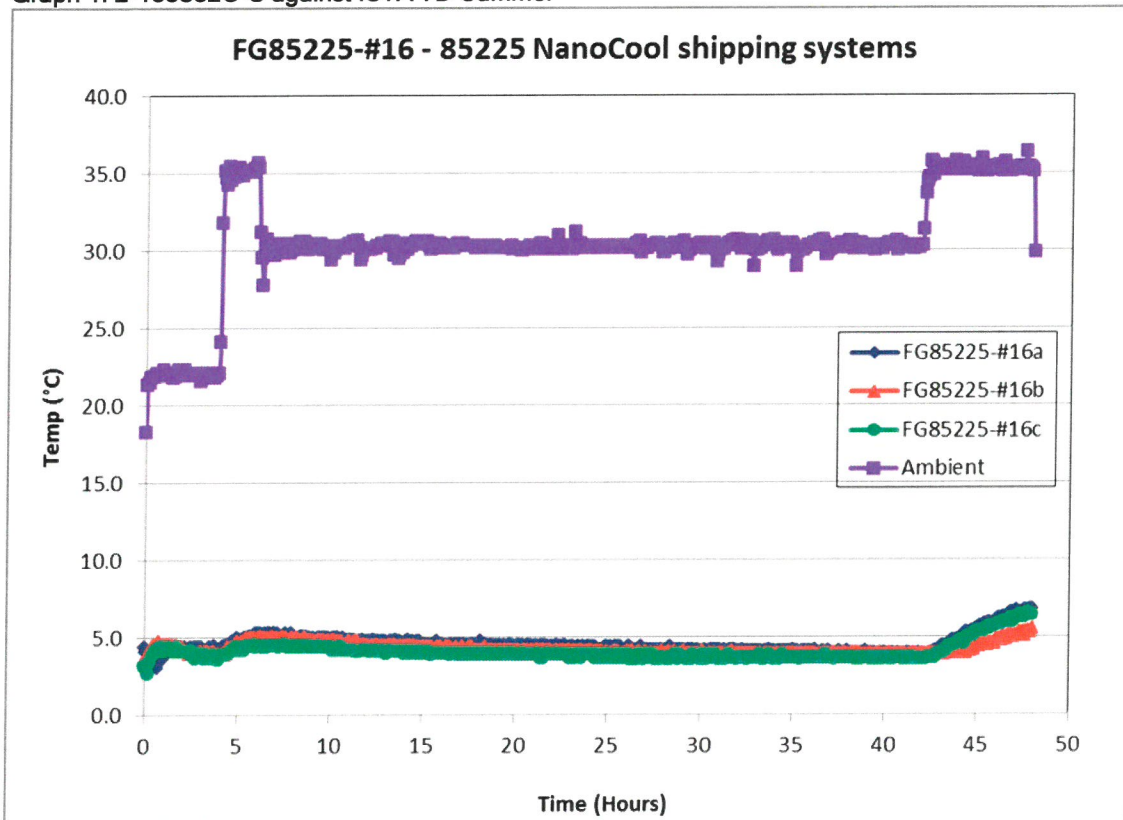
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## Summary of Results

### ISTA-7D 48 Hour Summer Profile

Test FG85225-#16 tested three 2-153852C-S NanoCool shipping systems. The test was performed against the ISTA-7D summer forty-eight hour profile (Graph 1). One 60mL Nalgene bottle was used as the test product. The product temperature ranged from 2.7 to 6.8°C over the forty-eight hour test and the average product temperature at forty-eight hours was 6.2°C.

Graph 1: 2-153852C-S against ISTA-7D Summer



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Chart 3 lists the maximum and minimum temperature recorded during testing. The forty-eight hour end product temperature is also noted. When a reading occurs more than once, the time of the first occurrence is shown.

Chart 3: ISTA-7D Summer

Test #	Profile	Minimum temperature recorded		Maximum temperature recorded		Temp. @ 48 Hours, °C
		Temp., °C	Time, Hours	Temp., °C	Time, Hours	
FG85225-#16a	Summer	3.1	0.7	6.8	47.9	6.8
FG85225-#16b	Summer	3.6	0.0	5.5	48.0	5.5
FG85225-#16c	Summer	2.7	0.2	6.6	47.8	6.4

### ISTA-3A Drop Test

Three 2-153852C-S NanoCool shipping systems were tested against a modified ISTA-3A drop sequence (Chart 2). All of the systems passed when checked against the acceptance criteria outlined earlier in the report. The NanoCool cooler engines maintained vacuum and cooling properties. There was no significant damage to the cooler, foam sleeve, or carton.

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## **Conclusion**

The tests have shown that the 2-153852C-S system maintains 2 to 8°C when tested against the ISTA-7D forty-eight summer profile. The system also passes drop testing against the modified ISTA-3A drop sequence, which shows that the system meets NanoCool's requirements for durability. These results are reported in good faith and the customer should use their judgment as to whether the system is appropriate for their application.

### **Liability Restriction:**

It should be noted that this report represents test results carried out by NanoCool LLC 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. As with any cool shipping system used in normal warehouse conditions some condensation will occur, we advise that the effect of this condensation on the product to be shipped is checked prior to usage.



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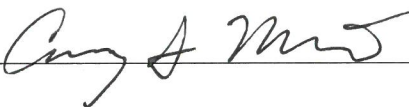
### Final QMOC/Protocol Approval


The signatures listed below indicate that these representatives have reviewed this document and approve of the Protocol activities and data documented herein. When all approval signatures have been obtained, the Protocol is considered complete.


#### Written By

Signature:  Date: 5/5/16  
Product Development/Tech Services

#### Approved By

Signature:  Date: 5/5/16  
Operations

Signature:  Date: 05/05/16  
Quality

Signature:  Date: 5/4/16  
Sales

## Environmental Test Chamber Register

Description	Dimensions	Model #	Serial #	Calibrated	Manufacturer	Range
Test Chamber #3 Gordon	38" x 38" x 38"	Z-Plus 32	ZP0453562	Annually	Cincinnati Sub- Zero	-20 °C to +50 °C
Register approved	Wendy White		November 2012			
Name .....		Date .....				

## Data Logger Register

Description	Note	Model #	Serial #	Calibrated	Manufacturer	Range
Data Logger Bubba	16 temp. channels, 1 pulse channel, 1 event channel	1025	EL-8174	Annually	Eltek Instruments	-200 °C to +200 °C
Register approved	Wendy White		February 2013			
Name .....		Date .....				