



FreshBoxx™ Performance Test

**Davao, Philippines
2-4 September 2013**

1. INTRODUCTION

The FreshBoxx™ variant of the CakeBoxx design was purposely developed to transport perishable and temperature sensitive cargo for short to medium duration trips without using a conventional mechanically powered reefer container. FreshBoxx™ protects cargos by minimizing temperature variations inside the boxx, maintaining cargo temperature within acceptable limits and preventing condensation without any mechanical refrigeration equipment. This makes the FreshBoxx™ both efficient and environmentally-friendly. The FreshBoxx™ design eliminates the need for mechanical reefer equipment – diesel and electrical gensets and produces the following operational benefits:

- Saves fuel costs
- Environmentally friendly - eliminates greenhouse gas emissions from the container
- Eliminates maintenance and repair costs of failed gensets and reefer equipment
- Eliminates possibility of refrigerant related mishaps
- Lower acquisition cost

There is very little conductive or convective heat gain inside a FreshBoxx™. FreshBoxx™ containers are constructed using high Total Solar Reflectance (TSR) paint that minimizes heat transfer and high performance insulation that virtually eliminates cooling loss and heat gain. Insulation thickness can be customized to customer specifications to address specific commodities. There are no moving parts other than the standard CakeBoxx latching mechanisms.

The interior of the FreshBoxx™ is lined with a durable, FDA approved food-grade fiberglass reinforced (FRP) coating. The floor is constructed of high performance, pultruded fiberglass reinforced plastic filled with polyurethane foam insulation and sealed to a water-tight condition.

FreshBoxx™ is ideal for the transportation of fruits, vegetables, meats and other perishable products on short-term trips (e.g. three to five days) such as from farm to processing center, processing center to cold storage distribution or from distribution hub to the end user.

For non-agricultural cargos such pharmaceuticals, electronics, wood, paper products or beverages that need protection from temperature fluctuations or condensation damage, FreshBoxx™ can flatten the heat / cool cycles of tropical and winter weather and provide temperature protection – even when loaded topside aboard ship or in the stack awaiting movement.



2. TEST PURPOSE, OBJECTIVES AND SCOPE

The purpose of this test was to demonstrate the effectiveness and viability of the FreshBoxx™ to meet cold chain requirements under ‘worst case’ operating and environmental conditions. To accomplish this we scheduled the test to be conducted over a 3-day period in a tropical environment using basic handling equipment as may normally be found in these regions. No specialized lifting equipment was allowed to be used, and no special operating instructions were given to the operators.

In addition to the extreme heat and humidity conditions of the location, to meet the “worst case” objectives we purposefully designed the evaluation to be conducted under these conditions:

- No pre-cooling of the FreshBoxx™
- Cargo loading completed by hand by a small crew
- Cargo loading in broad daylight with direct sun exposure
- FreshBoxx™ stored in an exposed, unshaded location

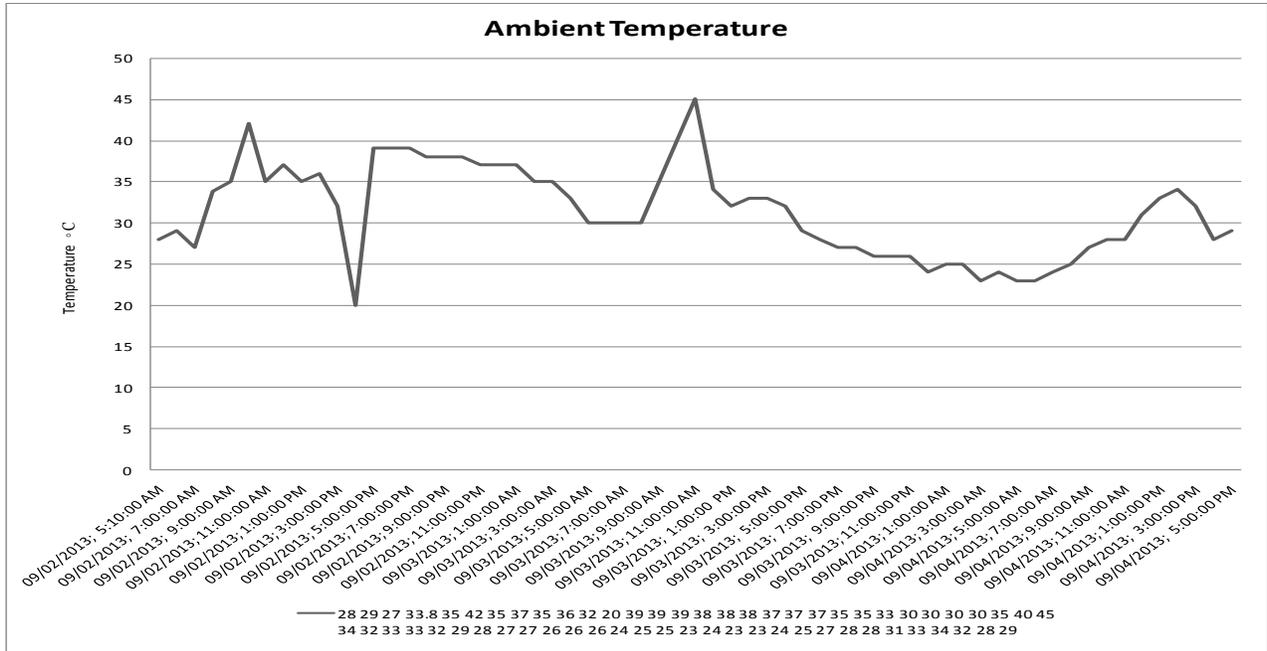
3. TEST OVERVIEW

Product tested – 20’ FreshBoxx™ of the CakeBoxx product line

- Model # CKXU 121 (20’ x 8.5’ x 8’)
- Construction – A36 and A588 (Cor-ten) steel frame sheet metal
- Insulation –
 - Sidewalls and roof: 40mm of Aerogel in sidewalls and roof (R-20+),
 - Deck: 100mm of 2 pound spray polyurethane foam (SPF) inside and beneath deck (R-25)
- Inner liner – 1/8” fiberglass reinforced plastic (FRP) food-grade liner.
- Paint – White, high total solar reflectance (TSR index 78.4), marine grade top coat and primer
- Flooring – 2.5” pultruded fiberglass reinforced polymer (FRP)
- All internal seams caulked with commercial strength sealing compound

Environment

- Physical location of the test – Davao, Philippines (7° N, 125° E)
- Annual temperature range varies from 75°F to 91°F and is rarely below 73°F or above 93°F
- The relative humidity typically ranges from 61% (mildly humid) to 95% (very humid) rarely dropping below 52% (mildly humid) and reaching as high as 100% (very humid)
- The ambient air temp on the days of the test are detailed in the chart below



Test Cargo

- 18,518KGs / 39,680pounds of block ice
- Each block of ice weighed 197kg; 94 blocks total
- Prior to loading the ice was stored at -12°C



Test Procedures and Conduct

- Test dates: September 2-4, 2013
- Ice provided by local service provider and delivered to test site in local delivery reefer truck
- FreshBoxx™ was delivered on a 20' chassis and parked on a packed road surface
- Boom truck was engaged to remove and replace FreshBoxx™ lid
- FreshBoxx™ deck and interior walls were hand-washed and cleaned after opening for sanitation
- 197kg ice blocks were manually transferred from the delivery truck to the FreshBoxx™ deck

- Data logger was activated and began recording at the time the FreshBoxx™ lid was opened. It registered an initial ambient temperature of 29 °C and was then placed on lid of the FreshBoxx™ to measure the temperature in the direct sunlight on the top of the boxx where it registered its highest temperature of 47.4°C.
- The data logger was then moved into the inside of the FreshBoxx™ and was fastened to the ceiling in the center of the boxx.
- After mounting the data logger inside the FreshBoxx™, temperature readings began to decrease gradually down to 28.3°C.
- After loading was complete and the FreshBoxx™ lid was replaced on the base and locked. Once closed, the temperature readings dramatically decreased then stabilized around 3.8°C.
- The internal temperature was maintained consistently between 3.8 and 4.5°C for a period of 48 hours except for with slight increases consistent with peak day time temperatures. Temperatures in the FreshBoxx™ decreased after daytime warming.
- After 60 hours of monitoring the FreshBoxx™ lid was removed. Temperature readings quickly returned to ambient.

The cargo mass was evaluated throughout the conduct of the test by measuring the amount of water collected from the run-off of the slowly melting ice. A total of 1694 kg of water was collected by this method, equaling 9.1% of the original mass of the cargo (18,518kg). Of this collected volume, 624kg (3.37%) was collected at the end the loading cycle at hour 6. 252kg (1.36%) was collected at the halfway point at hour 31, 426kg (2.3%) was collected through hour 60, and an additional 380kg (2.05%) collected at hour 61 after the lid was opened and the unloading begun.

5. EVALUATION

The results of the data logger indicate that the FreshBoxx™ successfully demonstrated its ability to maintain temperatures within a narrow band while used in an austere operating environment. Physical measurement of the cargo mass throughout the test period similarly indicated that just more than 9% of the cargo mass was lost due to temperature change / melting. Of this 9% loss, 3.37% was lost during the loading process and another 2.06% during the beginning of the unloading process when the cargo was once again exposed to ambient temperatures.

In harsh temperature and humidity conditions, loading at ambient temperature in direct sunlight, a protracted loading process and no pre-conditioning of the FreshBoxx™ itself, it was still capable of protecting this temperature-sensitive load with temperature increases of no more than 5°C over a 60 hour period and a recovery percentage of approximately 90% of the load.



6. CONCLUSION

This evaluation conservatively demonstrates FreshBoxx™'s ability to manage the shipment of temperature sensitive / perishable cargo for a minimum of 48 hours with minimal product loss without the use of a mechanically powered reefer container. Pre-conditioning the FreshBoxx™ and expeditiously loading and unloading it in a temperature controlled environment can be reasonably expected to minimize product loss by another 3-5% and extend carry times by 24 hours or more.

The operational impact and outcomes of the use of FreshBoxx™ in specific supply chain / ground logistics environments will be substantial. In these environments and segments of the supply chain FreshBoxx™ will:

- eliminate or reduce the need for conventional diesel powered reefer containers
- reduce operating expenses by reducing the need for diesel fuel
- reduce maintenance and repair costs for gensets
- eliminate extensive and time-consuming reefer pre-conditioning
- reduce down-time and resulting product loss due to reefer equipment failure
- reduce theft of genset parts and fuel
- reduce the acquisition or leasing costs of reefer equipment
- eliminate greenhouse gases emitted by diesel power gensets
- result in increased reliability of the supply chain

FreshBoxx™ is an easily deployed, high-payoff solution for many ground transportation supply chains where conventionally powered reefer containers are not viable and extreme product loss due to spoilage and theft is a persistent and limiting factor to economic growth and prosperity. In many cases, these same areas also experience high fuel and maintenance costs as well as growing concerns about air pollution caused by diesel powered equipment.

FreshBoxx™ is a configurable product. The insulation types and thickness, flooring material, paint and the unique Perimeter Tie-Down System (PTS™) allow for significant advantages over other types of containers for securing the load and ensuring its safe transit in multiple operating environments as specified by the user's requirements.