

**CASE STUDY: PACKAGING QUALIFICATION WITH  
INTEGRATED COLD CHAIN LOGISTICS DESIGN**



## BACKGROUND

A biopharmaceutical manufacturer contacted LifeConEx to help them with the launch of their new chemotherapy product. The medicine was scheduled to be shipped to India for packaging into finished doses. The manufacturer had limited logistics and quality resources, and was positioned in a geographically remote location in Canada. Reverse logistics processes would also need to be implemented as some product would need to be returned from India back to the manufacturer in Canada. Past shipments from YYG (Charlottetown) to BOM (Mumbai) and BOM to YYG were executed with mixed results.

Based on the initial shipments' lack of cold chain control, the Canadian manufacturer saw an urgent need to further qualify the trade lane. With limited internal resources, the manufacturer sought a partner they could trust in performing packaging qualification and shipping tests in a 12 to 15 week timeframe.

## APPROACH

### Step 1: Cold Chain Infrastructure Analysis

Understanding the infrastructure for the cold chain is a key when designing the transportation routing. The logistics process must ensure that the packaging can be placed inside the proper temperature controlled storage environment when needed. The average high temperature in Mumbai is +40°C with a relative humidity of 95 % so this becomes an immediate factor for consideration.

**The recommended port of entry into and out of India is Hyderabad (HYD). It possesses the most sophisticated cold chain infrastructure in the country:**

- The major airlines operating into and out of HYD are all preferred carriers within the LifeConEx network, meaning, they have a commitment to maintain a high level of pharma storage and handling level of services.
- The primary ground handling agent at HYD understands the importance of tarmac Considerations and knows that pharma and perishable shipments are different.
- Trusted trucking networks with refrigerated capabilities move pharma products from HYD to various parts of India domestically.
- Dedicated electrical outlets are available for Unicoolers & Envirotainer e1's (having access to electrical outlets can sometimes be a problem in ports with limited cold chain infrastructure).
- Passive shipping systems are currently being handled by HYD, with the majority of the systems possessing validation times ranging from 72 to 120 hrs.

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## Step 1: Cold Chain Infrastructure Analysis (Continued)

- The logistics routing from Canada to India is estimated at 96 hours with an additional customs clearance time of 96-120 hrs.

Export Pharma Zone - Dedicated Temperature Controlled facility for Pharmaceuticals			
Category	Area (Sq Mts)	Capacity	Temperature range
			(Degrees Celsius)
<b>Non – Bonded Area</b>			
Truck Dock	120	-	+15 to +25
Customs Inspection Area	736	20 - 32 tons	+15 to +25
Racking System (In examination area)	50	38 - 60 tons	+15 to +25
Cold Storage (250 cu.mt)	50	24 - 34 tons	+2 to +8
<b>Bonded Area</b>			
Ambient storage - (For build up ULD's)	342	36 - 54 tons	+15 to +25
Cold Storage - (For build up ULD's)	102	12 - 20 tons	+2 to +8
<b>Total</b>	<b>1400</b>	<b>130 - 200 tons</b>	

Import Cold Rooms			
Category	Volume (Cu Mt)	Capacity (in tons)	Temperature range (Degrees Celsius)
Chamber 1	50	5	0 to -20
Chamber 2	120	13	+2 to +25
Chamber 3	50	7	+2 to +25

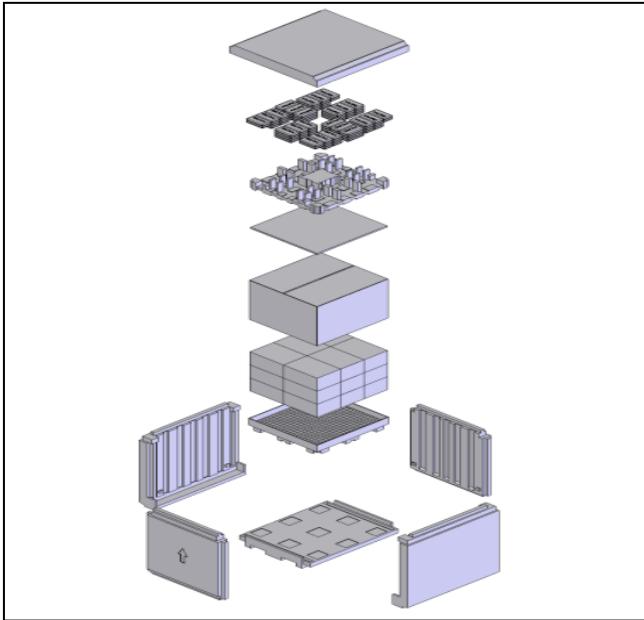
Source: DHL Global Forwarding

## Step 2: Packaging System Analysis

LifeConEx compared the advantages, disadvantages, and capabilities of the different types of thermal shipping systems available to the Canadian manufacturer and cross-referenced this data with the product stability data.

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## Step 2: Packaging System Analysis (Continued)



The container selected for thermal testing was the P-002, BioSphere, a polyurethane shipper manufactured by EnviroCooler. The P-002 is composed of five pieces molded polyurethane cell (base, front wall, back wall, two side walls) and a die cut polyurethane foam pad. A one piece corrugated box is placed over the assembled molded polyurethane cooler and referred to as the shipper. These shippers are designed to keep +2° to +8°C range for 183 hrs utilizing only frozen gel packs.

The advantages of these containers are their simplicity, long duration, size ranges, minimal temperature stratification within the payload area, and re-usability. Re-use is certainly a challenge in some situations depending on the type of recipient, but offers a significant environmental advantage and increases the return on investment.

### Additional benefits of the selected container:

- Pre-molded conduction blocks reduce temperature pockets
- The sliding ice tray separates coolant and product and directs thermal convection to designed locations of the cooler
- Interlocking walls, lids and bases reduce thermal convection between the external environment and the engineered internal atmosphere
- The convection engine employs pre-designed cavities to use thermal convection as an engine to evenly move and disperse energy within the container

## Step 3: Packaging System Analysis (Continued)

The goal was to target simulated product temperatures in measured locations between +2° to +8°C for a minimum of 120 hrs with allowable temperature excursions during the testing period of up to +25°C and down to 1°C.

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Products would be pre-conditioned at  $+5^{\circ}\text{C}\pm 3^{\circ}\text{C}$  for a minimum of 24 hrs prior to test start. The simulated product temperatures were documented immediately prior to pack-out for testing. The handling of materials during product packing and test chamber loading could result in initial product temperatures falling outside the conditioning range.

A programmable temperature chamber was used to expose the shipper to the expected temperature extremes likely to be encountered during warm and cold weather shipments. Temperature values of the chamber, the interior of the shipper (multiple locations) and the simulated product were all recorded.

Water was used to simulate frozen product for the minimum load (4L) and maximum load (70L) testing.

Proof of Concept Thermal Laboratory testing	<ul style="list-style-type: none"> <li>Thermal laboratory testing of solution – heat and cold</li> <li>144 hr profiles; min and max loads. In-singular testing – 2 runs total</li> <li>Protocol preparation</li> <li>Report preparation</li> </ul>
Design Qualification (DQ)	<ul style="list-style-type: none"> <li>Thermal laboratory testing of solution – heat and cold</li> <li>144 hr profiles; min and max loads. In-singular testing – 2 runs total</li> <li>Protocol preparation</li> <li>Report preparation</li> <li>Performed in accordance to ISTA 7E</li> <li>NOTE: Additional test runs may be required</li> </ul>
Operational Qualification (OQ)	<ul style="list-style-type: none"> <li>Thermal laboratory testing of solution – heat and cold</li> <li>144 hr profiles; min and max loads. In-triplicate testing – 6 runs total.</li> <li>Protocol preparation</li> <li>Report preparation</li> <li>Performed in accordance to ISTA 7E</li> </ul>
Physical Qualification (PQ)	<ul style="list-style-type: none"> <li>Protocol preparation</li> <li>Report preparation</li> <li>Performed in accordance to ISTA 7E</li> </ul>
Thermal Verification Qualification (TVQ)	<ul style="list-style-type: none"> <li>Project Management of in-triplicate TVQ ship tests between India and North America</li> <li>Protocol Preparation</li> <li>Report Preparation</li> <li>Logistics process integration</li> <li>Performed in accordance to ISTA 7E</li> </ul>

- **Proof of Concept** - The ISTA 7E Testing Standard for Thermal Transport was utilized for this qualification. Standard 7E is designed to evaluate the effects of external temperature exposures of individual packaged-products shipped through a parcel delivery system. It is used as a “standalone” profile standard.

As such, it is useful for general testing and qualification of insulated shipping containers. When it is used in conjunction with ISTA Standard 20, its usefulness is enhanced:

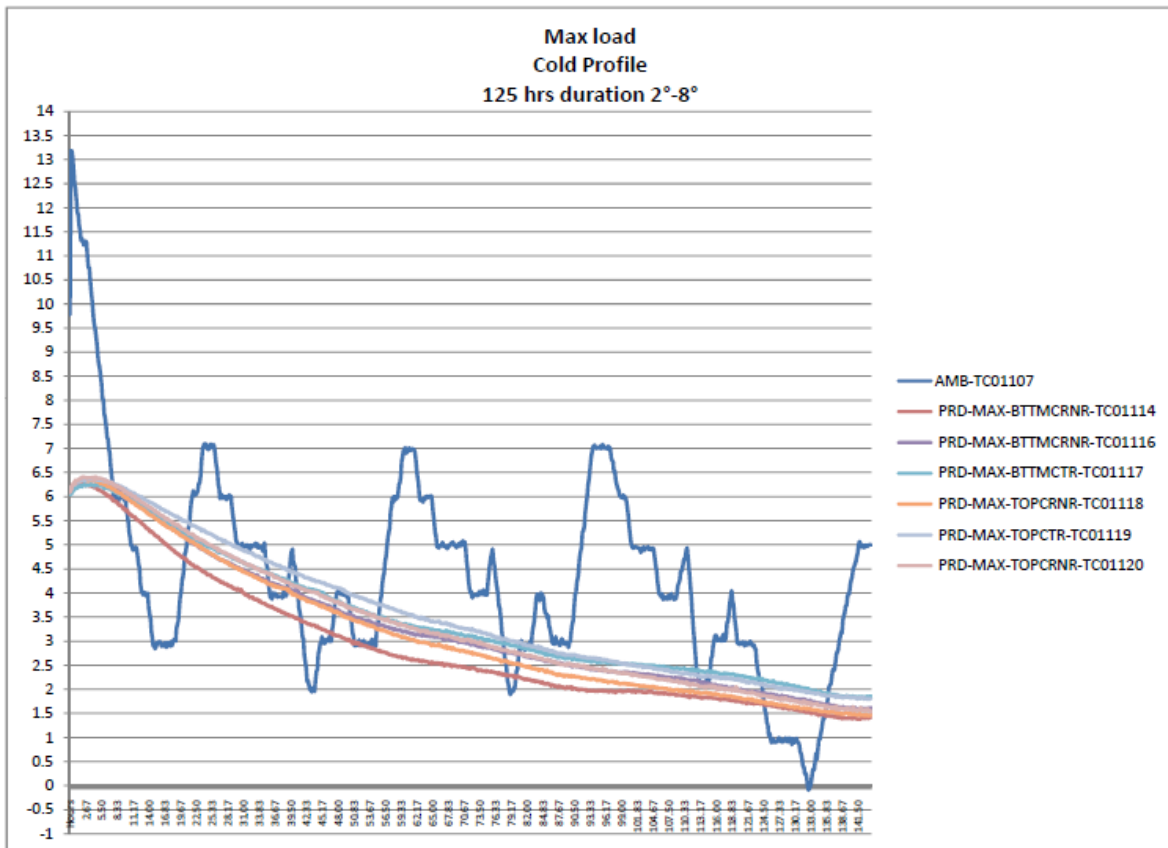
- It can be used for the development of temperature controlled transport packages made of any material
- It can be used for individual or comparative performance analysis of standard or insulated transport packages against normally encountered conditions
- It can provide a measure of the relative ability of a package to protect a product when exposed to test cycles that simulate both the range and time of exposure to ambient temperature conditions
- It allows the testing laboratory to submit results to ISTA for certification that the package conforms to testing according to
- The ISTA 7E, Standard 20 is recommended for use in supporting a FDA regulated organization’s compliance activities relative to the Center for Drug Evaluation and Research (CDER)

Source: [CDER website](#)

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Standardization establishes a rule or measure for quality and level of performance. The 7E standard was developed by characterizing the transport environment and developing Hot and Cold profiles to test packaging configurations with a high degree of confidence. The profiles are presented in Hot and Cold and for 72 hour and 144 hour durations.

- **Design Qualification (DQ)** - The purpose of this test was to measure the effects of varying ambient temperatures on the test product within the P-002 container. The basis for the profiles are the ISTA 7E Heat and Cold profiles (ISTA 7E 2010). LifeConEx reviewed historical shipping lane data and included heat and cold spikes to stress the solution greater than the ISTA 7E profiles temperatures and in-line with those temperatures the Canadian manufacturer's shipments may experience.



*\*Note: Sample Cold Profile*

- **Operational Qualification (OQ)** - The purpose of this test was to prove the ability of the P-002 unit to repeatedly maintain product loads tested between +1° to +25°C for a shipping duration of 120 hrs. Repeatability is proven by running 2 thermal qualification runs under the conditions detailed in this protocol in addition to the first DQ thermal qualification run, for in-triplicate testing. The basis for the profiles are the ISTA 7E Heat and Cold profiles (ISTA 7E 2010). LifeConEx reviewed historical shipping lane

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data and included heat and cold spikes to stress the solution greater than the ISTA 7E profiles temperatures and in-line with those temperatures the Canadian manufacturer's shipments may experience.

line	degrees	ramp	hours	minutes	soak	hours	minutes
1	28.1	ramp	1	0	soak	0	0
2	29	ramp	1	0	soak	0	0
3	29.8	ramp	1	0	soak	0	0
4	30.3	ramp	1	0	soak	0	0
5	30.4	ramp	1	0	soak	0	0
6	29.9	ramp	1	0	soak	0	0
7	29.2	ramp	1	0	soak	0	0
8	28.4	ramp	1	0	soak	0	0
9	27.8	ramp	1	0	soak	0	0
10	27.2	ramp	1	0	soak	0	0
11	26.7	ramp	1	0	soak	0	0
12	26.4	ramp	1	0	soak	0	0
13	26	ramp	1	0	soak	0	0
14	25.5	ramp	1	0	soak	0	0
15	25	ramp	1	0	soak	0	0

*\*Note: Sample Heat Profile Testing Points (15 of the 123 total tested points tested are depicted here).*

### \*Additional considerations:

- The design testing period was scheduled for 336 hours for the heat profile and 144 hrs for the cold profile
  - During the Design and Operational Qualifications, two cold extreme spikes were added to the cold profile run to last for 8 hrs at  $-20^{\circ}\text{C}$
  - One spike started approximately 12 hours into the run and the second spike started 30 hours into the run
  - The heat spike was  $+40^{\circ}\text{C}$  for approximately 8 hours, 72 hours into the run
  - The heat profile was extended to see when the packaging would reach temperatures in excess of  $+25^{\circ}\text{C}$
- **Physical Qualification (PQ)** – Physical qualification of the P-002 shipper is to be performed using three new unused shippers. Physical qualification is required to assure the impact of handling the shipper throughout the distribution cycle does not jeopardize the shipper's structural integrity. Only P-002 shippers having a maximum load as described in the thermal qualification protocol of the project were used for the physical qualification. The maximum load represented the largest mass as well as the potential for the greatest force to impact the shipper during physical qualification.

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- ▶ **Thermal Verification Qualification** - Field testing to affirm that laboratory thermal testing results are repeatable in field conditions was performed using sensor placement determined by prior laboratory testing.

### RESULTS

The end goal of the Canadian manufacturer was to test the packaging system to failure. They had to have the proper documentation to present to various regulatory authorities that would provide them confidence that they had a process in place that would protect their product for 12 to 14 days.

The final ISTA 7E packaging qualification report combined with LifeConEx SOP Integration was utilized by the Canadian Manufacturer to fulfill all requirements.

- ▶ Upstream logistics and packaging integration created faster turn-around on this project than could have been achieved internally at the Canadian Manufacturer
- ▶ Regulatory compliant SOP integrated and approved in conjunction with packaging selection and qualification
- ▶ Comparable cost to doing work internally also freed up limited resources of the Canadian Manufacturer for other projects

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### ABOUT LifeConEx

*LifeConEx offers peace of mind as the only industry-specific, end-to-end cold chain management solutions provider for the life science industry worldwide. With oversight of the entire global landscape, LifeConEx designs and orchestrates the shipment process end-to-end proactively and reactively, assuring the integrity of your product's desired condition. You experience shorter cycle times, a reduction in temperature excursions, and far fewer damages than typically experienced by shippers. LifeConEx it & Live your Life.*

*LifeConEx is supply chain party neutral (airlines, forwarders, truckers, packaging, and technology).*

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