PRACTICAL GUIDE

Making the Right Cold Chain Logistics Choices for Your Products

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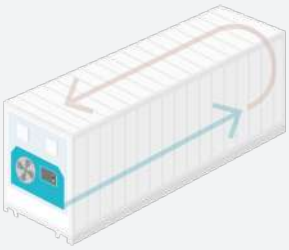
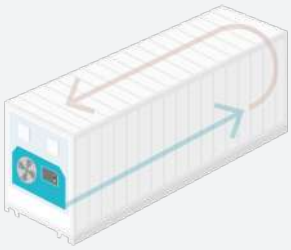
Making the Right Cold Chain Logistics Choices for Your Products

When you have a new product coming to market, or volumes are ramping up due to market demand, you are faced with important choices on how to ship your temperature-sensitive products. Your choices regarding transportation and packaging materials will influence what level of risk your product incurs and possible temperature deviations.

This guide outlines possible transport and packaging combinations and what risks can be taken in the supply chain. Then, you will learn about how to assess temperature data and excursions, how to use a cold chain database to correct false/positive alarms, and how to create CAPAs.

We hope this practical guide will help you make informed and educated decisions about your temperature-sensitive pharmaceutical products.

Transport mode and average trip length	**Solutions for +2 °C to + 8 °C**	**Solutions for +15 °C to +25 °C**
2 days	 Reefer truck/van	 Standard or reefer truck/van
	 Insulated box	 Thermal covers
5 days	 Air cargo heating and cooling container	 Air cargo cooling container
30 days	 Ocean reefer container	 Ocean reefer container

Temperature-controlled transportation options

Keeping the temperature stable during transport is a question of the mode (road, air, ocean), size (small product quantity vs. several pallets), temperature requirements (frozen vs. +2 °C to +8 °C strict vs. +15 °C to +25 °C) and trip length.

Based on the physical properties, typical shipment duration, and sizes, the main categories for temperature-monitoring devices are as follows:

	Size	Technology	Temperature ranges
Temperature-controlled van or truck	4–50 pallets	Insulated vehicle with electrical heating and compressor cooling	+2 °C to +8 °C +15 °C to +25 °C (+2 °C to +25 °C)
Air cargo container with active temperature control	LD3: 1 pallet LD9: 5 pallets	Insulated ULD* with electrical heating and compressor cooling	-20 °C +2 °C to +8 °C +15 °C to +25 °C (+2 °C to +25 °C)
Air cargo container with passive temperature control	1–5 pallets	Vacuum-insulated ULD* with PCM (phase-change material)	-20 °C +2 °C to +8 °C +15 °C to +25 °C (+2 °C to +25 °C)
Insulated box	Various box sizes, 1–1,000 liters (pallet size)	Vacuum-insulated box with PCM (phase-change material)	-20 °C +2 °C to +8 °C +15 °C to +25 °C (+2 °C to +25 °C)
Thermal cover	1 pallet	Insulated cover/hood covering the pallet	Light insulation breaking the peaks
Ocean reefer container	20 feet: 10–20 pallets 40 feet: 20–40 pallets	Insulated vehicle with electrical heating and compressor cooling	+2 °C to +8 °C +15 °C to +25 °C (+2 °C to +25 °C)

* *ULD = unit load device – a standardized air cargo container built and certified to be connected directly with the aircraft without using cargo nets.*

Risks to maintaining temperatures: Passive vs. active equipment choices

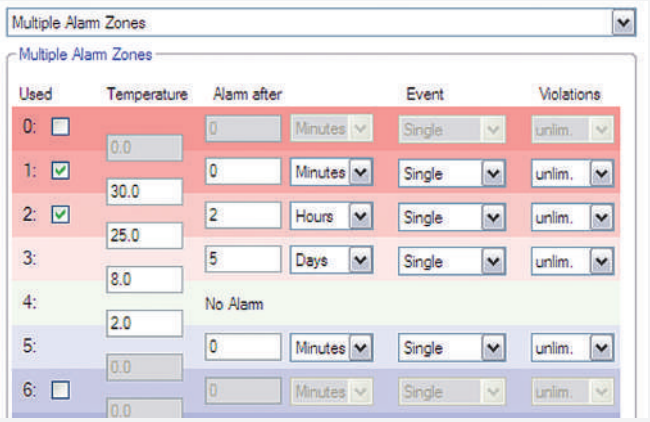
During transport, excursions from the defined transport conditions can and do happen. Why?
To know the risks, it is important to understand the equipment and what could possibly go wrong for each:

Based on the experience of millions of pharmaceutical shipments already analyzed in our database, we know that in less than 10% of all cases a true temperature alarm (deviation outside the defined shipping conditions) is found. Usually, half of the cases are due to delays or other errors that happen at the destination, which can be defined as "false deviations".

Risk	Aktive Containers & Trucks	Passive Boxes
Wrong loading 	The equipment must be "ready for use" and electrically powered. Airflow must never be blocked. → Minimal risk (< 0,5%)	Passive containers typically require a very special type of loading that includes many elements, such as vacuum-insulated panels and phase-change material (PCM). → Moderate risk (< 1%)
Extreme weather 	Extreme weather conditions outside the container/box specification can always occur. → Medium risk (1%–5%)	Extreme weather conditions outside the container/box specification can always occur. → Medium risk (1%–5%)
Technical failure during shipment 	Active containers/trucks contain hundreds of different mechanical parts that can fail. → Moderate risk (< 1%)	Passive boxes contain no mechanical parts and therefore almost never fail during shipment. → No risk (0%)
Handling errors during transport There are various risks in handling errors: 	> Rerouting (shipment takes different route than planned) > Delays (shipment takes longer than planned) > Wrong ambient temperature (e.g. container left on tarmac for too long) > Malfunction during battery charging → Medium risk (1%–5%)	> Rerouting (shipment takes different route than planned) > Delays (shipment takes longer than planned) > Wrong ambient temperature (e.g. container left on tarmac for too long) → Medium risk (1%–5%)
Late stop 	At the destination, site personnel often forget to press the stop button on the data logger. → Medium risk (1%–5%)	At the destination, site personnel often forget to press the stop button on the data logger. → Medium risk (1%–5%)

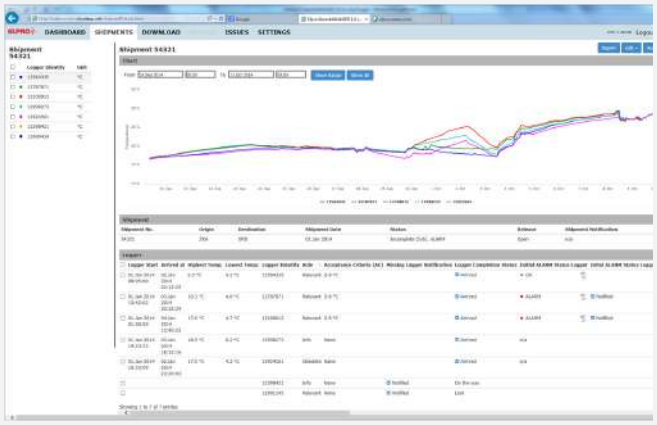
How to assess temperature in a shipment

Once a shipment has reached its final destination, a decision must be made immediately about whether to release or quarantine the product. To do so, the following data must be available:



- Complete measurement record from a calibrated sensor
- Start flag (clear date and time)
- Stop flag (clear date and time)
- Stability budget (assessment criteria) with clear conditions of temperature zones/limits and allowed times

Sometimes additional criteria are defined, such as the number of allowed excursions or number of freeze-thaw cycles. As soon as all the data is available, the assessment can be performed and a clear OK (= release) or ALARM (= quarantine) decision can be taken. Information exchange between the stakeholders usually takes place via e-mail.



How to use a cold chain database to handle and "correct" temperature excursions

Temperature alarms are brought to the attention of the product owner during a shipment (when using real-time devices) or after the shipment has been completed. However, these are often not the definitive result. Sometimes there are "false/positive" discrepancies that can be corrected by a cold chain database.

Let's take a look at some examples of common causes of "false alarms" and their interventions:

Cause of false excursion	Cold chain database intervention
Early start, sensor measures too early (before product has been loaded or conditioned)	→ Cold chain database can reassess the data using the correct time stamps
No temperature values available due to sensor failure (sensor not started or no sensor added)	→ If the shipment contains more than one device, it might be possible to use the data from the other sensors to release the entire shipment
Minor temperature excursion during shipment	→ Cold chain database can reassess the data using the stability data of the product
Wrong sensor setting triggers a temperature alarm	→ Cold chain database can reassess the data using the correct stability data
Late stop at destination, sensor continues to measure (at room temperature)	→ Cold chain database can reassess the data using the correct time stamps

In any case, it is important to have a “two-step” process in place. Alerts should be brought to attention of a logistics professional or a quality representative so that there is room for corrective action. Only the final assessment should be used to make a decision to release (or quarantine) a product.

How to deal with temperature excursions? CAPA!

In the event of a temperature excursion, GMP and GDP regulations require you to define a corrective and preventive action (CAPA) plan. CAPA is a structured process used in many different industries to investigate and identify the causes of problems. It also defines corrective actions to prevent recurrences.

Seven components of a cost-saving CAPA for temperature excursions:

1. Who discovered the temperature excursion, when, and where?

2. What is the scope of the case (shipment number, delivery, handling unit, pallet, product, batch)?

3. What is the severity of the excursion?
   > What is the label/transport condition?
   > What was the highest (or lowest) temperature measured?
   > What was the total time of the excursion? (Can the product still be released based on the remaining stability budget?)

4. What was the root cause of the excursion?

5. What corrective actions will be taken to eliminate this specific problem?

6. Have similar cases occurred before? Are there patterns in the data?

7. Can preventive measures be defined to eliminate similar incidents?

For a sustainable and solid CAPA system for cold chain management in your organization, a database is necessary where all data is available in a structured and well-documented way. A central repository of temperature data allows for examination of recurring excursions on specific routes, depots, or at logistics partners over longer periods of time.

The decision is yours

The nature of pharmaceutical products increasingly requires temperature control during distribution. Logistics partners don’t have all the answers, and you know your product best. More fully understanding how to select transportation and equipment for your temperature-sensitive products will help you establish a cost-effective supply chain with minimal risk.

To explore this topic further, please don’t hesitate to contact ELPRO.

This practical guide is part of the Cold Chain Monitoring Solutions & Logistics section for supply chain and QA professionals on our elpro.cloud website.

Topics include temperature-controlled transportation options, how to assess temperatures of a shipment, and how to use a cold chain database to handle and “correct” temperature excursions. In addition, how to handle temperature variations (CAPA) is also covered.

If you have any further questions about out monitoring solutions, please do not hesitate to contact us via e-mail at online@elpro.cloud.

More ELPRO knowledge online:
www.elpro.cloud/en/resources

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