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International
Union of
Marine Insurance



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24



“Frozen food – what cargo underwriters should be aware of”



“temperature controlled –
what cargo underwriters should be aware of”

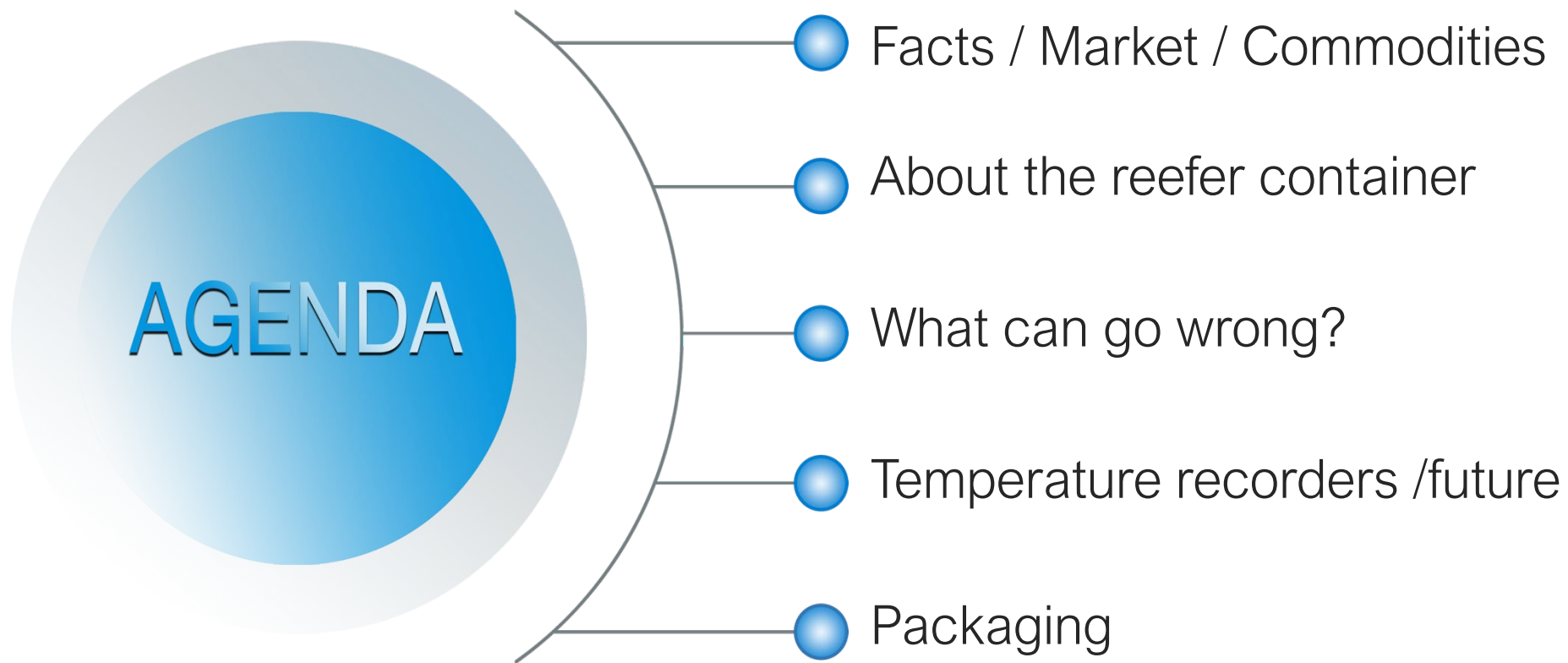
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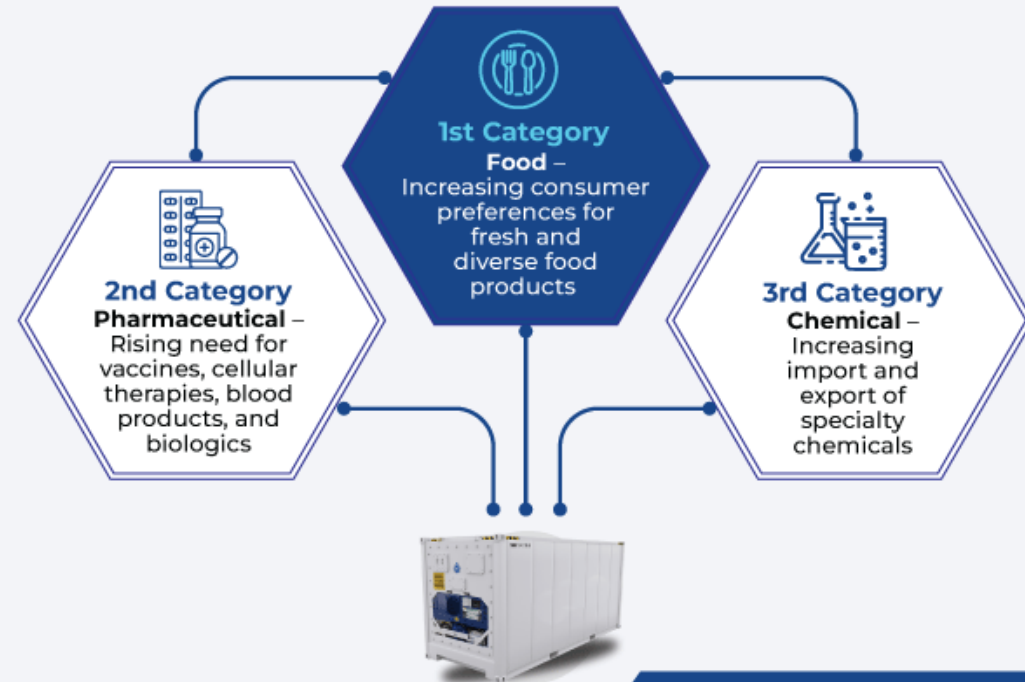
The global reefer container market is expected to reach 7,142.8 thousand twenty-foot units by 2030, an expected increase of 8.8% during 2024–2030.



Market by industry

- First category Food
- Second category Pharmaceuticals
- Third category chemical

Reefer Container Market, by Industry



Source: www.psmarketresearch.com



Refrigerated containers (reefers) account for, on average, about 5% of all the containers handled

Because of their specialized electronic components, reefer containers transports are more expensive than dry containers.

The pharmaceutical industry has witnessed a boom in recent years, with key players expanding their customer base globally, Most pharmaceutical drugs are temperature sensitive and are required to be stored and transported under a temperature-controlled environment, in order to maintain their efficacy along with other properties.



- In 2021, approximately 30% of food product claims were due to temperature abuse during transit. This equals hundreds of millions of dollars lost due to temperature abuse-related damages during transit.
- Pharmaceuticals: approximately 31% are refrigerated and 17% are frozen.
- In 2023, it was estimated around 20% of temperature-sensitive pharmaceuticals were compromised by temperature deviation during transit and storage.



Different commodities



SEAFOOD



FRUITS & VEGETABLES



MEAT & POULTRY



Different commodities (cont.)



CHOCOLATE



WINE



Different commodities (cont.)



FROZEN & REFRIGERATED FOOD



ANIMAL FOOD

Different commodities (cont.)



CHEMICALS



PHARMACEUTICALS



Market forecast shipping of frozen foods

REEFER CONTAINER MARKET

OPPORTUNITIES AND FORECAST,
2023-2032

Reefer container market is expected to reach **\$19.8 Billion** in 2032

Growing at a **CAGR of 7.5%** (2023-2032)



Report Code: A10780, www.alliedmarketresearch.com



Reefer basics



Imagine travelling internationally by auto, boat and train with the need to bring a mini refrigerator along for the trip with the requirement that your mini refrigerator maintain the same temperature and humidity for the entire trip!

Imagine the logistics of ensuring a consistent power source of electricity or diesel fuel to your mini refrigerator as you transfer from auto to boat to train.

How would you keep it running properly?
How could you prove that you did?

Type 1: Closed Reefer (most common) – one piece with an integral front wall



Type 2: Modified/Controlled Atmosphere (MA/CA) – enhanced insulation and more consistent interior environment



Type 3: Automatic Fresh Air Management Containers (AFAM) – ability to precisely control oxygen and carbon dioxide levels



Typical reefer interior





Electric power source



Portable generators or “Gensets”





Vessel powered reefers





Reefer tractor trailer





Reefer trailers “on rail” and Reefer BoxCar





Diesel fuel tank on reefer container chassis





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Reefer booking general guidelines

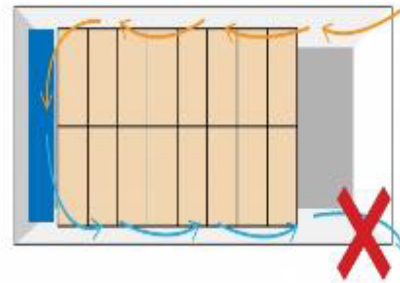
1. Specify origin and destination
2. Provide a detailed description of the product being shipped e.g. commodity name, quantity, weight, cubic measurement, and type of packaging (e.g. boxes, drums, pallets).
3. Specify preferred equipment size e.g. 20ft or 40ft HC.
4. Highlight preferred temperature settings in °F or °C.
5. Specify fresh-air exchange requirements in CFM or CMH.
6. Indicate modified or controlled atmosphere requirement:
 - a. Gas composition (O₂ and CO₂ in %)
 - b. Type of scrubber, if required
7. Indicate shipment availability date at origin and required delivery date at destination.
8. Specify special handling requirements (e.g. genset, dehumidification percentage level and cold treatment).
9. Provide any documentation requirement, including legal requirements.
10. Inform booking office if container pre-cooling is required.

Temperature and humidity settings for different commodities

Commodity	Temperature °C	Ventilation (air exchange) cbm/h	Humidity relative %	Dehumidification (max. relative humidity setting)	Approximate shelf life after harvest (in ambient air)	Methods for further shelf life extension
A						
Apples (fresh)	-1 to +4	10 to 60	90 to 95	OFF	1 to 7 months	CA containers often employed
Apricots (fresh)	-0.5 to 0	15 to 60	90 to 95	OFF	1 to 4 weeks	MA / CA Containers often employed
Artichokes, globe (fresh)	0 to +2	0 to 15	90 to 95	OFF	2 to 3 weeks	-
Asparagus (fresh)	0 to +2	15 to 25	90 to 98	OFF	2 to 3 weeks	MA packaging or CA containers often used
Avocados (fresh)	+4 to +13	30 to 60	85 to 95	OFF	2 to 3 weeks	MA / CA Containers often employed
B						
Bakery products (chilled)	+10 to +18	0 (=closed)	60 to 95	ON or OFF	depending on commodity	-
Bakery products (frozen)	-18 or colder	0 (=closed)	-	OFF	3 to 18 months	-
Bananas (fresh)	+13 to +14.4	25 to 60	90 to 95	OFF	18 to 22 days	MA packaging (Banovac) or CA containers often used
Beans, green snap (fresh)	+4 to +7.5	20 to 30	95 to 98	OFF	7 to 10 days	-
Blueberries (fresh)	-1 to 0	0 to 10	90 to 95	OFF	10 to 14 days	MA packaging or CA containers often used
Broccoli (fresh)	0 to +1	20 to 60	90 to 98	OFF	10 to 14 days	-
Butter (chilled)	0 to +8	0 (=closed)	--	OFF	2 to 6 weeks	-
Butter (frozen)	-18 or colder	0 (=closed)	-	OFF	8 to 12 months	-



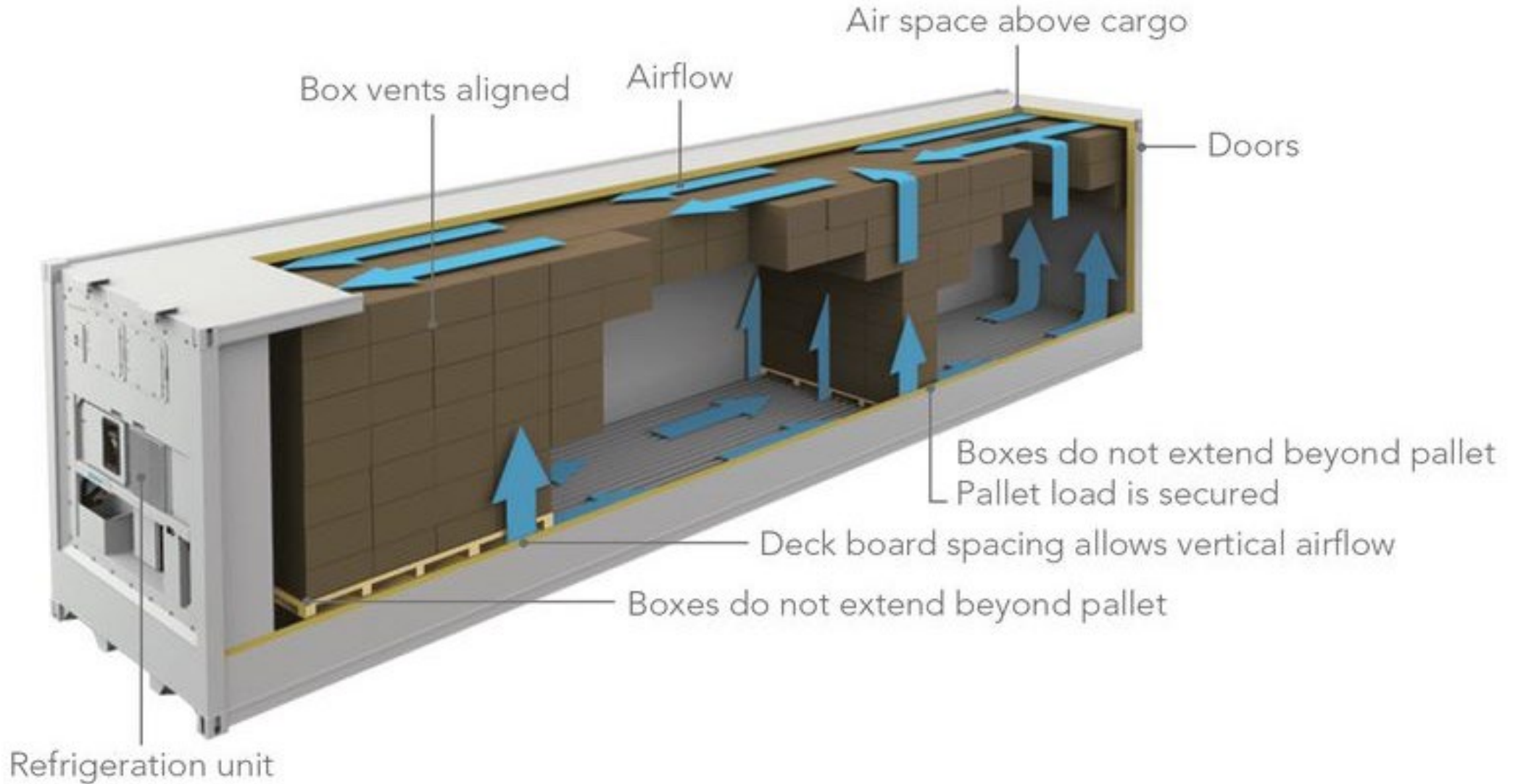
Airflow during Stuffing



HAULIO



Air flow in a reefer container





Frozen cargo





This is an excellent stow frozen cargo

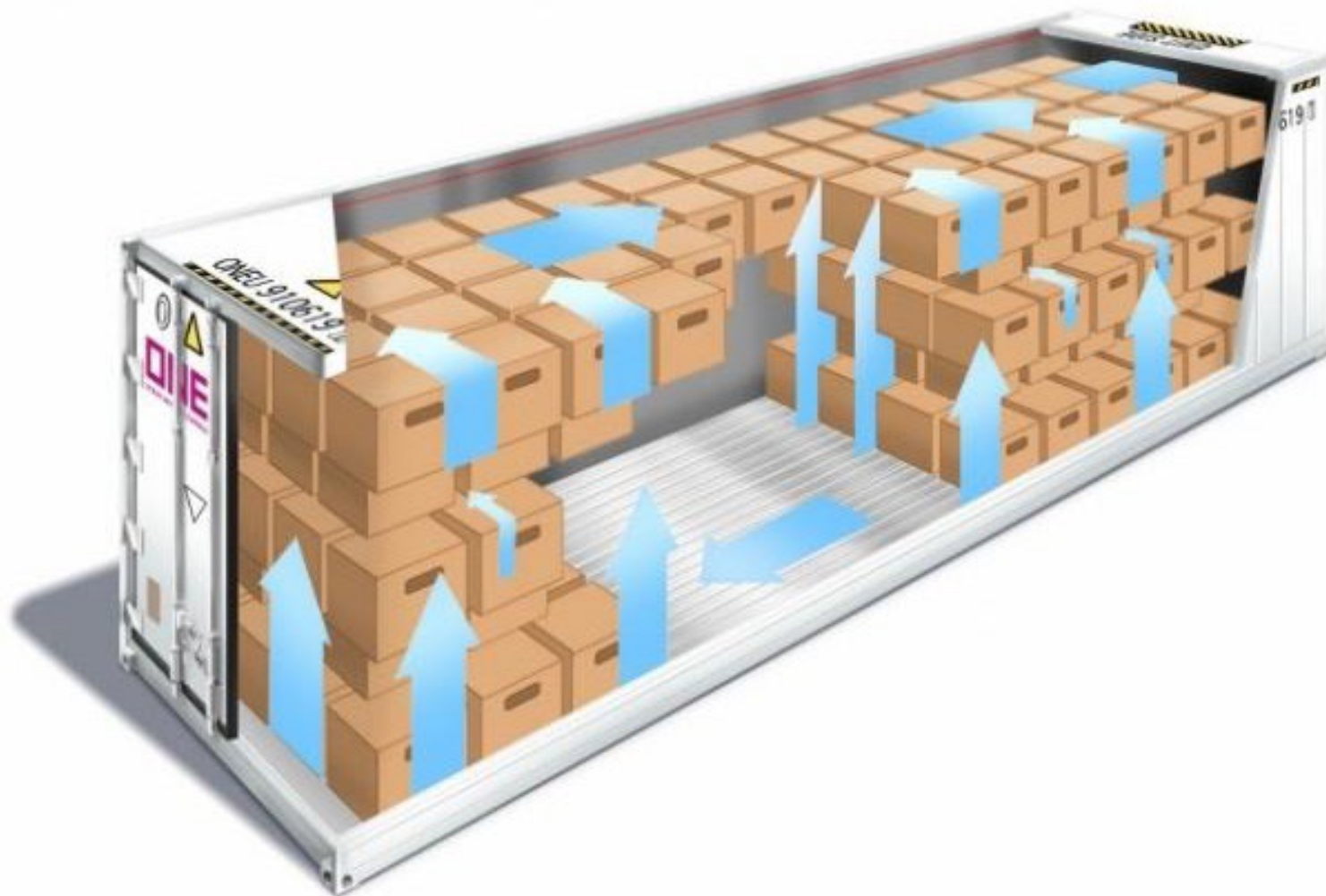


Properly stowed cargo frozen cargo





Chilled cargo requires increased airflow





Chilled cargo packing





Stuffing the container

- Make sure the container is pre-cooled
- The presence of hot ambient air will heat up the cargo
- During stuffing, the refrigeration unit should not be turned on
- Once loading is completed close to door turn on the unit as soon as possible



What could possibly go wrong?



- Mechanical error or malfunction of reefer unit / door seal Leakage
- Improper cargo stow – airflow/vents blocked by cargo
- Incorrect temperature settings on reefer display
- Incorrect temperature instructions on shipping documents
- Improper container type utilized
- Supply chain disruption resulting in lack of power source
- Pre-shipment temperature damages (goods not properly frozen / chilled)
- Highest risk in general is during mode transfer of reefers.

PTI Machinery breaks down (despite best intentions)





Door gasket leakage





Human error: paperwork

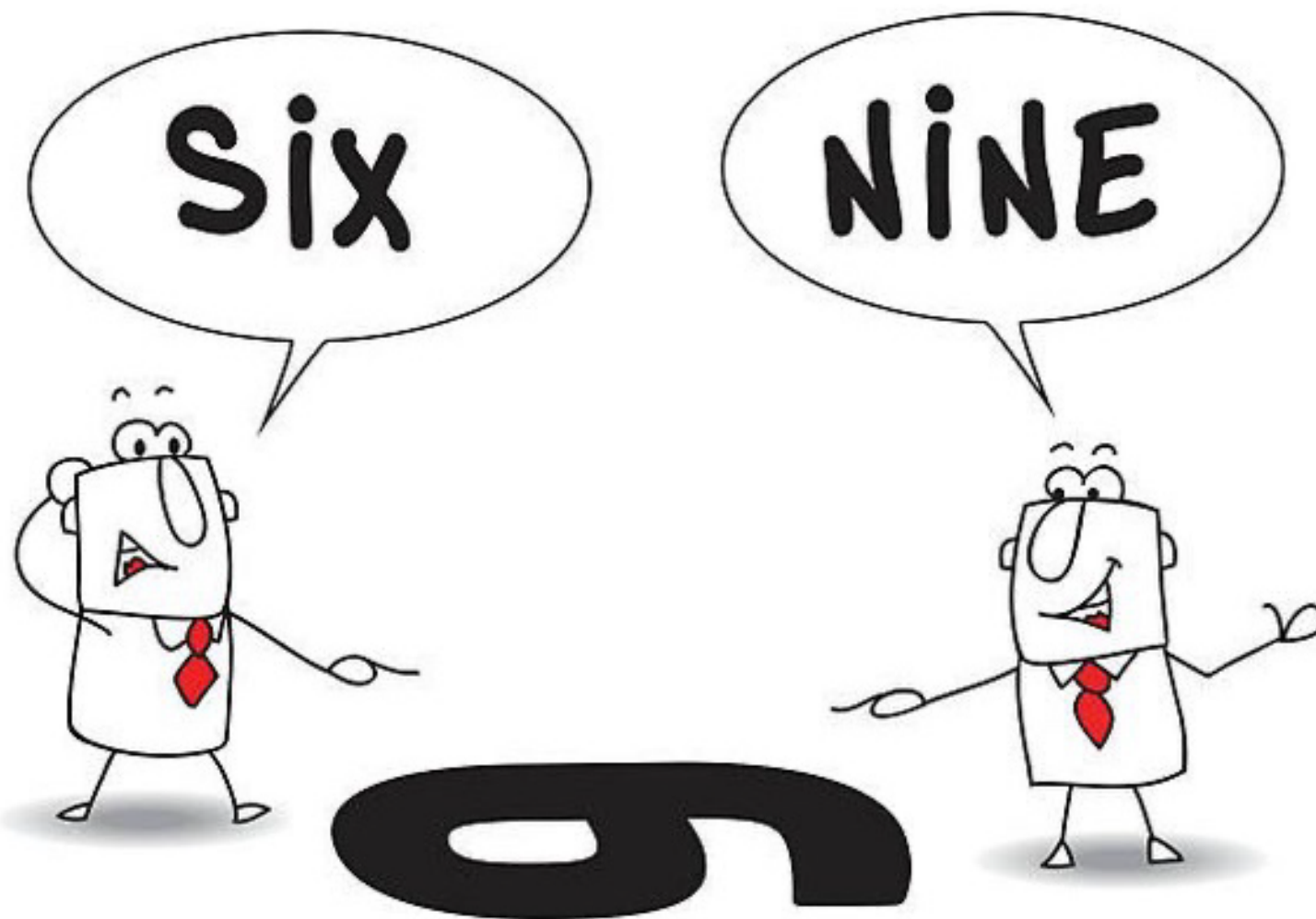


Human Error - Settings

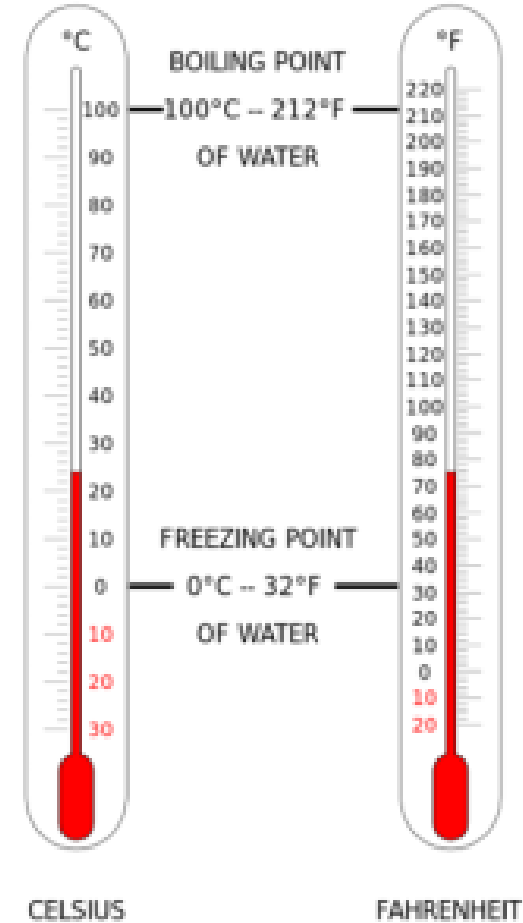




Who is responsible?



When does $^{\circ}\text{F} = ^{\circ}\text{C}$?





Container terminal congestion



Supply chain disruptions





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Potential pre-shipment issues

- The time between the processing of the (perishable) cargo and when it is loaded onto the reefer.
- Was pre-cooling of the reefer completed?
- Was required cargo temperature maintained before loading onto container?
- We have seen airtight temperature data chain of custody records, but the cargo is temperature abused.
- We have seen significant differences in temperature damaged cargo coming off the same sealed container with no temperature deviations noted.





Same commodity – same container – same transit.





Good recommendations (do's)

- Make sure cargo is at the right temperature before loading
- Make sure the packing is adequate for the commodity shipped
- Make sure the load it is stable to prevent shifting during the voyage
- Set the reefer unit at the correct temperature that the cargo requires
- Check the de-humidification controls
- Reeferers do not lower the temperature of the goods – rather they maintain the pre-cooled temperature of the goods.
- Set the correct ventilation settings



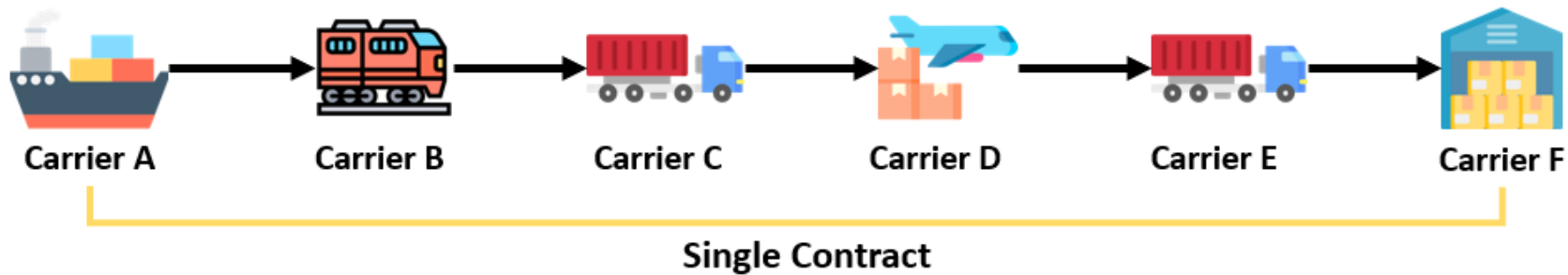
Not recommended (don'ts)

- Never stow cargo above the red load line
- Never stow cargo past the end of the T-Floor
- Never allow any restrictions to block the air flow.

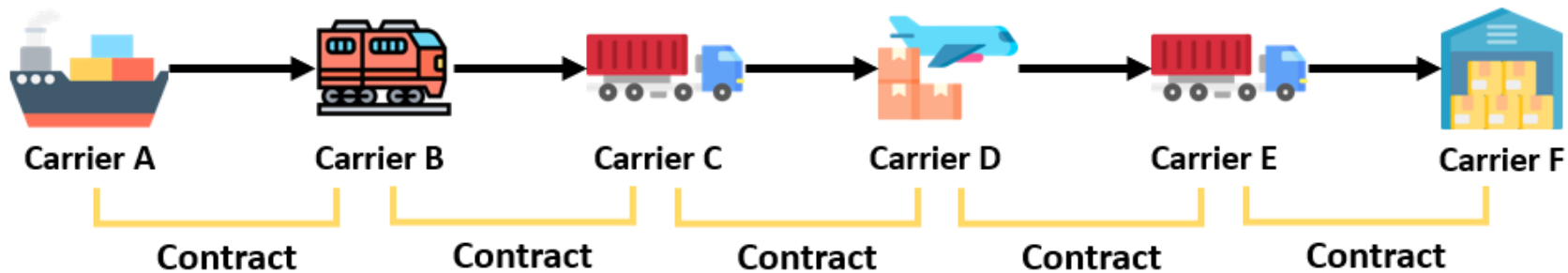


Multi-modal / inter-modal: both synonymous with “many hands”

Multimodal Transport



Intermodal Transport





- Generally, two sources of temperature data
 - A reefer data download from the physical container, which is typically owned and controlled by the carrier. Can be manual or dynamic.
 - Conventional portable data recorder placed on the cargo by the shipper –downloaded upon receipt
 - Real Time portable data recorder (monitor) – allows for possible intervention if a problem occurs.



Temperature Data Recorder placed inside the carton





Various Monitoring Devices applied by cargo owners



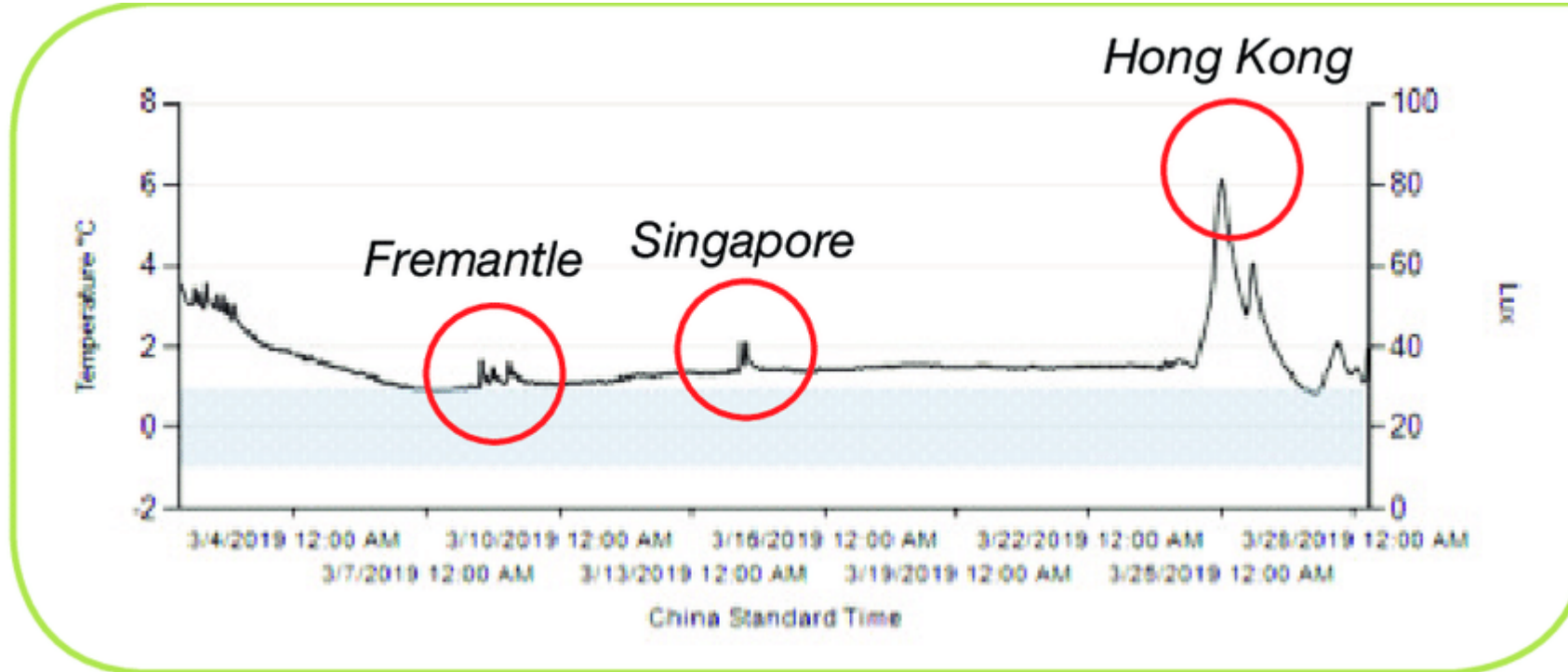
TempTale GEO



TempTale Ultra



Temperature Data / Graph





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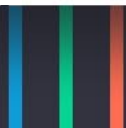
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Jeff Peters



- Cold chain monitoring technologies have evolved tremendously and offer a wide array of options.
- There are state-of-the-art technologies in the market that monitor conditions inside a container and provide a real-time view of location, temperature, humidity, oxygen, and carbon dioxide levels. In the event of a temperature or atmosphere deviation alert shippers can react more quickly to avoid or mitigate a loss

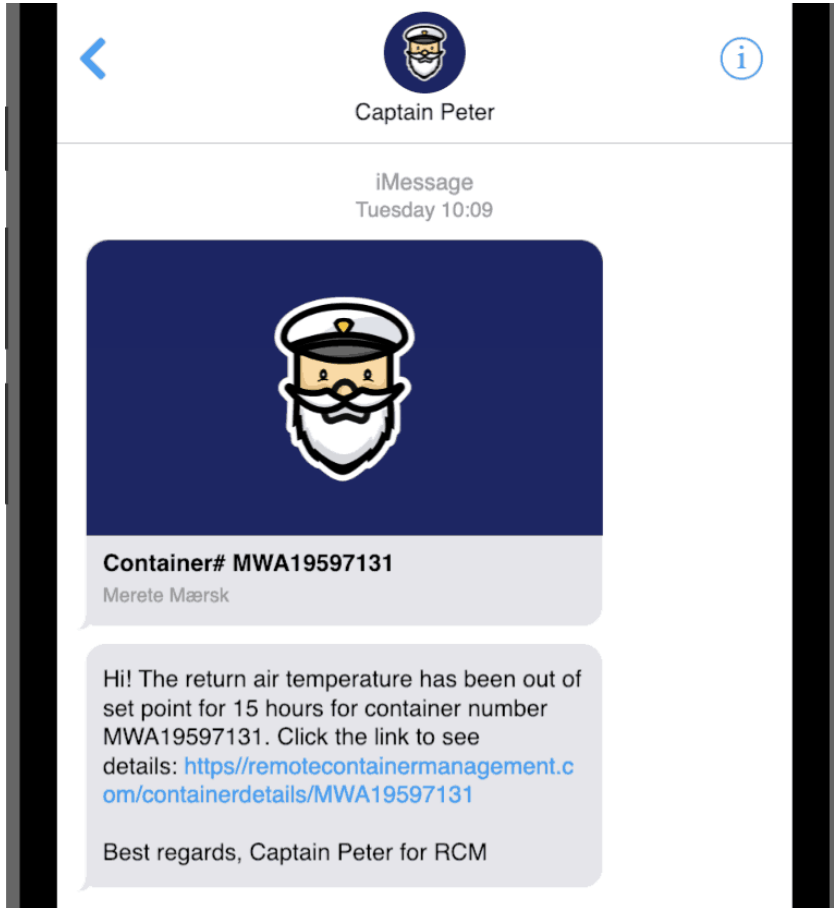




Hapag-Lloyd “SMART” Monitoring



Maersk's "Captain Peter"



Thanks to Captain Peter and our Remote Container Management system, cargo owners can have eyes on your cargo from the moment the goods are locked inside the container right up to the delivery at your port or store door destination.



Understanding temperature deviations and the temperature data

Types of cargo

Packaging

Conditions / damages



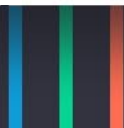
MISTAKES
Were
MADE



- Cold chain packaging, also known as temperature-controlled packaging, refers to packaging and distribution methods specifically engineered to keep products at a constant temperature from production through final distribution.
- Typically, the packaging is designed to help prevent temperature abuse related damages.
- Packaging varies based on the commodity.
- All packaging has one thing in common – none can prevent temperature abuse if the temperature of the environment around them becomes elevated.



Typical Fresh Seafood Packaging





Totes often used with dry ice



- Understand what occurred prior to performing the inspection.
- Conditions and damages may vary within the same shipment.
- Conditions and damage can range from light temperature damage to moderate, to heavy.
- In some instances, the temperature deviation was not long enough or did not fluctuate enough to visually show any damage.

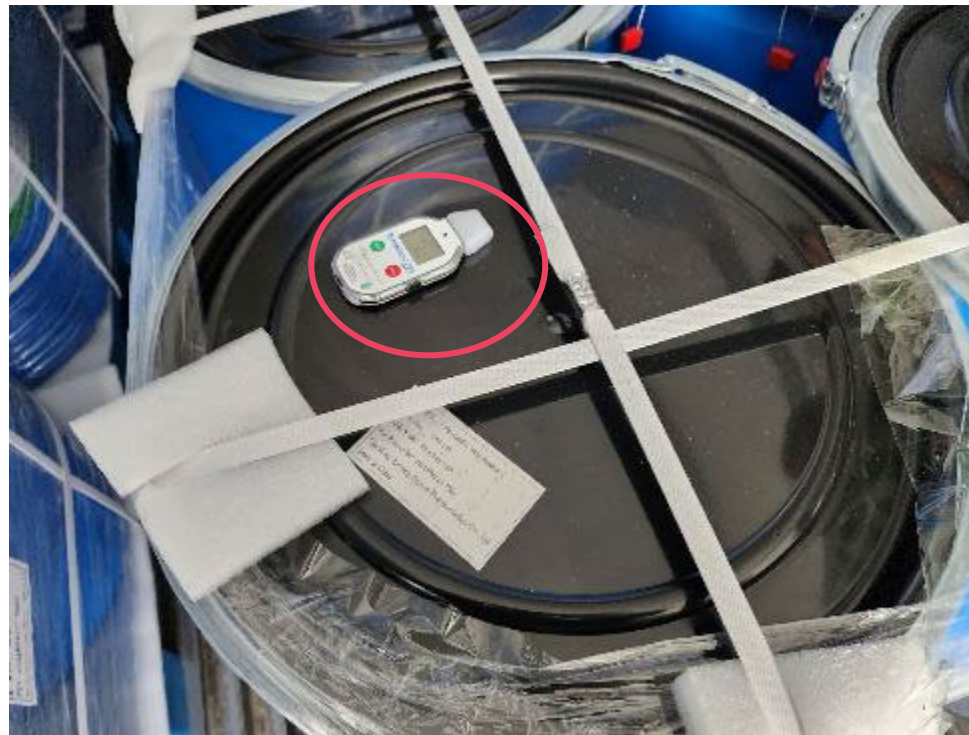


Damages are not always visible

- Pharmaceuticals
- Chemicals
- Even perishables









Cartons



- Soft
- Compressed
- Damp / wet
- Torn





- Staining
- Delaminated cardboard
- Ice / frost
- Deformed / compromised





Packages frozen together

Heavy ice build-up on exterior of carton









Icing Example





Dehydration / Freezer Burn





IQF “Glaze” deteriorating





Product leakage





Chocolate – Sugar Blooms and Fat Blooms





Fresh cherries delayed in transit







Condensation / moisture





Change in product characteristics





- We very strongly suggest the use of portable temperature data loggers for reefer consignments in almost every instance.
- GPS enabled portable data recorders with automated temperature threshold warnings allow for potential corrective action during transit.



- Once a reefer malfunctions it goes from being like a freezer in your home to acting like a giant thermos bottle.
- Without an operating refrigeration system, the container is dependent on the insulation properties in the sidewalls, roof, door and floor panels and the temperature of the cargo at the time of the reefer failure.
- Floor loaded frozen consignments will thaw from the outside of the stow inward, like a melting snowball.
- Temperature deviation does not necessarily mean temperature damage/abuse.

Temperature data

can be critical on the secondary market and with recovery

- A diminished appearance and quality of a product may be apparent from temperature abuse, but actual spoilage is another matter.
- The location of the container at the time of the warming incident can often be determined by comparing temperature data against available transit information such as carrier tracking data.
- This information can be very useful in pursuing recovery from the carrier.



Greening The Cold Chain: Sustainable Solutions

- Following the Paris Climate Agreement, more attention will be focused on green refrigeration solutions in the future.
- The refrigerated container markets will develop, with the aim to offer low environmental impact solutions.
- Innovations in energy-efficient refrigeration technologies and sustainable materials contribute to a greener cold chain, aligning with global initiatives for an eco-friendlier shipping industry.





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sedgwick | Thank you. *Questions?*