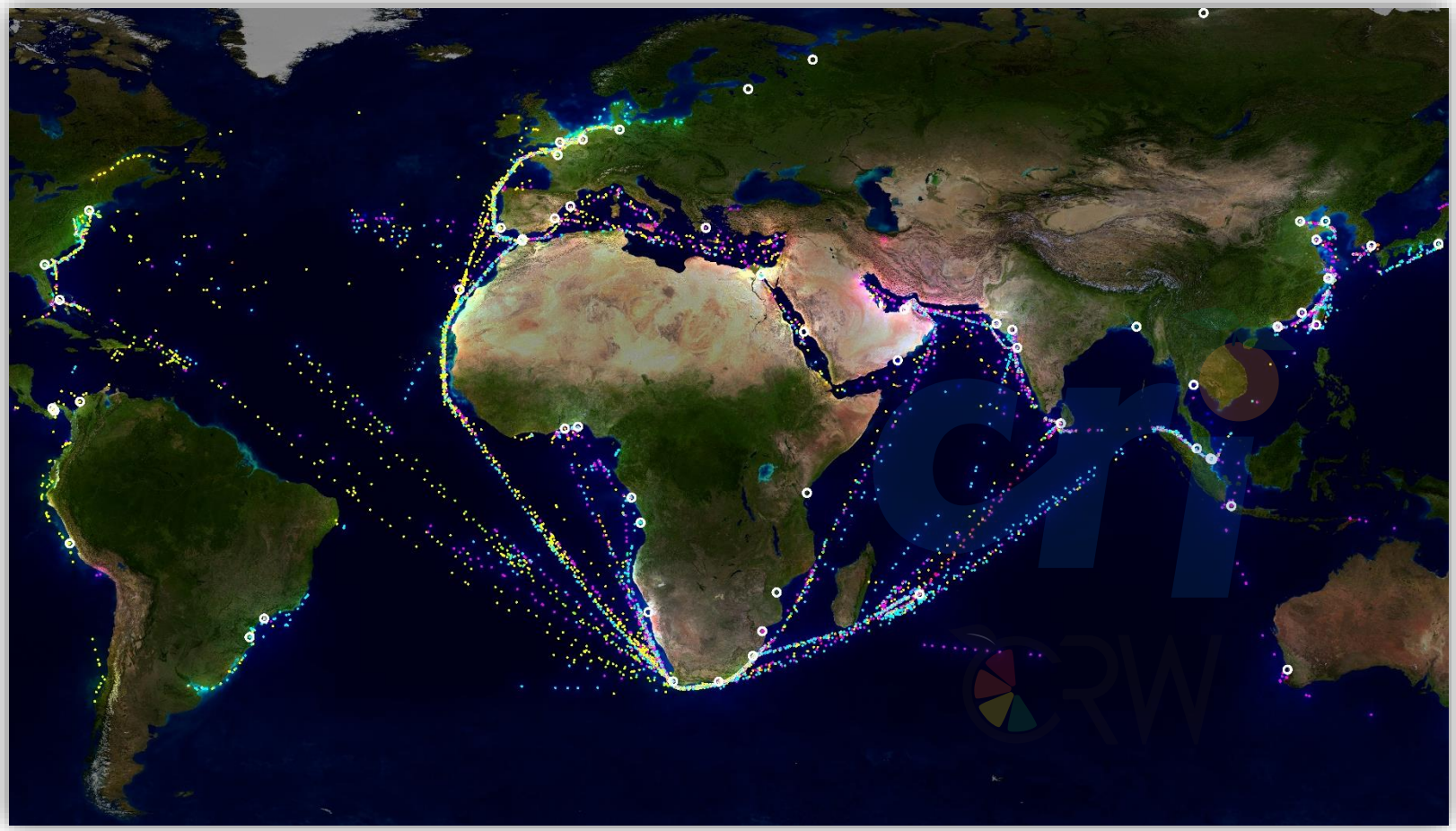

Cold treatment handling:

Best practise

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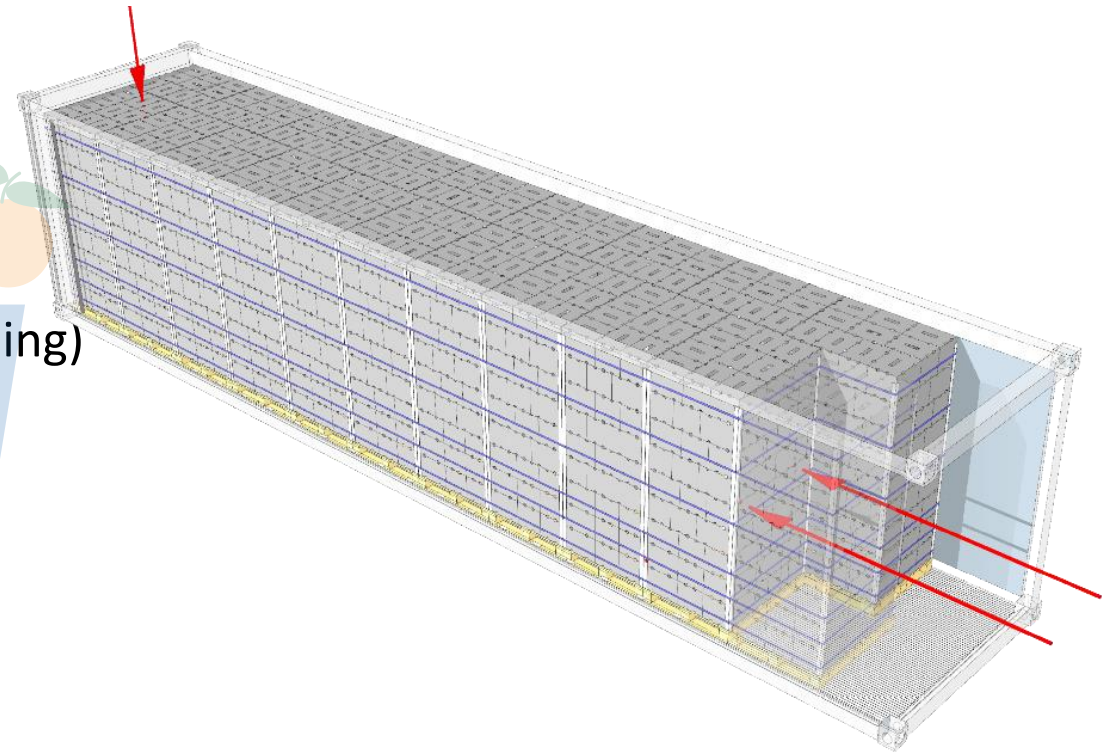
In-transit Cold Treatment markets

- In-transit Cold treatment markets
  - Application of a phytosanitary cold treatment during shipping
  - Treatment specified an immutable bilateral agreement

- Requirements
  - Specific precooling protocol
  - Temperature probe specifications (during container shipping)
  - Strict temperature monitoring tolerances

- Non conformance
  - Failure to conform to the protocol
  - Some markets more difficult than others
  - Significant loss in time, facility resources and money
  - Repack if possible
  - Container redirected to different market
  - Chilling injury



QUESTION 1

Which cold treatment market do you perceive as being the most challenging?

- Japan
- South Korea
- Thailand
- USA
- China

Summary of Cold Treatment Markets

List of various in-transit cold treatment markets:

	Market	China	South Korea	Japan	Thailand	Taiwan	Sri Lanka	Bangladesh	India	USA
Precooling	Recommended Delivery air temperatures	-1.50	-1.50	-1.50	-1.50	-1.50	-1.50	-1.50	-1.50	-1.50
	Minimum duration	72 hours	72 hours	72 hours	72 hours	NA	NA	12 hours	NA	72 hours (last 24 hours < -0.6°C)
	Target (max) temperature	-0.60	-0.60	-0.55	-0.55	-0.50	-0.50	-0.50	-0.50	-0.60
	Minimum allowed pulp temperature	-1.20	-1.20	-1.20	-1.20	-1.20	-1.20	-1.20	-1.20	-1.20
Container setup	Container vents	15 cfm	15 cfm	15 cfm	15 cfm	15 cfm	15 cfm	15 cfm	15 cfm	15 cfm
	pre-cool container temperature	0.00	0.00	0.00	0.00	NA	NA	NA	NA	-0.50
	pre-cool container duration	6 hours	6 hours	6 hours	6 hours	NA	NA	NA	NA	12 hours
Loading	Loading period	40 min	40 min	40 min	40 min	40 min	40 min	40 min	40 min	40 min
	Max pulp temperature through-out load	-0.60	0.00	-0.60	-0.60	0.00	0.00	0.00	0.00	-0.60
Probe location	Difficulty in maintaining probed temperature during shipping	Challenging	Mild	Moderate	Moderate	Challenging	Moderate	Challenging	Challenging	Challenging
Shipping	Protocol commencement temperature	-0.55	-0.60	-0.60	-0.55	0.00, 1.67, 3.33	0.00, 0.55, 1.10, 2.20	0.00	1.10 (2.00 lemons)	-0.55
	Recommended Delivery air temperatures	-1.50	-1.50	-1.50	-1.50	-1.00	-1.00	-1.00	0.50	-1.50
	Treatment duration	24 days	24 days	12 days (14 for clementines)	24 days	12, 14, 18 days	14, 18, 20, 22 days	14 days	12 (14 lemons) days	22 days
	Failure temperature	0.00	-0.10	0.00	1.11	NA	NA	0.00	NA	1.11
	Exceeding penalty temperature	-0.30	NA	NA	-0.27	NA	NA	NA	NA	-0.27
	Time penalty	8 hours segments	NA	NA	8 hours segments	NA	NA	NA	NA	8 hours segments

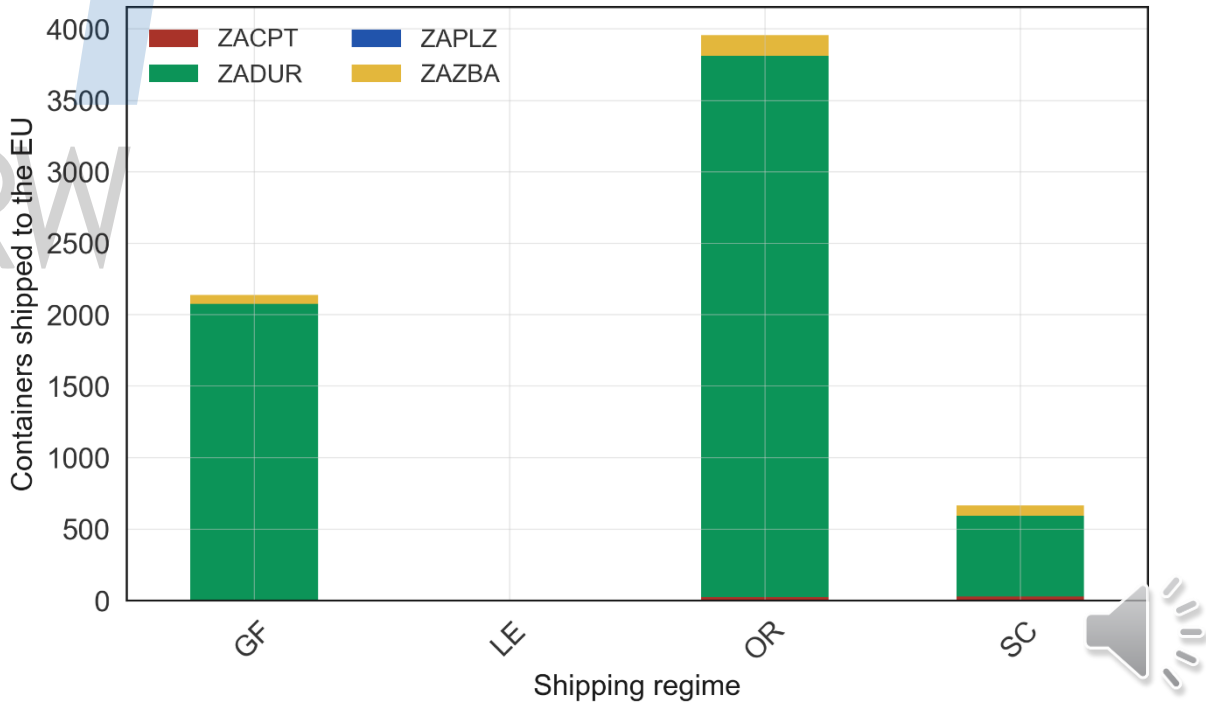
China and USA generally have the most challenging requirements

Cold Treatment Markets – Problem areas

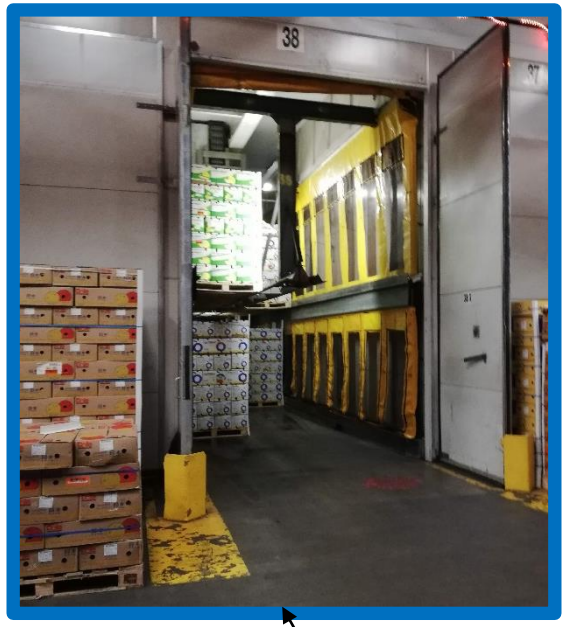
- USA - Generally less problems
  - Mainly shipped from Cape Town
  - High emphasis on cold storage (no breaks)

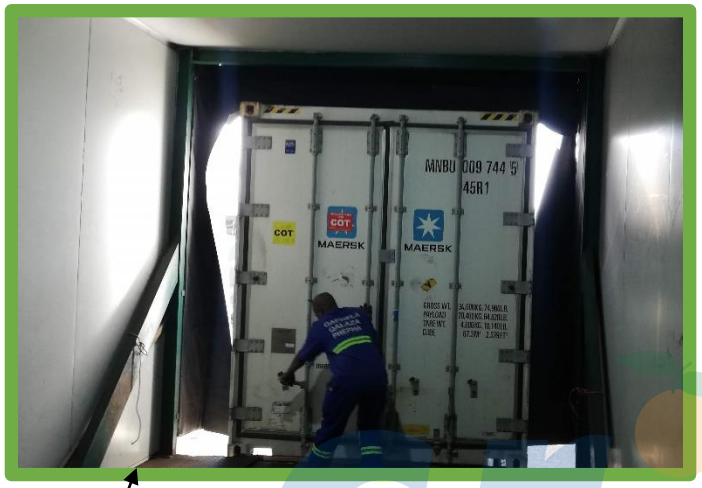
- China – Frequently reports of non-conformance
  - Predominantly shipped from Durban
  - Warmer conditions than Cape Town
  - Less cold storage infrastructure
  - More breaks in cold chain

China protocol needs to be addressed!



Process flow





Precooling

Loading

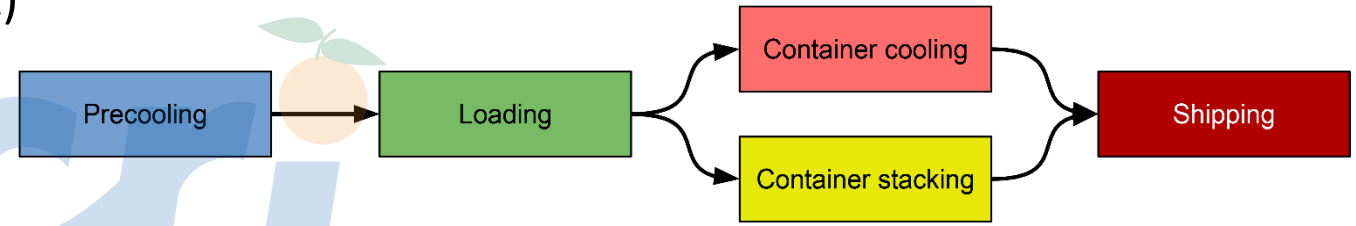
Container cooling

Container stacking

Shipping

Non-conformance – How does it happen?

- Temperature management
  - Protocol operate close to temperatures that can induce chilling injury.
  - Protocol: <-0.6°C
  - Chilling injury: -1.5°C (cultivar dependent)
  - Freeze damage: -2.0°C
  - Very little margin for error!

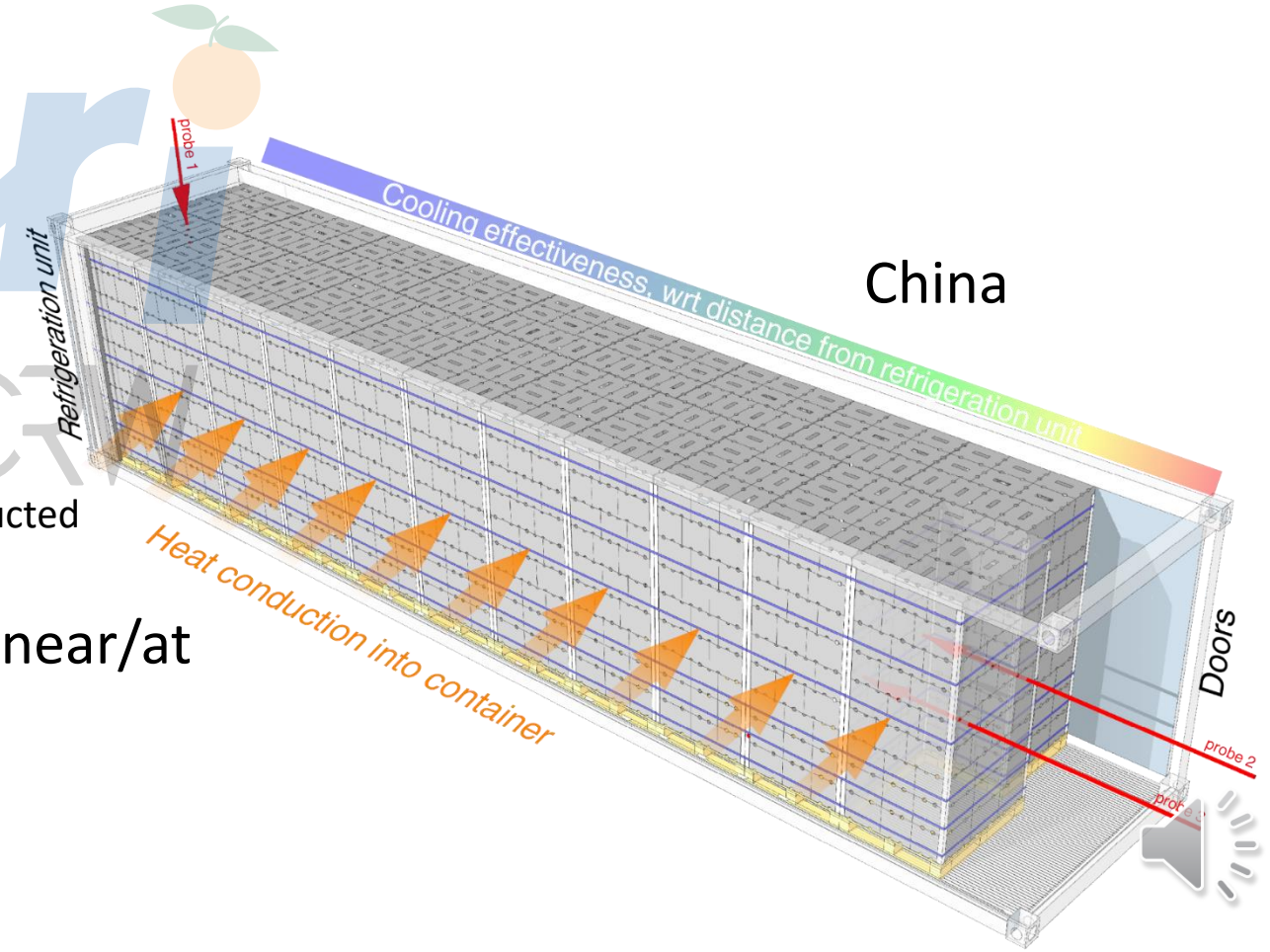


- Main cause: Container not loaded with fruit at protocol temperature
  - Container does not have the capacity to recool fruit (near door) back to protocol temperature
  - Application of cold blasts (-2°C set-point) causes chilling/freeze damage
  - Repacks of container

- Precooling and loading process are critical!

Non-conformance – Maintaining protocol temperature in container

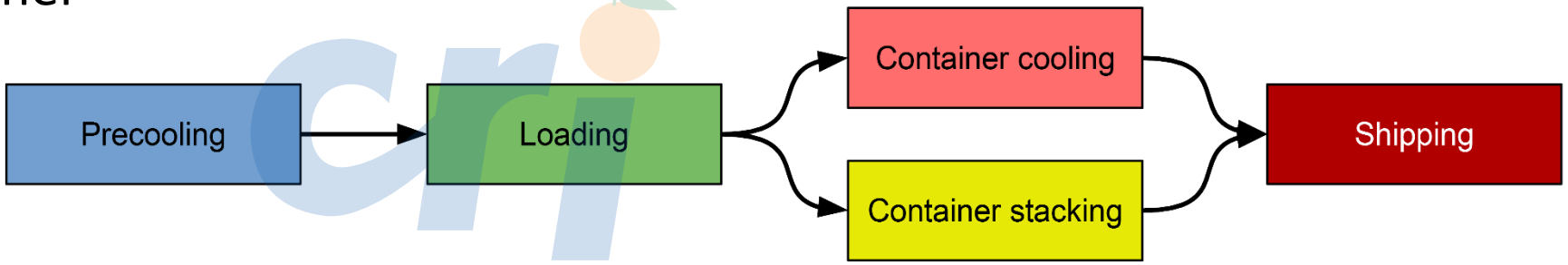
- Most common reason for non-conformance: Probe 3 readings exceed tolerances
- Probe 3 challenges:
  - Placed near the end of loading
    - Probed pallet may have spent more time at ambient temperatures
  - Closest to the door
    - Some warm air often “leaks in” here
  - Furthest from the refrigeration unit
    - Airflow rates decrease with increasing distance from refrigeration unit
    - Delivery air temperature increases with increasing distance from refrigeration unit
  - Close to the container wall
    - Absorbed heat (from radiation and outside air) is conducted into the air and fruit next to the container wall
- It is often not possible to recool warm fruit near/at probe 3.



China

How do we fix the problem?

- Most problems can be solved by:
  - Ensuring the container is loaded with fruit that are already on protocol temperature
  - i.e. <-0.6°C
  - Correct setup of container

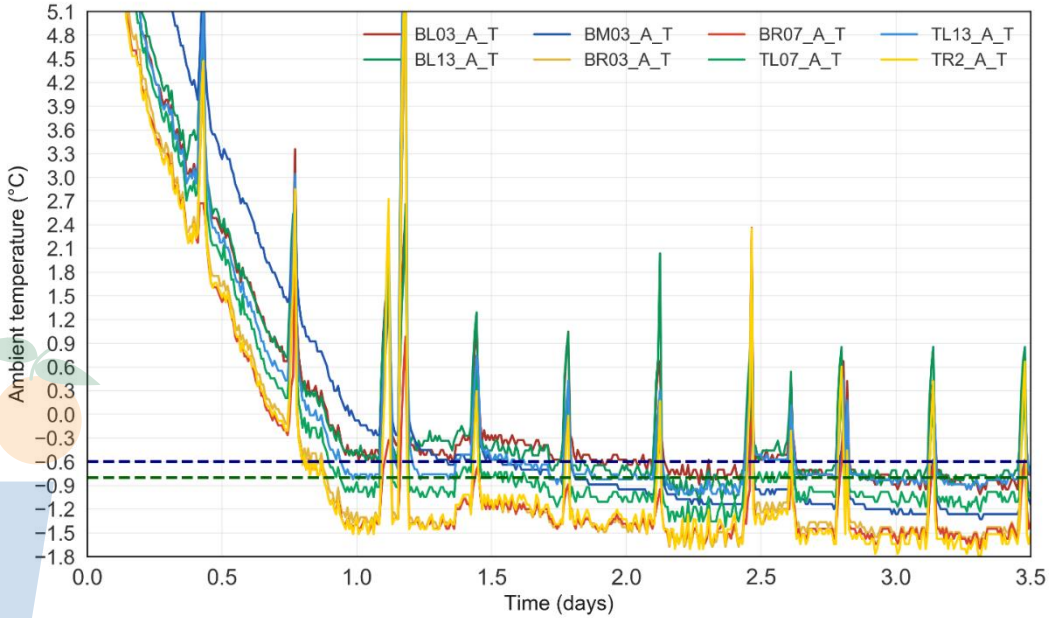


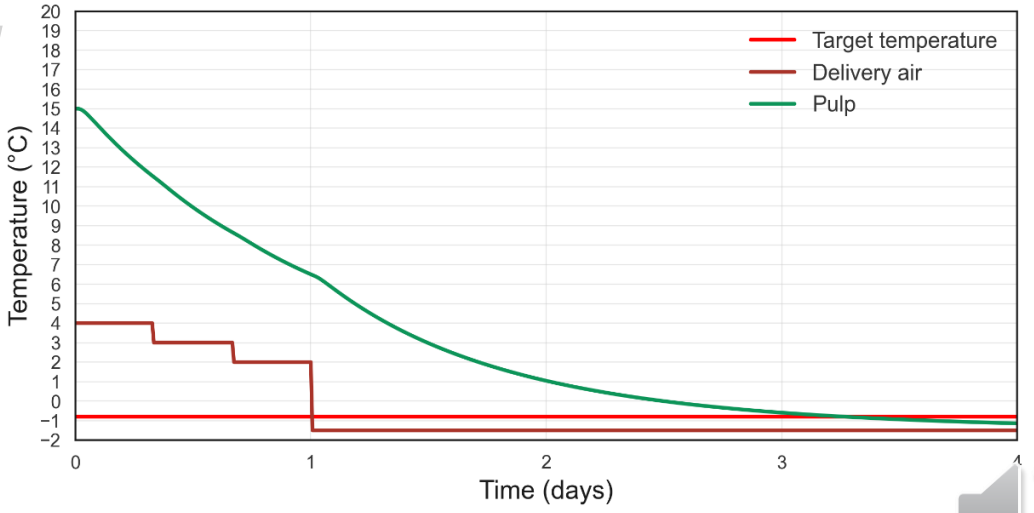
- Fully precool all fruit
  - No hot spots
  - Slightly below protocol temperature

- Container Loading
  - Do not break the cold chain between precooling and containerisation
  - Minimise heat energy absorption during loading
  - Immediately close container doors and activate genset after loading

Optimised protocols: Precooling (forced-air cooling)

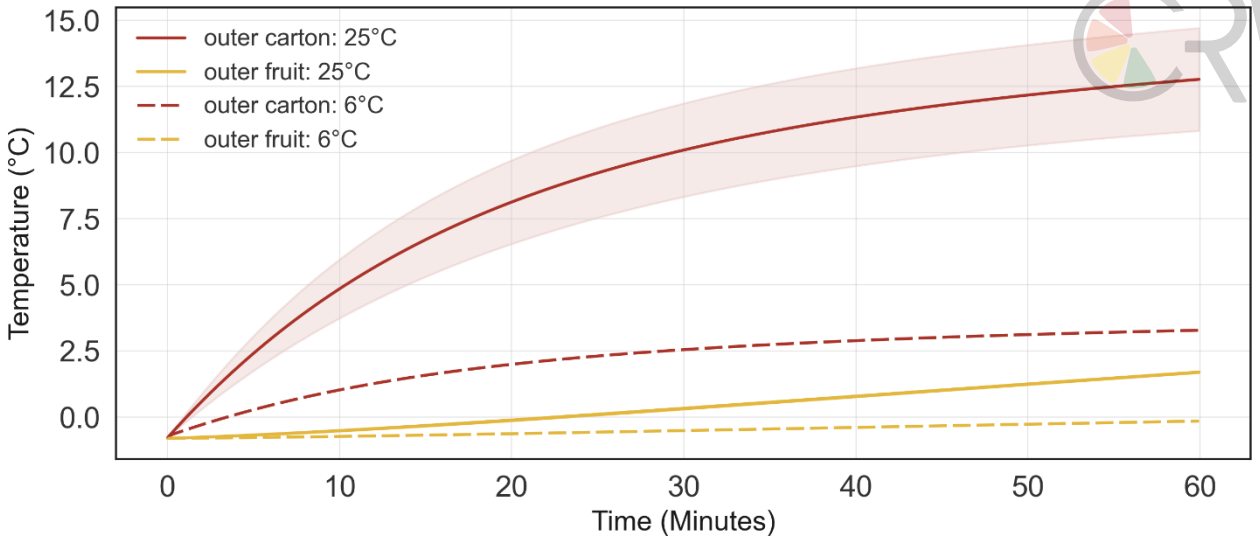
- Stabilisation period - Precooling
  - Fruit in forced-air cooling tunnel need time to stabilise after initial cool down
  - Eliminate lingering hot-spots
- Protocol amendment
  - A minimum of 72 hours of precooling
  - Precooling only complete once probe temperatures are below target temperature for 24 hours
- Recommendation
  - Application of a step-down protocol

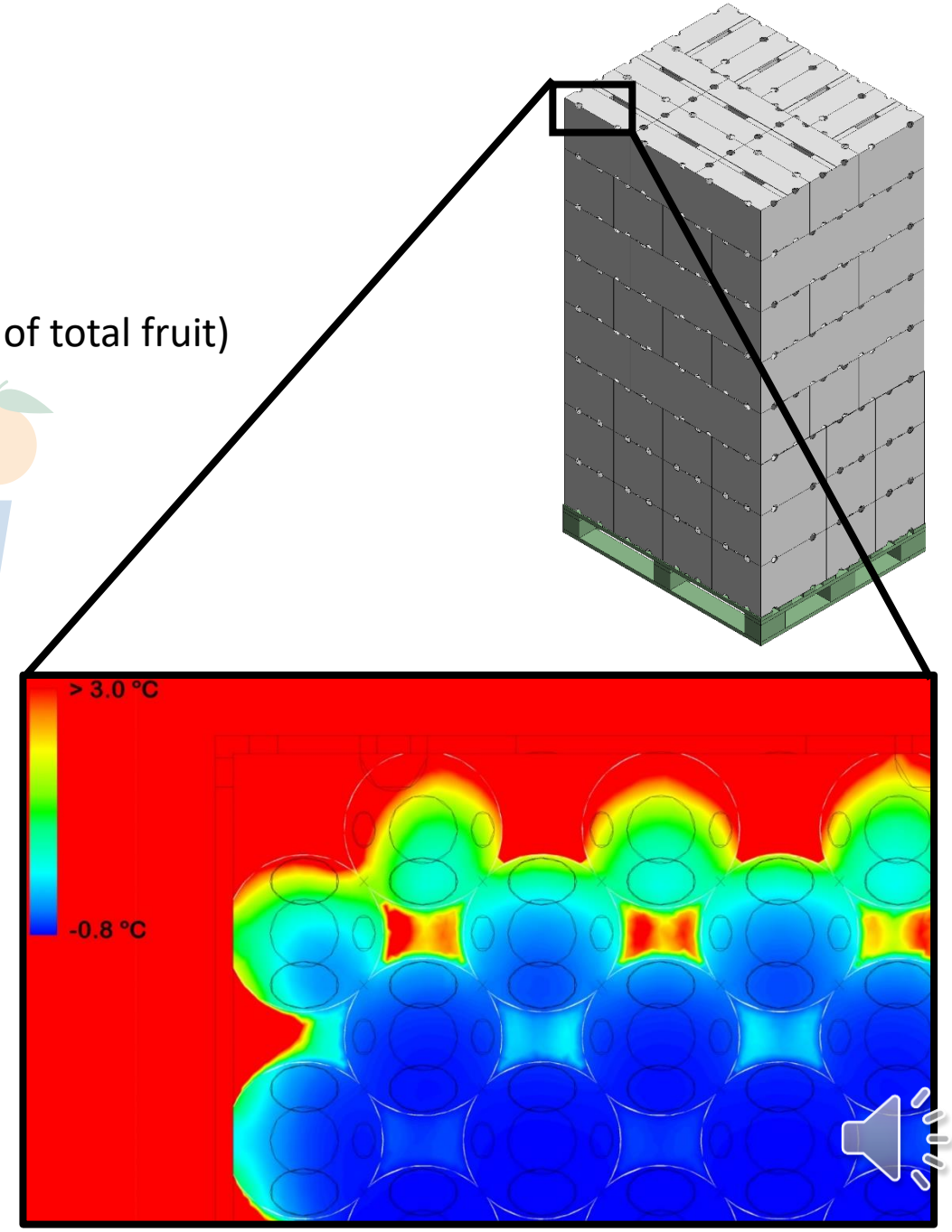




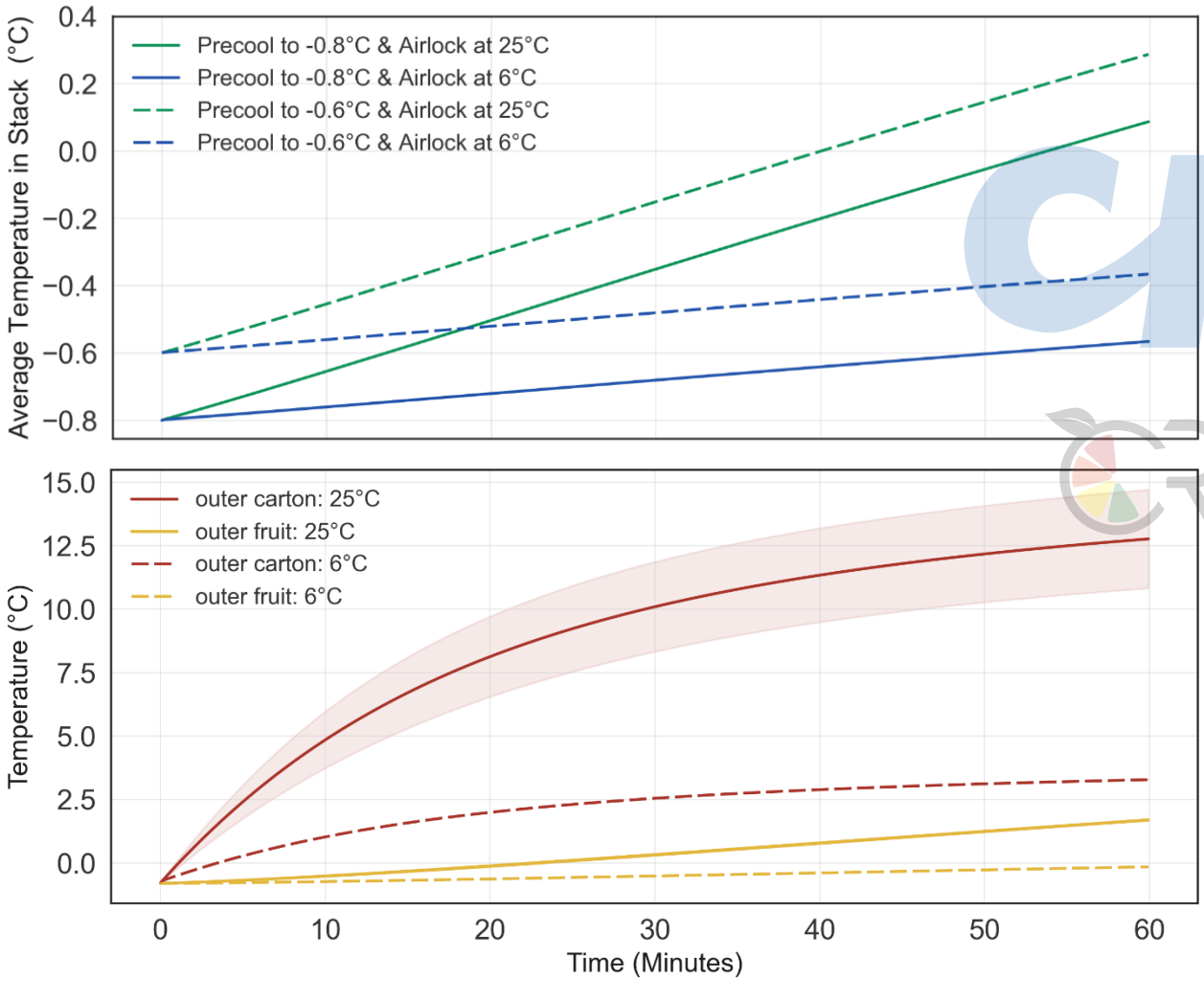
Optimised protocols: Container loading

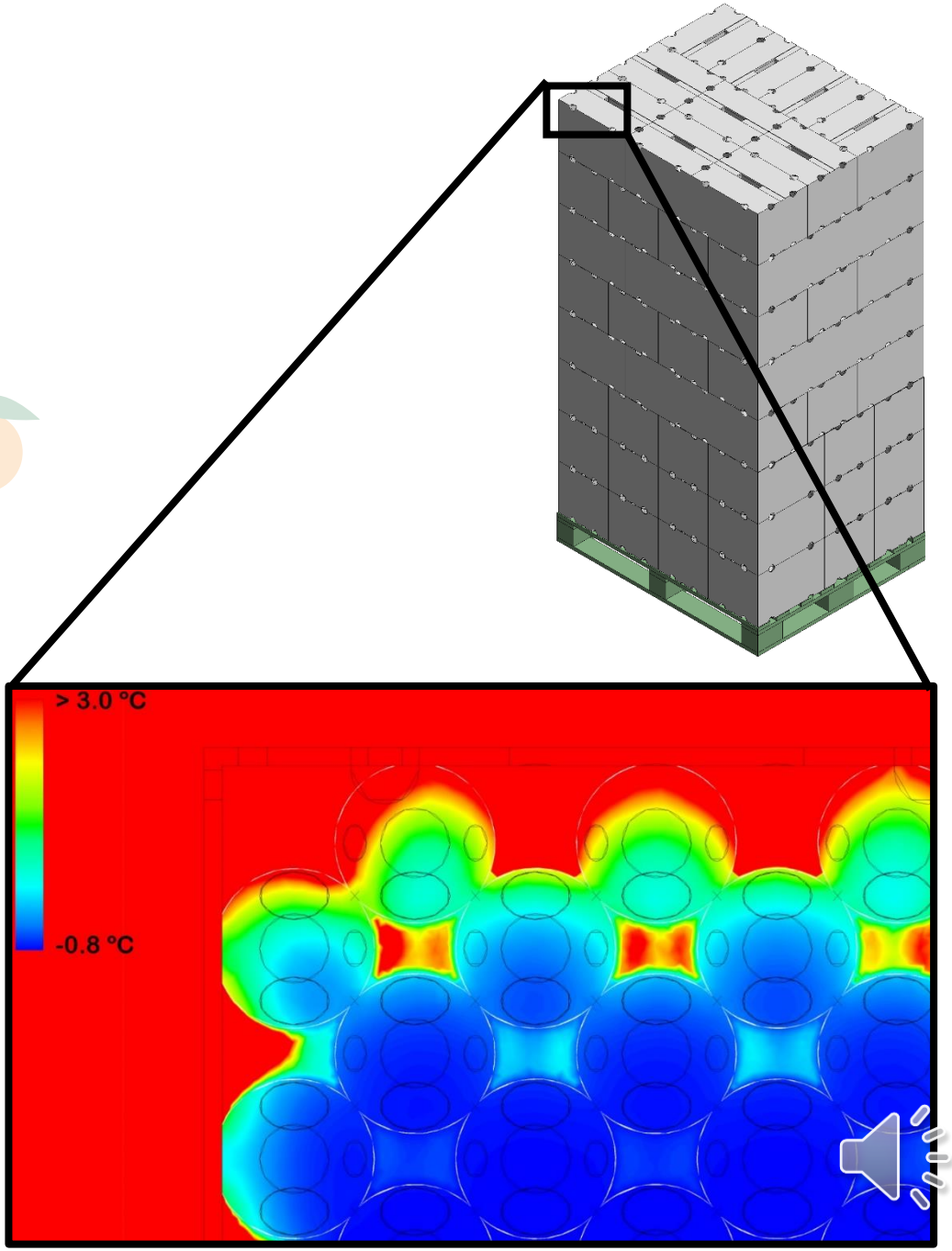
- Maintain protocol temperatures during loading
- Loading bay at ambient (e.g. 25°C)
  - Heat first absorbed into the moist paperboard (cartons)
  - Heat then transferred to the outer layer of fruit in the pallet (30% of total fruit)
- Over time, heat gradually dissipates evenly into fruit
  - Initial probe temperatures might be low
  - After loading, probe temperatures increase





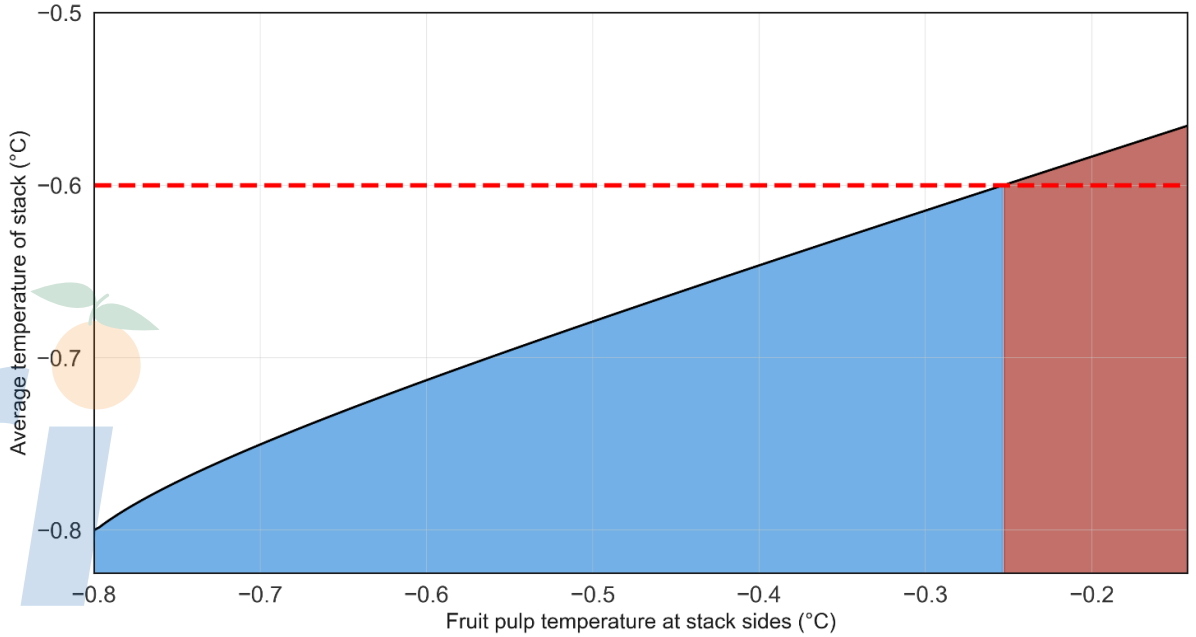
- After 20 min: @ 25°C (loading bay) and precooling to -0.6°C
  - Mean pallet temperature: -0.5°C – **Loaded out of protocol**
- After 20 min: @ 6°C (loading bay) and precooling to -0.8°C
  - Mean pallet temperature: -0.7°C – **Loaded inside of protocol**





Optimised protocols: Container loading

- Protocol amendment
  - Precool to a target temperature of -0.8°C (from -0.6°C)
  - Refrigerate loading bays (airlocks) to 6°C



- Recommendations
  - Sample the temperature of fruit near the exterior of the pallet during loading
  - If temperatures >-0.3°C: Stop loading and recool fruit

QUESTION 2

In your personal experience, which of the following factors do think contributes most to cold treatment non-conformance?

- Precooling
- Container loading
- Shipping line mismanagement of container
- Port infrastructure/systems (roads/strikes/stacks)
- Container malfunctions/setup

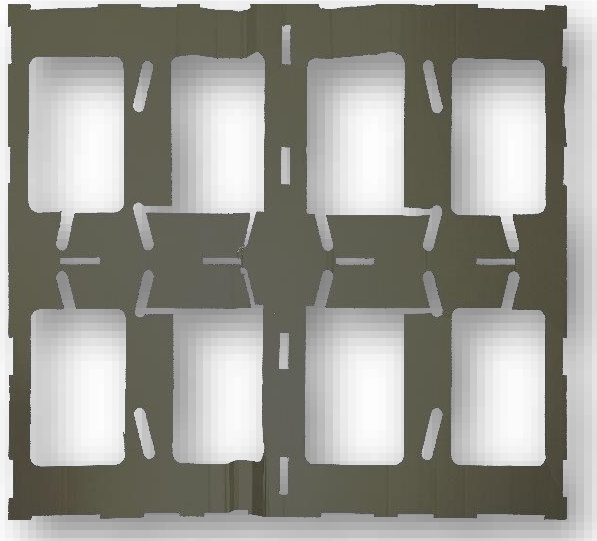
In-transit cold treatment: Recommendations

- Check that container baffle plate is not displaced
  - Restricts cooling airflow into container
  - Plate should be above the T-bar floor
  - Forklifts accidently bump the plate down during loading
  - Install shorter prongs on forklifts

Packaging: Ventilation and vent alignment

- Cartons should have 5-8% ventilation at the top and bottom of cartons
  - Vent holes should align when stacked
  - Pallet sheets openings should compliment carton vent holes
  - Pallet base should not obstruct vent holes

- Pallet build
  - Pallet base – only CRI recommended
  - Correct placement on pallet + use of corner pieces to ensure square pallet (vent alignment)

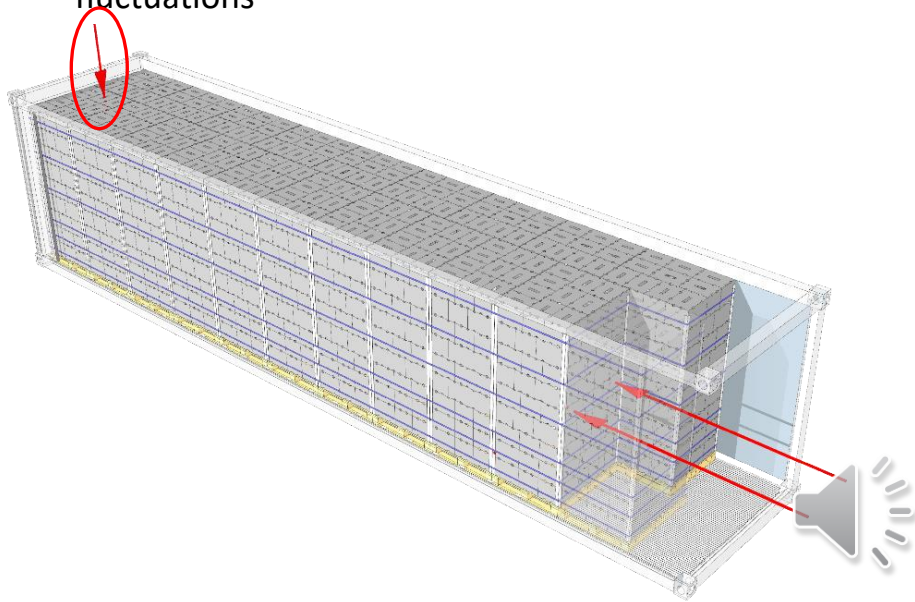


Example of a well ventilated securing sheet

Packaging: Pallet caps

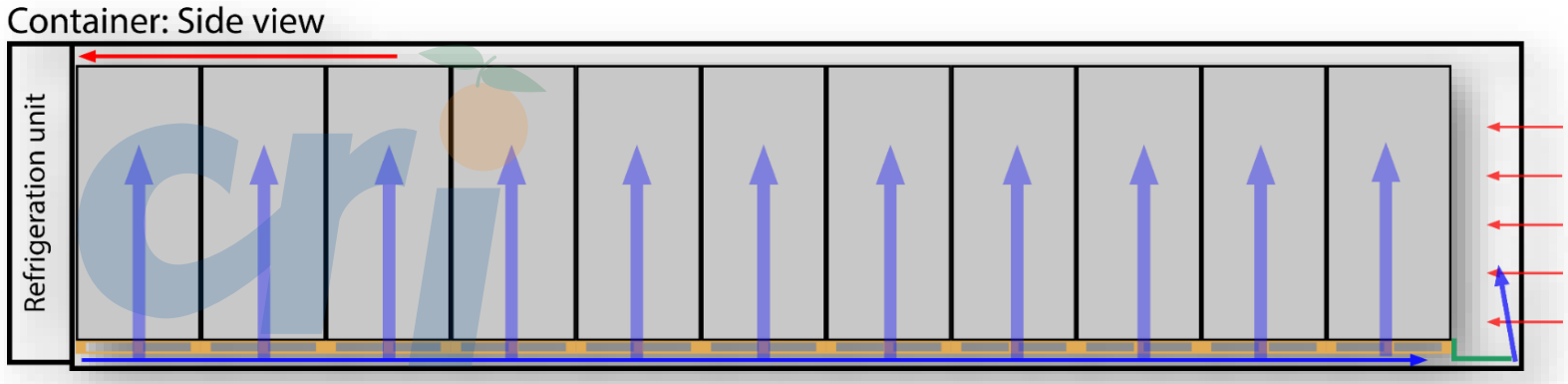
- Use pallet caps with multiple small vent holes
  - Larger vent holes allow gusts of air to penetrate deeper into the top carton (probe 1)
  - Can result in temperature reading fluctuations

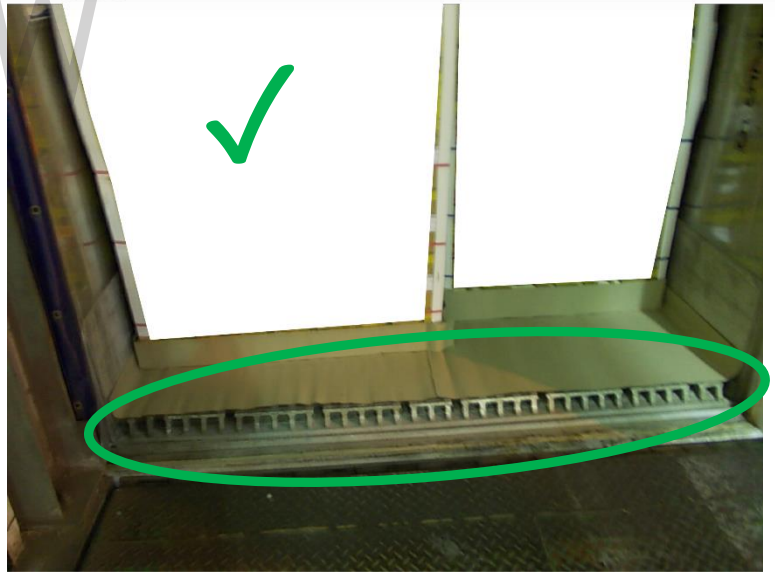
Probe 1 more susceptible to air temperature fluctuations



Container cooling performance: Void-plugs

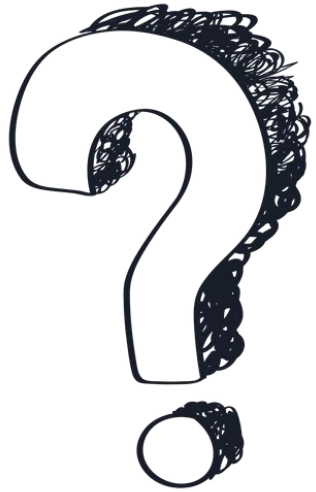
- Void-plugs stop airflow from bypassing pallet stacks
- Use corrugated-board to seal along both the pallet base sides and floor
- Important to leave ends of T-bar floor open so that heat gain from the less insulated door is removed.





Where do we go from here?

- The proposed protocol amendments and recommendations are very necessary
  - To reduce costs
  - To maximise efficient use of our limited cold storage infrastructure
  - To protect our SA brand



- Implement these protocols and suggestions into your own protocols

- These protocol further need to be included into the PPECB protocols

Thank you!

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