

Loading of Reefer Containers – Fruit

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By Johan Strydom

Loading reefer containers is the process of using a forklift to place 20 pallet loads into a 12-meter container. Once the doors are secured, the truck departs for the port. Two to three weeks later, the container arrives at an overseas port, delivering 20 perfect pallet loads of fruit in prime condition, ready for market distribution.

It seems simple, right?

NO, IT'S NOT!!!

The entire process begins much earlier, requiring meticulous planning and critical decisions to ensure that only quality fruit reaches consumers. Just as a high-rise building requires a stable foundation, successful container loading demands secure pallet loads.

1. Pre-Season Planning

a. *Crop Projections*

- Realistic crop estimates are essential for effective operational planning.

b. *Cooling*

- Ensure adequate pre-cooling and cold storage space is arranged before harvesting begins.
- The infrastructure must cool the fruit in accordance with the load-out temperature regulations set by the Perishable Products Export Control Board (PPECB).
- Develop contingency plans to address potential disruptions, such as load shedding, shipping space shortages, or labour disputes.
- Try to avoid making use of PPECB's T13 dispensation for higher load out temperatures as this will impact on shipping line accountability for temperature deviations.

c. *Shipping Space*

- Timely arrangements for shipping space, based on expected crop volumes, should be made well in advance of the harvesting period.

2. Training

a. *Product Knowledge*

- Personnel involved in handling fruit must grasp the fundamental principles of the cold chain and actively engage in the process.
- A solid understanding of various fruit types and cultivars enhances workers' ability to recognize the unique sensitivities associated with each.

- Cargo owners (exporters/growers) play a crucial role ensuring agents understand the total handling chain.

b. Process Knowledge

- The entire process, from planning to load-out, must be clearly defined, with specific responsibilities assigned to each role-player.
- Every team member should understand their role to ensure an efficient and effective container loading process.

3. Packaging

a. Cartons

- Carton dimensions (300x400mm or 400x600mm) must allow for stable stacking on ISO pallets (1000x1200mm).
- Apples packed in bushel boxes (500x333mm, 18kg) should be palletised on pallets measuring 1070x1000mm.
- The stacking strength of cartons must be robust enough to support a pallet load height of 2.4m under high humidity, preventing sagging between slats and excessive bulging of the bottom layers.
- Cartons should provide adequate horizontal and vertical ventilation to facilitate effective cooling in cold storage (horizontal) and containers (vertical). Note that some markets may require ventilation holes to be covered, which can affect the cooling rate of the fruit.
- The structural integrity of cartons should accommodate any weakening caused by ventilation holes.
- Non-telescopic cartons should feature interlocking designs to enhance pallet stability, while securing strips or sheets are essential for maintaining the integrity of the load.

b. Other Items

- Internal packaging materials, such as trays, punnets, bags, and wrappers, must not obstruct ventilation to the extent that it compromises effective cooling.

4. Pallets and Palletization

a. Pallet Bases

- The standard dimensions for ISO pallets are 1000mm x 1200mm. However, Citrus Research International (CRI) recommends a size of 1010mm x 1210mm for citrus, allowing corner pieces to sit securely on the pallet base, while with the standard white block pallet base, corner pieces extend to floor level.
- Pallet slats are intentionally not evenly spaced to ensure that carton edges rest on the slats rather than between them, preventing sagging of carton bottoms.

- Only high-quality pallets should be utilised for loading.
- All pallets must bear the specified ISPM15 mark, which should be clearly burned into at least two corner blocks.
- This mark specifically qualifies the accepted method for killing pests in wood.



- Avoid using pallets treated with the anti-fungal chemical SOPP, as this may introduce contamination with residue levels exceeding acceptable limits in the destination country.

b. Palletisation

- Cartons should be stacked tightly and securely on the pallet bases.
- Specified securing strips or sheets must be used to interlock cartons and maintain tight pillar positions.
- Corner pieces should be properly secured with adjustable plastic straps, which can be re-tightened before loading pallets into the container.
- Pallet ID stickers must be placed in designated positions for easy identification.

5. In-Season Planning

a. Cooling

- Utilise forced air pre-cooling to bring fruit down to the prescribed temperatures.
- Ensure that delivery air is applied with careful consideration of each cultivar's unique temperature sensitivities. Be cautious of using excessively low delivery air temperatures or cooling rates that are too rapid, as these pose risks to fruit quality.
- Inspect pallet load bases and verify for any damages or improper palletisation. Any defects must be addressed before stacking the pallet loads in the pre-cooling tunnel.

b. Ambient Loading

- Reefer containers are engineered to maintain optimal fruit temperatures by dissipating both heat generated by the fruit and any ambient heat that may infiltrate the insulation.
- Their cooling capabilities are exemplified in cases like 'Dual Temperature' plums, which are initially heated to +7.5°C post-loading and then re-cooled to -0.4°C within a few days.
- Successful trials with ambient-loaded citrus led to the establishment of protocols for loading hard citrus (excluding Navels) for non-EU markets.
- Notably, in 2006, over 100 containers were ambient loaded from Maputo Harbour with no quality defects reported, establishing ambient loading as a standard practice for hard citrus.
- This success accelerated the adoption of 'Super Vent' cartons, which enhance cooling efficiency.

- It is crucial to note that non-climacteric citrus is typically shipped at +4°C or higher, allowing for a more lenient target shipping temperature. In contrast, control over ripening is critical for climacteric fruits like pome and stone fruit, which are not allowed ambient shipments.

c. Booking Shipping Space

- Ensure that containers are booked well in advance of shipping to guarantee availability.

d. Inventory Control

- Implement an effective stockkeeping system to track the exact locations of individual pallets.
- Store pallets in block positions as much as possible to expedite the loading process.
- Conduct daily age analyses of pallets to adhere to the first-in-first-out (FIFO) principle.

e. Order Picking

- Identify pallets according to the consignment order.
- As a contingency, designate replacement pallets in case selected ones prove unsuitable (due to temperature, damage, etc.) during loading. This preparation helps prevent delays while waiting for instructions from exporters.

f. Pre-Tripping of Containers

- Empty containers must be cleaned and prepared at the empty depot before they are available for loading.
- The empty depot is responsible for the pre-tripping function, which includes checks for cleanliness, damage, and functionality. PPECB is responsible to verify that this has been done to high standards set..

g. Booking Containers

- When booking a container, PPECB must be informed according to prescribed procedures (online Q67 Export Notification).
- Essential specifications are required to ensure proper container preparation, including temperature settings, vent openings, vessel information, and discharge port details.

h. Stack Times

- Confirm container terminal stack times prior to arranging transportation.

i. Transportation

- Ensure timely booking of transportation for containers with reliable contractors.
- Trailers used must conform to specifications in terms of deck heights to fit loading docks at the loading point.

j. 21 Pallets

- Loading 21 pallets instead of the standard 20 is feasible, provided certain adjustments are made.

- The standard white block pallet (1000mm x 1200mm) is unsuitable for this purpose; attempting to load 21 pallets can lead to cargo damage and obstruct vital airflow at the door end.
- No pallet should extend beyond the T-bar floor.
- Modifications to both carton and pallet dimensions are necessary to ensure safe cargo shipping.
- The stacking pattern for 21 pallets differs from that of 20 pallets. After placing 5 pallets measuring 1200mm and 6 measuring 1000mm, the pattern must be reversed, covering the normal open area at the door end entirely.
- Note that this action could result in a square floor opening at the corners of the four pallets. This gap must be closed to prevent short circuiting of air.
- A gap of approximately 100mm should be maintained between the last pallet and the container doors, typically where the T-bar floor tapers.
- Be aware that not all containers have the same internal length, and some may not accommodate 21 pallets.

k. Slipsheets

- Slipsheets, which can replace wooden pallet bases under specific conditions and require specialised equipment, may be used.
- Durable plastic sheets, sized to match pallet bases, are placed on top of a pallet base with cartons stacked according to standard palletization procedures.
- The handling of the pallet load remains consistent with standard cooling procedures.
- When loading the pallet into a container, a special forklift attachment is used to lift the pallet load along with the slipsheet from the wooden base. The combined load is then placed into the container.
- A key advantage of slipsheets is that they provide an additional 153mm of vertical space, potentially allowing for an extra layer in the pallet load and reducing freight costs.
- **However**, it is essential to use the correct equipment, and the receiver of the consignment must have compatible equipment or be prepared to manually unload the container.

l. Dual Loads

- While dual loads—where a container is partially loaded at two locations—are not the preferred method, there are instances that may warrant consideration.
- Procedures for dual loads are outlined by PPECB and guidelines are included in Hortgro's Handling Protocols available on their website.

m. Cargo Mass

- The total mass of the container cargo, including palletisation materials, must be declared.
- This can be achieved by weighing individual pallet loads and calculating the total or by weighing the container before and after loading.
- The verified cargo mass must not exceed the gross mass indicated on the particular container.
- Care should be taken to ensure that the cargo does not cause the vehicle to exceed road regulations regarding axle mass distribution, especially with heavier fruits like pears and hard citrus.
- Be mindful of weight restrictions in the destination country. For high-mass pallet loads, such as citrus, it may be necessary to load only 19 pallets, following specific guidelines provided by CRI.

n. Mixed Loads

- When considering mixing different fruit types in a container, compatibility must be carefully assessed.
- Compatibility rules are available on PPECB's website and consider factors such as:
 1. Contamination (aromas)
 2. Temperature settings
 3. Packaging (Less ventilated cargo to be loaded first)
 4. Fruit characteristics (e.g., ventilation needs)
 5. Ethylene sensitivity
 6. Vent settings

o. Airlocks

- Cooled airlocks in loadout areas are strongly recommended and mandatory for cold sterilisation consignments.

p. Docking Station

- Docking stations, which allow containers to be sealed against warm ambient temperatures, are necessary for maintaining optimal conditions during loading.
- As container height decreases with the loading of cargo, the ramp must be adjustable to ensure safe forklift access.

q. Loading Ramp

- In the absence of loading docks (often at smaller sites), loading ramps may be utilised, though this is not ideal and special precautions are needed to minimize cargo damage.
- The ramp must provide ample space at the container's door end to allow forklifts to enter horizontally without incline.
- Loading ramps are typically employed outside of cold stores in ambient conditions, where factors such as distance from the cold store, ambient temperatures, loading speed, and weather conditions (rain, wind, dust) can negatively impact loading success.

r. Humidity

- Fruits begin to lose moisture immediately after being picked. To mitigate moisture loss, it is vital to maintain the fruit environment at a relative humidity (RH) above 85%.
- Both cold stores and containers are designed to achieve this humidity level, though containers may often fall short of the required standards.
- To combat moisture loss, consider using shrivel sheets for sensitive fruit types, such as certain plum cultivars.

s. Horizontal Airflow Cooling System

- Although not a common practice, exporters may choose to implement a Horizontal Cooling System, also Called Reefer Airflow Technology (RAFT), where the container floor is covered with a sheet, forcing air below the floor to the door end.
- Gaps above the pallet loads are blocked in several places to optimize airflow.
- This system directs air horizontally through the pallet loads from the door-end of the container, leveraging the effectiveness of horizontal ventilation over vertical airflow.

- Other techniques to change the air flow in reefer containers include floor coverings such as Ottflo and Airflow.

t. Cold Sterilisation

- Cold sterilisation is employed to eliminate potential insect pests in shipments to specific importing countries.
- Each country has stringent protocols that are strictly monitored, covering aspects such as pre-cooling, carton marking, maximum temperature limits, and duration of cold periods.
- Due to the complexity of cold sterilisation protocols, a separate set of guidelines exists that are not covered in this document.

6. Loading the Container

a. The Cold Chain

- It is critical to maintain the integrity of the cold chain during the container loading process.
- A well-executed loading should take no more than 30 minutes, ideally under 20 minutes.

b. Container Types

- **12m Hi-Cube Container:**
 - Standard 12m hi-cube (9'6") refrigerated containers (FEU) are commonly used for exporting fruit.
 - The internal width is typically 2,285mm, while the length may vary depending on the refrigeration unit (11 450 to 11 500mm).
 - Cold air is blown from one end through a T-bar floor, with return air passing back to the refrigeration unit above the pallet loads. Leave a 150mm gap between the top of the pallet loads and the roof for this purpose. Maximum pallet height is marked by the **red load line**.
 - The container temperature settings are configured at the empty depot as per booking instructions, checked by PPECB, and should be rechecked by the loading supervisor at the loading point.
- **12m Standard Container:**
 - With a height of 8'6", this type is rarely used for fruit shipments.
- **6m Standard Container:**
 - Not a common mode for fruit shipments.
- **6m Port-Hole Container:**
 - Introduced in 1977, this container used external refrigeration and was phased out in 2005. It handled around 15% of South African fruit exports during its use.
- **Controlled Atmosphere (CA) Container:**
 - Fully sealed with an atmosphere of nitrogen, inhibiting fruit ripening. Used mainly for avocados.

c. Container Check.

- Inspect the condition and temperature settings of the container (inside and outside) upon arrival.
- Ensure power points are available to verify temperature settings.
- Check that drainage plugs are open or closed as per loading instruction.

d. Vent Settings

- Vent settings should be included in the booking instruction.
- However, it is important that the loading point supervisor check that the settings are correct.

e. Drainage Plugs

- The container floor is equipped with four drainage plugs designed to remove excess water caused by condensation, washing, or defrosting.
- These plugs should be opened or closed based on booking instructions, as their position affects the container's humidity levels.
- Special seals must be applied as per PPECB instructions .

e. Pre-Cooling the Container

- Avoid pre-cooling empty containers in high humidity to prevent condensation, which can weaken cartons and reduce cooling efficiency.
- Pre-cooling is specified only for cold sterilisation shipments.

f. Selecting Pallets

- Select pallets per consignment order and place them in the pre-stacking area closest to the container bay.
- Mobile racking is recommended as it allows direct access to each pallet thereby avoiding additional pallet handling.
- Pre-stack only in a cooled airlock once the container's arrival is confirmed. For cold sterilisation, take pallets directly from the cold store to the container.

g. Pallet Inspection

- Check for and repair any pallet damage.
- Tighten loose pallet straps and ensure stability and correct inclusion in the consignment.

h. Pallet Loading

- Use floor covers if specified and load the warmest pallets first.
- Follow a 9/11 stacking pattern for 20 pallets per FEU.
- Load pallets swiftly to limit warming, using forklifts' side-shift capability for tight stacking.

i. Temperature Recorders

- Place temperature recorders in designated positions as per market or exporter instructions.
- It is recommended that recorders be placed in selected pallets before loading the container, thereby giving a more complete temperature history.
- Minimize time for this step. PPECB officials handle temperature probe placement for cold sterilisation shipments.
- Different recorder models monitor air and/or pulp temperatures from loading to overseas de-stuffing.

- Newer models use cellular networks to transmit data, eliminating the need for instrument retrieval.
- Recorders are vital for tracking cold chain integrity and supporting insurance claims. Refer to Hortgro's guidelines for recorder usage.

j. Void Plugs

- To prevent air short-circuiting at the container's door, cover pallet gaps and the floor area, but leave a 100mm opening at the door's T-bar floor.

k. Airflow Management

- The T-bar floor system cools cartons through channels, but palletised cargo increases the risk of short-circuiting airflow.
- Cold air is delivered from the refrigeration end, with cooling efficiency decreasing towards the door.
- Load warmer, high-respiration fruit first for better cooling. Additional methods, like floor covers, can equalise airflow, especially for cold sterilization shipments (refer to CRI guidelines).

l. Air Bags

- For open-top display cartons prone (citrus) to bulging, place air bags between the last pallets and doors to prevent pallet collapse.

m. Sealing the Container

- Close the doors immediately after loading and affix the necessary customs seals.

n. Documentation

- Complete the required documentation.

o. Gensets

- PPECB mandates a maximum of 6 hours for deciduous fruit (16 hours for citrus) to load, transport, and connect the container to terminal power. This includes 1 hour for loading, 2 hours of transit, and 3 hours to connect to power. This period is known as Time Temperature Tolerance (TTT).
- If it is expected that the TTT will be exceeded, a genset must be used. Confirm genset availability with the transport contractor during booking.
- Upon container arrival, the supervisor must ensure a genset is fitted and started before departure.

p. PPECB TempLog System

- Air temperature, both delivery (DAT) and return air (RAT) of each container, are reported daily by the vessel to PPECB.
- Although deviations detected are sporadically followed-up by PPECB, it is recommended that the shipper follows the cold chain by registering with PPECB to login to the TempLog system.

7. Arrival Condition Reporting

a. Temperature Data Collection

- Retrieve temperature data from temperature recorders whenever possible to assess the conditions during transit.

b. Problem Identification

- Analyse the data to identify issues that occurred during loading and any potential failures of the cooling equipment.

c. Damage Assessment

- Document instances of pallet load damage that may have occurred during loading, transit, or destuffing.
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8. Conclusion

a. Importance of the Loading Process

- The container loading process is critical to the export operation, with the condition of the fruit upon arrival overseas heavily reliant on the integrity of this process.

b. Vital Links in the Handling Chain

- Every link in the handling chain must be recognised as essential, and all role- players should understand the consequences of deviations from established protocols.

c. Post-Season Evaluation

- Conducting a post-season evaluation is recommended to assess effectiveness throughout the season, identify shortcomings, and establish a foundation for improvement in the next season.
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9. Disclaimer

While every effort has been made to compile these guidelines accurately, neither the author nor Hortgro will be held responsible for any consequences arising from the use of these guidelines.

10. Hortgro Webpage Link

For more detailed information and resources, visit the Hortgro webpage:

www.hortgro.co.za/science-tech-hub/pome-stone-handling-protocols/

