1. **REFERENCE:**

1.1 This procedure refers to the cold treatment of oranges, mandarins and deciduous fruit as prescribed by Sudan Plant Quarantine Authorities. This procedure will be applied by the PPECB as authorized by the DAFF. Also refer to PPECB ISO 9001-2000 Work Instructions AWI03 (Break Bulk) and AWI04 (Container) for loading procedures.

1.2 The Perishable Products Export Control Board (PPECB) is a statutory body in terms of the provisions of Act No. 9 of 1983 of the Republic of South Africa and is authorized to apply the following cold treatment procedures:

1.2.1 **Accurate calibration** of cold store and ship temperature controls and recording systems, inspection of vessels and container refrigeration equipment and registration of vessels and containers.

1.2.2 **Correct stacking** and air circulation control during pre-cooling and cold store management as well as frequent temperature monitoring.

1.2.3 **Correct handling** and loading procedures to ensure minimum temperature gain during shipment and the voyage.

1.2.4 **Temperature specification**, measurement and control as agreed on and specified by authorities of both the importing and exporting countries.

1.2.5 Specially authorized and trained PPECB technical personnel will supervise the cold treatment procedure for accuracy and completeness.

1.3 **PPECB Requirements**

PPECB is also responsible under Act No. 9 of 1983, to ensure that the most optimum handling, storage and transport temperatures are applied to ensure product quality maintenance. The carrying temperature for deciduous and citrus fruit is a specification of the importing country to prevent the importation of quarantine pests. It is therefore a requirement of the importing country and not of the PPECB.

Containers – The set point for the fresh produce loaded into the containers as listed in this document is a pulp temperature ratio versus minimum consecutive days.

 Reefer vessels – Air and pulp temperatures are available on an ongoing basis and it is therefore possible to monitor and manage the delivery air temperature (DAT) to control the commodity temperature.

The minimum cold treatment temperature for fresh fruit destined for Sudan is:

5 days at or below +1.7°C – en-route depending on the import permit requirement.

The Sudan officials will scrutinize the recorded temperature data and apply the following formula on the pulp temperatures as recorded by the relevant instruments. These are not official carrying temperatures, but merely tolerances. It must be noted that if at any stage the temperature exceeds 3.0°C the consignment will be rejected or the process will be restarted again.

2. **PRECOOLING OF THE FRUIT:**

2.1 Cold stores will be inspected annually and certified by PPECB. PPECB requires that a remote fruit pulp temperature monitoring system be installed to monitor pulp temperatures.
All the temperature sensors shall be calibrated in a bath of melting ice at 0.0°C prior to pre-cooling and connected to a temperature recorder in order to provide a permanent record of the pre-cooling operation. The cold store must also comply with the prescribed South African regulations and must have a valid PPECB certificate, which is issued in terms of Act No. 9 of 1983 and promulgated regulations No. R917 of 4 May 1984.

2.2 **Palletized fruit** that passed both quality and phytosanitary inspections and intended for cold treatment, will be loaded into the cold store according to standard procedures for **forced air pre-cooling** (also known as pressure cooling or FAC). Please note that the PPECB does not recommend double row stacking on either or both sides of the FAC tunnel because double rows often result in hot spots and therefore require careful and much longer cooling. PPECB requires that temperature sensors be installed into the fruit while building the FAC stacks and that the temperatures are continuously recorded to give a true reflection of the warmest and coldest product temperature of the total load. Air temperature sensors should also be installed to verify correct temperature and air circulation control. Temperature readings should be recorded at least once every hour at regular intervals during loading of the chambers and during pre-cooling. These temperature recordings will be filed for later scrutiny if necessary.

2.3 Fruit that passed phytosanitary inspection for Sudan must be stored at least one meter away from any other fruit not destined or not passed for Nigeria.

2.4 **Fruit to be shipped** must be pre-cooled to the target temperature or below. Recommended cold store delivery air must not be colder than minus 1.5°C and the pulp temperature not colder than minus 1.2°C.

2.5 **PPECB assessors may under no circumstances whatsoever, authorize commencement of loading if the above minimum pre-cooling requirements are not met.** (See also par 8.2.1 for maximum loading temperature tolerances for containers)

3. **INTEGRAL CONTAINERS TO BE USED FOR COLD TREATMENT:**

3.1 **PPECB registration**

3.1.1 PPECB will make use of the USDA updated list of registered containers that must be used for in-transit cold treatment to USA. **Only containers and temperature recording devices certified by the USDA may be used.**

Containers will then be selected from this list by the shipping agent for each particular shipment to Sudan. The above is based on criteria and specifications submitted by the ship's agents to the PPECB, relating to refrigeration capacity, temperature range for which the container is designed, temperature monitoring and recording equipment. Containers shall have adequate refrigeration, insulation and accurate thermostatic control to re-cool and uniformly maintain all fruit (pulp) temperatures within the protocol range. Containers must be properly designed to ensure good air circulating to all parts of the cargo spaces.

3.1.2 The PPECB will ensure that containers for in-transit cold treatment to Nigeria comply with the following requirements:

- Accurate and steady delivery air temperature (DAT) across the entire width of the air delivery plenum to control the delivery air temperature within 0.5°C of the thermostat set point.
- Sufficient refrigeration capacity to re-cool the fruit that has gained heat during loading.
- Sufficient refrigeration and thermal capacity to maintain the deciduous fruit at a temperature of
minus 0.5°C for at least 10 to 14 days at 2.0°C to 3.0°C.

- A defrost cycle and temperature maintenance procedure to ensure that the fruit pulp temperature will maintain the prescribed temperature.

- Automatic temperature recorders to continuously monitor and record fruit pulp temperatures in at least three (3) locations in the container and to monitor air temperatures in at least two (2) locations.

- The cargo pulp sensors must be marked at the sensor end of the cable for ease of identification and to ensure that each sensor is placed in the correct / dedicated position.

- Automatic monitoring from these locations must record temperatures on a recorder or data logger to produce a printout in a clearly legible form.

- Temperatures must be recorded at least once every hour in units of 0.1°C. An accuracy of ±0.3°C in the range minus 3°C to plus 3°C.

- The instrument shall maintain the specified accuracy for a minimum of one month after calibration.

- A means to access the air and fruit pulp temperatures without having to open the container doors is essential.

- In all other respects, the container must comply with standard international requirements for the carriage of perishable products and carry a valid certificate from an international certification society.

**PPECB approved containers** for in-transit cold treatment shall be fitted with at least two air temperature sensors (delivery and return air) and three fruit pulp temperature sensors, connected either to an onboard or independent temperature data logger. These pulp sensors will be inserted into the fruit in the Sudan designated positions.

### 3.2 Selection and registration of containers

In addition to holding a valid PPECB registration certificate for in-transit cold treatment to Sudan, the PPECB will confirm that the containers to be used for each shipment:

- Are equipped with PPECB approved temperature monitoring equipment to measure temperatures in the center of fruit (3 sensors) and air (2 sensors) in positions specified by Sudan.

- The temperature monitoring equipment is capable of continuously recording temperatures at least once every hour in units of 0.1°C, with an accuracy of ±0.3°C in the range of minus 3°C to plus 3°C.

- Containers that do not have an automatic built in PTI system must be pre tripped at 0.0°C (chill mode) and maintain a stable temperature of 0.0°C or colder for at least 12 hours prior to the pre-trip inspection by PPECB. A detailed recorded temperature log must be made available to the PPECB for scrutiny before the container can be approved. Temperature data must be recorded at least once every hour or as a continuous graph.

- All containers are then to run continuously until pick up for loading. Containers that do have an automatic built in PTI system must be operating satisfactorily at the set point temperature when the PPECB pre-trip inspection is carried out.
4. CANCELLATION OF PPECB REGISTRATION:

4.1 Cancellation

Containers withdrawn from service or that are no longer used for in-transit cold treatment to Sudan, will be removed from the respective lists and will only be reconsidered if re-inspected and approved by PPECB.

4.2 Non compliance

PPECB approval for in-transit cold treatment will be cancelled with immediate effect if any one of the specifications laid down in this document is no longer being met or if the container(s) could not successfully implement in-transit cold treatment during any previous cold treatment program.

5. CALIBRATION CONTAINERS:

5.1 Procedures

5.1.1 Authorized PPECB personnel must do calibration of the temperature monitoring and recording devices.

5.1.2 Only PPECB approved temperature data loggers or permanently on board units may be used.

5.1.3 Authorized PPECB personnel shall perform the calibration procedures applicable to the specific data logger.

5.1.4 The container depot personnel shall electronically “DEPLOY” the data logger by calibrating the different sensors in melting ice and checking correct sensor identification. Authorized PPECB personnel will audit the process and note the outcome.

5.1.5 Instrument identification and calibration data shall be recorded and made available to Nigeria.

5.1.6 Authorized PPECB personnel will ensure that the sensor cables are satisfactory in length.

5.1.7 All temperature sensors must be immersed in an insulated container filled with crushed melting ice at 0,0°C. The ice bath temperature must be checked regularly with a calibrated reference thermometer.

5.1.8 All temperature measuring and recording devices must be calibrated by the PPECB prior to every in-transit cold treatment shipment.

5.1.9 If the consecutive sets of readings are not both within the applicable tolerance of 0.1°C end the calibration procedure and reject the container for in-transit cold sterilization shipments.

5.1.10 All calibrated readings must be verified on laptop or similar device or printout and noted on the Q14 form.

6. LOCATION OF TEMPERATURE SENSORS:

6.1 Air Sensors

For control and recording of the delivery air temperature and to ensure that fruit core temperatures remain within the protocol range the following shall apply:

6.1.1 Containers must be equipped with one air temperature sensor positioned in the delivery (supply) air to the
cargo and one sensor positioned in the return air.

6.1.2 The air temperature supplied to the fruit must be controlled in the delivery air stream prior to coming into contact with the fruit.

6.2 Fruit Sensors

Containers are required to have a minimum of three (3) fruit pulp sensors inserted into the fruit and to be placed in the Sudan prescribed positions.

6.2.1 P1 - First pallet at cooler LHS, top of the pallet, centre line of container.
P2 - Middle of container, sensor should be placed half the height of the pallet center line of container.
P3 - Second last pallet-row from the door on the LHS at half the height, centerline of pallet.

6.2.3 The sensor cables must be positioned in such a way that they cannot be damaged during loading and or the voyage.

6.2.4 Sensor position specified by Sudan:

7. STANDARDS FOR TEMPERATURE RECORDING SYSTEMS:

7.1 General

Recording instruments whether separate (loose) or an integral part of the container, to be used for cold treatment conducted in integral refrigerated containers must be approved by the PPECB. Full specifications of the temperature sensors and recording system must however be submitted to the PPECB. The PPECB reserves the right to test the container and the recording instrument performance with or without a load.

The standards are intended to meet PPECB requirements for a temperature recording installation used in containers engaging in the in-transit cold treatment program for fruit. The recording system shall have an overall accuracy of ±0,3°C in the range of minus 3°C to plus 3°C or ±0,5°F in the range of 27°F to 37°F, with a resolution of 0,1°C or 0,1°F.

The design, construction and materials used shall be such that the performance of the installation is unaffected by marine conditions. The calibration accuracy of ±0,3°C shall be maintained for at least one
7.2 Requirements

7.2.1 The instrument shall be capable of recording temperature data at least once every hour during calibration and the voyage, and storing such data for at least thirty (30) days.

7.2.2 Recording instruments that form an integral part of the container must have a visual display so that all temperature readings can be viewed manually during calibration, during storage (port terminals etc.) and during the cold treatment period (voyage).

7.2.3 The printout shall identify each sensor and indicate date and time that each temperature is printed, the container number and recorder serial number.

7.2.4 At least three (3) fruit sensors (data logger) and two (2) air sensors (container logger) are required for each container.

7.2.5 Charts must be of sufficient length to display the complete treatment record for the entire voyage.

7.2.6 Data loggers must have sufficient memory to store all temperature data from time of loading until discharge of the cargo.

7.2.7 Independent (separate or loose) PPECB approved temperature data loggers shall be delivered to the PPECB for deployment using specialized computer equipment and programs, alternatively a calibration certificate must be supplied for every portable temperature logger.

7.2.8 Integral (permanently fixed) PPECB approved data loggers shall be calibrated by the PPECB after completion of the cleanliness and pre-trip inspection (PTI) procedure at the container depot.

7.2.9 All temperature sensors shall be immersed in an insulated container filled with crushed melting ice at 0,0°C.

7.2.10 A printed record or log confirming calibration accuracy shall be obtained by the PPECB and included in the documentation to Sudan.

7.2.11 Sensor identification shall be confirmed by the PPECB.

7.2.12 The cargo pulp sensors must be marked at the sensor end of the cable for ease of identification and to ensure that each sensor is placed in the correct / dedicated position.

7.2.13 Faulty sensors or temperature data loggers, i.e. if the instrument does not comply with the specifications in par 3.2 of this document, shall be rejected by the PPECB.

8. LOADING CONTAINERS:

8.1 Authorization

The PPECB will authorize commencement of loading if:

8.1.1 Fruit to be shipped must be continuously pre-cooled in PPECB certified inland or quayside cold stores to the target temperature. Refer to the Cold Treatment Protocols “yellow” card.
8.1.2 It is advisable to pre-cool containers and held at the carrying temperature until commencement of loading.

8.1.3 Temperature sensors and recording devices are operating satisfactorily within the specified tolerances.

8.1.4 Only one type of product may be loaded into a container i.e. no mixing of different products unless approved in writing by Sudan at least 72 hours prior to commencement of loading.

8.2 Supervision

Authorized PPECB technical personnel will perform the following functions during loading:

8.2.1 Frequently measure and record fruit temperatures with a calibrated thermometer to ensure that the following stipulated fruit temperatures are not exceeded.

- **Maximum fruit temperature tolerances:**
  
  In the pre-cooling store = minus 0.5°C

  Due to the fact that the cold store environment may affect the accuracy of thermocouple and electronic thermometer connections, **pulp temperatures in the cold store shall only be measured with PT100 or similar type of thermistor temperature sensors.**

8.2.2 From time to time and according to the situation, open pallets to take pulp temperatures in the center.

8.2.3 Ensure that containers are loaded directly from cold stores without delay. It is unacceptable to accumulate pallets outside the cold store prior to loading into the containers. Scanning of the bar codes on each pallet must be done prior to loading out of the cold store. Effective loading platforms and equipment must be provided. Container loading including installation of the pulp temperature sensors must be completed within 40 minutes for 40ft containers and 30 minutes for 30ft containers.

8.2.4 Completion the required loading documents.

8.2.5 Insert temperature monitoring sensor no. 1, 2 and 3 of independent or fixed recording devices, into fruit in the Sudan prescribed positions.

8.2.6 Measure and record the fruit temperatures during loading. These temperatures shall be recorded in the PPECB shipping documents that are to be presented to Sudan.

8.2.7 Clearly identify pallets with temperature sensors with a brightly coloured "PPECB temperature sensor inside" sticker to ensure that the sensors are not damaged during discharge.

9. **ON COMPLETION OF LOADING:**

Authorized PPECB personnel will do the final checks. This will include the following:

9.1 **Make out a pre-cooling and cold treatment certificate**

9.2 **Distribution of documents**

Cold treatment will continue for the respective periods stipulated in par 1.3. During this period and for the
remainder of the voyage, a complete temperature history must be **printed or recorded at least once every hour.**

The PPECB carrying temperature letter will instruct the Master to maintain the prescribed temperature until discharge. The required commodity temperature will also be stipulated.

Containers will be sealed with standard customs seals. These seals may only be broken or removed on instruction by Sudan official.

10. **DURING THE VOYAGE:**

Master shall be instructed to:

10.1 Maintain facsimile or **preferably E-mail contact with PPECB** supplying the relevant temperature data as requested in the carrying instructions. This is to ensure compliance with the temperature specification during the voyage.

10.2 Change temperature set points or fresh-air supply if necessary.

11. **AFTER THE VOYAGE:**

11.1 The documentation confirming that various actions were successfully carried out before the vessel left South Africa will be checked by the Sudan officials to ensure compliance.

11.2 Container seals will be checked to establish that they are still intact.

11.3 The temperature recording equipment will be checked to establish that it has operated correctly, has not been tampered with and that the temperature for the entire duration of the cold treatment process was recorded as prescribed.

11.4 Sudan officials may re-calibrate the temperature monitoring equipment after cold treatment or cargo discharge.

12. **GENERAL:**

The mere fact that the PPECB has ensured that all equipment used and loading procedures applied, complies with PPECB requirements for in-transit cold treatment, does not imply that the Sudan authorities will accept that effective cold treatment took place en route.

13. **CONTACT PERSONS**

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PROCEDURE FOR IN-TRANSIT COLD TREATMENT OF ORANGES, MANDARINS AND DECIDUOUS FRUIT SHIPPED FROM SOUTH AFRICAN PORTS to SUDAN

Approved By: Senior Cold Chain Specialist
Manager: Research & Development
General Operations Manager: Coastal
Name: R Robinson
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Responsibility Regional Operations Managers (ROM) Refer to Page 9

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