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## 1. REFERENCE

- 1.1 This procedure refers to the cold treatment of **fruit fly in apples and pears** as prescribed by the United States Department of Agriculture (USDA). This procedure will be applied by PPECB as authorized by the South African Department of Agriculture Land Reform and Rural Development (DALRRD) and USDA. Also refer to PPECB ISO 9001 Work Instructions AWI03 (Specialised Refrigerated Vessel) 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.
- 1.2.6 A separate clause in the Carrying Instruction will be given for cold treatment shipments. The **following codes** are in place to assist vessel planners and PPECB in identifying these types of shipments. (Refer to Yellow Cold Treatment Card and PPECB website [www.ppecb.com](http://www.ppecb.com))

SD: Steri Deciduous

SC: Steri Citrus

SL: Steri Landbase


These codes must be used for in-transit shipments, commencement of cold treatment in the container and en-route to final country of destination.

Landbase treatment must commence and complete in a PPECB land-based cold treatment approved facility. A PPECB official will scrutinize the hourly, tabular printed temperature log for correctness before loading can continue.

## 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 citrus and deciduous 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. To achieve this, it is necessary to:

- **Containers** – It is a recommendation to set the thermostat control to deliver air at minus 1.3°C (SD3) for apples and pears (T107-a) or sometimes even colder depending on commodity, packaging and return air temperature (RAT) readings.
- **Fresh Air Ventilation** settings for apples and pears are preset in the closed position prior loading to introduce zero (0) cubic meters of fresh air per hour into the container. The settings can change or differ as per separate agreement between the Exporter and Shipping Line.

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- **Carton and pallet markings** – Each carton and pallet must have specific markings in accordance with the protocol.
- The minimum cold treatment temperature for fruit fly in apples and pears destined for the United States of America is: **14 days at or below 1.1°C**

This treatment is specified as T107-a by the USDA as follows:

Temperature °C	Exposure Period
1.1°C	14 days
1.67°C	16 days
2.22°C	18days

## 2. PRECOOLING OF THE FRUIT


- 2.1 **Cold stores will be inspected annually** to be certified by PPECB. PPECB requires that a remote fruit pulp temperature monitoring system be installed to monitor pulp temperatures. Suggested sensor specification probe sheath length 50mm and thickness ±2,3mm surgical steel. 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 stack 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 must be stored at least one meter away from any other fruit not destined or not passed for USA.
- 2.4 Fruit to be shipped must be pre-cooled for **at least 72 hours of which the last 24 hours the pulp temperatures must be minus 0.5°C** or below. Recommended cold store delivery air must not be colder than minus 1.5°C and the pulp temperature must not be colder than minus 1.5°C.

Maximum pulp temperatures in the centre of pallets at time of measuring in the pre-cooling cold room:

Containers	-	minus 0.5°C
Specialised refrigerated vessels	-	minus 0.5°C

- 2.5 PPECB Technicians will under no circumstances whatsoever, authorize commencement of loading if the above minimum pre-cooling requirements are not met.

## 3. INTEGRAL CONTAINERS TO BE USED FOR COLD TREATMENT

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### 3.1 PPECB registration

- 3.1.1 PPECB will make use of the USDA list of registered containers, refer to USDA website – [HTTP://TREATMENTS.CPHST.ORG/cont](http://TREATMENTS.CPHST.ORG/cont). **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 USA. 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) temperature at minus  $0.5 \pm 0.5^{\circ}\text{C}$  or colder. 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 USA comply with the following requirements: (Portable recorders or Fixed on board data loggers)


- Accurate and steady delivery air temperature (DAT) across the entire width of the air delivery plenum to control the delivery air temperature within  $0.5^{\circ}\text{C}$  of the thermostat set point.
- Sufficient refrigeration and thermal capacity to maintain the fruit at a temperature of  $1.1^{\circ}\text{C}$  and colder for at least 14 consecutive days.
- A defrost cycle and temperature maintenance procedure to ensure that the fruit pulp temperature will be maintained in the range of minus  $0.5 \pm 0.5^{\circ}\text{C}$ .
- 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.
- It is recommended that the pulp sensors must have an outer sheath of 6,4 mm (0.25 inch) diameter or less. The sensing element must be located within the first 2,5 cm (inch) of the sensor.
- 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  $0.1^{\circ}\text{C}$  and with an accuracy of  $\pm 0.3^{\circ}\text{C}$  in the range minus  $3^{\circ}\text{C}$  to plus  $3^{\circ}\text{C}$ .
- 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.

**USDA 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 USDA designated positions.

### 3.2 Selection and registration of containers

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

- Are equipped with USDA approved temperature monitoring equipment to measure temperatures in the center of fruit (3 sensors) and air (2 sensors) in positions specified by the USDA.
- The temperature monitoring equipment is capable of continuously recording pulp temperatures at least

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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 6 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.
- It is advisable to pre-cool containers for at least 12 hours prior to being picked up for commencement of loading.

#### 4. CANCELLATION OF PPECB REGISTRATION

##### 4.1 Cancellation

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


##### 4.2 Non-compliance

USDA Certification and 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 maintained in-transit cold treatment during any previous cold treatment programs.

#### 5. CALIBRATION OF CONTAINERS

##### 5.1 Procedures

- 5.1.1 Calibration of the temperature monitoring and recording devices must be done by authorized PPECB personnel according to the agreed PPECB requirements.
- 5.1.2 Only USDA approved temperature data loggers or permanently on board units may be used.
- 5.1.3 USDA 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 Authorized PPECB personnel will ensure that the sensor cables are satisfactory in length, probes at the door end must be at least 15m in length.
- 5.1.6 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.
- 5.1.7 Two consecutive reading must be recorded for each sensor at the lowest temperature obtainable. There shall be at least a 60 second interval between the two readings for any one sensor; however, the interval should not exceed 5 minutes. The variance between the two consecutive readings must not exceed 0.1°C.
- 5.1.8 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.
- 5.1.9 All calibrated readings must be verified on a laptop or similar device, calibration reading must be printed out and noted on the **Q14** form.

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5.1.10 All temperature measuring and recording devices must be calibrated by the PPECB prior to every in-transit cold treatment shipment; alternatively where applicable a calibration certificate must be supplied for every portable temperature data logger.

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

## 6. LOCATION OF TEMPERATURE SENSORS

### 6.1 Air Sensors

For control and recording of the delivery air temperature and to ensure that fruit pulp temperatures remain in the range of minus 0.5°C and colder, 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 in prescribed positions. Detailed positions are as per **par 6.2.5** below.


6.2.1 **No.1 sensor** must be inserted in the fruit in the top layer of the first pallet on the left-hand side (LHS) of the container, close to the centre line of the container.

6.2.2 **No.2 sensor** to be inserted into the fruit within a pallet in the middle of the container at half height and close to the centre line of the container.

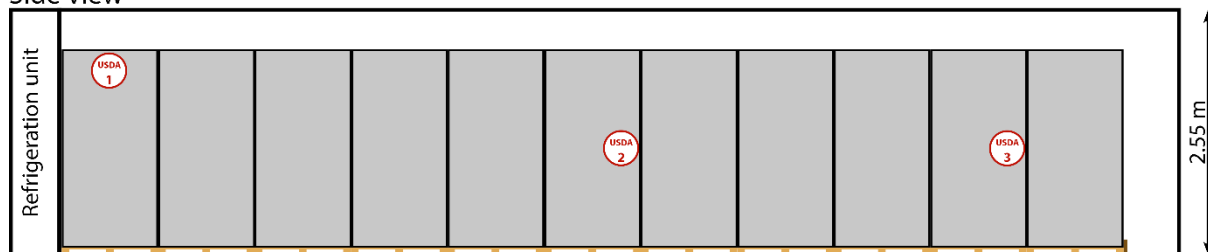
6.2.3 **No.3 sensor** must be inserted in the second last pallet row from the door on the left-hand side (LHS) at half height and close to the centre line of the container.

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

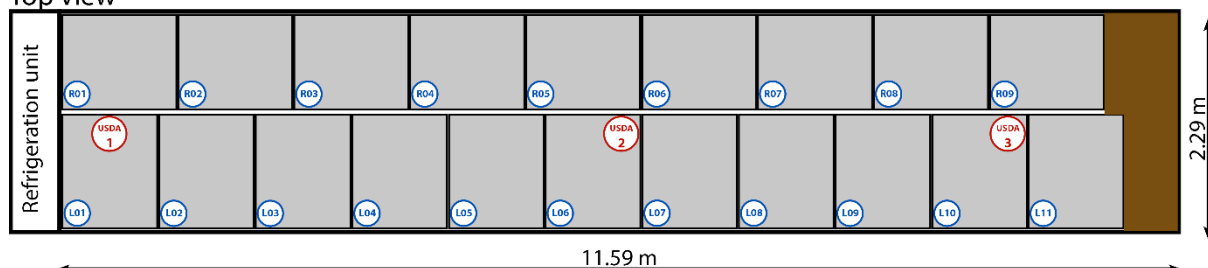
6.2.5 Sensor positions specified as per USDA layout:

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Side view



Top view



#### 6.2.6 Supervise Loading and Placement of Temperature Sensors

The tip of the sensor must not extend beyond the fruit. In the case of grapes, this sensor must be placed in the cluster of grapes. The berries, must be carefully inserted onto the spear until fully covered, then placed amongst the bunches of grapes.

If a portable recorder is to be carried inside the container, the means must be provided to obtain the recorded temperature data without having to open the container doors.

### 7. STANDARDS FOR TEMPERATURE RECORDING SYSTEMS

#### 7.1 General

Recording instruments whether separate (loose) or an integral part of a container that is to be used for conducting in-transit cold treatment **must be approved by the USDA**. 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 USDA and the 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  $\pm 0.3^{\circ}\text{C}$  in the range of minus  $3^{\circ}\text{C}$  to plus  $3^{\circ}\text{C}$ , with a resolution of  $0.1^{\circ}\text{C}$ .

The design, construction and materials used shall be such that the performance of the installation is unaffected by marine conditions. The calibration accuracy of  $\pm 0.3^{\circ}\text{C}$  shall be maintained for at least 30 days after calibration.

#### 7.2 Requirements

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

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- 7.2.3 The downloaded printout shall identify the container number and data logger serial number and each sensor, indicating date and time of printing.
- 7.2.4 If the data logger is to be carried inside the container, all temperature data must be accessible from outside without having to open the container.
- 7.2.5 At least three (3) fruit sensors (data logger) and two (2) air sensors (container logger) are required for each container.
- 7.2.6 Recorded data must be of sufficient capacity to display the complete cold treatment record for the entire voyage.
- 7.2.7 Data loggers must have sufficient memory to store all temperature data from time of loading until discharge of the cargo.
- 7.2.8 Integral (permanently fixed) USDA 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 USDA-APHIS.
- 7.2.11 Sensor identification shall be confirmed by the PPECB.
- 7.2.12 The cargo sensors must be marked on both sides 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 this document, shall be rejected by the PPECB.
- 7.2.14 Temperature readings, downloaded printouts and calibration records must be indicated in °C.
- 7.2.15 The data logger must be capable of showing the results of more than one calibration on the downloaded printout.
- 7.2.16 The data logger must have a unique serial number that is also included on the download printout. In the case where the serial number can not be verified the Shipping Line must seal the controller unit with its own Shipping Line seal and supply PPECB with such information on a company letterhead.

## 8. **LOADING CONTAINERS**

### 8.1 **Authorization**

The PPECB will authorize commencement of loading if:

- 8.1.1 Fruit to be shipped has been continuously pre cooled in an approved PPECB certified inland or quayside cold stores for a minimum of 72 hours of which the last 24 hours the pulp must be at the target temperature of minus 0.5°C or colder. Refer to the cold treatment yellow card.
- 8.1.2 Temperature sensors and recording devices are operating satisfactorily within the specified tolerances.
- 8.1.3 Hourly, tabular temperature printouts to be supplied within an hour before commencement of loading for

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approval.

8.1.3 Only one type of product (apples or pears) and one type of carton may be loaded into a container i.e. no mixing of different products unless approved by the importing country.

8.1.4 It is advisable to pre-cool containers and held at the carrying temperature until 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 at the time of loading:**

During loading - 1.1°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 Where temperature discrepancies are found the deciding factor will be to brake down the pallets to take pulp temperatures in the center of the pallet.

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 12m/40ft containers and 30 minutes for 6m/20ft containers.

8.2.4 Insert temperature monitoring sensor no. 1, 2 and 3 of independent or fixed recording devices, into fruit in the USDA prescribed positions. (Sensor layout position, refer to par. 6.2.5).

8.2.5 Clearly identify pallets with temperature sensors with a brightly coloured “**PPECB temperature sensor**” 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 The PPECB shall authorize commencement of cold treatment once a download of the container is received by PPECB from the respective Shipping Line. This must be received by PPECB no later than six (6) working hours prior to vessel departure. All USDA pulp sensors must be within the stipulated protocol temperature. In the event that downloads are not received on time then a pre-cooling certificate may not be issued. No pre-cooling certificate shall be issued for containers that have been shipped without supplying the down loads to PPECB.

9.2 Fully complete the relevant pre-cooling and cold treatment certificate and carrying temperature instruction letter.

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

9.4 The PPECB carrying temperature letter will instruct the Master to maintain the prescribed temperature until



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discharge. The required commodity temperature will also be stipulated.

9.5 Containers will be sealed with standard shipping line seals. These seals may only be broken or removed on instruction by the USDA 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. These temperature details will also be forwarded to the exporter or his agent.

10.2 PPECB must be informed of changes to temperature set points or fresh-air supply.

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 USDA Aphis 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 USDA Aphis officials will examine the temperature records at the port of entry to establish that the prescribed cold treatment procedures had been carried out according to specification. The USDA Aphis officials will reflect the date and time of completion of the process, on the phytosanitary certificate prior to discharge of the fruit from the container.

11.5 USDA Aphis officials may re-calibrate the temperature monitoring equipment after cold treatment or cargo have been discharged.

12. **VESSELS TO BE USED FOR IN-TRANSIT COLD TREATMENT**


12.1 **General PPECB requirements for approval of refrigerated compartments.**

A vessel must have adequate refrigeration, insulation and thermostatic control to re-cool and hold fruit at minus  $0.5 \pm 0.5^{\circ}\text{C}$  or colder during the period of transit. Proper design of compartments is necessary to ensure good distribution of circulating air so that all parts of the cargo spaces are maintained at the same temperature level. The PPECB does not furnish specifications for refrigerating equipment, or designs for construction. However, reefer vessels presented for approval and registration must be classified under the rules of an internationally recognized ship classification society. **Vessels to be used for in-transit cold treatment to the USA must have a valid USDA certificate.** If this certificate has expired, special agreements for temporary certification must be reached between USDA - APHIS and the PPECB prior to loading the vessel for the USA. (It must be emphasized that re-certification can only be done in the presence of an authorized USDA-APHIS inspector.)

12.2 **PPECB requirements for vessels**

The PPECB will ensure that vessels for in-transit cold treatment to the USA comply with the following requirements:

12.2.1 **Air delivery temperature (DAT)** control must be accurate to within  $\pm 0.5^{\circ}\text{C}$  from the thermostat set point.

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**Please note** that this specification refers to the accuracy of the temperature control thermostat and not to product temperature tolerance.

12.2.2 **Sufficient refrigeration capacity to re-cool the fruit** in each compartment from a maximum loading temperature of 1.0°C to 0.0°C within a maximum period of 72 hours.

**Please note** that this specification refers to the cooling capacity of the equipment and not to product loading temperatures.

12.2.3 **Sufficient refrigeration capacity to maintain the fruit** in each independent or in the case of twin/common deck, then both compartments, at a temperature of minus 0.5°C or colder for a minimum period of 14 days. This will be a minimum requirement for false codling moth and Natal fruit fly.

12.2.4 **A defrost cycle** and procedure in each compartment to be such that the fruit temperature is maintained within the temperature tolerances specified by the USDA T107-a.

12.2.5 **Continuous, automatic temperature recording equipment** to monitor fruit pulp temperatures in at least two locations (more for larger decks) in each compartment and to monitor air temperatures in at least two locations in each compartment. Where one cooling unit provides refrigeration to a twin deck compartment, then a minimum of five (5) pulp temperatures and three (3) air sensors (deck sizes will determine the number) must be used. **Temperatures must be recorded at least once every hour** in units of 0.1°C with accuracy as specified in paragraph 12.3.2, for a minimum of one month after calibration.

**The vessel must comply with standard international requirements, in all other aspects for the carriage of perishable products.**

### 12.3 Vessel selection and registration


12.3.1 A list of USDA registered vessels that may be used for in-transit cold treatment to the USA will be supplied to PPECB and updated regularly by the USDA. In the event of a vessel being removed from the list for any reason whatsoever, the USDA will inform the PPECB accordingly. The PPECB will also inform the USDA should the vessel or equipment not function within specification.

Registration of vessels will be for a period of 3 years. On expiry of the three years period, vessels must be re-inspected by the USDA in compliance with the criteria for renewal of registration. **Application for re-certification must be filed directly with the USDA and not with the PPECB.** Form to be used, T-CT-E-A-110 revision 2 of 18/06/2010.

USDA registered vessels will then be selected by the shipping agent from this list for each particular shipment to the USA, based on the criteria and specifications relating to refrigeration capacity, temperature range for which the vessel is designed, temperature monitoring and recording equipment, compartment layout and location of fruit and air temperature monitoring devices.

12.3.2 In addition to holding a valid USDA registration certificate for in-transit cold treatment to the USA, the PPECB will confirm that the vessel to be used:

- Is equipped with USDA approved temperature monitoring equipment to measure fruit and air temperatures.
- The temperature monitoring equipment is capable of **recording temperatures every hour** with an accuracy of  $\pm 0.3^{\circ}\text{C}$  within the range of minus  $3.0^{\circ}\text{C}$  to  $3.0^{\circ}\text{C}$ . Instrument accuracy must be maintained for a minimum period of one month after calibration.

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**Please note** that the range of 3.0°C to minus 3.0°C refers to the temperature “span” within which the instrument reading must be linear and may not deviate by more than ±0.3°C. This does not refer to product temperature.

- Has proved that, prior to loading and the use of USDA temperature sensors, the air temperature in each compartment of the vessel can be held at minus 0.5°C ± 0.5°C for a continuous period of 24 hours with temperatures measured and recorded every hour. This period forms part of the required 48 hour pre-cooling of the decks.

#### 12.4 Temperature requirements for vessels

**The owner must submit** complete specifications and drawings of the recording systems the recorder and sensors. The vessel shall be made available to the PPECB for final physical inspection. For inspection to be made at a foreign location, prior arrangement and a cooperative agreement must be established with the PPECB.

**Calibration and sensor identification** tests will be made during such an inspection. The refrigerated compartments shall be pre-cooled for a minimum period of 24 hours to minus 0,5°C. Following this, a stable temperature of minus 0.5°C ± 0.5°C must then be maintained for a further minimum period of 24 hours prior to calibration.

**A communication system** shall be made available to facilitate communication between personnel in the compartments and the recording room during calibration and loading.

**It is recommended that a representative** from the temperature recording Instrument Company, who is familiar with the installation, **shall be on standby** to advise on the performance of the instrument and to conduct the necessary maintenance, service and repairs. The owner vessel or his agent shall finalize the necessary arrangements prior to requesting inspection.

#### 12.5 PPECB registration of vessels

Upon meeting all requirements, the vessel is accepted as being approved to conduct in-transit cold treatment to the USA in the specified compartments as per agreement between the PPECB and the USDA authorities. Only vessels and compartments complying with USDA and PPECB specifications shall be authorized for in-transit cold treatment.

##### 12.5.1 Cancellation

Vessels withdrawn from service or that are no longer used for in-transit cold treatment to the USA, will be removed from the list and will only be reconsidered if re-inspected and approved by the USDA or, if authorized, by the PPECB.


##### 12.5.2 Non compliance

USDA Certification and PPECB approval for in-transit cold treatment will be cancelled with immediate effect if any one of the specifications laid down in this document are no longer being met or if the vessel could not successfully implement in-transit cold treatment during any previous cold treatment program.

### 13. STANDARDS FOR TEMPERATURE RECORDING SYSTEMS

#### 13.1 General

The standards described in this document are intended to meet USDA and the PPECB requirements for a

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temperature recording installation for use in vessels engaging in the in-transit cold treatment of fruit. The recording system shall have an overall accuracy of  $\pm 0.3^{\circ}\text{C}$  in the range of minus  $3.0^{\circ}\text{C}$  to  $3.0^{\circ}\text{C}$ , with a resolution of  $0.1^{\circ}\text{C}$ .

The design, construction and materials used shall be such that the performance of the installation is unaffected by marine conditions. The calibration accuracy of  $\pm 0.3^{\circ}\text{C}$  shall be maintained for at least one month after calibration. Plans indicating sensor positions in specialised refrigerated vessels decks and specifications of the temperature recording instruments and equipment are to be submitted for review and approval. Operating and service manuals must always be available on board vessels. Sufficient spares to carry out minor repairs and routine maintenance must be placed on board. Personnel should be trained to carry out such repairs and maintenance.

### 13.2 Display standards for strip chart recorders

- 13.2.1 The scale deflection of the chart shall not be less than 5 mm for each degree Celsius (0,10 inches for each degree Fahrenheit). A print interval of approximately 2 minutes and a chart speed near 5 cm per hour is usually satisfactory.
- 13.2.2 The chart scale shall be graduated with major scale marks at every degree temperature and minor scale marks at every 0.2 of a degree temperature.
- 13.2.3 Temperature values for each sensor shall be printed **at least once every hour**.
- 13.2.4 Each symbol on the print wheel must correspond to and identify the sensor it represents.
- 13.2.5 Charts shall be of sufficient length to display the complete treatment record for the entire voyage.
- 13.2.6 All the required printed data must be clearly legible. Failing this, the vessel will be rejected for loading.


### 13.3 Display standards for Data Loggers

- 13.3.1 The temperature and number of each sensor shall be printed **at least once every hour** on continuous log sheets accurate to one decimal place. Each entry must contain a clear, fully informative record including the date and time. Text may be preprinted, or printed at the time of each temperature printout.
- 13.3.2 Temperature monitoring devices must have the capacity to record the temperatures at least once every hour for the full duration of the voyage.
- 13.3.3 Data loggers shall have sufficient memory to store all temperature data from loading to discharge of the cargo.
- 13.3.4 Service intervals for temperature recorders must be done every six months, unless a purchase receipt can be produced for a brand new recorder purchased within a six months.

## 14. REQUIREMENTS FOR TEMPERATURE SENSORS

### 14.1 Manufacturing Standards

- 14.1.1 Sensors designated for fruit temperatures must have an outer sheath of 6,4mm (0,25 inch) diameter or less. The sensing unit must be located within the first 25mm (1 inch) of the sensor.
- 14.1.2 The sensors shall have a waterproof connection that must be suitable for total immersion in an ice/water mixture.

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## 14.2 Accuracy Standards

14.2.1 The sensors shall be accurate to  $\pm 0.1^{\circ}\text{C}$  in the range of minus  $3^{\circ}\text{C}$  to plus  $3^{\circ}\text{C}$ .

14.2.2 The sensors shall show a steady indication of temperatures within 3 minutes when immersed in a mixture of crushed ice and water at  $0.0^{\circ}\text{C}$ .

## 14.3 Identification of sensors in refrigerated compartments

All sensors in the refrigerated compartments shall be identified so as to distinguish the sensors in one compartment from those in other compartments (e.g. A1, A2, .....B1, B2,.....etc). A common letter designation is also required for twin deck compartments.

The sensors for each compartment shall be identified so that the air sensors are numbered first (e.g. A1, A2, = air, A3, A4, A5, etc = fruit pulp).

All sensors shall be identified according to the assigned number on the recording system. This number shall be placed on the box where the sensor is stowed or on the bulkhead near the sensor and on a permanent tag/marker attached to the cable within 300 mm from the sensor.

A diagram illustrating the exact location and identification of every sensor by compartment shall be displayed adjacent to the recording instrument.

## 15. CALIBRATION PROCEDURES


15.1 **Pre-cooling conditions** required prior to calibration of the temperature recording system are:

15.1.1 All specialised refrigerated vessel shipping compartments to be used for in-transit cold treatment are to be pre-cooled for at least 48 hours at a set point of minus  $0.5^{\circ}\text{C}$ . A steady temperature of minus  $0.5^{\circ}\text{C}$  must be maintained for a minimum continuous period of 24 hours prior to calibration. The results of the 48 hours temperature maintenance check must be printed every hour by the respective recording systems. A complete printout must be made available to the PPECB.

15.1.2 Temperature recorders must be serviced and operating effectively within all the required specifications:

- New printer ribbon, printer paper and if applicable strip chart recorder ribbon/cartridge, strip chart paper.
- Prior to loading for USA an accredited agent must service all recording components within a period of six months.
- Service certificates must be forwarded to PPECB or must be available for presentation to the PPECB official before the survey of a vessel and probe calibration.
- Purchase of order, receipt must be provided for new recorders bought within a six month period of ETA. If the recorders were replaced, proof must be provided that the USDA-APHIS was informed of the new versus old serial numbers.
- Where Strip Chart recorders are concerned, an accredited service **agent must carry out a sensor accuracy span verification**. Written proof that the span for each probe/sensor was within the factory standard must be provided to PPECB official before the survey of a vessel and probe calibration.

## 15.2 Calibration procedures – specialised refrigerated vessels

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15.2.1 The following spare sensors are required to be onboard the vessel and will be checked during the survey:

- **5 x 12 metre pulp sensors**
- **2 x 3 metre air sensors**

15.2.2 Calibration of the temperature monitoring devices and temperature recording equipment may only be done by USDA authorized PPECB personnel according to the agreed USDA and PPECB requirements.

15.2.3 All hatch covers and access doors must be closed. No work within the cargo decks will be permitted prior to or during calibration.

15.2.4 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 thermometer.

15.2.5 A printed record or log of at least 2 subsequent sets of readings must be obtained from the recorder to ensure that there is no drift or change in the readings during calibration.

15.2.6 If the consecutive set of readings is not both within the applicable tolerance of 0.1°C end the calibration procedure and reject the container for in-transit cold sterilisation shipments.

15.2.6 The recorder charts will be clearly endorsed by USDA authorized PPECB personnel indicating the dates and times **when calibration was commenced and completed.**

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

## 16. LOCATION OF TEMPERATURE SENSORS

16.1 **USDA registered vessels** used for in-transit cold treatment shipments are equipped with at least two (2) air temperature sensors and at least three (3) fruit temperature sensors per independent deck, or at least five (2+3=5) fruit and three (3) air temperature sensors per twin deck compartment. The required quantity depends upon the deck cubic capacity. Sometimes only two (2) fruit sensors are installed in the smaller forward independent decks. The number, location and identification will be specified in accordance with the submitted drawings of the refrigerated spaces.

16.2 **For control and recording of the delivery air temperature** to the particular compartment (to ensure that fruit core temperatures remain in the range minus 0.5 ±0.5°C) the following shall apply:

16.2.1 **Air temperature sensors shall be located** on the centre line of the vessel ±30 cm from the ceiling (bulkhead).


16.2.2 **Air temperature sensors shall be attached** in such a way that they do not touch the bulkhead (side-walls) and are protected from damage by the cargo.

16.2.3 **Air temperature sensors shall be readily detachable** and connected to cables at least **3 m in length.**

16.2.4 **One air temperature sensor shall be located** on the fore and one in the aft bulkheads of each compartment. In the case of twin deck compartments, two sensors are required in the upper compartment plus one sensor in the lower compartment. The latter sensor is to be located on the bulkhead furthest from the cooling unit. They must be mounted in such a way that they are in the airflow at all times.

## 16.3 Fruit Sensors

16.3.1 **Fruit temperature sensors shall be distributed** throughout the shipping compartment (deck) to adequately

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monitor temperatures from a represented cross-section of the compartment concerned. The number and position of these sensors are based on the volume of the shipping space and must be indicated on a plan.

16.3.2 **These sensors will be installed in the fruit** within in the centre of a pallet, in the second (2<sup>nd</sup>) layer of cartons from the top (the warmest position). There must be an even distribution of pallets around each pallet that contains a sensor.

16.3.3 **Fruit sensors shall be fixed to cables** of at least **12m in length** and are to be stowed in protective boxes when not in use.

16.3.4 **The equipment** is to be installed in accordance with the highest standard of the classification society concerned. The number, location and identification of sensors will be specified in the plan that will form part of the documents to be submitted by the PPECB with every shipment to USDA - APHIS.

## 17. **LOADING OF VESSELS**

### 17.1 **Authorization**

The PPECB will authorize commencement of loading if the following conditions are met:

17.1.1 **Fruit to be shipped** must be continuously pre-cooled for at least 72 hours in a quayside cold store to a pulp temperature of minus 0.5°C or colder.

17.1.2 **Shipping compartments** to be used are pre-cooled for at least 48 hours and a stable temperature of minus 0.5°C was maintained for at least the last 24 hours.

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

### 17.2 **Supervision**

17.2.1 **During loading** authorized PPECB technical personnel will perform the following functions:


- **Ensure** that different commodities that may cause cross tainting are not loaded in the same deck or common deck.
- **Frequently measure** and record fruit temperatures during loading into each compartment or container with calibrated thermometers to ensure that the following stipulated fruit temperatures are not exceeded.

➤ Maximum fruit temperature tolerances for apples and pears are as follows:

During loading into the deck	-	0.0°C
In vessel: stop loading and re-cool	-	1.0°C
Recommence loading	-	0.0°C

17.2.2 **Take the following precautions** during loading of the vessel to ensure minimal fruit temperature increase.

- Fruit will be held at the required temperatures in the pre-cooling store until the pre-cooled shipping compartments are ready to receive the fruit. During the loading, fruit temperatures will be measured with a calibrated thermometer fitted with a thermistor type, fruit temperature probe.
- From time to time the PPECB will require opening pallets in order to take pulp temperatures in the centre.
- 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 be measured with PT100** or similar type thermistor temperature sensors only.
- Full chambers will be past for shipping with the exception of only two bays not to be on temperature. These

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two force air cooling bays will only be allowed to be shipped once all chambers has been emptied.

- Fruit will be transferred from the pre-cooling facility to the quayside as quickly as possible for loading into the ship's compartment. Delays of the crane will be limited to the absolute minimum since the rate of loading will determine the rate at which the fruit not under cooling will increase in temperature. No more than two "swings" per crane will be permitted on the quayside at any one time.
- Loading of compartments will be planned to proceed as quickly as possible without delays so that cooling can commence as soon as the compartment is loaded and closed.
- Time of the commencement and completion of loading will be noted and will be recorded on the PPECB documents to USDA-APHIS.

- 17.2.3 **Specialised refrigerated vessel decks:** Insert temperature-monitoring sensors into the centre of a fruit, in the centre carton, of the second layer of cartons from the top of the pallet (expected warmest position). The monitored pallets will be evenly spread throughout the shipping compartment to ensure that fruit pulp temperatures are monitored in positions representing the entire shipping space.
- 17.2.4 **Pallets with temperature sensors** will be marked clearly with a brightly coloured "**PPECB temperature sensor inside**" sticker to ensure that the sensors are not damaged during discharge.
- 17.2.5 **Position and numbers of temperature sensors** in refrigerated decks will be indicated on a plan for each individual cargo compartment.
- 17.2.6 **All product temperature sensors** in refrigerated decks will be monitored on the temperature recorder at least once every two hour to ensure that temperature of product already loaded does not increase to above plus 0.5°C.
- 17.2.7 **All loading** in a cargo hold will be stopped, the hatch cover will be closed and cooling will commence if any one of the product temperature sensors indicates a pulp temperature greater than 1.0°C.
- 17.2.8 **Loading may only recommence** if all product temperature sensors in the specific hold indicate 0.0°C or colder.

## 18. ON COMPLETION OF LOADING

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


- 18.1.1 Fruit destined for the USA shall never be mixed in the same compartment with any other fruit destined for another country.
- 18.1.2 When part loads are being shipped, fruit for the USA will be loaded into separate shipping spaces according to the above temperature and other specifications. These spaces shall be completely isolated from any other spaces and be refrigerated separately.
- 18.1.3 Spaces containing fruit for the USA shall under no circumstances be opened in any other loading or discharge port. The PPECB shall ensure that no cross contamination is possible during loading and shipping.
- 18.1.4 A final temperature check on the temperature recorder will be done just prior to sailing.

The recorder charts will be clearly endorsed by USDA authorised PPECB personnel indicating the dates and **times when loading was commenced and completed.**

## 19. Documentation

Apart from the standard approved PPECB documents and certificates the following will also be included in the



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full set of documents:


- USDA instruction to the Master – USDA form to be completed and signed by the PPECB.
- A plan of the vessel showing the exact location of all temperature monitoring sensors in each compartment. Each sensor location will be clearly identifiable and numbered to correspond with the number used on the temperature recording equipment.
- Two sets of the original and signed composite document, containing all the particulars listed will be delivered by hand to the Master of the vessel before the vessel departs for the USA. One set for the Master and the second set for the USDA-APHIS officer in charge in the port of discharge.
  - USDA-APHIS-PPQ  
Officer in charge  
Discharge port: containers  
Discharge port: specialised refrigerated vessels

#### 19.1 Carrying temperature instruction

- The PPECB will compile written carrying temperature instructions, which will be handed to the Master to ensure that the specified cooling, and temperature maintenance and recording procedures are applied during the specified cold treatment period and the rest of the voyage. **These instructions will be legal and binding and will be in compliance with the USA Ahips in-transit cold treatment specifications** (i.e. T107-a).
- The temperature letter will instruct the Master to deliver air to a particular compartment in order to maintain the prescribed fruit pulp temperature.
- The Master will be instructed verbally and in writing to apply the cold treatment by maintaining the fruit at a temperature of 1.1°C or colder.
- 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 vessel will be allowed to depart the South African loading port as soon as all pulp temperatures, as indicated by the ship's data logger are at or colder than 1.1°C.

#### 20. DURING THE VOYAGE

- 20.1 Maintain **E-mail contact with PPECB** to ensure compliance with the temperature specification during the voyage.
- 20.2 In the event of a fruit temperature sensor returning a reading, which exceeds 1.1°C during the voyage, the delivery air temperature (DAT) in the compartment concerned can be lowered to a minimum of minus 2°C for a period of 6 hours out of every 24 hours (cold blast). When all fruit temperature sensors are again at or below 1.1°C can the specified DAT be applied to maintain the product temperature within protocol. If the temperature cannot be maintained for any reason, the PPECB must be informed and the PPECB will furnish new instructions. **Please also refer to USDA T107-a specification as per par 1.3 above.**
- 20.3 The temperature recorder chart must be signed by the Master or Chief Engineer every 24 hours during the process of cold treatment, to confirm that temperatures during the preceding 24 hours have been checked and are within the required range.
- 20.4 Air and fruit temperature readings must be recorded **at least once every hour** from the time the vessel depart from a South Africa port until a final check has been conducted by USDA-APHIS officials after arrival of the vessel in the USA.

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20.5 The cold treatment shall be completed prior to the opening of the shipping compartments in the USA port of discharge.

**21. AFTER THE VOYAGE**

21.1 The documentation which confirms that various actions were successfully carried out before the vessel left South Africa, will be checked by USDA-APHIS officials to ensure compliance.

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

21.3 The USDA official at the port of entry will examine the temperature records to ensure that the prescribed cold treatment procedures have been carried out according to specification and to reflect the date and time on the phytosanitary certificate of cold treatment completion, prior to discharge.

21.4 The USDA-APHIS official may re-calibrate the temperature monitoring equipment after cargo discharge.

**22. GENERAL**

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

***NB: IT IS IMPORTANT TO INFORM PPECB OF ANY COLD TREATMENT FAILURES THAT TOOK PLACE DURING AND/OR ON ARRIVAL AT THE PORT OF DISCHARGE.***

**23. CONTACT PERSONS**

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