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Treatment Manual

Nonchemical Treatments

Cold Treatment (CT)

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Intransit Cold Treatment in Conventional Vessels, Self-Refrigerated (Integral) Containers, and Warehouses

The use of sustained cold temperatures as a means of insect control has been employed for many years. Rigid adherence to specified temperatures and time periods effectively eliminates certain insect infestations. Treatments may be conducted in warehouses, refrigerated compartments of transporting vessels (Conventional Vessels), containers cooled by the ship's refrigeration system (Container Vessels) or by individually refrigerated containers (Self-Refrigerated/Integral Containers). Information concerning conventional vessels, self-refrigerated containers, and warehouses is found in this chapter.

Only certified USDA representatives have permission to conduct warehouse, vessel and/or container approval tests under the general guidance of TQAU. The following website provides information for the testing of specific vessels and/or containers:

<http://www.cphst.org/treatment/index.cfm>

Precooling Procedures

Experience with in-transit cold treatments and Computational Fluid Dynamics (CFD) modeling of refrigerated vessel compartments show that the fruit must be precooled at or below the prescribed cold treatment temperature before loading. Otherwise, a large quantity of fruit in the middle of large pallet groups may require a week or more to reach the cold treatment temperature.

Fruit intended for intransit cold treatment must be precooled to the temperature at which the fruit will be treated prior to beginning treatment.

Precooling cannot be conducted in the conveyance in which the commodity is loaded unless authorized by the APHIS official.

Conduct random fruit pulp sampling in the precooling location prior to loading in order to verify that the commodity has completed precooling.

Use the following general guidelines for fruit pulp sampling in the precooling location:

- ◆ Pulp temperatures will be taken by personnel authorized by APHIS, which includes industry representatives

- ◆ Take pulp temperatures by probing the fruit on the periphery of the pallet
 - ❖ If pulp temperatures are 0.28 °C (0.5 °F) or more above the temperature at which the fruit will be treated, the pallet will remain in the precooling location for further precooling

Also, sample fruit pulp temperatures **immediately** before the fruit is loaded on the intransit cold treatment conveyance. Take fruit pulp temperatures by probing fruit in the **top** of the pallet. An official authorized by APHIS will sample the fruit pulp temperatures in all sections of the load to verify temperatures have not risen appreciably. If the pulp temperatures for the sample are 0.28 °C (0.5 °F) or more above the temperature at which the fruit will be treated, the pallet will be rejected and returned to the precooling location for further precooling until the fruit reaches the treatment temperature.

Initiating Intransit Cold Treatment in Vessels and Containers

For cold treatments conducted in approved vessels and containers, the ship's officers will have already received instructions on the APHIS requirements from their owners. However, a discussion by the authorized APHIS official with these individuals will provide for better understanding and cooperation. Such a discussion should include:

- ◆ General treatment procedures in accordance with 7CFR 305.15
- ◆ Stowage arrangement
- ◆ Temperature sensor and instrument calibration testing
- ◆ Treatment conditions

Ensure that there is an adequate communication system in place between personnel in the compartments and the recording room.

Verification of Temperature Recording Equipment

Approved vessels and containers must be capable of maintaining fruit pulp temperatures within the specified CT schedules. To monitor these treatments, they must be equipped with a temperature recording device which meets the approval of [TQAU](#). All approved temperature recording devices must be password protected and tamperproof and have the ability to record the date, time, sensor number, and temperature during all calibrations and actual treatments.

If APHIS determines that the records and calibrations can be manipulated, the vessel and/or container will be suspended from conducting cold treatments until proper equipment is installed. Submit any changes to the temperature recording and monitoring equipment to [TQAU](#) for approval before installation in the vessel or

container. Compare the existing equipment with the equipment listed at <http://treatments.cphst.org/vessels/> to determine if new equipment has been installed that was not approved by TQAU.

Specifications for temperature recording installations and other requirements for approval are discussed in [Chapter 6-4: Certifying Cold Treatment-Standards for Temperature Recording Systems](#). Refer to [Appendix H](#) for a list of approved temperature recorders.

Strip Chart Recorder



Important

Since December 31, 2005, strip chart recorders were no longer acceptable temperature recording devices. Consequently, by December 31, 2008, there should be no strip chart recorders in use for APHIS cold treatment.

Contact TQAU for approved temperature recording instrumentation.

Data Logger

A sufficient supply of log sheets must be available to provide a continuous record of calibration and treatment temperatures. The instrument should be in operation for at least 30 minutes prior to calibration tests. Examine a completed log sheet printout and the functioning of the visual scanner, the printer, and the high limit setting. Check the logsheets for proper format and serialization. Activate the temperature set-point for an alarm printout to verify that this function is operational.



Important

Data logger installations are utilized to record various components of the vessel's operating systems. Temperature recording is only a part of the record produced. Under TQAU approval requirements, the logsheets upon which the intransit cold treatment is recorded are generally more detailed in design than the standard commercial logsheet. They are prepared and serialized to facilitate scanning and to provide a level of security against fraudulent records. The USDA log should be printed on separate sheets with no other ship data interspersed. Data loggers are programmed to print out the temperatures above a set limit in a contrasting color. Some instruments print a symbol to indicate this. The limit is set at the time of loading to a temperature level that coincides with the projected treatment schedule.

Verification of Temperature Sensors

Check individual sensors to verify that they are properly labeled and correctly connected to the temperature recorder. This can be accomplished by hand warming each sensor when its' number appears on the visual display panel of the recording instrument. A temperature change, which can be observed at the instrument, should occur. If the instrument fails to react, the sensor is incorrectly connected or malfunctioning and should be corrected by the instrument representative.

Calibration of Temperature Sensors

Calibrate all air and pulp temperature sensors in a clean ice water slurry mixture that is at 0 °C (32 °F), the freezing/melting point of freshwater.

1. Prepare a mixture of clean ice and fresh water in a clean insulated container.
2. Crush or chip the ice and completely fill the container.
3. Add enough water to stir the mixture.
4. Stir the ice and water for a minimum of 2 minutes to ensure the water is completely cooled and good mixing has occurred.
 - ❖ The percentage of ice is estimated at 80 to 85 percent while the water fills the air voids (15 to 20 percent).
5. Add more ice as the ice melts.
6. Prepare and stir the ice water slurry to maintain a temperature of 0 °C (32 °F).
7. Submerge the sensors in the ice water slurry without touching the sides or bottom of the container.
8. Stir the mixture.
9. Continue testing of each sensor in the ice water slurry until the temperature reading stabilizes.
10. Record two consecutive readings of the stabilized temperature on the temperature chart or logsheet.
 - ❖ The temperature recording device should be in manual mode to provide an instantaneous readout.
11. Allow at least a 1 minute interval between two consecutive readings for any one sensor; however, the interval should not exceed 5 minutes.
 - ❖ The variance between the two readings should not exceed 0.1°.
12. Contact an instrument company representative immediately if the time interval exceeds the normal amount of time required to verify the reading and accuracy of the sensor and recorder system
 - ❖ The recorder used with the sensors must be capable of printing or displaying on demand and not just at hourly intervals.
13. Correct any deficiencies in the equipment before certification.
14. Replace any sensor that reads more than plus or minus 0.3 °C (0.5 °F) from the standard 0 °C (32 °F).
15. Replace and recalibrate any sensors that malfunction.

- 16.** Document the recalibration and replacement of the sensor(s).
- 17.** Determine the calibrations to the nearest tenth of one degree.

Loading of Commodity in Conventional Vessels and Self-Refrigerated (Integral) Containers—General



Important

In countries with which USDA-APHIS has a cooperative agreement, these activities can be conducted by qualified officials from that country. Contact the [TQAU](#) for a list of qualified officials.

1. Each compartment or container must contain only one type of fruit loaded in one type of carton.
2. Load fruit directly from the precooling area so fruit temperatures do not rise significantly after loading and during the transfer of the container to the vessel.
3. Open the cartons in which the sensors will be located and insert the sensors well into the fruit ([Figure 3-7-1](#)). The tip of the sensor must not extend through the fruit.

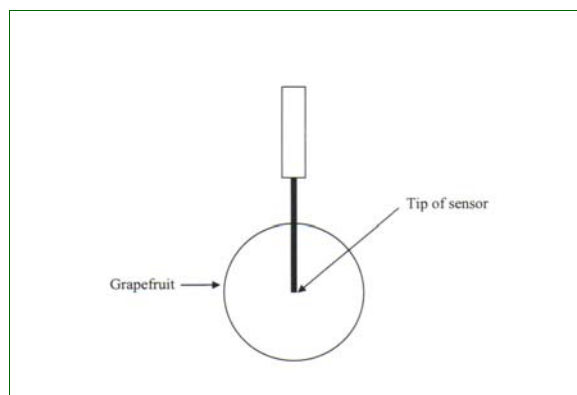


FIGURE 3-7-1 Proper Placement of Pulp Sensor within Larger Fruit

In the case of small fruit, cover a minimum of two thirds of the tip of the sensor using multiple fruit. If, for example, the fruit is grapes, insert the sensor directly into the grapes in a shis-ka-bob fashion ([Figure 3-7-2](#)). Completely cover the probe with the top layer of fruit in the top of the box or carton located in the middle of the pallet.

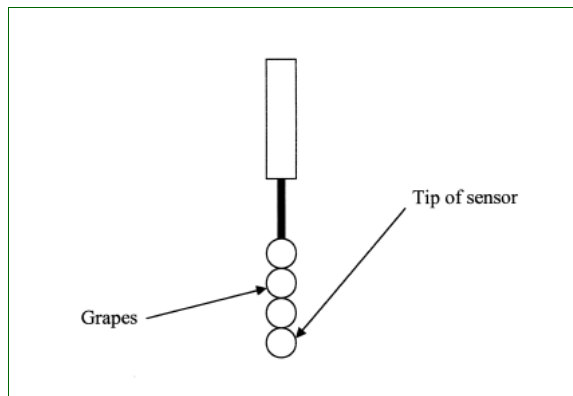


FIGURE 3-7-2 Proper Placement of Pulp Sensor within Smaller Fruit

4. Securely close the cartons following insertion of the sensors. If the fruit is palletized, it may be necessary to insert the sensor into the fruit from the side of the carton. If the side of the carton or box is opened to insert a sensor, reseal the opened side of the carton or box using tape.

Conventional Vessels



Hanging decks, hatch coamings within vessels and double-stacking of pallets are not approved for intransit cold treatment. The treatment will not begin until all double-stacked pallets are reconfigured into a single-stack pallet arrangement and any pallets located in hanging decks or hatch coamings are removed.

Contact [TQAU](#) for more information regarding hatch coamings or hanging decks for particular vessels.

There are two sensor types used for the compartments during cold treatment.

- ◆ Ambient air sensors—the cables which are attached to the ceiling of the compartment, should be long enough to extend from the ceiling to the floor. Place the sensors on the center line of the vessel approximately 30 centimeters from the ceiling. Attach the sensors in such a way that they do not touch the bulkhead and are protected from damage from the cargo. One sensor must be located on the fore and 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. Place the lower sensor on the bulkhead furthest from the cooling unit. Ensure that all sensors are readily detachable and stowed in compartments to protect from damage when not in use.

- ◆ Fruit pulp sensors—the cables which are attached to the side walls of the compartment must be distributed throughout the compartment so that all areas of the compartment can be reached. The cables should be long enough to extend from the hold walls to three meters beyond the center line of the ship hold.

Placement of Temperature Sensors

All of the sensors for conventional vessels must be located at the mid level of the pallets as depicted in [Figure 3-7-3](#). The black circles represent pulp sensors.

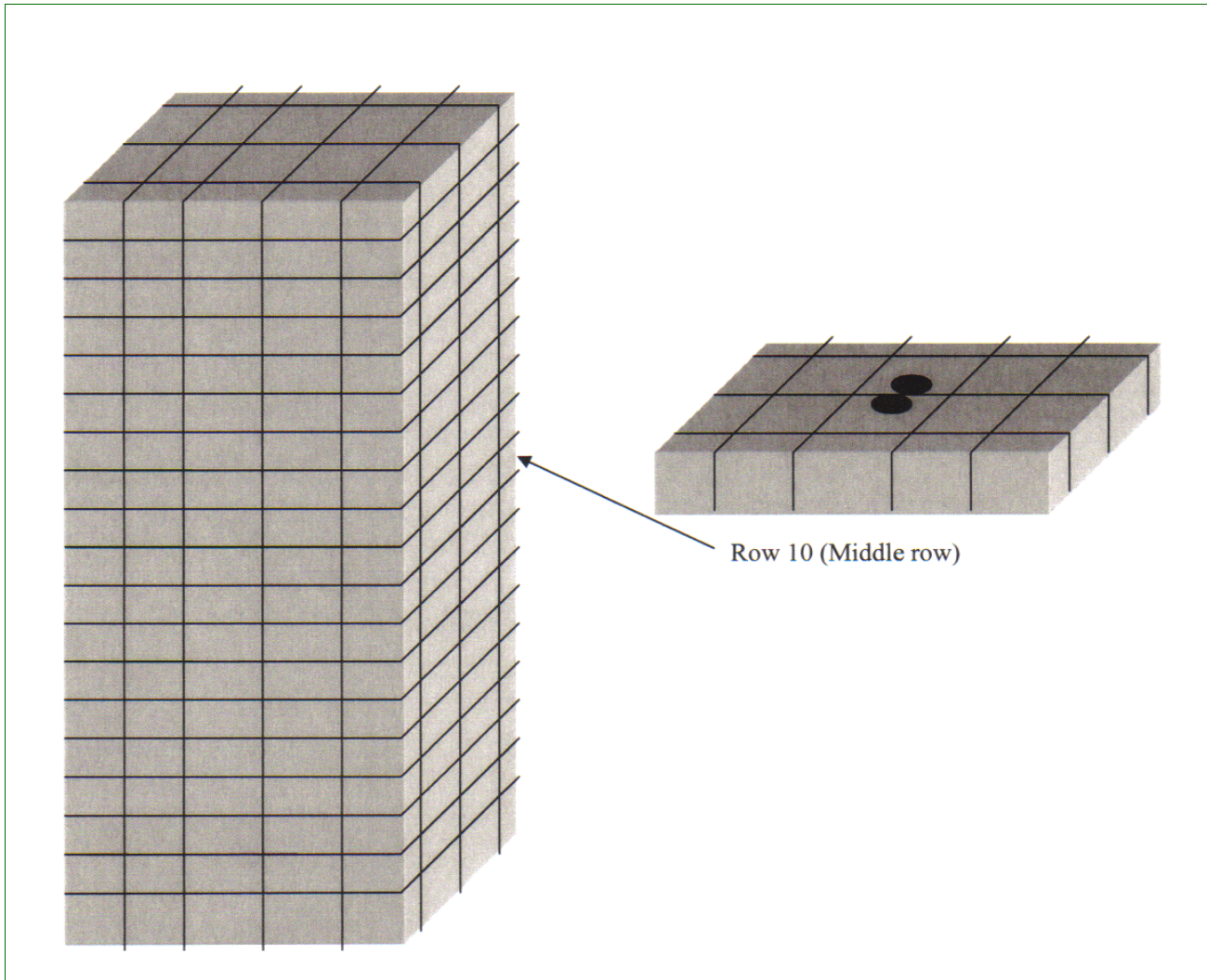
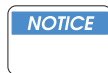


FIGURE 3-7-3 Fruit stack with middle row temperature probe placement



It is highly recommended that more temperature sensors be installed than the minimum number required for each refrigerated compartment. If a sensor malfunctions during a treatment, the certified USDA representative has the option of disregarding it, providing that an additional working sensor is present, and the functional sensors were appropriately placed, certified, and calibrated. Otherwise, the entire treatment must be repeated for the fruit in that compartment.

Self-Refrigerated (Integral) Containers

When loading refrigerated containers, place the warmest fruit in the last quarter of the load (near the back doors of the container), completely cover the floor and ensure that the load is of uniform height.

Place a numbered seal on the loaded container. This must not be removed until the load has been cleared at the port of destination.

Use a minimum of three pulp sensors. Place all sensors as far into a box of fruit as possible. Use [Figure 3-7-4](#) as a general guideline for sensor placement.

- ◆ Place the first sensor, labeled USDA1, in a box at the top of the stack of fruit nearest to the air return intake.
- ◆ Place the second sensor, labeled USDA2, slightly aft of the middle of the container, halfway between the top and bottom of the stack.
- ◆ Place the third sensor, labeled USDA3, one pallet stack in from the doors of the container, halfway between the top and bottom of the stack.

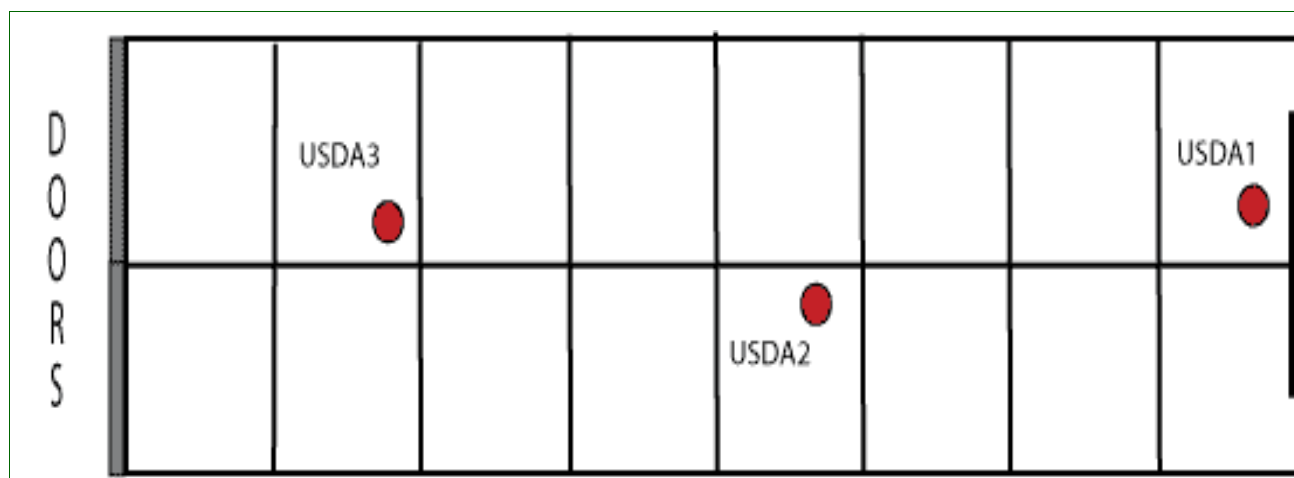


FIGURE 3-7-4 40 foot Refrigerated Container with 18 Pallets of Fruit (not drawn to scale)

Secure the Load

Place a piece of cardboard that extends from the front edge of the second-to-last pallet row to the back doors on the container floor before the last pallet row is loaded. Once the cardboard is installed properly, load the last pallet row so the pallets rest on top of the cardboard. Place a second piece of cardboard perpendicular to the first piece of cardboard and staple to the cartons in the last pallet row (Figure 3-7-5). The placement of the cardboard between the back doors of the container and the last row of pallets aids in maximizing air flow through the pallets. Complete this procedure for all pallets in the last pallet row of the container.



FIGURE 3-7-5 Proper placement of cardboard between the last pallet row of fruit and the back doors of the container

Treatment Requirements

Temperatures must be recorded at intervals no longer than 1 hour apart. Gaps of longer than 1 hour may invalidate the treatment or cause treatment failure.

Fruit pulp temperatures must be maintained at the temperature specified in the treatment schedule with no more than **0.39 °C (0.7 °F)** variation in temperature between two consecutive hourly readings. Failure to comply with this requirement may result in treatment failure.

The time required to complete the treatment begins when all temperature probes reach the prescribed treatment schedule temperature.

Prepare Documents

Complete the following PPQ forms and worksheets:

- ◆ "Calibration of Temperature Probes" record showing the temperature readings as taken from the temperature chart or log sheet during the calibration testing. Record readings to the nearest tenth of one degree. When the loading of each compartment has been completed, obtain the temperature reading of each fruit probe from the temperature recorder and record on this form.
- ◆ "Instructions to Captain" form letter.
- ◆ "Location of Temperature Sensors" record to show the actual position of each fruit temperature sensor. (See sample form in Appendix A.) This can be accomplished by a written description or by a diagrammatic sketch. Include compartment loading start and end times and dates on the form.
- ◆ PPQ Form 203, Foreign Site Certificate (for APHIS pre-inspected fruit)
- ◆ Shipper's manifest containing the quantity and kind of commodity.

Distribution of Documents

Conventional Vessels and Self Refrigerated (Integral) Containers

Place the following documents in a sealed envelope and give to the Captain for presentation to the clearance official at the port of arrival.

- ◆ Original "Calibration of Temperature Probes"
- ◆ Original "Location of Temperature Sensors"
- ◆ Copy of the "Instructions to Captain"

For reference purposes, present the Captain with the following documents:

- ◆ Original "Instructions to Captain"
- ◆ Copy of the "Calibration of Temperature Probes"
- ◆ Copy of the "Location of Temperature Sensors"

Send copies of all documents to the clearance official at the port of arrival and to [TQAU](#).

Clearance of Cold Treated Shipments

The TQAU is in the process of designing electronic versions of all required cold treatment documentation. In the future the forms that are filled out overseas (excluding the preclearance forms) will be entered on-line through a secured website so that the port of arrival will be able to view all required documentation before the certified vessel or container undergoing intransit cold treatment arrives at a U.S. port of entry. Until the new database and electronic forms are finished, continue following the instructions listed below.

Off-loading of self-refrigerated containerized fruit that is under treatment must be accomplished rapidly. Containers must be off-loaded and treatment reconvened within 2 or 3 hours from the time the container was disconnected from the refrigerating unit. The pulp sensors should never exceed the maximum allowable treatment temperature.

Observe the stacking pattern. Double stacking is not permitted. Do not release the shipment if the pallets have been double stacked.

Conventional Vessels

The "Calibration of Temperature Sensors" and "Location of Portable Sensors" documents from the country of origin should have been received at the port of entry prior to the arrival of the carrying vessel.

The document, "Calibration of Temperature Sensors", is required for all shipments and includes information regarding the loading date and location of temperature sensors within the commodity, as well as calibration correction factors for every sensor.

Check the TQAU web site (<http://treatments.cphst.org/vessels/>) to familiarize yourself with the compartment layout.

Check the documents, and any accompanying correspondence for comments relating to deficiencies noted at origin. The documents must bear the signature of an APHIS-approved official or of an authorized official of the exporting country. A list of authorized names and signatures for each country is on file at TQAU and is available upon request.

Inform shipping line officials and pier supervisors of the quarantine safeguards to be observed pending clearance. The authorized APHIS official boarding the vessel must have several calibrated thermometers.

PPQ Form 556, In Transit Cold Treatment Report

Complete PPQ Form 556, In Transit Cold Treatment Report. Record the date and time of completion of each compartment and the officer's signature on the temperature chart or log sheet. Do not add fruit to the compartment after loading has been completed.

Complete the entries on the PPQ Form 556 during the actual performance of each step of the clearance procedure. The PPQ Form 556 instructions provide for a progressive clearance in the event that treatments are not completed before a vessel sails for a second U.S. port.

The Officer responsible for a U.S. vessel is typically the Chief Engineer or Reefer Engineer. The Officer responsible for a Foreign Flag vessel is typically the Chief Officer or Captain.

Inform the ship's officer to withhold discharging the treated commodity until clearance has been completed.

Obtain the clearance officer's copy of the calibration documents from ship's officer (Record in blocks 1-6, and 10).

Proceed to the data logger with the ship's officer and retrieve a temperature printout.

Review the temperature chart.



If the initial treatment period is broken because of excessive temperatures, failure of the recorder, or improper procedure, and the treatment is later restarted, enter the date and time of restart on the second line of item 28. Air temperatures may occasionally exceed treatment temperatures during defrost cycles; however, fruit temperatures should not rise appreciably during this time and must not exceed the temperature listed in the schedule. During non defrost times, the temperatures of the air sensors should never exceed the maximum allowable treatment temperature. For each compartment of a hold, the hourly sensor printouts will be examined by a PPQ Officer at the port of entry. Based on these records, the PPQ Official will make a determination as to whether to accept the treatment as satisfactory. In case of dispute, the ultimate decision will be made by the Officer in Charge (PPQ), who will take all factors into consideration. Occasionally, for example, there are cases in which one or two sensors in a compartment mechanically malfunctioned during the voyage, due to situations beyond the ship's control (e.g., rough seas). This is generally excusable, as long as the other sensors in the same compartment showed no readings higher than the cold treatment schedule allows. If, however, the ship stopped at another port while in route to the discharge destination in the U.S., but failed to have the facility sensor(s) repaired and recalibrated, it may be considered negligence on the part of the shipping line. The fruit from such refrigerated compartments would have to be retreated (in a cold warehouse) to be eligible for entry.

If a sensor is reading consistently high, it should be tested by using the ice-water bath technique. If this sensor proves to be accurate (i.e., readings within plus or minus 0.3 °C from zero) then it must be assumed that the high readings obtained in the fruit were indeed accurate, which would be sufficient grounds for rejection. For additional evidence, the PPQ Official can also obtain independent fruit pulp readings from a hand-held portable temperature-sensing instrument in the area of the load where high readings were obtained from the ship's sensor(s).

The vessel is permitted to store logged temperatures on magnetic media instead of printed on paper. However, the stored data must be printed in the presence of the authorized APHIS official.

Assemble logsheets so that a review can be made starting at the beginning of the temperature record. Check the calibration record; compare the actual calibration readings on logsheets with the calibration data on the calibration document (Record in block 23).



Many data logger installations are programmed to record temperature variations to one-hundredth of a degree centigrade (0.01°C). With this high resolution of temperature readings, a deviation of up to three-hundredths of a degree can be expected from consecutive readings in a standard ice water test. Accordingly, calibration certifications that are acceptable under our accuracy requirements show either the average of two consecutive calibration readings or two consecutive readings that are within three-hundredths of a degree centigrade of each other. Report deviations beyond this standard.

Review the logsheets up to when the loading of the compartment was complete. Determine the maximum and minimum fruit temperature at the time the sensors were inserted (Record in blocks 24, 25, and 26).

Continue reviewing the logsheets through the precooling period to the time when treatment commenced. Note abnormalities in the temperature readings that could indicate an irregularity in the treatment process (Record in block 27).

Review the treatment portion of the logsheets for irregularities and excessive temperatures (Record in block 28).



If the initial treatment period is broken because of excessive temperatures, failure of the data logger, or improper procedure, and the treatment is later restarted, enter the date and time of restart on the second line of item 28.

Clearance Action by Authorized APHIS Official

The authorized APHIS official will:

- ◆ Release shipment for discharge if all requirements have been met and notify ship's officers, pier superintendents, and Customs and Border Protection Agriculture Inspector(s).
- ◆ Hold shipment pending further evaluation if total effects of irregularities are not consistent with treatment requirements (Contact the supervisor regarding the reasons for holding the shipment).
- ◆ Record all exceptions in narrative form and attach to the clearance report.

Inspection of Load and Compartments

Time permitting, examine the load and compartments during and after unloading. Observe sensor locations, labeling, and physical condition and report irregularities.

Distribution of Clearance Documents

After final clearance, the completed PPQ Form 556 with supporting documents are to be distributed as follows:

- ◆ Keep copies of the PPQ Form 556 and the chart printouts at the port of arrival.
- ◆ Send copies of the PPQ Form 556 to [TQAU](#).

Self-Refrigerated (Integral) Containers

Obtain the temperature printout and match it with the corresponding "Location of Temperature Sensors" and "Calibration of Temperature Probes" documents by using the container or recorder number. Check the documents and any accompanying correspondence for comments relating to deficiencies noted at origin. They must bear the signature of a PPQ Official or of an authorized official of the exporting country.

Compare the printout with the loading document to ensure the calibration factors, recorder start time, recorder serial number and recorder start date are the same. If the information is not the same, there must be proof that the equipment was exchanged and calibrated at the country of origin. Undocumented discrepancies will be cause for treatment failure.

Using PPQ Form 556, complete blocks 1-6 and 10. Record the container number in block 24. Six containers can be cleared per form.

Record the maximum and minimum fruit temperatures from the printout at time of loading (Blocks 25 and 26).

Review the temperatures and mark the printout where treatment commences at each temperature according to the appropriate treatment schedule. Determine date and time each treatment commenced (Block 27).

Review the treatment portion of the printout for irregularities and excessive temperatures (Block 28). If necessary, subtract or add correction factors to obtain the true temperature.



If the initial treatment period is broken because of excessive temperatures, failure of the data logger, or improper procedure, and the treatment is restarted, enter the date and time of restart on the second line of Block 27.

Determine the amount of time needed to complete the treatment if the treatment has not been completed, and report this to the persons responsible for the container. Check the temperature recordings to determine if the treatment has been completed at the end of the predicted completion period.

Record the last readings of the printout in Block 30. Investigate discrepancies.

Submit documentation even if the treatment was negated.

Cold Treatment in Refrigerated Warehouses

The warehouse must be approved by PPQ (see Certifying Facilities).

The shipment must move directly from the port of entry to the cold storage warehouse with no diversion or delay.

The warehouse must provide the necessary security for safeguarding each shipment.

The unloading of containers which arrive at the warehouse under seal must be conducted under PPQ supervision.

Initiating the Cold Treatment

The procedures for the verification of recording equipment and calibration of temperature sensors are the same as those outlined for vessels in [“Intransit Cold Treatment in Conventional Vessels, Self-Refrigerated \(Integral\) Containers, and Warehouses”](#) on [page-3-7-2](#), [“Initiating Intransit Cold Treatment in Vessels and Containers”](#) on [page-3-7-3](#), [“Verification of Temperature Recording Equipment”](#) on [page-3-7-3](#) and [“Calibration of Temperature Sensors”](#) on [page-3-7-5](#). These activities must be performed under the direction of an authorized APHIS official.

Arrange stowage to provide for adequate air distribution throughout the shipment, and to allow for the sampling of pulp temperatures in any desired location. To accomplish this, leave aisles between rows of pallets, with the aisles parallel to the air flow. Allow space between pallets. Double stacking of pallets is not allowed; therefore treatments will not begin until pallets are reconfigured to a single stacked pallet arrangement. However, rack systems are acceptable provided they have been approved by TQAU.

Placement of Temperature Sensors:

After loading is completed, take fruit temperatures at various locations throughout the load to determine the location of the warmest fruit. Place temperature sensors throughout the load, being sure to place sensors in the warmest areas. Under some conditions, additional air circulation will be required to cool the shipment uniformly. The use of additional fans or blowers will depend on the particular circumstances at the time of treatment.

Placement of sensors should be under the direction of an authorized APHIS official. Insert the sensor well into the fruit. The tip of the sensor must not extend through the fruit ([Figure 3-7-1 on page-3-7-7](#)). If necessary (in the case of small fruit), the sensor should

penetrate multiple fruit (Figure 3-7-2 on page-3-7-8). The number and location of the temperature sensors are determined during warehouse certification (Figure 3-7-6).

Number of Pallets	Number of Air Sensors	Number of Pulp Sensors	Total Number of Sensors
1 - 100	1	2	3
101 - 200	1	3	4
201 - 300	1	4	5
301 - 400	1	5	6
401 - 500	1	6	7
501 - 600	1	7	8
601 - 700	1	8	9
701 - 800	1	9	10
801 - 900	1	10	11
901 - 1000	1	11	12
1000 +	Must be approved by TQAU		

FIGURE 3-7-6 Number of Sensors in a Warehouse

Contact Information

TQAU

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