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Treatment Manual

Certifying Facilities

Certification of Hot Water Immersion Facilities

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Introduction

Quarantine treatment by immersion in hot water is used primarily for fruits that are hosts of tropical fruit flies. Exposing the fruit to a temperature of at least 115°F (46.1°C) for specific periods of time (depending upon the specific pest, type of fruit, and size of fruit) constitutes a quarantine treatment. The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) incorporates this principle of insect control into its regulations to facilitate the importation or interstate movement of certain fruits from areas where tropical fruit flies are the significant pests of concern.

Commercial facilities using hot water immersion treatment are subject to USDA-APHIS, certification on an annual basis. More frequent tests may be required at the option of APHIS. APHIS certification is given solely in conjunction with quarantine treatment requirements.



The certifying official shall check with the manager of the facility to be sure that he is aware of the requirement for using potable water. Whenever water comes into contact with fresh produce, the water's quality dictates the potential for pathogen contamination. To reduce the risk of food-borne illnesses, the water used for washing, treatments, and cooling must be fortified with sodium hypochlorite (household bleach), and constantly maintained at a chlorine level not to exceed 200 ppm.

Preliminary Performance Testing

If the facility has not been previously certified by APHIS, the operators should conduct preliminary, informal performance tests on their own (together with an engineer, if needed), to assure themselves that their equipment is in good working order.

By trial and error, the manager of the facility should decide on a tentative temperature set point for their tanks. This should be done by immersing one or more full baskets of fruit into each tank, to be certain that the water temperature (nearest the fruit) reaches at least 115.0°F (46.1°C) within 5 minutes. A thermostatic set point for each tank is typically in the range of 115.8°F to 116.9°F (46.6°C to 47.2°C).

As an option, some hot water immersion systems use an initial higher set point for the first several minutes, then automatically drop to a lower set point for the remainder of the treatment. (If this programming option is used, the change to the second set point must be done automatically, not manually.)

Data from the preliminary tests need not be recorded on official forms. These data, however, must be presented to APHIS, as evidence that the facility is ready for the official performance test.

Once the facility has been officially certified, APHIS does not require the facility to present preliminary performance test data in subsequent years, except when there have been major engineering changes to the equipment.

New Procedures for Hot Water Facility Certification and Commercial Testing

These guidelines have been issued to provide a more accurate reflection of the tank's coldest temperatures. They are not intended to replace existing procedures, but to be used in conjunction with the current operational framework. These guidelines are only needed for facilities **not** capturing interior probe temperatures with actual sensors and are **only** in place until each facility begins capturing interior temperatures with actual sensors. Furthermore, these guidelines will be in effect until each facility develops a procedure for placing probes in the coldest locations of the tank. Facilities already using temporary probes as a routine part of commercial testing can disregard the procedures outlined below. All new equipment and procedures must be approved by the Treatment Quality Assurance Unit (TQAU) before implementation.

Refer to the following Figure for information regarding adjusted temperatures and set points:

1	2	3	4	5	6
Tank Sensor (Lowest) (F)	Portable Sensor (Lowest) (F)	Adjusted Tank Sensor Temperature ¹ (F)	Set Point (F)	Treatment Interval (minutes)	Pulp Temperature (F)
116.0	115.9	115.1	117.0	5	78
115.5	115.4	115.1	116.0	6 - 30	78
115.3	115.2	115.1	115.5	31 - 60	78
115.1	115.0	115.1	115.3	61 - 75	78
115.0	115.0	115.0	115.0	76 - 90	78

FIGURE 6-1-1 Hypothetical Certification Results: Treatment Tank with Multiple Set Points

1 Adjusted Tank Sensor Temperature Equation:

Take the amount of temperature exceeding 115.0 from Portable Sensor (Lowest) in column 2, and subtract it from Tank Sensor (Lowest) in column 1 ($116.0 - 0.9 = 115.1$).

1. Average minimum pulp temperatures must be taken from a minimum of 5 fruit extracted from the coldest fruit before treatment. On certification day, this average pulp temperature becomes the minimum commercial treatment pulp temperature permitted. All fruit must be at or above 70°F to be hot water treated.
2. The "adjusted tank sensor temperature" is determined by taking the amount of temperature exceeding 115.0 from Portable Sensor (Lowest) in column 2, and subtract it from Tank Sensor (Lowest) in column 1.
3. During certification, establish the set point with its lowest corresponding charted temperature. Document these values on the PPQ Form 482, Certificate of Approval and an attachment in the format of [Figure 6-1-1](#).
4. The [Figure 6-1-1](#) attachment and PPQ Form 482 must be displayed in a prominent location at the facility.
5. During commercial treatments, the "Adjusted Tank Sensor Temperature" is used as the lowest treatment temperature. The commercial treatment fails if the tank temperature is below the "Adjusted Tank Sensor Temperature"

Mango temperatures prior to treatment

During certification, determine and record an average pulp temperature (prior to treatment). Calculate this averaged pulp temperature by averaging pulp temperatures from the 5 "coldest" mangoes before treatment (mangoes extracted from the coldest

locations). This temperature becomes the minimum pretreatment pulp temperature allowable for commercial treatments. Therefore, during subsequent commercial treatments, mangoes must be at or above this minimum temperature before beginning treatment. (Any fruit below 70°F cannot be treated per manual requirements).

Permanent probe temperatures

During certification, record from the printout/chart each set point with its lowest corresponding charted (permanent probe) temperature. A treatment tank may have one set point or multiple set points. If the tank has multiple set points, these set points are for a fixed length of treatment time. Refer to [Figure 6-1-1](#) for a detailed explanation. This "adjusted tank temperature sensor" (always above 115.0°F) becomes the lowest temperature permitted for that set point, or the "standard" at that set point. Commercial temperatures (permanent probe temperatures from the chart/printout) must be equal to or greater than the set point standard for each length of time. Document each "adjusted tank sensor temperature" determined during certification, on the PPQ Form 482, Certificate of Approval and on the attachment to the Certificate.

Procedures for Conducting the Annual APHIS Performance Test

To approve the facility, the APHIS officer (or designated representative) shall take the following steps:

- 1.** If the facility has not been previously certified, or if modifications have been made since the last performance test, compare the plans and drawings with the actual installation.

Clearly show dimensions, water circulation, temperature sensing and recording systems, and safeguarding precautions in the plans and specifications.

- 2.** Conduct a performance test (at least annually), during an actual treatment (as described below), to determine (or verify) a temperature "set point" for the system, and to determine the minimum duration of time required between the immersion of successive baskets of fruit within the same tank.
- 3.** Inspect the heating, water circulation, and alarm systems, and check to see that all necessary safeguards (including screens, fans, locks, and air curtains) are secure and operational.
- 4.** Calibrate the portable sensors, recording the results on APHIS form 205 (or a plain sheet of paper).

- A.** Using a factory-calibrated, glass mercury thermometer as the standard, compare the reading of each portable sensor to the standard, and record any deviation.
 - B.** To facilitate this process, a specially designed, portable temperature calibrator may be used, which uses either hot air or a swirling hot water bath, set at approximately the temperature at which treatments will take place; a treatment tank can also be used for this purpose, provided that the water is kept in motion.
- 5.** Examine the calibration of the tank's permanent RTD sensors, and record the results on APHIS form 206.
- 6.** Tape the cords of three or four portable "water temperature sensors" to the skins of three or four selected fruits in each basket. (Do not cover the end of the sensor with tape.)
- 7.** Insert a portable "pulp temperature sensor" approximately one centimeter into the flesh of one or more fruits in the tank.
 - A.** Hold the sensor in place with tape.
 - B.** *It is not necessary to have a pulp temperature sensor in each basket.*
- 8.** Set the fruit at ambient temperature (70°F or above) immediately prior to the performance test.

If the fruit is pre-warmed by artificial means, note this routine as a condition of approval that should be followed for each commercial treatment.

- 9.** On the location diagram (APHIS form 207), show the relative position of each portable sensor used in the test, and indicate whether it is a "water" or a "pulp" sensor. Number each sensor.
- 10.** While the fruit are immersed in water, use an electronic thermometer to monitor the temperatures of each portable sensor at various times throughout the test. (record this information on APHIS form 208 for each tank.)

As a second option, a portable, automatic recording instrument can be used; it must, however, operate independently from the temperature recording system installed at the facility.

- 11.** During the performance test, lower the baskets of fruit into the hot water immersion tank.
 - A.** Closely monitor the "water temperature sensors" during the first five minutes of treatment.

APHIS requires that the temperatures of all “water temperature sensors” must reach at least 115°F (46.1°C) within 5 minutes; if not, in order to achieve the 5-minute temperature recovery requirement, repeat the test using other fruit, using a slightly higher water temperature set point, and/or a slightly longer time interval between subsequent basket immersions.

- B.** Run the test for the full duration (up to 90 minutes, depending upon fruit size).

During that time, all “water temperature sensors” must read at least 115°F (46.1°C) at the 5 minute point and beyond; in addition, the “pulp temperature sensor” (or sensors) must read at least 113°F (45°C) *by the end of the test*.



It should be noted that APHIS standards for passing the official performance test are higher than the standards accepted for commercial treatments. This is intentional. *During commercial treatments* of mangoes, the water in the tank is allowed up to 5 minutes to reach the minimum treatment temperature of 115°F after the fruit have been submerged.



The mango hot water schedules also have a built-in tolerance for subnormal temperatures in the range of 113.7°F to 114.9°F for up to 10 minutes (in the case of 65 or 75-minute treatments), or 15 minutes (in the case of 90-minute treatments). This tolerance was designed to “save” an ongoing treatment during an emergency situation such as an electrical power outage. However, *for purposes of the official performance test*, all water temperature sensors are required to read at least 115.0°F within the first 5 minutes, and to maintain temperatures at or above that threshold during the remainder of the treatment.

- 12.** For issuance of a Certificate of Approval (PPQ form 482), submit all supporting documents to the APHIS-Regional Office (or to another APHIS office delegated by the Region).
- 13.** APHIS will certify the facility only when all requirements are met, including *two* successful hot water immersion treatments in each tank, using standard fruit loads.

For annual recertification, however, only *one* successful performance test is required per tank, unless the Work Plan requires additional tests. Submit a copy of PPQ Form 482, the corresponding attachment ([Figure 6-1-1](#)), all forms used in the certification or recertification and printouts from the temperature recorder to [TQAU](#).

List of Possible Remedies When a Hot Water Immersion Tank Fails Its Performance Test

Remedies *Not* usually requiring an engineer to implement

Cages (baskets) holding the fruit:

- ◆ In tanks that use more than one basket (cage), submerge the cages of fruit in a different order, e.g., leaving vacant water space between subsequent cages
- ◆ Require a longer period of time between submerging each basket (e.g., 15 minutes instead of 8)
- ◆ Operate the tank at less than full capacity, including:
 - ❖ Immerse fewer baskets at a time
 - ❖ Immerse fewer crates per baskets
 - ❖ Fill crates less full

Temperature measurement:

- ◆ Require a higher thermostatic set-point
- ◆ Recalibrate or replace any faulty sensors (permanent sensors in the tank, as well as portable sensors used in the performance test)

Remedies Usually Requiring an Engineer to Implement

- ◆ Replace the existing boiler with one that has a higher capacity. (1,000,000 BTU is typical for large multibasket tanks)
- ◆ Redesign the baskets or crates to allow a greater water flow around the fruit
- ◆ Increase the blade size, number, and speed (rpm) of the propellers used in water circulation, and change their position within the tank
- ◆ Increase the diameter and change the location of water delivery pipes

At least three copies of the plans and drawings must be submitted; the ministry retains one copy and forwards two copies to APHIS.



Important

APHIS will return (without action) any unsolicited plans that are received directly from exporters or engineering firms. Correct protocol requires that all proposals, plans and drawings must be submitted through, and be recommended to APHIS by the Ministry of Agriculture. The two copies that APHIS receives should either be written in English, or have an English translation attached.

7. The APHIS Area or Regional Office considers the accessibility of the location proposed for facility construction; depending upon availability and workload of trained APHIS inspectors required to monitor treatments, APHIS sets a limit on the number of facilities it will be able to monitor in each country.



Important

The ideal location for a hot water immersion treatment facility should be near an international airport or seaport, and not far removed from production areas. Availability of adequate temporary lodging for an APHIS inspector (PPQ Officer) should also be considered.

APHIS Area or Regional Office corresponds with the fruit exporter applicant and engineering firm, as needed, keeps a file copy of each proposal, and submits (for technical comment) a second copy to **TQAU**.

8. Specialists at **TQAU** analyzes the plans and drawings for technical compliance with APHIS requirements, and corresponds, as needed, with the engineering firm and exporter applicant.

TQAU notifies the APHIS Area or Regional Office that plans are technically approved or need modification.

9. APHIS Area or Regional Office notifies the potential fruit exporter applicant and the host country government that the proposed plans are technically approved or disapproved, and what modifications are needed, if any.



Important

Once APHIS has granted approval to begin construction, APHIS may later revoke approval if the applicant has not completed construction within two years. In that case, the fruit exporter applicant may initiate another application, but must start the entire approval process over.

10. Engineering firm and potential fruit exporter applicant make any required modifications on the equipment, and notify CPHST and the APHIS Area or Regional Office when this has been accomplished.

- A.** The applicant will request an official visit for the purpose of inspection, testing, and certification; included in the request should be a proposed time frame.
- B.** The applicant can call APHIS for an inspection when construction is 75% complete (this is optional, not required).



In selected cases, a specialist from CPHST will be dispatched to conduct the inspection and initial performance testing. This requires advanced notice to arrange for preparation of the travel authorization, passport, visa, country clearance, and airline tickets. *All costs, including salary, per diem, and travel shall be charged to the trust fund, which shall be paid in advance by the fruit exporter applicant. In cases in which the equipment being installed is judged not to be unique, then another authorized APHIS official shall be assigned this duty.*

- 11.** The APHIS Area or Regional Office confirms that all agreements are properly signed and the trust fund is in place, then notifies CPHST of the proposed date for official inspection and performance testing of the new facility.
- 12.** CPHST acknowledges the proposed date, or proposes a different date that would be mutually convenient, and takes steps to secure the needed travel documents.

CPHST requests the exporter or engineering firm to do at least one preliminary performance test on its own; instructions will be provided, as needed (note: the notification to CPHST must come from the appropriate APHIS office, and not from the engineering company or facility manager).

- 13.** Engineering firm or exporter sends the results of its preliminary performance test to the APHIS Area or Regional Office, who may, if necessary, fax copy to CPHST.

APHIS officer need not be present to oversee a preliminary performance test.

- 14.** Upon receiving the data from the preliminary performance test, APHIS and CPHST analyze the data to determine acceptability. If acceptable, APHIS then sends an officer to serve on temporary duty at the new facility.
- 15.** Two or more official performance tests are conducted at the hot water immersion treatment facility, under the on-site direction of an APHIS inspector or a specialist from CPHST. These tests will require the following:
 - A.** The presence (on site) of a representative of the engineering firm that constructed the facility.

- B.** Several packinghouse employees (including at least one who speaks English), including a forklift operator, a hoist operator, someone to monitor the temperature recorder, and a crew to load and unload baskets, weigh fruit, monitor the stopwatch, and assist in the placement and removal of portable temperature sensors.
- C.** Enough fruit to run two or more tests (per tank) at full-load capacity. The fruit should be of uniform size and shape.
- D.** Two dozen portable temperature sensors with leads at least 10 ft. in length, and a hand-held digital thermometer (or computerized recording system), an accurate scale for weighing individual fruit, and an immersible certified calibrated glass thermometer for reading water temperatures.
- E.** Pending the outcome of the inspection and performance tests, the new facility may be certified. An official Certificate of Approval (PPQ form 482) will be issued by the APHIS Regional or Area Office, or by the APHIS officer on site.



Important

Fruit used during the performance tests must be adequately safeguarded if they are to be exported to the U.S., but shipment must await the arrival of the assigned APHIS inspector, who will issue the preclearance document (PPQ form 203) to accompany each shipment. If this is impractical, then these fruit may be sent to other markets.

- 16.** The APHIS officer supervising the official performance tests notifies (by telephone) the APHIS Area or Regional Office of the results (pass or fail). In case of failure, the operator of the facility should make the required adjustments or improvements, then call APHIS to conduct another official performance test at a later date.
- 17.** Assuming that the performance tests were successful, the following chain of events will quickly occur.
 - A.** The APHIS Area or Regional Office notifies the Preclearance Coordinator (USDA, APHIS, PPQ, Quarantine Policy, Analysis and Support (QPAS), Riverdale, Maryland) of treatment facility approval.
 - B.** The Preclearance Coordinator notifies the Permit Unit, (PPQ, APHIS, Riverdale, Maryland) of treatment facility approval.
 - C.** The Permit Unit notifies (by electronic mail) all PPQ field offices at U.S. ports of entry. Ports expected to receive immediate shipments may be notified by telephone. The Permit Unit also issues any pending permits to the respective fruit importer(s) in the U.S.

- D.** APHIS will dispatch an inspector to monitor hot water immersion treatments of fruit for export to the U.S. PPQ inspectors are generally assigned to this duty on a 30 to 60-day rotating basis.
- E.** The PPQ inspectors' salary, transportation, and living expenses are borne by the fruit exporters, through a formal trust fund agreement arranged in advance. All commercial treatments and shipments to the U.S. must be done under the monitoring of the inspector assigned to a particular treatment facility (or to 2 or more facilities located within 5 km of one another).



Important

In countries that have special agreements with the U.S., including Mexico and Haiti, APHIS may hire and train a local national to monitor treatments. In the special case of Puerto Rico, where APHIS has a large presence, local PPQ Officers will be assigned to monitor. In other countries, an inspector from the U.S. will be sent on temporary duty.



Important

APHIS may temporarily withdraw its inspector from a facility for many valid reasons including the facility's failure to comply with instructions, or attempting bribery. The inspector may also be withdrawn for reasons of personal safety, including threats, civil unrest, a disease epidemic such as cholera, or a natural disaster.

- F.** The inspector who monitors the performance tests will depart after this task has been accomplished. Upon request, however, he/she may remain on site for another day, if needed, to provide a smooth transition for another inspector newly assigned to the facility.



Important

APHIS is a regulatory agency of the U.S. Department of Agriculture. We are not a funding agency and cannot become involved in financing proposed commercial ventures. Financial arrangements are the sole responsibility of the exporter in cooperation with his investors.



Important

APHIS reserves the right to limit the number of hot water immersion treatment facilities which are approved in each country.

Address for Technical Contact

TQAU

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