NSPM-15

Guidelines for Certification of Hot Water Immersion Treatment Facilities for Mango Fruits

Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation
Directorate of Plant Protection, Quarantine & Storage
N.H-IV, Faridabad-121001

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Contents

Endorsement

This standard entitled **'Guidelines for Certification of Hot-Water Immersion Treatment Facilities'** provides necessary guidelines for minimum requirements and procedures for certification of hot-water immersion treatment facilities used primarily for quarantine treatment of certain kind of fruits that are hosts for fruit flies so as to facilitate the export of fresh fruits in compliance of phytosanitary requirements of specified countries.

This standard is approved for adoption on 12th May 2005 by:

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Review & Amendment

This standard would be subject to periodic review and amendment by Plant Protection Adviser (PPA) and updated and revised, if necessary. The standard holder should ensure that the current edition of this standard is being used.

Control & Distribution of standard

The master copy of this standard shall be held with PPA and controlled copies would be distributed by Joint Director (PQ), Directorate of Plant Protection Quarantine & Storage, Faridabad to the National/Regional Plant Quarantine Stations; and APEDA as listed below and to any other organization, to whom the distribution has been approved by the PPA. Any clarifications/enquiries regarding this standard would be made to the Joint Director (PQ), Dte of PPQS, Faridabad-121001**.**

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Introduction

Scope

This standard describes the guidelines and procedures required for certification of hot water immersion treatment facilities for fresh fruits of mango, as a quarantine treatment against fruit flies, to facilitate their export in compliance with phytosanitary requirements.

References

USDA. 1998. Treatment Manual. United States Department of Agriculture, Animal & Plant Health Inspection Service, USA (Revised up to 2005).

Definitions & Terms

Authority	An individual or organization entrusted with the responsibility for granting approval and certification of hot water immersion treatment facilities.
Pulp temperature	Temperature recorded at the center of fruit with the help of sensor inserted into the pulp of the fruit.
Quarantine area	An insect-proof exclusive area, where treated fruits are kept remaining until loaded into shipping container.
Quarantine pest	A pest of potential economic and/or environmental importance to an area where it is not yet present, or is present but not widely distributed and being officially controlled.
Quarantine treatment	Any kind of treatment that is applied for quarantine purpose for elimination of pest in accordance with phytosanitary regulations of the importing country.
Schedule	Refer to the pulp temperature raised using water heated to between 46.1-47.8 ^{0}C for a prescribed period of time
Treatment	Any treatment applied to a commodity to eliminate the pest and shall include fumigation, irradiation, hot-water, hot air, vapour-heat and cold treatments

Outline of Requirements

This standard describes the procedures for certification of hot water immersion treatment facilities for treating fresh fruits of mango against fruit flies in compliance with phytosanitary requirements. Hot water treatment facilities are primarily used for treating tropical fruits against treptidae fruit flies. In this treatment the fruits are exposed to a temperature of at least 46.1-47.8 ^{0}C (115^0 and 118^{0}F) by immersing in heated water for a specified period of time depending upon the specific pest, type of fruit (species/variety) and size of fruits. It is further essential to maintain constant and uniform temperature during the period of treatment to ensure effective treatment. The certification process involves the submission of proposals to the Dte of PPQS and initial approval of plans and design of facility by the Plant Protection Adviser (applicable in case of new facilities).

The standard prescribes the checklist of minimum requirements for certification of facility and also the requirements of preliminary performance testing by the operator of facility on their own or with the help of engineers (if the facility is not previously approved). Further it describes the procedures for conducting official performance test for certification by the officers of Dte of PPQS and annual re-certification and the operational requirements of the facility.

1. General Requirements

1.1. Authority

The Plant Protection Adviser to the Government of India, Directorate of Plant Protection, Quarantine & Storage, N.H.IV., Faridabad (Haryana) shall be the competent authority to approve and certify the hot-water immersion treatment (HWT) facilities for undertaking quarantine treatment of tropical fruits against fruit flies. PPA may refuse certification of the facility, if in his opinion safety deficiencies such as open motors with exposed gears, un-protected fan belts within 2 metres (6ft) from the floor level; exposed control panel; and that temperature measuring and monitoring equipments on testing did not guarantee required level of accuracy.

1.2. Registration Protocol

All applications for certification of hot water immersion treatment facilities shall be made to the Plant Protection Adviser in the prescribed form (**Appendix-1)** in duplicate along with the requisite information as per data sheet (**Appendix-2**) and accompanied by a bank draft for Rs. 2000/- drawn in favour of 'Accounts Officer, Dte of PPQS., Faridabad' towards registration fee. The applications would be scrutinized and those duly completed in all respects would be registered by the PQ Division of Dte of PPQS, Faridabad-121001. PPA, if satisfied with the information provided by the applicant, shall order a preliminary inspection of the facilities with in one month from the date of registration.

1.3. Treatment Schedules

The facility shall under take all the treatment operations as per schedules approved by the Plant Protection Adviser. The time-temperature relationship varies with the commodity and pest. Usually, the pulp temperature of the fruit raised using heated water between 46.1-47.8 ^{0}C (115^0 and 118^{0}F) for prescribed period of time.

1.4. Approval of the Plans & Drawing of the Facility

Prior approval of the plans & drawings of the facility by the Plant Protection Adviser shall be required in the case of new facilities to ensure that the minimum requirements of certification prescribed in the Standard are met with. However, such prior approval of the plans and drawings shall not be required for the hot water immersion treatment facilities that have been established prior to adoption of the Standard. However those facilities must meet the minimum requirements of the standard for certification. Any proposed changes or improvements such as installation of additional treatment tanks, adding cold storage room and changing the temperature recorder, boiler and replacing the temperature sensors shall be made only with the written approval of the Plant Protection Adviser.

1.5. Check list of Minimum Certification Requirements

1.5.1. Location, construction & design of facility

The location, construction and design of the facility should be as per the safety norms and standards prescribed by the concerned local Authority and as per approved plans and drawings of the new facility. However it is preferred to have the facilities integrated with package houses or located near to the ports. Dte PPQS does not provide any construction details of facility, but only the checklist of minimum requirements of facility for certification.

There are two basic designs of the facility, which shall include the batch system and the continuous flow system.

1.5.1.1. Batch system (Jacuzzi system)

In this system, baskets of fruits are loaded into a platform, which is then lowered into the hot water immersion tank, where the fruits are held at prescribed temperature for a certain length of time, then are taken out, usually by means of an overhead hoist. In this system, the treatment chart must indicate (by an identifiable marking) when a fruit basket is prematurely removed from the tank. Other alternatives include a solenoid switch, sensor or similar device that disengages whenever a basket is removed from the treatment tank, or a locking device to make it physically impossible to remove the fruit until the treatment is fully completed.

1.5.1.2. Continuous flow system

In this type of system, the fruit are submerged (either loosely or in wire or plastic mesh baskets) on a conveyor belt, which moves slowly from one end of the hot water tank to the other. Belt speed is set to ensure that the fruits are submerged for the required length of time. This system requires an instrument to monitor the speed of the conveyor belt. This can be accomplished by attaching a speed indicator (encoder) to the gear mechanism. The belt speed is recorded on the same chart as the time and temperature, and also indicates whether the belt is moving or stopped during the treatment cycle. Smaller fruits require less treatment time than larger fruits. Therefore, conveyor belt speed should be adjustable to accommodate treatments of different lengths of time. As an alternative, the belt speed may remain constant, but the length of the submerged portion of the belt is adjusted according to the length of treatment time required for the particular size of fruit. The conveyor must prohibit either forward or backward movement of the fruit during treatment (due to flotation).Some operators believe that treating fruit while it passes through the system on a conveyor belt is an advantage. However mechanical fruit damage (scratching of the peel) often occurs, if the fruits are not in baskets. The system also occupies much more floor space in the plant than a batch system.

1.5.1.3. Water Quality

The facility shall be located at a site, which has assured supply of potable water. The water used for washing, dipping, or showering the fruit should be chlorinated, and maintained at a level of 50 to 200 ppm to prevent the microbial contamination of fruit at the facility. Also, hydrocooling tanks must be chlorinated to the same level. This level is easier to maintain if the water is first filtered and run through a flocculation process to remove organic material, which would otherwise bind with the chlorine.

Water should be sampled regularly for microbial contamination. Water should be changed, as necessary, to maintain sanitary conditions. Standard operating procedures should be implemented to include water change schedules for all processes that use water. In addition, surfaces that come into contact with water, such as wash tanks, hot water tanks, and hydrocooling tanks should be cleaned and sanitized as often as necessary to ensure the safety of the produce. Equipment designed to assist in maintaining water quality, such as chlorine injectors, filtration systems and back flow device's, should be routinely inspected and maintained to ensure efficient operation.

1.5.2. Requirements of Electrical/Electronic Components

1.5.2.1. Wiring

Electrical wiring throughout the facility must meet the safety norms of local authority concerned. Earth grounding is required for all electrical wiring located in the vicinity of water, to eliminate shock hazard. Wires must be concealed inside metal or PVC conduit to prevent damage.

1.5.2.2. Computers and microprocessors

These shall be located in a climate-controlled (air-conditioned) room, to maintain accuracy and reliability. This room shall be raised above tank level, and provide a clear view of the treatment tank(s), and be capable of being locked. This room may also serve as an office for the phytosanitary inspector.

1.5.2.3. Commercial line conditioner (surge protector)

The computers and microprocessors must be provided with surge protector, to provide protection from voltage irregularity (power surges), noise reduction, and harmonic distortion.

1.5.2.4. Diesel power generator

A suitable diesel power generator should be provided for use as a back-up power supply, in the event of a power outage, to provide a secondary source of electricity to enable continued operation of the plant.

1.5.2.5. Fruit Sizing Equipment

The facility should have a fruit sizing equipment (electronic) with an accuracy of +or- 25 gm for sorting out different sized fruits, since no more than 10% of the in any batch are allowed to weigh more than the maximum weight for their particular weight class. The inspecting PQ officer shall periodically record the weights of 100 fruits in a particular batch that has been sorted prior to treatment to be sure that the accuracy of the sizing equipment stays within these parameters. If the weight range is too broad, some calibration adjustment will be required on the equipment. Since it is possible for the immature stages of fruit flies to survive in fruit that are under-treated for their weight, it is especially important to assure that all fruits are sorted accurately into precise weight classes, as required by the treatment.

1.5.3. Boilers and Thermostatic Controls

1.5.3.1. Specifications of Boilers

The hot water treatment facility must have a boiler with adequate water heating capacity and thermostatic controls. A boiler used for the purpose of heating the water in a two-tank batch system must have an output rating of approximately 1,000,00 BTU, or 30 horsepower.

1.5.3.2. Thermostatic controls (set point)

The hot water treatment facility should have automatic thermostatic controls accurate enough to hold the water temperature at or above the temperatures prescribed in the treatment schedule for the given duration of time. The temperature set point(s) will be determined and approved during the official performance test, and shall be high enough to ensure that the water in the treatment tank will meet or exceed minimum treatment temperature prescribed for the fruit. Once approved, the temperature set points may not be tampered with. Temperature set points shall remain constant for the entire shipping season. However, if the operator of the facility requests a change in set points, the inspecting officer of Dte PPQS shall conduct a new performance test. If this test is unsuccessful, then the operator shall revert to using prior set points. The treatment provider shall have option to use two set points (multiple option) for each tank. In this type of system the initial dip temperature (set point no. 1) is set slightly higher for the first 5 minutes. The second set point is the temperature to be maintained for the remainder of the treatment. This must be verified during the official performance test, and the same procedure must be repeated on each subsequent commercial treatment. However, this arrangement makes it easier for the tank to pass its performance test. This system works only for tanks that treat only one cage (basket) of fruit (basket) of fruit at a time.

1.5.3.3. Water Circulation System

The facility shall have a water circulation system installed in the tank, to provide uniform water temperatures throughout the treatment process and avoid the formation of cool pockets during treatment. The controls for the circulation pumps or propellers shall be tamper-resistant, to guarantee that the equipment is not turned off during the treatment process. Pulleys on all pumps located within 6 feet of the floor shall be concealed for the safety of personnel working in the area. Temperatures recorded from the various sensors shall not vary by more than 1°C at any given time after the fruit have been immersed for the first 5 minutes of treatment. The fruit must be kept at least 10.2 cm (4 inches) below the water surface during the treatment, by use of a flotation barrier.

Note: - Tanks are not allowed to have any set point that is lower than the standard treatment temperature for the commodity being treated (46.1°C (115^{0}F) in the case of mangoes).

1.5.4. Temperature Sensors

1.5.4.1. Type of sensor

The facility shall have Platinum 100-ohm resistive thermal detectors (RTD sensors) installed permanently in the lower third of the tank. The sensor unit shall be located within the distal 2.54 cm (one inch) of the sensor rod. The sensor shall have an outer sheath of 6.4 mm (0.25 inch) in diameter or less.

1.5.4.2. Number of sensors and their placement

The minimum number required shall at least 10 per tank for continuous flow systems, which must be spaced throughout the length of the conveyor. For batch systems, the requirement is at least two sensors

per tank. However, in tanks that treat multiple baskets (cages) of fruit there must be at least one sensor per basket position.

Note: - A tank with 4 basket positions, for example, would require at least 4sensors. In both the batch and continuous flow systems, sensors shall be installed in the lower third of the tank.

1.5.4.3. Tank access for temporary placement of portable sensors

The hot water tank must be designed to accommodate the temporary placement of numerous portable sensors or probes to be used during the performance testing procedure required for certification or re-certification. During the testing procedure, the temporary sensors shall be positioned throughout the load of fruit, at the direction of the inspector who conducts the performance test. The facility is required to purchase and have available, 24 portable thermistor or thermocouple sensors (each with its own flexible cord at least 3 metres (10 ft). in length), and a portable temperature monitor which reads to the nearest one tenth of a degree.

1.5.4.4. Certified glass-mercury thermometer

The treatment facility is required to have at least one high-accuracy, water-immersible, certified Centigrade glass-mercury stick thermometer on the premises at all times. This thermometer shall be accurate to 0.1°C (or °F), and will cover the range between 45°C (113 °F) and 47.8°C (118 °F). It will be used as the standard against which all sensors are calibrated. Normally, one glass thermometer is left hanging in each tank during the performance testing procedure.

1.5.5. Temperature Recorder

An automatic temperature recorder (strip chart or data logger) shall be used to record the time and temperature during each treatment.

1.5.5.1. Automatic operation

The instrument used for recording the time and temperature must be capable of automatic operation whenever the hot water treatment system is activated.

1.5.5.2. Long-term recording

The recording equipment must be capable of non-stop recording for an extended period of time. Continuous flow systems must require recording equipment capable of operating for upto twelve consecutive hours.

1.5.5.3. Recording frequency

The time interval between prints will be for every two minutes. Alternatively, a strip chart system may be used which gives continuous color pen lines. The numerical print or pen line representing each temperature channel (sensor) must be uniquely identified by color, number, or symbol. It is not necessary to record temperatures from sensors located in portions of the tank not in use.

1.5.5.4. Accuracy

The combined accuracy of the entire temperature recording system (i.e., sensors, controllers and recorders) must be within 0.3 °C (0.5 °F) of the true temperature (as verified by a certified centigrade glass mercury thermometer).

1.5.5.5. Repeatability

The recording equipment must be capable of repeatability to within 0.l°C of the true calibrated readings when used under field conditions over an extended period of time. Failure to maintain reliability, accuracy and readability in a previously approved instrument will result in cancellation of approval. The design construction and materials used shall be such that the typical environmental conditions (including vibration) will not affect performance.

1.5.5.6. Calibration

The temperature sensors must be individually calibrated against a certified Centigrade glass mercury thermometer reading in tenths of a degree Centigrade, within the range of 45° to 47.8°C (113 °F to 118°F). The engineering firm that installs the recording equipment shall also calibrate it. (Calibration equipment often used for this purpose includes, for example, a Decade instrument and relay range cards.) The calibration procedure should be done at or near the fruit-treatment temperature around 46.1°C (115°F), but not at 0°C (32°F)..

1.5.5.7. Temperature Range

The temperature recorder must be programmed to cover the entire range between 45 ° to 47.8 °C (113 °F to 118 °F), with a resolution of one-tenth of a degree. The range should not extend below 37.8°C (100 °F) nor above 54.4°C (130°F). If the range band of the recorder is wider than this, it must be restricted (narrowed) by proper programming.

1.5.6. Alarm System

An alarm is required for all batch (Jacuzzi) systems. In order to notify packing house employees that a treatment has been completed for a particular basket (cage), an alarm system must be installed. This system may be an audible noise (such as a horn, buzzer, or bell), or a highly visible light, attached to a timing device located on the equipment that indicates time and temperature. Some facilities use both a noise and a light. The alarm system alerts the operator of the hoist to remove a basket from the tank at the end of treatment, to avoid "over-cooking."

1.5.7. Safeguarding the Treated Fruits

1.5.7.1. Layout and flow pattern

The flow pattern of the fruit moving through the hot water treatment process should be so designed that fruit waiting to be loaded into the hot water immersion tank cannot become mixed with fruit that has already completed treatment. A drawing that shows the proposed layout of the packinghouse shall be submitted to Dte of PPQS for approval.

1.5.7.2. Garbage disposal

Cut fruit, culled fruit, rotting fruit, and miscellaneous garbage shall be placed into covered containers and removed form the premises daily, in order not to attract fruit flies.

1.5.7.3. Quarantine area

Treated fruit must be brought to an insect-free enclosure immediately after treatment, and must remain there until loading into insect-proof shipping containers. The designated enclosure is usually a screened room. Packing line equipment, hydro cooling equipment, and a cold storage room (if any), should be located in this area. Effective procedures shall be enforced to prevent the movement of untreated fruit (accidentally or intentionally) into the insect-free quarantine area.

1.5.7.4. Insect-proof screening

The facility shall have the doors/windows/ventilators provided with insect-proof netting (at least 100 meshes per square inch) to exclude fruit flies. It must be inspected regularly and repaired as often as needed.

1.5.7.5. Air curtain

An air curtain (such as fans or blowers and associated air-directing chambers or enclosures such as baffles, boxes, etc.) shall be located on the wall or ceiling prior to entering any quarantine area. This device shall exclude the possible entry of fruit flies into the insect-free enclosure. Vertically hanging, clear plastic flaps are required at the doors to the insect-free enclosure as a minimum.

1.5.7.6. Loading of treated fruit

Doors leading from the quarantine area to the loading dock shall be kept closed when not in use. When loading, truck vans and containers shall form a fly-proof seal with the exterior wall. Truck vans and containers shall be inspected and disinfected prior to loading. If wooden pallets are used, they must be completely free from wood-boring insects and debarked in compliance with ISPM-15. A numbered Dte PPQS seal shall be applied to each container before its departure.

1.5.8. Pre-treatment Warming Options

Pre-warming the fruit is sometimes desirable in order to meet the Dte PPQS requirements that all fruit pulp temperatures must be at least 20.1°C (70°F) before the commencement of treatment. This will ensure that the required minimum treatment temperature of 46.1°C (115°F) shall be achieved within the first 5 minutes of treatment The requirement of having fruit at or above 20.1°C (70°F) in the case of mangoes prior to hot water treatment may not be met (a) when the fruit have come directly from a refrigerated room, (b) when the weather is rainy or cloudy, or (c) in the early morning hours. These conditions may cause a treatment facility to close temporarily until the fruit pulp temperature has warmed sufficiently to allow treatment. It is the usual practice at many facilities to use the hoist to hang a basket of fruit a few inches above the surface of the hot water tank prior to submerging it. However, except for the bottom layer of fruit in the basket, the fruit do not absorb a sufficient amount of heat to make this a practical means of pre-warming the entire basket load. To accelerate the pre-warming process, several viable options are available. Dte PPQS suggests the following methods for pre-treatment warming:

1.5.8.1. Treatment Tank

In tanks that treat a single basket (cage) of fruit at a time, pre-heating may be accomplished within the tank itself, by use of a timer or delay switch. (The extra time in the water is not considered as part of the treatment, but is in addition to the treatment.) This approach, however, is not feasible to use in a multi-basket tank (in which the baskets enter the tank at different times), and is not an approved option in this instance.

Alternatively a separate hot water tank may be used for pre-heating purposes or hot air may be blown onto the fruit or the fruit may be placed in a heated room.

1.5.9. Post-treatment Cooling Options

Cooling the fruit after hot water treatment is not a requirement of Dte PPQS. However, from the stand point of fruit quality, many facilities choose to install a system to cool the fruit after removal from the hot water to extend storage life and prevent softening.

1.5.9.1. Refrigerated room

Hot water-treated mangoes may not be moved directly to a refrigerated room until at least 30 minutes following treatment. Allowing the fruit to simply stand for at least 30 minutes after removed from the hot water tank is thought to be helpful in killing immature stages of fruit flies, because the mangoes complete their "cooking" process during that time. The recommended storage temperature for mangoes is 12.8°C (55°F) to 13.9°C (57°F) at 85 to 90% relative humidity. This delays softening and prolongs storage life to approximately 2 to 3 weeks.

1.5.9.2. Fans

Dte PPQS allows the use of fans in the screen room to blow air over the fruit as soon as they are removed from the hot water tank (if desired). However, the ambient air must not be less than 20.1°C (70°F).

1.5.9.3. Hydro-cooling

Dte of PPQS allows the use of a cool water tank or shower system, but with the following provisions: Hydrocooling (either by showering or water immersion) is optional. However, it may not be done until a waiting period of at least 30 minutes has elapsed, after the fruit have been removed from the hot water tanks. During the waiting period and hydrocooling period, the mangoes must be safeguarded in a room or tunnel, separate from the hot water tanks. Water temperature used during hydrocooling is not regulated. However, if it is too cool (below 18°C (65^0F), it may cause some of the fruit to split their skins, making them unmarketable. Water used for hydrocooling should be chlorinated (50 to 150 ppm). Any other chemicals, such as fungicides, are optional, but must be approved by the Dte of PPQS.

1.5.9.4. Safety and Health Checklist

- An adequate lavatory.
- Fire extinguisher, located near the boiler.
- First-aid kit, located near moving machinery.
- Hard hats for use by workers and visitors in the treatment and

- loading areas. (This is optional if not required by local regulations.)
- Approved safety ladders or walkways (catwalks, etc.) for use in observing treatment tank operations.
- Electric power must meet safety code requirements. Electrical wiring, including switches and other connections, shall be contained in metal or PVC conduit, and grounded to prevent electrical shock.
- Steam and hot water pipes shall be insulated or otherwise protected.
- Sufficient lighting shall be provided in working areas.
- Engines, pulleys, drive belts, and other hazardous moving parts, if located within 6 feet of floor level, shall be guarded with a safety shield or barrier
- The admission of children or unauthorized persons into the treatment and packing areas shall be prohibited, if not accompanied by a responsible employee.
- Dirty water in the tanks is a health concern, as well as an embarrassment to the operator. The Dte PPQS inspector can provide advice on how often the water should be changed. In addition, Dte PPQS recommends that operators should install a light sensor in each tank, to monitor the turbidity of the water.

1.6 Responsibilities of approved facility

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The approved facility shall be responsible:

- to carry out all treatment operations through a qualified operator and comply with the requirements of the standard;
- to not to tamper with temperature set points set by the inspecting officer of Dte of PPQS during the official performance test;
- to maintain the equipments in good working condition and ensure periodical calibration of temperature sensors, control instruments and recorders;
- to maintain proper records of all treatment operations carried out at the facility including the data logs or temperature record sheets or diskettes;
- to ensure that all treatments of fresh fruits carried out as per treatment schedules approved by the Plant Protection Adviser;
- to abide by the instructions and guidelines issued by the PPA from time to time and extend all the cooperation and necessary arrangements to the inspecting officers of Dte of PPQS for carrying out performance tests and audit checks of the facility;
- .to not to make any alterations or changes in construction & design of facility or equipments without written approval of Plant Protection Adviser;

- to undertake proper safety measures and ensure utmost hygienic conditions of the facility are maintained; and

- to ensure that water used for washing, dipping, or showering the fruit should be appropriately chlorinated (50 to 200 ppm) and changed at periodical intervals to prevent microbial contamination.

2. Specific Requirements

2.1. Preliminary performance testing

If the facility has not been previously certified by Dte of PPQS, 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.

Note: - 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 between 50 and 200 ppm.

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 46.1°C (115°F) within 5 minutes. A thermostatic set point for each tank is typically in the range of 46.6°C (115.8°F) to 47.2°C (116.9°F). 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. The check sheet of preliminary performance testing **(Appendix-4)** shall be duly completed by the firm and forwarded to Dte of PPQS, as evidence that the facility is ready for the official performance test. Once the facility has been officially certified, Dte of PPQS 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.

2.2. Performance testing for certification

To approve the facility, the inspecting officer of Dte of PPQS shall take the following steps:

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

Plans and specifications must clearly show dimensions, water circulation, temperature sensing and recording systems, and safeguarding precautions.

2. 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.

3. Calibrate the portable sensors, recording the results on **Appendix-5**. Using a factory-calibrated, glass mercury thermometer as the standard, compare the reading of each portable sensor to the standard, and record any deviation. 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 about the temperature at which treatments will take place. A treatment tank may also be used for this purpose, provided that the water is kept in motion.

4. Check the calibration of the tank's permanent RTD sensors, and record the results in prescribed format in **Appendix-6**.

5. 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.

6. To prepare for the performance test, the officer of Dte of PPQS shall tape the cord of 3 or 4 portable "water temperature sensors" to the skin of selected fruits in each basket. (Do not cover the end of the sensor with tape.)

7. Insert a portable "pulp temperature sensor" approximately 1 cm into the flash of one or more fruits in the tank. Hold them in place with tape. *It is not necessary to have a pulp temperature sensor in each basket.*

8. The fruit should be at ambient temperature 20.1^0C (70°F or above) immediately prior to the performance test. However, if the operator chooses to pre-warm the fruit by artificial means, then this routine must be noted as a condition of approval, and must also be followed for each commercial treatment following certification.

9. On the location diagram **(Appendix-7**), show the relative position of each portable sensor used in the test, and indicate whether it is"water" or "pulp" sensor. Each should be numbered.

10. While the fruit are immersed in water, the officer of Dte PPQS shall use an electronic thermometer to monitor the temperatures of each portable sensor at various times throughout the test. (Record this information for each tank on **Appendix-8**) for each tank.) As a second option, a portable, automatic recording instrument may be used. It must, however, operate independently from the temperature recording system installed at the facility.

During the performance test, the operator lowers the baskets of fruit into the hot water immersion tank. The "water temperature sensors" are closely monitored during the first 5 minutes of treatment. Dte of PPQS requires that the temperatures of all "water temperature sensors" must reach at least 46.1°C (115°F) within 5 minutes. If not, then the test must be repeated, using other fruit, using a slightly higher water temperature set point, and/or a slightly longer time interval between subsequent basket immersions, in order to achieve the 5-minute temperature recovery requirement, The test should be run for the full duration (up to 90 minutes, depending upon fruit size). During that time, all "water temperature sensors" must read at 46.1°C (115°F) at the 5minute point and beyond. In addition, the "pulp temperature sensor" (or sensors) must read at least 45°C (113°F) by the end of the test. At the end of official performance test, the inspecting PQ officer, will furnish the report to the Plant Protection Advisor in the format prescribed in **Appendix-9.**

Note: - The standards set by the Dte of PPQS 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 46.1°C (115°F) after the fruit have been submerged.

Note: - The mango hot water schedules also have a built-in tolerance for subnormal temperatures in the range of 45°C (113.7°F) to 46°C (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 46.1°C (115°F) within the first 5 minutes, and to maintain temperatures at or above that threshold during the remainder of the treatment.

2.3. Possible Solutions for Tanks that have failed Performance Test

2.3.1.1. Solutions usually not requiring an engineer to implement:

Cages (baskets) holding the fruit:

- In tanks that use more than one basket (cage), try submerging the cages of fruit in a different order, such as leaving vacant water space between subsequent cages.

- Requires a longer period of time between submerging each basket (for example, 15 minutes instead of 8).

- Require operating the tank at less than full capacity, including,
  - immersing fewer baskets at a time
  - immersing fewer crates per baskets
  - filling crates less full.

Temperature measurement:

- Require a higher thermostatic set-point

- ❖ Recalibrates or replace any faulty sensors (permanent sensors in the tank, as well as portable sensors used in the performance test).

2.3.1.2. Solutions that usually require an engineer to implement:

.

Replace the existing boiler with one that has a higher capacity. (1,000,000 B.T.U. is typical for large multi-basket tanks.) . Re-design the baskets or crates to allow a greater water flow around the fruit. . Propellers used in water circulation—increase the blade size; increase their number; change their position within the tank; increase the speed (rpm). Water delivery pipes—increase their diameter; change their location.

2.3.1.3. Address for Technical Contact

Directorate of Plant Protection, Quarantine & Storage
N.H-IV, Faridabad-121001
Haryana (State)
Tel: 0129-2418506/2413985
Fax: 0129-2412125

2.4 Issuance of certificate of approval of facility by PPA

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The PPA will issue a Certificate of Approval (**Appendix-10**) after receipt of satisfactory official performance test. Dte of PPQS will certify the facility only when all requirements are met, including two successful hot water immersion treatments in each tank, using standard fruit loads. The certificate issued is valid for one year unless revalidated.

2.5. Refusal of Certification/De-recognition of Certified Facility

PPA may refuse the certification of the facility, if in his opinion, the temperature measuring and monitoring equipments installed at the facility does not confer the required level of accuracy and or safety norms have been compromised with. However in the event of refusal, no refund of registration fee would be made.

PPA may de-recognize the certified facility, if the facility does not abide by the terms and conditions stipulated in the certificate or if it fails to carry out the appropriate treatments consistent with this standard. or if it involves in maintenance of fraudulent records or in the event of receipt of notification of repeated non-compliance from the importing countries.

2.6 Re-Certification of Facility

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Re-certification of facility shall be carried out on annual basis. For this purpose, the facility manager shall apply at least one month prior to expiry of the certificate for revalidation along with Rs.1000/- towards revalidation fee payable by bank draft in favour of 'Accounts Officer, Directorate of Plant Protection, Quarantine & Storage, N.H-IV, Faridabad. For annual re-certification, however, only *one* successful performance test is required per tank.

2.7. Recognition of Foreign Facilities

The foreign hot water immersion treatment facilities established must meet the requirements of this standard for recognition, by the Plant Protection Adviser, Dte of PPQS, as approved treatment provider and may be further governed by signed Work Plan. The foreign facility seeking recognition shall submit the proposals to the Plant Protection Adviser forwarded through their Ministry of Agriculture for necessary consideration.

2.8. Documentation & Records

The approved facility should maintain treatment records and the same should be serially numbered and duly signed by the qualified technical operator and preserved in the appropriate folder along with prints of data loggers for future reference and necessary verification during audit checks by PQ Officer.

3.0 Operational Requirements

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The entire treatment of fresh fruits shall be under the general monitoring of Dte of PPQS and may be further governed by a signed Work Plan (for foreign facilities) or Compliance Agreement (for domestic facilities).

3.1 Pre-treatment procedure

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The operator of the facility shall conduct all treatments in an approved tank provided with temperature set points during official performance test. The operator should not tamper with official seals. The operator must check for proper operation of the heating, circulation, and recording equipment before the start of each treatment. Continuous flow equipment (submerged conveyor belt) will be checked at the start of each day or run. Commodity will not be refrigerated before treatment, and must be at or above the prescribed minimum temperature if specified in the treatment schedule. Commodities subject to size restrictions require a preliminary culling procedure to eliminate oversized items prior to treatment.

3.2 Treatment procedure

•

The operator should load the immersion tanks in a manner approved by the Dte of PPQS, usually using baskets with perforations that allow adequate water circulation and heat exchange. Each treatment container or lot shall be given an identifying number before being placed in the immersion tank. An automatic temperature recording system shall record the temperature and duration of each hot water dip. A responsible employee of the packing company shall indicate on the printed temperature record the starting time, lot number, duration of each treatment and initial each entry.

3.3. Post-treatment procedure

All boxes of hot water treated fruit will be stamped *Treated with Hot Water, DPPQS, India* together with the numerical designation that APHIS has assigned to the particular treatment facility.

Commodities treated at origin will be moved to an insect free enclosure promptly after treatment and maintained insect-free throughout the shipping process. This may be accomplished by using insect-proof containers, screened or enclosed rooms, doors with air-curtains, or some combination of these.

3.4. Treatment certification

The supervising officer of Dte of PPQS, at the end of successful treatment, will endorse the particulars of hot water treatment on the phytosanitary certificate, if required by the country of export.

3.5. Essential Equipments for Setting-up of Facility

The essential equipment required for setting-up of hot water immersion treatment facilities given in Appendix-XI for necessary guidance.

Appendix-1

Application for Certification of Hot water Immersion Treatment Facility for treating Mango fruits	
1. Name/address/location of the facility **(include telephone/fax/e-mail)**	
2. Nature of the Manager/In-charge of Facility	
3. Name of the technical operator of facility	
4. Construction & design by **(Name & address of Engineering firm)**	
5. Whether the facility proposed is new one? **(If so, enclose two sets of plans and drawings for verification and approval of PPA)**	Yes /No
6. Whether the application is for certification of existing facility? **(If so, submit plans & drawings for verification)**	Yes/No
7. Any changes or improvements proposed including additions to existing facility **(additional tanks/cold storage room/change of boiler/temperature recorder/replacement of sensors etc.).** If so, give particulars	Yes/No
8. Whether the application is for revalidation of certificate **(If so, enclose original certificate for verification & endorsement)**	Yes/No
9. Whether information furnished in the datasheet enclosed with application is correct & complete in all respects	Yes/No
10. Particulars of payment of registration fee **(Bank Draft No./Bank/Branch/Amount)**	

11. Name/Signature of Authorized Signatory with date & seal			
For Official Use by Dte of PPQS			
Application Number:	Date of Receipt:	Acknowledgement issued.	Initialed by/Date
Date of Scruitinization:		Deficiencies communicated.	Initialed by/Date
Date of Assessment	Assessed by	Assessment Report received.	Initialed by/Date
Registration Number	Date of Issue/ Revalidation:	Registration certificate issued/ endorsed	Initialed by/Date
Accreditation Number	Date of Issue/ Revalidation	Accreditation certificate issued/ endorsed	Initialed by/Date

Acknowledgement Slip - Directorate of Plant Protection Quarantine & Storage

Application Number_____**Date of Receipt**_____
Received from M/s_____
along with Bank Draft No._____**dated**_____**on**_____
For Rs._____**(**_____**).**

_____
Signed by/Date

Appendix-2

Data Sheet for Hot water Immersion Treatment (HWT) Facility for Mango fruits						
1. Name of the HWT Facility						
2. Location of Facility						
3. Type of Facility	Batch system/Continuous flow system					
3. Construction & Design Particulars (**enclose plan and drawings**)						
Office Space	Computer Room	Receiving Area	Operational Area	Pre- cooling room	Cold storage Room	Other Areas

2. Particulars of Computer/Microprocessors/UPS/Surge Protector etc).

- Computer:
- Microprocessors:
- UPS/Surge Protector:

5.Diesel Power Generator o Make: o Capacity (HP):
6.Fruit Sizing Equipment o Make: o Specification
7. Boiler o Make: o Heat Capacity: o Type:
8. Water Circulation System o Pump type: o Number of Pumps: o Circulation Capacity:
9. Temperature sensors (permanent) Type: Make/Supplier: Number of Sensors: Placement plan:
10. Portable sensors with monitor for use during performance testing o Make: o Type: o Numbers:
11. Certified glass mercury thermometer for during performance test Make Range o Numbers

12. Temperature Recorder (Type Make Model Duration of recording Frequency Accuracy Repeatability Range Ports
13. Description of alarm system (**Applicable only in case of batch system**)
14.Description of conveyor type/speed indicator/gear mechanism (**Applicable only in case of continuous flow system**)
15. Treatment Tank o Type: o Dimensions o Capacity o Number of tanks o Cages type: o Fruit holding capacity:
16. Description of hydrocooling system, if any:

17. Description of packing/grading system, if any:	
18. Name & signature of technical operator with date	
19. Name & signature of authorized signatory with date	

Appendix-3

COMPLIANCE AGREEMENT

1. From	**2. To** The Plant Protection Adviser Dte of Plant Protection Quarantine & Storage, N.H-Faridabad-121001

3. Agreement related to
Certification of hot water immersion treatment facilities for treating fresh fruits

4. Applicable Phytosanitary Regulatory Requirements
To meet the PPQ regulations

5. I/we agree to the following:

-to carry out all treatments through trained & qualified operator
-to ensure periodical calibration of temperature sensors and maintain the facility in working condition
-to provide all testing equipments, labour and extend necessary assistance and cooperation to the nominated PQ officers during the visit to the facility for undertaking performance test of the facility
-to follow all safety requirements or procedures during treatment operations and abide by the instructions and procedures required by the Plant Protection Adviser in the planning, set-up and conduct of treatment
- to carry out hot water immersion treatment of fruits as per the schedules duly approved by the Plant protection Adviser
-to maintain record of treatment operations as per format prescribed and preserve data logs for future verification
-to pay TA/DA for the inspecting PQ officers as per admissible rules for carrying out preliminary performance test/official performance test for certification.

6. Date:	**8. Name, Signature & Designation of Authorized Signatory:**
7. Place:	

9. Signed in presence of

_____
(Name/ /Signature of PQ officer)
Designation

10. Approved by

_____
( )
Plant protection Adviser
to the Government of India
Directorate of Plant Protection, Quarantine & Storage
N.H-IV, Faridabad-121001

Appendix-4

Check Sheet for Preliminary Evaluation/Testing of the Hot Water Immersion Treatment Facility			
S. No.	**Evaluation/Testing of Activity**	**Yes/ No**	**Critical Status**
1.	Location, construction & design of facility as per safety norms and as per regulations of local authority		Critical
2.	Engineering plans and drawings are approved by the PPA (applicable for new facility)		Critical
3.	Assured supply of potable water and chlorination of water at appropriate levels (50-200 ppm) to prevent microbial contamination		Critical
4.	Compliance with minimum requirements of certification as per this standard		Critical
5.	Electrical wiring through out the facility meet the safety norms and regulations of local authority including earthling and PVC conduiting		Critical
6.	Control panels/Electric Meters etc., are adequately rain protected		Critical
7.	Computers/microprocessors are located in air-conditioned to maintain accuracy and reliability and installed with surge protectors/UPS		Critical
8.	Support of Diesel generator to have uninterrupted power supply		Critical
9.	Installation of fruit sizing equipment (required for batch system)		Critical
10.	Boiler with adequate water heating capacity and thermostatic controls.		Critical
11.	Installation of treatment tank (		
11.	Installation of adequate water circulation system and testing		Critical
12.	Installation of adequate number of calibrated RTD temperature sensors in the tank		Critical
13.	Installation of time/temperature control switches & testing		Critical
14.	Installation and testing the performance of temperature recorder/data logger and recording frequency		Critical
15.	Installation and checking of alarm system (required for batch system		Critical
16.	Installation and checking of Lodestar electronic chain hoist system (required for batch system)		
17.	Installation and testing of conveyer /speed indicator/gear system (required in case of continuous flow system)		Critical
18.	Insect proof screening of doors/windows/ventilators to exclude fruit flies		Critical
19.	Installation of air curtains prior to entry into quarantine area		Critical
20.	Installation of hydro-cooling system (optional)		Non-critical
21.	Installation of grading and packing system (optional)		Non-critical
22.	Name and Signature of Technical Operator with date		
23.	Name and Signature of Manager/In-charge of facility with date and seal		
23.	Verified by (Name/Signature/Designation of officer of Dte of PPQS) with date		

Appendix-5

Dte of PPQS **Instruction and Worksheet for Calibrating Portable Temperature Sensors**	Record No: Date:

1. Name of Facility	
2.Location/Address of facility	
3.Name of Facility Manager	
4. Name of the person calibrating the sensors	

Calibrating instruction

The instructions for calibrating portable temperature sensors that will be used in performance tests for hot water treatment tanks are as follows

- Assign each portable sensor a unique number (write sensor numbers on a piece of duct tape or tag and attach them near **'dry'** end of each sensor
- Submerge the **'wet'** end of the sensors into a circulating hot water bath in a temperature range of 46.1^0C - 48.9^0C in close proximity to the bulb of submersible certified glass mercury thermometer. Both must be submerged to same depth. The mercury thermometer used as Standard for calibrating portable sensors should read one tenth of a degree Centigrade.
- Record the temperature obtained from each portable sensor and the mercury thermometer in succession. Calculate the difference between the two temperatures, if any and record this also.
- If the temperature shown by the portable sensor falls within 0.3^0C of the temperature shown on certified mercury thermometer, then this sensor considered to be within tolerance limit and may be used in the performance test. Any sensors reading outside the tolerance limit do not meet this Standard for accuracy and should not be used and the same may be recommended for destruction..

Temperature recordings in ^{0}C

Portable Sensor No.	Sensor Reading	Mercury Reading	Difference	Remarks

Signature of the person calibrating sensors with date	

Appendix-6

Dte of PPQS **Test of the Accuracy of the Permanent RTD Sensors Installed in Hot Water Treatment Tanks**	Record No: Date:
1. Name of Facility	
2.Location/Address of facility	
3.Name of Facility Manager	
4. Name of person testing the sensors	

Testing instructions

The instructions for testing the accuracy of permanent RTD sensors installed in hot water treatment tanks, which are connected to a temperature recorder installed in control room, are as follows:

- Calibrate all available portable sensors against the certified glass mercury thermometer (see appendix) standard
- Select the portable sensor that shows the least deviation from the certified mercury standard. This particular sensor will now be used as a tool for testing the accuracy of each of the permanent RTD sensors installed in the tanks.
- Uusing 2 metres PVC rod and .duct tape, fastened the wet end of the portable sensor wire to one end of the rod, being careful not to cover the metal sensor tip with the tape. Tape the sensor wire also to the center, opposite end of the rod to remove the slack
- Raise the water temperature in the tanks to 45.1- 48.9 C and run the pump to ensure uniform distribution of heat. Inspect the sides of the tank to locate the exact position of each permanent RTD sensor. Using the portable sensor and rod assembly, dip into the hot water until the portable sensors comes in close proximity of the tank sensor. (Note: - Each basket position should have its own sensor). Plug the portable sensor into a hand held digital monitor and read the display. Compare this reading with display on the data logger or strip chart recorder in the control room (You may need an assistant for this purpose). Record the results from the chart on this form. Repeat the procedure for each permanent sensor in the tank.
- Decision:If the temperature shown on the dispay in control room matches the temperature shown on the hand held portable temperature monitor (as calbrated), then the permanent sensor in the tank is acceptable. If the two temperatures do not match exactly, but are within 0.3 C, then this small amount of deviation is considered within tolerance limits. Any permanent sensor that fail this standard must be repaired or replaced;.

Hand held digital temperature monitor (Portable sensor number:_____used)				**Make & Model of Temperature Recorder (_____)**		
Tank No/RTD sensor No (Basket Position).	Reading Obtained (^{0}C) hand held	Correction factor (+ or -)	True reading (^{0}C)	Reading obtained (^{0}C) (in control room)	Difference between (^{0}C) (4-5)	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)

Signature of person testing the sensor with date						

Appendix-7

Dte of PPQS **Actual Performance Test for Hot Water Immersion Tank**			**Date of Test**
Name of the Facility		Location	
Facility Manager			
Fruit variety tested:		Stage of Ripeness:	
Temperature at start of test			
Thermostatic set point	Water in the tank	Fruit pulp	Ambient air
Notes			

Basket No._____ Tank No_____Test No_____

Readings taken at specific times (minutes)before calibration adjustment, if any. Use one or two pulp sensors per tank. Indicate pulp sensors with an asterisk (*)

Portable sensor No *	**Calibration**		**0-1**	**1-2**	**2-3**	**3-4**	**5**	**30**	**60**	**75**	**90**
		Time									
		Temp									
		Time									
		Temp									
		Time									
		Temp									
		Time									
		Temp									

***use at least three portable sensors**

Name & Signature of Inspecting Officer with Date	

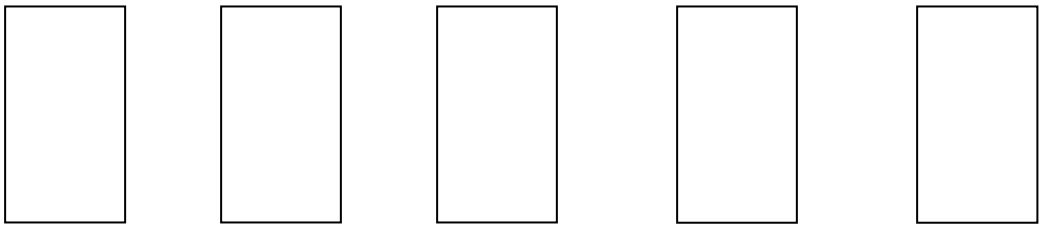
Appendix-8

Dte of PPQS **Sensor Location Diagram, Fruit Weights and Pulp Temperatures**		**Record No:** **Date**
Name of the Facility	Tank No	Test Number

Instruction

Show sensor numbers and their approximate location within each basket (Use 3 or 4 sensors per basket. Place an asterisk (*) besides fruit pulp sensors (Use 1 or 2 per test). Indicate by arrow the direction of water flow in the tank (If the tank is of unusual safe, example round please use the reverse side of the pump to draw a diagram showing the position of baskets and sensors).

Basket 1 Basket 2 Basket 3 Basket 4 Basket 5



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Weight (g) of ten fruits selected at random		Weight (g) of six largest fruits	Fruit pulp temperature (taken at random)	Net weight of a typical field crate of mangoes
				Number of field crates per loaded basket
Mean weight (g)		Mean wt (g)	Mean temp	

Remarks

Name & Signature of Recording Person with date	

Appendix-9

Dte of PPQS Performance Test Report for certification of Hot water Immersion Treatment Facilities for Mango Fruits	Report No: Date:
1. Name of Facility	
2. Location/Address of Facility	
3. Type of Facility	
4. Name of the Facility Manager (including telephone number, Fax etc)	
5. Dates of Inspection	
6 Test carried out by (Name & Designation of officers of Dte PPQS)	(i). (ii).
7. Actual installation of facility is in line with engineering plans and drawings approved by PPA (applicable in case of new facility) or no alterations or modifications affected to existing facility since last performance test o Yes o No o Not applicable	
Comments	
8. Inspection of the heating, water circulation, and alarm systems, and checking to see that all necessary safeguards (including screens, fans, locks, and air curtains) are secure and operational. o Secure and operational o Insecure and Non-operational	
Comments	
9. Calibration of portable sensors with certified glass mercury thermometer (**see Appendix-5**) o Sensor readings are within tolerance limits o Sensor readings are outside tolerance limits	

Comments	
10. Test of Accuracy of permanent RTD sensors positioned in the tank (**see Appendix-6**) o RTD sensors passed the test o RTD sensors failed the test	
Comments	
11. Actual performance test of hot water immersion tank **(see Appendix-7 & 8)** o Passed the test. o Failed the test	
Comments	
12. Remarks & Recommendations for Certification o Recommended for Certification o Requires modifications o Not Recommended for Certification	
Reasons for not recommendation	
13. Signature of inspecting officers of Dte of PPQS with date	

Appendix-10

Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation
Directorate of Plant Protection, Quarantine & Storage
N.H-IV Faridabad-121001

Certificate No.	**Date of Issue:**
	Valid up to:

Certificate of Approval of Hot Water Immersion Treatment Facility

This is to certify that the hot water immersion treatment facility as described below has been inspected and after official performance test approved for treating fresh fruits in line with the requirements of the Standard and subject to terms and conditions specified below:

Date:
Place

_____
( )
Plant Protection Adviser
to the Government of India

Description of Facility	
Name of facility	
Location/Address of Facility	
Type of Facility	
Capacity of Facility	

Terms & Conditions:

1. The Certificate should be displayed at prominent place and available for verification during inspections to the facility;
2. Any changes or modifications or additions to the facility shall be made with the written approval of the Plant Protection Adviser
3. The certificate shall be valid for a period of one year from the date of issue unless otherwise revalidated prior to expiry for treating fresh fruits
4. All the treatment operations should be performed by a qualified operator of the firm and necessary treatment records/data log sheets are maintained for necessary verification
5. All the treatments should be performed as per the schedules approved by the Plant Protection Adviser..
6. The certified facility should abide by the instructions and guidelines issued by the Plant Protection Adviser from time to time
7. The certified facility shall comply with the requirements and conditions stipulated in the Compliance Agreement.

Endorsements:
Revalidated on _____ by_____
Revalidated on_____by_____
Cancelled on_____by_____
Re-certified on_____ __by_____

Copy to:

Appendix-11

List of Essential Equipment for setting-up of Hot Water Immersion Treatment Facility

Equipment	Make	Specification
Temperature Recorder:	**Strip chart type:** Honey Well DPR 3000 Version D4 (32 channel capability) or or Honey Well DPR 1000 (6 channel type) or equivalent **Data logger type:** Honey Well DPR 3000 Version D4 (32 channel type) or HAACP warrior PTR-4 (4 channel type) or PTR-10 (10 channel type)	Type: Automatic recording type
		Recording time: 12 hrs
		Frequency of Recording: two min interval
		Recording Type: Numerical print or pen line representing each channel by colour, number or symbol
		Accuracy: With in 0.3^0C
		Repeatability: With in 0.06^0C
		Measuring range: between 37.8^0C and 54.4^0C
Chart paper		Scale: ^{0}C
		Scale deflection: 5 mm for each 1^0C
		Subdivisions: one tenth or one twentieth of a degree in the range of 45^0C to 47.8^0C
		Chart speed: 2.5 cm for every 5 min
		Chart length: upto 12 hours in case of continuous flow treatment or sufficient for one entire treatment in batch type system
Temperature Sensors		Platinum 100 Ohm resistive thermal detectors (RTD) sensors. The sensor units located within the distal 2.54 cm of the sensor rod and sensor shall have an outer sheath of 5.4 mm in diameter or less
Portable sensors or probes	Cooper Instruments Corporation model TM 99A or TC100A	Thermistor or thermocouple sensors each with its own flexible cord at least 30 cm
Portable temperature monitor	Cooper Instruments Corporation model TM 99A or TC100A	24 channel type, which can read to the nearest one tenth of a degree
Certified Centigrade glass-mercury thermometer		The thermometer shall be accurate to 0.1^0C and will cover the range between 45^0C and 47.8^0C

Constant temperature Hot-water bath	------	-------
Steam Boiler		Oil-fired, gas-fired or combination, A boiler used for the purpose of heating the water in a two-tank batch system must have an output rating of approximately 1,000,00 BTU, or 30 horsepower
Chain Hoist (Electronic type)		Lodestar electronic chain hoist, capacity to 3 tons
Fruit sizing equipment		Roller type sizing equipment, automatic
Safety Alarm equipment		This system may be an audible noise (such as a horn, buzzer, or bell), or a highly visible light, attached to a timing device located on the equipment that indicates time and temperature.
Fruit crates (plastic)		Standard, plastic fruit crates required for batch system
Portable balance		For weighing individual fruits
Batch system	Agri-Machinery Inc., USA	2 tank system with 4 baskets each with Honey Well strip chart recorder
Continuous flow systems (complete instrumentation)	Fruitico International Mexico	