NSPM -20

Guidelines for Certification of Vapour Heat Treatment Facilities for Fresh Fruits & Vegetables

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

December 2005

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Endorsement:

This standard entitled **'Guidelines for Certification of Vapour Heat Treatment Facilities for fresh fruits and vegetables'** has been prepared by the Directorate of Plant Protection, Quarantine & Storage (Dte of PPQ&S), Faridabad-121001. This standard describes the guidelines/procedures for certification of vapour heat treatment facilities for treating fresh tropical fruits and vegetables against fruit flies (Tephritidae).

This standard was duly approved for adoption on _____ by

_____
(P.S. Chandurkar)
Plant Protection Adviser
Dte of PPQ&S
Faridabad-121001.

Review & Amendment

This standard is subject to periodic review by the Plant Protection Adviser and amendment would be updated and revised as necessary. The standard holders should ensure that the current edition of the standard being used.

Control & Distribution of the standard

PPA will hold the master copy of this standard. JD (PQ) will distribute the controlled copy of this standard to the officers of Plant Quarantine Stations listed below and to any other person specifically authorized by PPA. The holder of controlled copy must ensure that only current copy of the standard will be used. Any enquiries regarding this standard should be made to the PPA, Dte of PPQS, Faridabad-121001.

Controlled Copy Holder	**Copy No.**
JD (PQ), Dte of Plant Protection, Quarantine & Storage, N.H.IV., Faridabad-121001	1
PQ Division, Dte of Plant Protection, Quarantine & Storage, N.H.IV., Faridabad	2
Dy Director (PP/Ent), In-charge of National Plant Quarantine Station, Rangapuri, New Delhi-110037	3/4
Dy Director (Ent.), In-charge of Regional Plant Quarantine Station, Amritsar	5
Dy. Director (Ent./PP), In-charge of Regional Plant Quarantine Station, Kolkata	6
Dy. Director (Ent/PP), In-charge of Regional Plant Quarantine Station, Chennai	7/8
Dy Director (PP/Ent.), In-charge of Regional Plant Quarantine Station, Mumbai	9

Introduction

Scope

This document provides guidance for certifying vapour heat treatment facilities for treating fresh tropical fruits and vegetable against fruit flies belonging to the order Tephritidae

References

APPPC. 2003. Guidelines for the Development of Heat Disinfestation Treatment of Fruit Fly Commodities, FAO., RAP., Bangkok, Thailand.
USDA-APHIS. 2002. PPQ Treatment Manual, USA.

Outline Requirements:

This standard prescribes the guidelines/procedures for certification of vapour heat treatment facilities for fresh tropical fruits & vegetables against fruit flies. This treatment uses heated air which is saturated with water vapor to raise the temperature of the commodity to a required point and holds the temperature for a specified period. The latent heat released by the condensation of the vapor on the commodity raises the pulp temperature quickly and evenly and thus prevents damage. In application, a fine mist and air under forced circulation is present with the saturated vapor. This standard describes the authority to approve the facilities, application procedures for certification, minimum requirements of the facility, preliminary performance testing and official performance testing and certification of facility.

1.0. General Requirements

1.1. Authority to approve the facility

Treatment units and facilities are required to be approved or certified by the NPPO before any treatment commences in accordance with RSPM No. 1. *Guidelines for the development of heat disinfestations treatments for fruit fly commodities*. The Plant Protection Adviser to the Government of India (PPA), Directorate of Plant Protection,, Quarantine & Storage, N.H.IV., shall be the competent authority to approve and certify the vapour heat treatment (VHT) facilities for fresh tropical fruits & vegetables against fruit flies (Tephritidae). No such approval is required for the vapour heat treatment facilities that are established for research/experimental purpose, but however, such facilities must meet the minimum requirements specified in this standard and subject to verification and auditing by PPA.

1.2. Nomination of Experts for Official Inspection

PPA will nominate an expert, who has sufficient knowledge and experience of operation of VHT facilities, for inspection/performance testing/verification of facilities for certification in association with a PQ officer. The nominated expert in association with a PQ officer will inspect/verify the facilities and carry out official performance testing before making necessary recommendations for approval and certification.

1.3. Responsibilities of Approved Facility

The certified facility is responsible:

- to carry out all treatment operations through a qualified operator
- to report to the PPA of any out of service of the facility for 10 days or more on account of any mechanical and electrical failures or annual maintenance checks or any lay-offs
- to maintain the equipments in good working conditions and 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 the vapour heat treatments of fresh fruits and vegetables carried out strictly in accordance with the approved protocol specified by PPA or the NPPO of importing country, as the case may be.
- to abide by the instructions and guidelines issued by the PPA from time to time and extend all cooperation to the inspecting PQ officers for carrying out performance tests and audit checks.

1.4. 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 engineering design and plans. The facility may be integrated with package house for easy of operations. The treatment facilities should be located in a secure area to prevent re-infestation of treated fruits.

1.5. Prior Approval of the Plans & Drawing of the Facility:

A prior approval of the plans and specifications showing dimensions, air circulation, and other specifications of the heating and temperature recording systems by PPA shall be required in the case of new facilities to ensure that the minimum requirements prescribed in this standard are met with. For this purpose, the owner of proposed facility will send an application enclosing therewith the plans and specifications showing the above to PPA for necessary consideration. After preliminary scruitinization of the plans and specifications, an on-site survey will be conducted by the expert nominated by PPA to compare the installation to the approved plans; to check the air and water vapor circulation system, and to check the calibration of the temperature monitoring system. However, the above condition shall not be applicable for the vapour heat treatment facilities that have been established prior to adoption of this standard but those facilities must meet the minimum requirements of this standard. Any proposed changes or improvements in the existing facility shall be made only with the written approval of the Plant Protection Adviser.

1.6. Minimum Requirements of facility

The minimum requirements for approval or certification of facility shall include:

- location of treatment facility in secured area to prevent reinfestation of treated fruits

- assured supply of good quality and potable water
- assured power supply and back up by diesel generator
- insect-proof screening of all openings to external area to prevent fruit fly entry
- hygienic handling of fruits during grading, packing &storage at the facility
- regular calibration of temperature sensors, temperature and humidity recording and pressure testing equipments and maintenance of calibration records
- adequate air and water vapour circulation system
- adequate boiler capacity to raise the chamber temperature to about 50-52^{0}C so as to ensure the pulp temperature of 46-48^{0}C within a ramp up time of 4 hours
- adequate number of portable/permanent temperature sensors to monitor the temperature of treatment
- temperature recording through an approved strip chart recorder or data logger
- adequate measures for disposal rotten fruits/fruit waste at the facility

1.7. Treatment Schedules

The temperature-time relationship varies with the commodity and the pest involved. In case of treatment against fruit flies, the pulp temperature of the commodity will be raised by the saturated water vapor to 46-48 ^{0}C during a ramp up time of 4 hours and then the fruits will be held at the required temperature for a period of 30 min. The exposure periods and the treatment temperatures will vary with kind of fruit fly species and commodity involved. Where more than one fruit fly species is known to infest a commodity, laboratory experiments should be carried out with 100-1000 individuals for determining the most heat tolerant species. The small-scale trials should be carried out with 3000-5000 individuals to determine the most-heat tolerant stage of determined fruit fly species and this should be further confirmed by large scale treatment trials involving 30,000 populations of first instar larvae of the most heat tolerant fruit fly species, ensuing Probit 9 security level to prove the efficacy of treatment for commercial application.

1.8. Recognition of foreign treatment facilities

The foreign facilities that are required to be recognised by the PPA must meet the requirements of this standard. It shall be the responsibility of the NPPO of exporting country to provide a list of such approved facilities to the Plant Protection Adviser, Directorate of Plant Protection, Quarantine & Storage, N.H.IV., Faridabad-121001 for granting such recognition.

2.0. Specific Requirements

2.1. Registration of Application

An application for certification of VHT facility will be made in prescribed format (Appendix-I) to the PPA in duplicate along with the requisite information as per data sheet (Appendix-II) and the compliance agreement (Appendix-III). The application should be accompanied by a bank draft for Rs. 2000/- in case of new facility and for Rs.1000/ for renewal and should be drawn in favour of 'Accounts Officer, Dte of PPQS, Faridabad' towards registration fee. The application should be accompanied by the plans and specifications showing

dimensions, air circulation, and other specifications of the heating and temperature recording systems in case of a new facility and also whenever any alterations/modifications made to existing facility in case of approved facility. The applications received at PQ Division of Dte of PPQS will be registered. If the application is for renewal of certification of facility, it will be assigned with previous number and if it is a new a unique identification number will be assigned. The application will be scrutinized to ensure that the application is complete and correct and deficiencies if any will be communicated to the applicant. If the application found complete in all respects, PPA may order inspection of the facilities.

2.2. **Preliminary Performance Testing**

If the facility has not previously been officially certified, the operator of the facility must conduct preliminary performance tests on his own, to verify that all equipments are in good working order. A checklist of minimum requirements of facility is given in Appendix-IV. By trial and error, the operator shall establish a tentative temperature set point for the VHT chamber, such that the fruit center temperature will reach the treatment temperature within a reasonable period of time. The operator shall do at least two trial treatments, with sensors placed in various parts of the load, to determine where the coolest spots occur. (For purposes of this test, the load in the VHT chamber must contain fruits). Further the operator of the facility should conduct a preliminary performance test at the beginning of each season under the direction of PPA, Dte of PPQS. At the end of preliminary performance test, the operator will forward the preliminary trials data along with his comments to PPA, Dte of PPQS, Faridabad as a evidence that the facility is ready for conducting official performance test.

2.3. Official Performance Test for Certification

The official performance test will be carried out in three stages: (1) calibration of the portable sensors; (2) calibration of the permanent sensors installed in the VHT chamber; and (3) performance of an actual test treatment, which are as under:

2.3.1. Calibration of the portable sensors

Each portable sensor used for calibration of the permanent sensors installed in the chamber should be calibrated by using a factory-calibrated, certified glass-mercury thermometer (readable in tenths of a degree) as the standard. The resulting readings from each portable sensor should be compared to the standard and any deviation should be recorded. For this purpose, a swirling hot water bath should be used (Calibration should be done at or near the required treatment temperature and not in an ice-water bath.), Each sensor should be identified with a unique number or letter before start of the test, and the correction factor for each one should be recorded. Any sensor that deviates by more than $\pm$ 0.3° C from the standard should not be used for calibration of permanent sensors. The number of portable sensors required during the test must be at least one half (1/2) of the number of permanent sensors required to be installed in the treatment chamber. The test results should be recorded in prescribed format (Appendix-V).

2.3.2. Calibration of the permanent sensors

The calibration of permanent sensors that are installed in the chamber will be carried out in the same manner as that of calibrating the portable sensors. A portable sensor (with a "zero" correction factor) should be used instead of the certified glass thermometer as the standard against which the permanent sensors are compared. Both permanent and portable sensors must pass the same high standard of accuracy (.If cordless sensors are used, these are already factory-calibrated, and require no further calibration by the user). It is also permissible to substitute additional permanent sensors for portable sensors, provided that the temperature recorder is capable of monitoring them. The test results should be recorded in the format prescribed in Appendix-VI.

2.3.3. Conduct of an actual test treatment

The inspecting officer/expert will insert the numbered portable and permanent sensors into the pulp of fruits for carrying out actual test treatment. The portable sensors should be placed especially in the load at the sites, where the coolest spots are most likely to occur.

. The inspecting officer/expert will draw a three-dimensional diagram showing where each numbered sensor has been placed. The operator should place the fruits into the VHT chamber, close the door, turn on the heat generator and start the automatic temperature recorder. The inspecting officer/expert must take readings on the portable sensors at least once every 5 minutes. He should note the ram up time i.e, time taken to reach the chamber temperature around 50-52 ^{0}C and the pulp temperature of 46-48 ^{0}C. The exposure period starts when all the pul sensors indicate the required treatment temperature and then holds it for the minimum amount of time required by the particular treatment schedule. He should review all temperature records from the portable as well as permanent sensors and record in format prescribed in Appendix-VII and recordings of pulp sensors (Appendix-VIII). One successful test is required, for certification or recertification. At the end the inspecting officer/expert will submit a official performance test report (Appendix-IX) along with his comments and recommendation for certification.

2.4. Issuance of Certificate of Approval of Facility

PPA will issue a Certificate of Approval (Appendix-X) if satisfied with results of official performance testing.

2.5. Frequency of performance testing

A new performance test shall be required (1) at least once a year (usually at the beginning of the each fruiting season), and (2) whenever the VHT chamber has been out of service for 10 days or more. In addition the VHT chamber's permanent sensors shall be recalibrated whenever sensors are replaced. Portable and permanent sensors shall not be placed in the same fruits, but may be in the same trays. Additional performance tests are not required for each type or size of fruit, nor when the operator wishes to vary the delivery air temperature, blower speed, or column height. This is because a successful treatment is based solely upon pulp temperature.

2.6. Refusal of Certification/De-recognition of Facility

PPA may refuse the certification of the facility because of safety deficiencies at the plant or if in his opinion, the equipment installed does not confer the required level of accuracy. However in the event of refusal, no refund of registration fee will be made. PPA may de-recognize the certification granted to any 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 is involved in clandestine issue of treatment certificates without appropriate treatments or if it involves in maintenance of fraudulent records or in the event of receipt of notification of repeated non-compliances from the importing countries.

2.7. Appeal & Revision

An aggrieved applicant/certified facility may appeal against the decision of PPA to the Joint Secretary (PP), Department of Agriculture & Cooperation, Ministry of Agriculture within a maximum period of seven working days of the communication of decision by PPA.

The memorandum of appeal should clearly set out the grounds for appeal. Joint Secretary (PP), shall acknowledge the receipt of the appeal within seven working days and endeavour to make a decision on the appeal in writing within 30 working days of the receipt of all available facts relating to the matter.

Joint Secretary (PP) may call for all the records relating to the decision from the PPA for the purpose of satisfying it self to the legality or propriety of any such decision passed by the PPA before any such order as it thinks fit shall be passed and before any such order is passed PPA shall be given a reasonable opportunity is being herd and no such order shall be passed after expiry of 30 working days.

2.8. Documents & Records Control

The approved facility should maintain treatment records as per the format prescribed in **Appendix-XI** 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

3.1. Pre-treatment conditioning

The fruits before subjecting to VHT should be conditioned usually at a relative humidity less than 100 percent.

3.2. Treatment Procedure

All the vapour heat treatments will be carried out only at vapour heat treatment facilities approved by the PPA. Temperature sensors are used to determine the pulp temperature of the commodity under treatment, psychrometers are used to determine the existing relative humidity. The tips of the sensors are

inserted in the centers of individual fruits and vegetables; a typical sensor placement in the crates is shown below:

Vapor heat processors employing a duct system, which delivers the vapor directly to each individual stack of commodity and which channels the air flow directly through the stack, may utilize the following sensor placement: Bottom, Middle, and Top Layers (A total of 9 sensors); Hot air duct—2 sensors (1 wet, 1 dry = psychrometer);

Vapor heat chamber equipment should be tested for correct functioning before each treatment. The accuracy of each temperature sensing element should be checked once a month during regular use with water at temperatures near the normal treatment temperatures. All sensors, after calibration corrections, must register the required temperature or above at the beginning of treatment. A 0.3 °C deviation is considered within the range of acceptable tolerance thereafter. This tolerance applies to the humidity check sensors as well as those for host temperature recordings. Extend the treatment time by an amount equal to any periods when specifications are not met. Chambers must be equipped with recording temperature and humidity indicators. Detailed records of each treatment must be kept. Final calibration values for each temperature sensor must be recorded for the port files.

3.3. Post-treatment Cooling

The fruits and vegetables should be cooled immediately after VHT treatment. Allowing the fruit to simply stand for at least 30 minutes after removal from the VHT chamber in insect proofed and well-ventilated room would be helpful before the fruits and vegetables subject to pre-cooling process. The recommended storage temperature for mangoes is 55 °F to 57 °F (12.8 °C) at 85 to 90% relative humidity.

3.4. Quarantine safeguards

Adequate safeguards must be maintained to prevent re-infestation or contamination of the treated commodities or their containers. Packing rooms must be fly-proof and only treated host material permitted therein.

3.5. Official verification & Auditing

All certified VHT facilities shall be officially verified at least once during the beginning of fruiting season each year by a PQ officer to ensure proper functioning of essential equipments (Appendix-XII) and that the treatments carried out are as per protocols approved by PPA. Such official verification involves the auditing of treatment records and calibration records of temperature sensors, temperature and humidity recording and pressure testing equipments.

Appendix-I

Application for Certification of Vapour Heat Treatment Facility for Fruits & Vegetables	
1. Name of the Facility	
2. Location/Address of the Facility	
a. Street	
b. City/Town	
c. State	
d. Pin Code	
2. Name of the Manager	
a. Position	
b. Tel/Fax/E-mail	
3. Name of the technical operator	
a. Qualification	
b. Training/Experience	
4. Name & Address of Construction & Design Engineer of the Facility	
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 by PPA)	Yes/No
7. Any changes or improvements proposed including additions to existing facility. If so, submit revised plans and specifications (Additional treatment chambers/cold storage rooms; change of boiler/temperature recorder; replacement of sensors etc.).	Yes/No
8. Whether the application is for renewal of certificate (If so, enclose original certificate for verification & endorsement by PPA)	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	
a. Amount	
b. Draft No.	
c. Bank Name	
d. Branch	
11. Name/Signature of authorized person with date & seal	

For Official Use by Dte of PPQS					
Check list	**Status**		**Scrutinized by**	**Action taken**	**Applicant's Response**
Application complete	Yes	No			
Data Sheet complete	Yes	No			
Approved Plans & drawings (If applicable)	Yes	No			
Preliminary performance report (check sheet)	Yes	No			
Compliance Agreement	Yes	No			
Receipt of fees	Yes	No			
Final Action Taken (accepted/refused):				By: _____	

Appendix-II

Data Sheet for Vapour Heat Treatment (VHT) Facility for Fresh Fruits & Vegetables						
1. Name of the VHT Facility						
2. Location/Address of Facility						
3. Type of Facility				Manual/Automated		
4. Accomodation/Space Particulars (enclose plan and drawings (ground/elevation))						
Office Space (m^2)	**Computer Room (m^2)**	**Receiving Area (m^2)**	**Operational Area (m^2)**	**Pre- Cooling (m^2)**	**Cold Storage (m^2)**	**Other (m^2)**
5. Total Carpet Area:						
6. Particulars of Computer and/or Microprocessor facility o ***Computer:*** o ***Microprocessor:*** o ***UPS/Surge Protector***:						
7. Diesel Power Generator o ***Make:*** o ***Capacity (HP):***						
8. Fruit Sizing Equipment o ***Make:*** o ***Specifications***						
9. Steam Boiler o ***Make:*** o ***Heat Capacity:*** o ***Type:***						
10. Air-watervapour circulating system o ***Pump type:*** o ***Number of Pumps:*** o ***Circulation Capacity***:						
11. Temperature sensors (permanent) o ***Type:*** o ***Make/Supplier:*** o ***Number of Sensors:*** o ***Placement plan:***						

12. Portable sensors with monitor for use during official performance testing o ***Make:*** o ***Type:*** o ***Numbers:***
13. Certified glass mercury thermometer for use during official performance testing o ***Make*** o ***Range*** o ***Numbers***
14. Temperature Recorder o ***Type*** o ***Make*** o ***Model*** o ***Duration of recording*** o ***Frequency*** o ***Accuracy*** o ***Repeatability*** o ***Range*** o **Ports**
15. VHT chamber o ***Dimensions*** o ***Capacity*** o ***No of compartments*** o ***No of fruit trays/Size***
16. Description of pre-cooling/cold storage facilities:

17. Name & signature of technical operator with date	
18. Name & signature of Facility Manager with seal & date	

Appendix-III

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 Vapour Heat Treatment Facilities for Fresh Fruits & Vegetables

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 experts 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 vapour heat treatment of fruits and vegetables as per the treatment 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 official performance test for certification/renewal of certification & auding.

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-IV

Check Sheet for Preliminary Evaluation/Testing of the Vapour Heat Treatment Facility for Fresh Fruits & Vegetables		
S. No.	**Evaluation/Testing of Activity**	**Status (Yes/No/NA)**
1.	Location, construction & design of facility as per safety norms and as per regulations of local authority	
2.	Engineering plans and drawings are approved by the PPA (applicable for new facility)	
3.	Assured supply of potable water and chlorination of water at appropriate levels (50-200 ppm) to prevent microbial contamination	
4.	Compliance with minimum requirements of certification as per this standard	
5.	Electrical wiring through out the facility meet the safety norms and regulations of local authority including earthing and PVC conduiting	
6.	Control panels/Electric Meters etc., are adequately weather protected	
7.	Computers/microprocessors are located in air-conditioned to maintain accuracy and reliability and installed with surge protectors/UPS	
8.	Support of Diesel generator to have uninterrupted power supply	
9.	Fruit sizing equipment installed	
10.	Steam boiler with adequate water heating capacity and thermostatic controls and performance testing	
11.	Installation of vapour heat treatment chamber with vapour inlets	
11.	Installation of air and water vapour circulating system and checking	
12.	Installation of permanent RTD temperature sensors in the chamber	
13.	Installation of PID Controller and testing the performance	
14.	Installation of strip chart recorder/data logger and performance testing	
15.	Installation and checking of alarm or other safety system	
16.	Insect-proof screening of doors/windows/ventilators to exclude fruit flies	
17	Name and Signature of Technical Operator with date	
18.	Name and Signature of Facility Manager with seal and date	
19.	Verified by (Name/Signature/Designation of Expert/Officer of Dte of PPQS) with date	

Appendix-V

Directorate of Plant protection Quarantine & Storage **N.H.IV, Faridabad-121001**	Record No: Date:

Instruction and Worksheet for Calibrating Portable Temperature Sensors

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 temp erature 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**	**Thermometer Reading**	**Difference**	**Remarks**

Signature of the person calibrating sensors with date	

Appendix-VI

Directorate of Plant protection Quarantine & Storage **N.H.IV, Faridabad-121001**	Record No: Date:

Test of the Accuracy of the Permanent RTD Sensors Installed in Vapour Heat Treatment Chamber/Pulp Sensors

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 chambers/pulp sensors
- The calibrated portable sensors are suspended in the vapour heat chamber or tied to a plastic stand at the same level of permanent RTD sensors fixed in each compartment of the chamber or inserted into pulp in level with pulp sensors .
- Raise the temperature of vapour heat chamber to 46- 48^{0}C by running the air-water vapour circulation system to ensure uniform distribution of air-water vapour. 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 format at different temperature segment levels . Repeat the procedure for each permanent sensor in the vapour heat chamber
- Decision: If the temperature shown on the display in control room matches the temperature shown on the hand held portable temperature monitor (as calibrated), then the permanent sensor in the chamber 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 (_____)**		
RTD sensor No/location (Fruit Tray 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-VII

Directorate of Plant protection Quarantine & Storage N.H.IV, Faridabad-121001	**Date of Test**

Actual Performance Test for Vapour Heat Treatment Facility

Name of the Facility	Location
Facility Manager	
Fruit variety tested:	Stage of Ripeness:

Temperature at start of test

Thermostatic set point	Temperature of Steam	Fruit pulp	Ambient air

Notes

Fruit Tray No_____ Position_____Test No_____

Readings taken at specific times (minutes)before calibration adjustment, if any. Use one or two pulp sensors per each compartment of chamber for each level. Indicate pulp sensors with an asterisk (*)

Portable sensor No*	**Calibration adjustment**		**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-VIII

Directorate of Plant protection Quarantine & Storage **N.H.IV, Faridabad-121001**	**Record No:**
	Date

Sensor Location Diagram, Fruit Weights and Pulp Temperatures

Name of the Facility	*Tank No*	*Test Number*

Instruction

Show sensor numbers and their approximate location within each tray (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 vapour flow in the chamber.

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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-IX

Directorate of Plant protection Quarantine & Storage **N.H.IV, Faridabad-121001**	Report No: Date:

Official Performance Test Report for certification of Vapour Heat Treatment Facilities for Fresh Fruits & Vegetables

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 Vapour Heat Treatment Chamber **(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. Signatures of expert/inspecting PQ officer with date 1._____ 2_____

Appendix-X

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 Vapour Heat Treatment Facility

This is to certify that the vapour heat treatment facility as described below has been inspected and approved for treating fresh fruits in line with the requirements of this 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-XI

_____ (Name & Address of Facility)	**T.R. No:** **Date:**

Treatment Record

1. Name of the commodity:	
2. Batch No:	**3. Quantity (Wt/No):**
4. Fruit Variety:	**5. Stage of ripeness:**
6. Destined to:	**7. Port of shipment:**
8. Treatment schedule:	
9. Distinguishing marks, if any:	**10. Container particulars:**

11.Temperature at start of test

Thermostatic set point:___^{0}C	***Temperature of steam::___^{0}C***	***Fruit pulp: ___^{0}C***	***Ambient air: ___^{0}C***

12. Temperature recordings during treatment time (Recordings at every 5 min intervals made through a data logger or strip chart recorder. Attach log sheets)

Permanent RTD Sensor No	***Calibration factor***	***Location (Ambient/Fruit pulp/Tray No)***	***Position (Top/Middle/Bottom)***	***Time of record (ST/RT/ET*)***	***Temp in ^{0}C***

*ST: Start time; RT: Ramp up time; and ET: End Time.

Mean weight of fruits (in g)		Mean number of fruits per tray (Average of six trays)	Mean Net Weight of fruit tray
Average of six random fruits	Average of six large fruits		

Name & Signature of the technical operator with date	

Appendix-XII

List of Essential Equipment for setting-up of Vapour Heat Treatment Facility

Equipment	Make	Specification
Temperature Recorder:	**Strip chart type:** Honey Well DPR 3000 Version D4 (12 channel capability) or **Data logger type:** Honey Well DPR 3000 Version D4 (12 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
PID Temperature Controller (Thermostat)		
Temperature Sensors	Cooper Instruments Corporation model TM 99A or TC100A or equivalent	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 or equivalent	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 or equivalent	12 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
Diesel Power Generator		
Air-Water vapour Mixing Unit & circulation system		
Vapour Heat Treatment Chamber		Made of Stainless steel fitted with steam inlets of appropriate size for holding the fruits in trays
Fruit sizing/grading 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 Trays		Stainless steel perforated trays for stacking of commodity in treatment chamber
Portable balance		For weighing individual fruits
Water Circulation Pump		
Computer/Microprocessor		