



Australian Government

Australian Quarantine and Inspection Service

TREATMENTS AND FUMIGANTS

AQIS HEAT TREATMENT STANDARD

Version 1

DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY

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1 GLOSSARY OF TERMS

Term	Definition (for the purpose of this standard)
Ambient temperature	Temperature of the air at the site where the treatment chamber is located.
Accredited Party	A party which is certified by a government or international body as being competent to provide a particular service.
Commodity	The article being moved for trade or other purpose.
Core	The central, most inner part of the object being treated.
Core probe	A manually positioned temperature sensor (usually a thermocouple) housed inside a sealed, non-conductive tube, which can be inserted into a commodity to measure core temperature.
Core temperature	The temperature at the centre of the commodity
Fixed Temperature Sensor	A temperature sensor fixed to, placed on or suspended from, the internal walls or ceiling of the treatment chamber and used to measure air temperature inside the chamber.
Free air space	Empty space between, above or around a commodity to allow the hot air access to the commodity to eradicate pests.
Heat treatment certificate	Documentation certifying that a heat treatment has been undertaken in compliance with AQIS requirements.
Heat treatment chamber	A closed structure used for heating commodities to a specified core temperature for a specified time, for the purpose of killing pests and disease. A kiln, used for drying logs and timber, may also be used to conduct heat treatments.
Heat treatment rate	A specific time-temperature schedule.
ISPM 15	The 'International Standards for Phytosanitary Measures Publication No. 15: Guidelines for Regulating Wood Packaging Material in International Trade'.
Pest	Any animal, plant or other organism that may pose a threat to the community or the natural environment.
Specified core temperature	The required minimum temperature as specified by the heat treatment rate.
Temperature	Refers to dry bulb temperature
Temperature Sensor	A temperature sensing element, usually a thermocouple within a protective sheath.
Thermocouple	Used for measuring temperature, it consists of two dissimilar metals, joined together at one end. When the junction of the two metals is heated or cooled a voltage is produced that can be correlated back to the temperature.

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Timber (also known as lumber)	A term of commerce for wood, either as logs or sawn units.
Treatment exposure period	The time period for which the specified treatment temperature must be continuously maintained, as determined by the heat treatment rate.
Treatment temperature	Temperature of the air immediately surrounding the commodity within the treatment chamber.
Warm-up time	The initial time taken to attain the specified core temperature of treatment.

HOW TO USE THIS STANDARD

This heat treatment standard is a general methodology for performing dry heat treatment to meet Australian quarantine requirements. This standard does not cover hot water immersion treatment, steam treatment, vapour heat treatment or heat treatment for fresh produce.

This standard is divided into two main sections:

- AQIS Requirements
- Descriptive Appendices

AQIS Requirements

AQIS requirements for this section are designed to be subject to audit during quality control procedures, by AQIS, by other quarantine authorities or by authorised agents of either.

This section is divided into two main columns:

MANDATORY

This column lists conditions that **MUST** be achieved and actions which **MUST** be undertaken in order to conform to the requirements of the AQIS Standard.

INFORMATIVE

This column lists information that may be helpful to treatment providers in achieving the Mandatory Requirements.

Descriptive Appendices

These appendices provide information on a range of issues that may be helpful to a treatment provider on various aspects of the heat treatment procedure.

MANDATORY	INFORMATIVE
2 HEAT TREATMENT CHAMBER	
The chamber	
<p>2.1 The heat treatment chamber must be designed and insulated to ensure the specified core temperature can be achieved and maintained for the duration of the treatment exposure period.</p>	
Hot air delivery and circulation	
<p>2.2 Heating elements must be positioned to ensure that the hot air is rapidly, effectively and evenly distributed throughout the heat treatment chamber and commodity being treated.</p> <p>2.3 Airflow must ensure that an even distribution of hot air is attained within the chamber during treatment.</p> <p>2.4 Airflow from fans/blowers must be sufficient to ensure the core of the commodity is maintained at the specified core temperature for the required duration.</p>	<p>Heat exchangers should be exposed to the full air circulation to heat air effectively and evenly. Recycling of the heated air is encouraged.</p> <p>To ensure effective heat treatment there should be sufficient air circulation to achieve the desired temperature uniformly throughout the load in the treatment chamber. Also refer Section 9.</p> <p>Larger chambers may require more powerful fans to aid in the uniform distribution of hot air throughout the chamber and the commodity being treated.</p> <p>Hot air mixed with steam/humidity is often used to treat sensitive products at temperatures below 100°C. If steam/humidity is applied to the chamber it should not interfere with the heat treatment rate.</p>
3 TEMPERATURE MEASURING EQUIPMENT	
<p>3.1 Even temperature distribution throughout the chamber must be determined by either:</p> <ul style="list-style-type: none"> • Calibration of the chamber on an annual basis to ensure even temperature distribution for all possible loading configurations or; • Fixed temperature sensors (refer to sections 4.1 - 4.4). <p>3.2 In addition core temperature probes must be placed throughout the commodity in accordance with sections 5.4 and 5.5</p>	

MANDATORY	INFORMATIVE
<p>4 FIXED TEMPERATURE SENSORS (THERMOMETERS)</p>	
<p>4.1 Fixed temperature sensors must be able to measure to the highest temperature required to be reached during treatment.</p> <p>4.2 Fixed temperature sensors must be positioned in such a manner as to provide records of air temperature throughout the chamber to within +/- 0.5°C.</p>	
<p>Placement of fixed temperature sensors</p>	
<p>4.3 Fixed Temperature Sensors must be positioned as follows:</p> <ul style="list-style-type: none"> • where the chamber has bottom hot air delivery, sensors should be placed at the level of the top and middle of the loaded commodity; • where the chamber has top air delivery, sensors should be placed at the level of the bottom of the loaded commodity; and • where the chamber has top and bottom hot air delivery, the sensors should be placed at the level of the middle of the loaded commodity. 	<p>It is the responsibility of the treatment provider to ensure that the entire commodity is heated uniformly</p>
<p>4.4 Multiple sensors to measure treatment temperature must be:</p> <ul style="list-style-type: none"> • permanently fixed no more that 7 metres apart, perpendicularly to the air flow; • positioned at different heights in the front, rear and on either side of the chamber. 	<p>The exact position and temperature readings of each sensor should be identifiable on the monitoring output.</p> <p>Use of an aspirated temperature sensor for measurement of air temperature can increase the surface heat transfer coefficient and reduce the sensor response time.</p>

MANDATORY	INFORMATIVE
<h2 style="text-align: center;">5 CORE PROBES (MANUALLY POSITIONED TEMPERATURE SENSORS)</h2>	
<p>5.1 A minimum of five core probes must be inserted throughout the loaded commodity.</p> <p>5.2 At least one core probe must be placed at the coolest measuring point in the chamber.</p> <p>5.3 Core probes must be able to measure to the highest temperature required to be reached during treatment.</p>	<p>Sheathed core probes are the most effective and versatile to use when probing commodities. Care should be taken when inserting core probes into the commodity, as any damage to the core probe or the lead will result in inaccurate temperature readings.</p> <p>The exact position and temperature readings of each core probe should be identifiable on the data logging equipment output.</p> <p>The coolest measuring point in the chamber can be identified by either:</p> <ul style="list-style-type: none"> - monitoring the sensors in the chamber; or - conducting thermal mapping.
<p>Placement of core probes to measure core temperature of commodity</p>	
<p>5.4 Core probes must be inserted:</p> <ul style="list-style-type: none"> • in the centre of the smallest packaged unit* of the commodity; • within the centre of the largest packed unit; and • at different heights in the front, middle and rear of the chamber. <p>* When treating timber, the core probe must be placed in the thickest piece of timber in the stack. Additionally core probes must be inserted into holes drilled into the centre of the timber. The holes must be no larger than necessary to accommodate the diameter of the core probes, to avoid contamination of the timber core temperature readings by treatment temperature. Core probes must be sealed into the holes using heat resistant, insulating filler.</p> <p>5.5 Core probes must not be placed close to metal objects (e.g. nails).</p>	<p>The centre of a unit being the middle, as measured by the shortest distance from the outside. For example, if treating bagged commodity the core probe should be inserted into the centre of one of the bags.</p> <p>If the bagged commodity is stacked on pallets, the core probed bag of commodity would be located in the centre of the pallet.</p> <p>The probe should be completely encased by the commodity to avoid heat travelling down protruding components and giving false readings.</p> <p>Sawdust can be used as heat resistant and insulating filler. However, if sawdust is likely to enter Australia with the commodity, additional Australian Quarantine requirements apply – refer to ICON (see section 8.1).</p> <p>Probing close to metal objects such as nails should be avoided, as heat transfer along the metal objects may interfere with the integrity of the temperature recorded by the core probe.</p>

MANDATORY	INFORMATIVE
<p>6 MONITORING AND RECORDING TEMPERATURES</p>	
<p>6.1 Heat treatment chamber temperatures must be monitored and recorded either:</p> <ul style="list-style-type: none"> • Manually; or • using data logging equipment. 	
<p>6.2 The fixed temperature sensors and core probes must be connected to suitable equipment to enable accurate monitoring and recording of temperature readings.</p>	
<p>6.3 The monitoring and recording equipment must be able to continuously monitor temperatures of all sensors and core probes throughout warm-up and treatment exposure period.</p>	
<p>6.4 All components of the monitoring and recording system (sensors, core probes, extension wires, data logger, etc.) must be compatible and meet national codes and requirements.</p>	
<p>7 CALIBRATION AND MAINTENANCE OF EQUIPMENT</p>	
<p>7.1 All indicators and recorders must be readable to one tenth of a degree and the measurement systems must be accurate within +/- 0.5°C, when calibrated at 0°C and within 5°C of highest specified core temperature.</p>	<p>Measuring and monitoring equipment requires regular calibration and maintenance to ensure that it is operating effectively. It is particularly important to maintain core probes and temperature recording equipment. Where batteries are used, they should be regularly checked for working condition.</p> <p>Approximate calibration can be carried out by exposing the sensor or core probe to an established fixed-point environment, such as the ice-point of water. Calibration can be carried out against a certified thermometer; such as a mercury-in-glass thermometer.</p>
<p>7.2 All sensors, core probes and monitoring/recording equipment must be calibrated regularly, in accordance with the manufacturer’s instructions</p>	
<p>7.3 Calibration must be carried out by the manufacturer or the manufacturer’s representative or by another accredited third party, at least annually.</p>	

MANDATORY	INFORMATIVE
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8 PRE-TREATMENT CONSIDERATIONS – COMMODITY AND RATE

Commodity

8.1 The commodity and associated packaging must be suitable for heat treatment.

See the ICON database www.aqis.gov.au/icon for information on specific commodities.

Some commodities are unsuited to dry heat treatment as it can damage the goods. This can be overcome by maintaining sufficient levels of relative humidity.

Heat treatment is not recommended for goods/packing made of plastic (where there is a risk of excessive plasticiser migration from packing to commodity) or goods which have glue within their structure.

If there is concern that a commodity may be adversely affected by heat treatment, importers, exporters and heat treatment providers should seek expert advice (outside of AQIS) regarding its effects or conduct tests on the commodity.

Some packing materials may not withstand high temperatures; therefore ensure that the packaging is suitable for heat treatment.

Heat treatment rate

8.2 Heat treatment rates must conform to:

- **Permit conditions to import quarantine risk material into Australia and/or AQIS Import Conditions (ICON) database; or**
- **ISPM 15 heat treatment rates (for wood packing only); and**
- **Any other Quarantine Directions.**

See ICON database www.aqis.gov.au/icon

MANDATORY	INFORMATIVE
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9 PREPARATION OF COMMODITY FOR HEAT TREATMENT

Free air space

<p>9.1 The chamber must be loaded to allow the designed air circulation through the load.</p> <p>9.2 Commodities must not obstruct air inlets or outlets when the chamber is fully loaded.</p> <p>9.3 The commodity must be loaded into the chamber with free air space around the commodity to allow for effective circulation of the hot air</p> <p>9.4 Free airspace must exist under the commodity. The commodity must not be placed directly on the floor of the chamber.</p> <p>9.5 Free airspace must exist between dense commodity components or units. Bagged commodities packed on pallets must be stacked in such a way that air can circulate freely at the centre of the pallet.</p>	<p>Stacking bagged commodities around the edges of a pallet can create a ‘column’ of air in the centre of the pallet through which air can freely circulate. See Appendix C4: Free Airspace.</p> <p>Timber: there is no requirement for the spacers to be a specific horizontal distance apart. However, they should maintain a continuous gap along the length of the timber. Individual units of product should be packed in such a way that maximum surface area of the product is exposed to the heated air, e.g. in layers with spacing sticks at least 20mm thick for air flow from side to side.</p> <p>Over sized timber of any dimension can be treated effectively provided the heat treatment chamber is large enough to allow for circulation of air around the timber. It can take days or weeks to reach the required core temperature. This is dependant on the size and total volume of the timber.</p>
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10 PERFORMING AND MONITORING THE HEAT TREATMENT

Warm-up time

<p>10.1 The delivery air must be warmer than the targeted core temperature.</p> <p>10.2 Temperature readings must be recorded at a minimum of every 30 minutes, until the specified core temperature is reached and held at all measuring points in the chamber.</p>	<p>The delivery air temperature should be warmer than the targeted core temperature.</p>
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MANDATORY	INFORMATIVE
Treatment exposure period	
<p>10.3 Timing of the treatment exposure period begins when core temperatures at all measuring points in the chamber exceed and are maintained at or above the specified core temperature.</p> <p>10.4 The specified core temperature must be maintained or exceeded for the duration of the treatment exposure period.</p> <p>10.5 During the treatment exposure period, temperature readings must be recorded every 5 minutes or less.</p>	<p>For the purpose of maintaining quarantine integrity, the treatment exposure period only commences after the specified core temperature has been reached and held and the humidity (if applied) in the treatment chamber has stabilised.</p>
11 COMPLETING THE HEAT TREATMENT	
Review temperature records	
<p>11.1 At the end of the treatment, temperature readings must be reviewed to ensure all sensors and core probes recorded temperatures that were at, or above the specified core temperature for the required duration of the treatment.</p> <p>11.2 The heat treatment has failed if at any point during the treatment exposure period the temperature falls below the specified core temperature.</p> <p>11.3 In the event of a failure the treatment process must be repeated. Timing of the treatment exposure period must restart from the time the specified core temperature is re-achieved.</p>	<p>The heat treatment can be declared successful when all the temperature readings have been maintained at or above the specified core temperature throughout the treatment exposure period.</p> <p>For further information on factors which may lead to a failed treatment, see: APPENDIX C3: Considerations when using thermocouples.</p>
Storage of treated goods	
<p>11.4 Treated commodities and their packaging must be stored to maintain freedom from infestation and contamination.</p> <p>11.5 The treated commodities and their packaging must be stored undercover at least 5 metres from untreated goods, in an area which is clean, dry, well ventilated and free of insects and vermin.</p>	

MANDATORY	INFORMATIVE
Documentation	
11.6 All records must be kept for a minimum of 2 years. Records should contain sufficient detail to enable verification of the treatment at audit.	
11.7 If a heat treatment certificate is required, the information provided on it must be accurate.	See APPENDIX C1: Example of a heat treatment certificate. See APPENDIX C2: How to use the AQIS heat treatment certificate.

APPENDIX C1: Example of a heat treatment certificate

COMPANY LETTERHEAD

(Including address)

Certificate Number: _____

AFASHT ID No.: _____

HEAT TREATMENT CERTIFICATE

This is to certify that the following regulated article has been heat treated according to the appropriate procedures to conform to the current phytosanitary requirements of the importing country.

ARTICLE DETAILS

Description of goods:
Quantity declared:..... Distinguishing marks:
Consignment link:
Country of origin: Port of loading:
Country of destination:..... Declared point of entry:
Name and address of consignor/exporter/shipper:
.....
Declared name and address of consignee/buyer/notified party:
.....

TREATMENT DETAILS

Name of treatment provider:
Date of heat treatment:
Place of heat treatment:
Treatment exposure period: (hr/min)
Core temperature maintained:(°C)
Minimum and maximum treatment temperature:(°C)
Fruit core temperature (if applicable):(°C)
Timber thickness (if applicable)..... (mm)
(Where 'thickness' is defined as the distance between vertical stickering in a stack)

ADDITIONAL DECLARATIONS

.....
.....
.....

I declare that these details are true and correct and that the heat treatment has been carried out in accordance with the AQIS Heat Treatment Standard.

Place and Date:

Company stamp:

Signature and name of approved treatment provider
or government agency:

APPENDIX C2: How to use the AQIS heat treatment certificate

The following information (critical fields) must be supplied for a heat treatment certificate to be accepted by AQIS. This information should be on a single page and be in the same format as the example certificate. The critical fields are as follows:

1. Certificate must be supplied by an AQIS-acceptable treatment provider:

- ISPM 15 treated timber packing should be marked in accordance with ISPM 15. AQIS accepts:
 - a packing declaration from a packer/supplier declaring all timber packing is marked with ISPM 15 compliant stamps; or
 - an official government Phytosanitary certificate certifying “all timber packing is marked in accordance with ISPM 15”.
- For the Non-ISPM 15 treatments, AQIS accepts the following:
 - Official government Phytosanitary certificates provided they include details of the treatment;
 - Treatment certificates issued by treatment providers accredited under an AQIS recognised government program or its equivalent; or
 - AFAS heat treatment certificates (provided the AFAS ID number is in the top right hand corner).

2. Certificate must be on a treatment provider’s letterhead.

This letterhead should include the business address of the heat treatment provider.

3. Certificate must provide a description of the goods being treated.

This information should be supplied in the ‘Description of Goods’ section.

4. Certificate must be signed by a representative of the treatment provider or government agency.

The signature must appear below all of the information on the certificate. Where a certificate is endorsed by a government agency, the endorsement should also appear on the same page as the heat treatment details.

5. Consignment identification.

Acceptable consignment links are: a container number, a bill of lading number, marks and numbers, a commercial invoice number, a preferential tariff certificate number, a packing list number or a letter of credit number. Where a document does not contain one of the above forms of consignment identification, it must have a direct numerical link to another document that does contain one of the above forms of consignment identification.

6. Certificate must be dated.

Both the date of the treatment and the date of signing must be displayed on the document.

7. Treatment exposure period: the time period from achieving the required treatment temperature to the end of the specified treatment exposure period.

8. Core temperature maintained for treatment exposure period: This is the temperature reached and held at the centre of the commodity for the duration of the treatment exposure period.

9. Minimum and Maximum treatment temperatures: This is the recorded temperature of the air immediately surrounding the commodity within the treatment chamber during treatment

All critical fields must be free from any erasures or alterations unless they are endorsed by the original provider of the document. The only suitable endorsement is a company stamp/seal and signature applied adjacent to the alteration.

APPENDIX C3: Temperature sensor (thermometer) considerations

Considerations when using Thermocouples

Thermocouples are popular temperature sensors. They are cheap, interchangeable, have standard connectors and can measure a wide range of temperatures. The main limitation is accuracy. Sufficient accuracy can be obtained if the thermocouples are used carefully and provided precautions are taken to avoid problems associated with this instrument.

Listed below are some of the more common measurement problems which may occur when using thermocouples:

Connection problems: Measurement errors can be caused by unintentional thermocouple junctions; any joining of two different metals will cause an unintentional thermocouple junction. When increasing the length of the leads from the thermocouple to the measuring device, the correct type of thermocouple extension wire must be used (e.g. type K for type K thermocouples). Using a different type of wire will introduce a thermocouple junction. Any connectors used must be made of the correct thermocouple material and correct polarity must be observed.

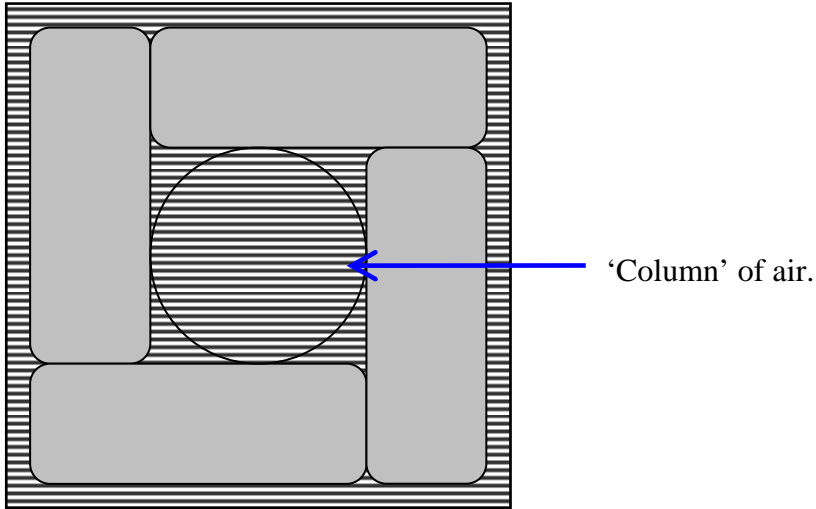
Lead Resistance: To improve response times, thermocouples are made of thin wire. This may cause the thermocouple to have a high resistance, making it sensitive to noise. Thin wires can also cause errors due to the input impedance of the measuring instrument.

Decalibration: This is the process of unintentionally altering the makeup of thermocouple wire. Fatigue from constant bending of lead wires can be a cause of decalibration. Lead wires, particularly for core probes, should be made up using appropriate multi-strand thermocouple extension wire, which will be more flexible than an equivalent thickness of single strand wire. Alternatively, single strand cables may be used provided they are replaced regularly.

Noise: The output from a thermocouple is a small signal, so it is prone to electrical noise pick up. Most measuring instruments reject any common mode noise (signals that are the same on both wires), so noise can be minimised by twisting the cable together to help ensure both wires pick up the same noise signal. If operating in an extremely noisy environment, it is worthwhile considering using a screened extension cable. If noise pickup is suspected first switch off all suspect noisy equipment and see if the reading changes.


APPENDIX C4: Free air space

Stacking bagged commodity around the edges of a pallet, can create a ‘column’ of air in the centre of the pallet through which air can freely circulate.



Key/Legend

 Pallet

 Bagged commodity

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