



Australian Government
Department of Agriculture
and Water Resources

Sulfuryl fluoride fumigation methodology

Version 1.1



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Purpose

This methodology sets out the minimum requirements for treatment providers performing sulfuryl fluoride fumigations on commodities and/or associated packaging suited to such treatments for Quarantine and Pre-shipment (QPS) purposes. This methodology is the basis for compliance auditing of treatment providers to monitor their performance of effective QPS treatments with sulfuryl fluoride.

Scope

This document applies to commercial and government treatment providers performing QPS sulfuryl fluoride fumigation treatments for countries that have adopted a specific sulfuryl fluoride treatment schedule.

This document is not intended to specifically cover the performance of sulfuryl fluoride fumigation treatments under ISPM 15. However, the basic principles, requirements and recommendations described in this document and the associated guideline are still generally applicable.

Even though the basic principles and requirements would be relevant, this document is not intended to specifically cover fumigations of vessels (whether it is the vessel itself or its cargo), silos or other storage facilities, buildings or other fumigations that are not done in the types of enclosure described herein and not related to import or export.

General

Best fumigation practice is the result of a practical combination of all procedures required during a fumigation treatment to ensure that:

- the people conducting the fumigation remain safe and are not harmed
- all people in the area around the fumigation treatment area remain safe and are not harmed
- the environment is not harmed
- all life stages of all target pests are killed
- the commodity, or product, or equipment being treated inside the fumigation enclosure is not damaged in any way.

Fumigation treatment providers registering to perform official treatments in accordance with these requirements must have the equipment, facilities, competent licenced fumigators and management and administrative procedures necessary to ensure that all relevant treatments comply with these requirements.

Importing countries have the right to impose more stringent treatment conditions to address their individual biosecurity risks. If that is the case, those additional conditions take precedence

over these requirements and must be complied with to the satisfaction of the relevant authority of the importing country.

Countries receiving treatment certification through this system expect the treatment has been undertaken in accordance with this methodology. Treatment providers found to be wilfully and consistently not complying with the requirements of this methodology and/or other specified treatment conditions will have their registration status changed to 'unacceptable' until such time as they can demonstrate satisfactory compliance.

Performing fumigations in accordance with these requirements will reduce the use of sulfuryl fluoride by minimising the need for re-treatment of consignments due to ineffective fumigations caused by poor fumigation practices.

How to use this document

Some of the requirements in this methodology only apply in certain circumstances, generally related to the type of enclosure used. It is important for the fumigators and compliance auditors to understand the purpose of the requirements and the outcomes they are intended to achieve and the particular circumstances in which they apply.

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1 Prior to fumigation

1.1 Target of the fumigation

- 1.1.1 The fumigator must know the correct treatment schedule to be applied for the pest/commodity/country combination.
- 1.1.2 The fumigator must have the relevant regulatory approval and training.
- 1.1.3 The fumigator must have the appropriate resources to undertake the fumigation in compliance with this methodology.
- 1.1.5 The fumigator must know what the target of the fumigation is.
- 1.1.6 The target of the fumigation must be recorded on the fumigation documentation.

1.2 Consignment suitability

- 1.2.1 The fumigator must determine if the target of the fumigation is suitable for fumigation with sulfuryl fluoride.
- 1.2.2 If the target of the fumigation is unsuitable for fumigation with sulfuryl fluoride, remedial action must be taken to ensure it is suitable or an alternative, acceptable treatment must be conducted.

1.3 Free airspace

- 1.3.1 There must be sufficient free space throughout the enclosure to allow the fumigant to freely circulate around the target of the fumigation.
- 1.3.2 There must be sufficient free airspace to permit the positioning of sampling tubes in appropriate locations within the enclosure. See [4.1 Concentration sampling tubes](#).

1.4 Timber thickness and spacing

- 1.4.1 Untreated timber products must have at least one full physical dimension which is less than 200mm thick.
- 1.4.2 Timber and timber product fumigations must be conducted before any surface coatings are applied, unless all parts of the timber or timber product have at least one uncoated surface with a maximum thickness of 100mm from the uncoated surface.
- 1.4.3 Where timber is the target of the fumigation, it must be separated by a minimum of 5mm of airspace every 200mm. This separation can be horizontal or vertical.

1.5 Impervious wrappings, coatings and surfaces

- 1.5.1 Where penetration into the target of the fumigation is required, the target of the fumigation must not be coated in materials that will prevent sulfuryl fluoride from penetrating into the target of fumigation such as lacquers, paints, waxes, natural oils, veneers or plastic wraps.
- 1.5.2 Where penetration into the target of the fumigation is required, impervious wrappings must be removed, opened or slashed prior to fumigation in such a way to allow sulfuryl fluoride to come into contact with and, if needed, penetrate into the target of the fumigation.

1.6 Site suitability

1.61 The fumigation site must:

- have adequate space to establish a risk area around the enclosure
- allow for safe ventilation
- be flat and even
- be well ventilated
- have power available, either mains or generator.

2 Safety

2.1 Risk assessment

2.1.1 Before commencing any fumigation a risk assessment must be carried out to determine if any hazards are present and evaluate the potential consequences to:

- fumigation personnel
- people in the vicinity
- occupants of surrounding buildings.

2.1.2 Appropriate control measures must be in place to address the hazards identified.

2.1.3 The risks must be reviewed as needed to respond to changing circumstances and the control measures must be adjusted accordingly.

2.1.4 The designated fumigator-in-charge is responsible for the safe conduct of the fumigation.

2.2 Risk area

2.2.1 A risk area must be established around the perimeter of the enclosure warning people the fumigation is taking place.

2.2.2 The risk area must be demarcated by a physical barrier for the duration of the fumigation.

2.2.3 The size of the risk area should be set according to the risk but must not be less than:

- 3 metres from the enclosure outdoors
- 6 metres from the enclosure inside a building or structure.

2.2.4 For fumigations in a chamber, see [3.4 Fumigation chambers](#), a risk area is not required after the fumigant has been applied provided that the chamber is locked from the time the fumigant is ready to be applied until the fumigant has been ventilated and the concentration verified at or below the TLV-TWA. See [9.1 Threshold limit value—time weighted average \(TLV-TWA\)](#).

A risk area must still be established according to requirement [2.2.3](#) and Personal Protective Equipment (PPE) must be worn while injecting the fumigant into the chamber to protect the fumigator and others against accidental exposure to the fumigant from a failure in the supply system.

2.2.5 Warning signs must be placed around the enclosure. They must:

- be large enough to be visible from a reasonable distance
 - be visible from all angles of approach
 - display easily understood symbols indicating danger and/or toxic gas is in use
 - provide 24 hour contact details of the fumigator
 - be in a language or languages appropriate to the location.
- 2.2.6 The risk area, with the exception of chamber fumigations, must be in force from the time immediately prior to connection of the sulfuryl fluoride supply to the supply system up until the gas concentration in the risk area and the enclosure is verified at or below the TLV-TWA.
- 2.2.7 Anyone entering the risk area while it is in force must be wearing appropriate PPE at all times.

2.3 Personal protective equipment (PPE)

- 2.3.1 Suitable respiratory protection must be worn at all times inside the risk area while it is in force.
- 2.3.2 Respiratory protection must be worn at all times when inside the buffer zone during ventilation. See [9 Ventilating the enclosure](#).
- 2.3.3 Self-contained breathing apparatus must be:
- operated in accordance with the manufacturer's instructions
 - used only by properly trained personnel
 - maintained in good working order
 - refilled from a safe source.

3 Fumigation enclosures

3.1 Gas-tightness

- 3.1.1 All fumigation enclosures must be sufficiently gas-tight to retain the fumigant for the duration of the exposure period and maintain the concentrations at or above the requirements.

3.2 Sheeted enclosures

- 3.2.1 The surface on which the sheeted enclosure will be created must be:
- impervious to sulfuryl fluoride or covered with a gas-proof sheet if the surface is not impervious
 - free of debris that might prevent a gas-tight seal or damage the sheet
 - free of cracks and drains or other openings.
- 3.2.2 The fumigation sheets must be impervious to sulfuryl fluoride. They must be able to retain the required concentration for the duration of the fumigation without needing to add additional sulfuryl fluoride due to permeation through the sheet.
- 3.2.3 A gas-tight seal must be created between the fumigation surface and the sheet.

- 3.2.4 If one or more shipping containers are fumigated in a sheeted enclosure at least one door of each container must be open during the fumigation.

3.3 Un-sheeted shipping containers

- 3.3.1 A shipping container can be used as a fumigation enclosure if it can be sealed to make it adequately gas-tight. The fumigator must;

- check the container for any visible holes or damage that would make it unsuitable
- seal the air vents
- install sampling tubes— see [4.1 Concentration sampling tubes](#)
- install a fan—if there is insufficient space, the container must be fumigated as a sheeted enclosure
- arrange the tubes and leads so they exit the container where the doors meet at the base of the container
- create a barrier to reduce air flow under the container when the container is situated on the ground.

- 3.3.2 The sulfuryl fluoride must be applied through the door seals and the supply pipe must be removed after the process is complete. This is easiest to do through the door seals where they meet at the top of the container.

- 3.3.3 Where a false door is fitted to create a gas tight seal, the supply pipe, sampling tubes and power leads must pass through the false door.

- 3.3.4 Where an un-sheeted shipping container fumigation is conducted on a skeletal trailer, leak checks must be conducted on the underside of the container. A barrier to reduce airflow under the container is not required.

- 3.3.5 Soft top containers must be sheeted.

- 3.3.6 Shipping containers under gas must not be moved until they have been ventilated.

- 3.3.7 If the target of the fumigation includes the exterior of the container, for example Giant African Snail treatments, the container/s must be enclosed under gas-proof sheets.

3.4 Fumigation chambers

- 3.4.1 Fumigation chambers are permanent structures designed specifically for fumigation. To be considered a fumigation chamber for the purposes of this methodology they must:

- be constructed from rigid materials on all sides, including the door
- be permanently sealed along all joins between the walls, roof and floor
- be gas-tight once the door is closed without the need to use tape, sealant, sand snakes or any other means.
- not have anything, such as sampling tubes, supply pipes or electrical leads, enter the chamber through the door that will interfere with the seal
- have an inbuilt extraction system that actively removes the fumigant from the enclosure
- pass a pressure test at least every six months according to [3.5 Pressure testing](#).

3.5 Pressure testing

- 3.5.1 Raise the pressure in the enclosure by 250 Pa. Count the seconds it takes to fall from 200 Pa to 100 Pa. If the time is 10 seconds or more, the enclosure has passed the pressure test and is considered gas-tight for fumigation purposes.
- 3.5.2 The pressure test must be performed with the enclosure set up ready for fumigation. Sampling tubes, supply pipes and electrical leads must be in place during the pressure test as they would be for a fumigation.
- 3.5.3 A pressure test record must be created and maintained for audit purposes for a minimum of two years. The record must detail who performed the test, its completion date and result.

4 Preparing the fumigation enclosure

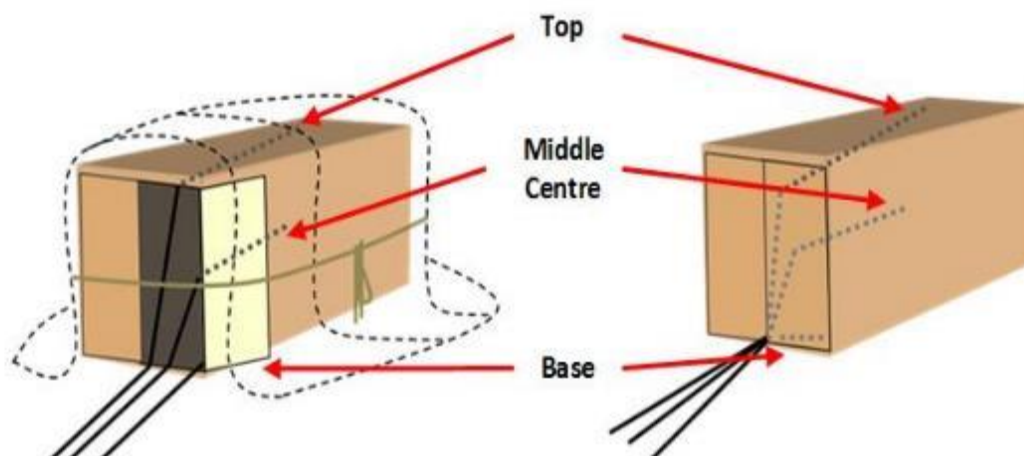
4.1 Concentration sampling tubes

- 4.1.1 Each sampling tube must be clearly identified according to their location within the enclosure.
- 4.1.2 The sampling tubes must be free of kinks and blockages.
- 4.1.3 The diameter of the sampling tubes must fit the inlet of the concentration measuring instrument.

4.2 Concentration sampling tube placement

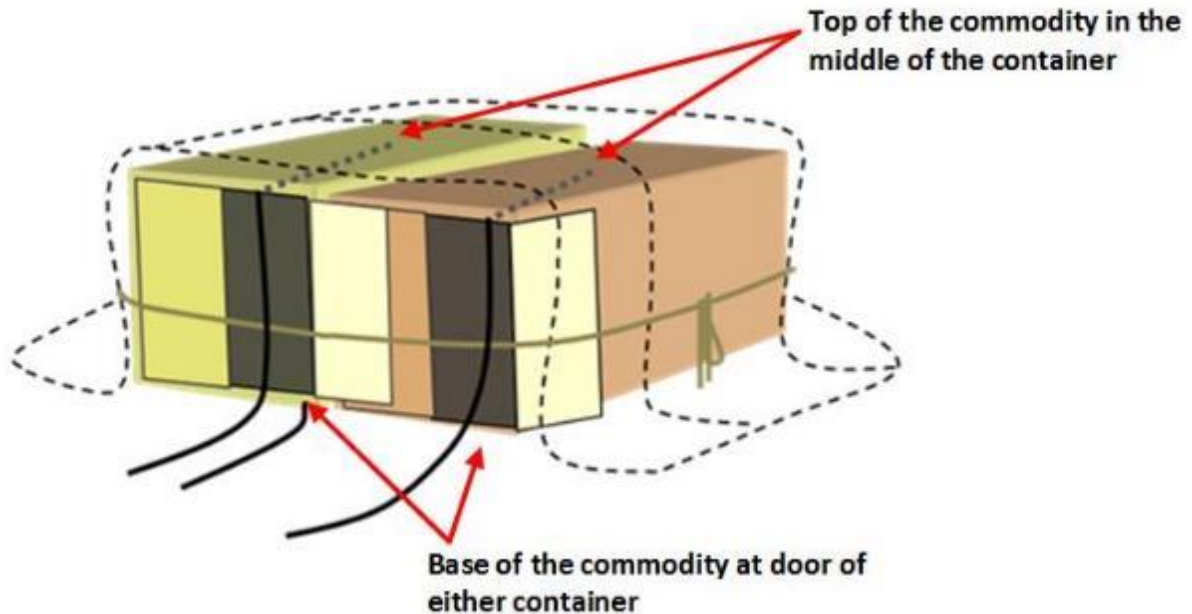
- 4.2.1 Enclosures that are 30m³ or less in volume require at least one sampling tube positioned as near as practicable to the top centre of the commodity.
- 4.2.2 Enclosures larger in volume than 30m³ must have at least three samplings tubes. The sampling tubes must be positioned to check that even distribution of the fumigant has been achieved (Figure 1). The tubes must be placed as close as practicable to:
- the top of the commodity at one end of the enclosure
 - the centre of the commodity around the middle of the enclosure
 - the base of the commodity at the opposite end of the enclosure from the top sampling tube.

Figure 1 Concentration sampling tube positions within a single enclosure



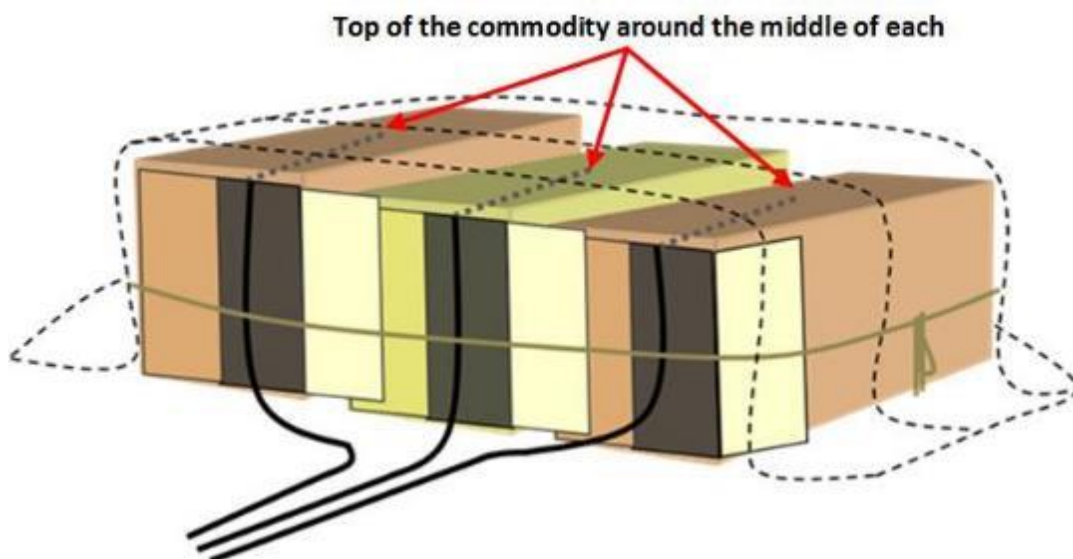
- 4.2.3 If a consignment consists of more than one un-sheeted container then each container is a separate fumigation and needs to have a minimum of three sampling tubes in each container.
- 4.2.4 Two containers under a single gas-tight sheet is considered a single enclosure and must have at least three sampling tubes placed as close as practicable to (Figure 2):
- the top of the commodity in the middle of each container
 - the base of the commodity at the door in either container.

Figure 2 Concentration sampling tube positions within two containers under a single enclosure



- 4.2.5 Three or more containers under a single gas-proof sheet is considered a single enclosure and must have at least one sampling tube placed as close as practicable to the top of the commodity in the middle of each container (Figure 3).

Figure 3 Concentration sampling tube positions within three containers under a single enclosure



- 4.2.6 Four containers under a single gas-proof sheet is considered a single enclosure must have at least four sampling tubes, five containers, five sampling tubes and so on.

4.3 Fumigant supply pipes

- 4.3.1 Multiple containers fumigated in a single enclosure must have at least one supply pipe placed in each container.
- 4.3.2 For fumigations under sheets the supply pipes must be left in position for the duration of the exposure period.
- 4.3.3 The supply pipes must be sealed once the fumigant has been applied.

4.4 Fans

- 4.4.1 Enclosures must have at least one fan for each 100m³ of volume or part thereof.
- 4.4.2 Multiple containers fumigated in a single enclosure must have at least one fan placed in each container.

4.5 Temperature

- 4.5.1 The temperature of the entire enclosure and fumigation target must be equal to or above the minimum temperature specified in the treatment schedule before any fumigant can be applied.
- 4.5.2 Where the fumigation is not performed in a controlled temperature environment, the fumigator must check what the forecast minimum temperature will be during the exposure period for the location closest to the fumigation site. The forecast minimum temperature and the source of the information must be recorded.
- 4.5.3 Fumigation is not permitted if the forecast minimum temperature for the exposure period is below the specified minimum temperature unless the temperature can be raised to and maintained at or above the allowable temperature for the exposure period by using heaters or moving the consignment inside a structure where the temperature can be adequately controlled.
- 4.5.4 Where the fumigation is performed in a controlled temperature environment, the temperature within the enclosure must be monitored and recorded at least once every 60 seconds.

One (1) temperature monitoring instrument is required for every concentration sampling tube for enclosures larger in volume than 30m³.

Two (2) temperature monitoring instruments are required for enclosures that are 30m³ or less in volume.

- 4.5.5 One (1) temperature monitoring instrument must be positioned in the enclosure as far as practicable from the heat source. The remaining temperature monitoring instruments must be positioned in different sections of the commodity that are expected to be hardest to heat.
- 4.5.6 Temperature monitoring instruments used must be accurate to within +/-0.5 °C.
- 4.5.7 Temperature monitoring and recording instruments used must be calibrated/serviced in accordance with the manufacturer's requirements.

5 Calculating the dose

NOTE: There are two approved options for conducting sulfuryl fluoride fumigations in accordance with this methodology, specifically:

1. Follow the treatment schedule (initial dose, temperature, duration and retention requirements) prescribed by the relevant regulatory authority, or
2. Use an approved third party system (concentration-time (CT) product, duration and retention requirements) prescribed by the relevant regulatory authority.

Section 5 of this methodology **does** apply to treatment providers using the department's prescribed treatment schedule (option 1). These treatment providers must adhere to all requirements of the section.

Section 5 of this methodology **does not** apply to treatment providers using approved third party systems (option 2). These treatment providers must follow the dosage calculation requirements in the approved system.

5.1 Dose rate

- 5.1.1 The dose rate for the appropriate temperature prescribed by the relevant authority must be used for QPS fumigations with sulfuryl fluoride.

5.2 Dose calculation

- 5.3.1 The dose must be calculated by multiplying the dose rate by the volume of the enclosure. The formula is:

$$\text{Dose (g)} = \text{Enclosure Volume (m}^3\text{)} \times \text{Dose Rate Concentration (g/m}^3\text{)}$$

5.3 Enclosure volume

- 5.4.1 If the fumigation is conducted under gas-proof sheets, the external dimensions must be measured each time and used to calculate the volume.
- 5.4.2 For fixed sized enclosures such as chambers and un-sheeted containers, the internal volume must be used to calculate the volume.

5.4 Rounding

- 5.5.1 Once the dose has been calculated, the amount must be rounded up to next increment that can be accurately measured by the equipment used to dispense the fumigant dose.
- 5.5.2 The dose must not be rounded up until all calculations have been completed.

6 Applying the dose

6.1 Releasing the fumigant

- 6.1.1 Fumigant cylinders must be inside the risk area when fumigant is released.
- 6.1.2 The time that the sulfuryl fluoride injection was completed must be recorded.
- 6.1.3 The connections in the supply system must be free from leaks.

- 6.1.4 Scales used to measure the dose applied must be calibrated at least annually and have an accuracy of +/-0.1kg.

6.2 Checking for leaks

- 6.2.1 Suitable electronic leak detection equipment must be used.
- 6.2.2 Leak detection equipment must be able to detect sulfuryl fluoride concentrations down to at least 20ppm.
- 6.2.3 Leak detection equipment must be maintained and calibrated in accordance with the manufacturer's instructions.
- 6.2.4 During the injection of the dose, the supply system must be checked for leaks. If a leak is detected, the problem must be rectified before continuing to inject the dose.
- 6.2.5 The fumigation enclosure must be checked for leaks, especially around doors, vents, sheet joins and the bottom of enclosures. If leaks are detected, they must be rectified.

6.3 Circulating the fumigant

- 6.3.1 The fans must be operating prior to and during the injection of the fumigant dose into the enclosure.
- 6.3.2 The fans must be turned off before taking concentration readings.

7 Monitoring fumigant concentration levels

NOTE: Section 7 of this methodology **does** apply to treatment providers using the department's prescribed treatment schedule. These treatment providers must adhere to all requirements of the section.

Section 7 of this methodology **does** apply to treatment providers using approved third party systems. These treatment providers must adhere to all requirements of the section **except for** [7.3.5-7.3.8](#).

7.1 Concentration measuring instruments

- 7.1.1 Instruments used for measuring fumigant concentrations in the enclosure must be fit for purpose and in good working order.
- 7.1.2 Concentration measuring instruments must be calibrated and/or serviced according to the manufacturer's instructions.
- 7.1.3 The fumigator must have a copy of the user's manual for the particular instrument they use and must operate the equipment in accordance with the manual.
- 7.1.4 Concentration measuring instruments must be fitted with any filters as specified by the manufacturer to suit the circumstances of the fumigation.

7.2 Monitoring frequency

7.2.1 Concentration readings must be taken at the start of the fumigation and at the end of the exposure period for all fumigations.

Additional readings can be taken at any time during the exposure period to check the concentrations are equal to or above the levels required for an effective treatment. See [8. Topping-up to compensate for low concentrations](#) for details on topping-up the concentration levels.

7.2.2 Fumigations with exposure periods longer than 24 hours must have concentration readings taken at least every 24 hours in addition to the start and end point readings.

7.3 Start time of the fumigation

7.3.1 The fumigation exposure period starts when:

- equilibrium has been established
and
- all concentration readings are equal to or above the required dose concentration [note: does not apply to treatment providers using an approved third party system]
or
- the approved third party system indicates the exposure time has commenced [note: only applies treatment providers using an approved third party system]

7.3.2 Equilibrium is achieved when the highest concentration reading is within 15% of the lowest concentration reading. The formula for calculating equilibrium is:

$$\frac{\text{Highest reading} - \text{Lowest reading}}{\text{Lowest reading}} \times 100 = \%$$

7.3.3 If the result of this calculation is more than 15%, equilibrium has not been achieved and the fans must be turned on again to further circulate the fumigant. Additional readings must then be taken until equilibrium has been achieved or the concentration falls below the standard concentration.

Note: Once initial equilibrium has been achieved, it is not required at any other time.

7.3.4 A concentration reading must be taken from all sampling tubes.

7.3.5 The concentration readings must all be at or above the standard concentration for the relevant treatment schedule in Appendix 3.

7.3.6 If additional fumigant needs to be added before start point has been reached, the amount must be calculated by subtracting the lowest concentration reading from the initial dose rate and multiplying that by the volume of the enclosure.

The formula for this is:

$$(\text{Initial dose rate} - \text{Lowest concentration reading}) \times \text{Volume}$$

7.3.7 If more fumigant is added to the enclosure before start time is achieved, the time the injection of additional fumigant is completed becomes the new injection completion time for determining the required start time concentration.

- 7.3.8 All initial concentration readings and the time they were taken must be recorded. This includes any readings taken prior to achieving start point.

7.4 Minimum concentration levels

- 7.4.1 A minimum specified concentration of fumigant, must be maintained within the enclosure during the exposure period. This will be detailed in the relevant prescribed treatment schedule.

7.5 End of the exposure period

- 7.5.1 The elapsed time between the start time and the end time of the fumigation must not be less than the prescribed exposure period.
- 7.5.2 After the specified exposure period has elapsed, concentration readings from all sampling tubes must be taken. The readings and the time they were taken must be recorded on the Record of Fumigation.
- 7.5.3 The final concentration readings must all be at or above the required concentration for the required exposure period. If any of the readings are below the required concentration, the fumigation has failed unless the option of end point top-up is permitted.

8 Topping-up to compensate for low concentrations

NOTE: Section 8 of this methodology **does** apply to treatment providers using the department's prescribed treatment schedule. These treatment providers must adhere to all requirements of the section.

Section 8 of this methodology **does not** apply to treatment providers using approved third party systems. These treatment providers must follow the topping-up requirements in the approved third party system.

8.1 Topping-up

- 8.1.1 If concentration monitoring indicates that fumigant levels are at risk of falling below the required concentration, then the target of the fumigation may not be exposed to the minimum lethal dose needed to for effective treatment. Therefore, in some circumstances, the fumigator can add extra sulfuryl fluoride to increase the concentration levels to prevent the fumigation from failing.
- 8.1.2 Topping up must be undertaken when the lowest concentration reading is below the standard concentration (Figure 4 – A) and above the Minimum concentration to allow top-up (Figure 4 – B).
- 8.1.3 The top-up amount must be applied to the enclosure the same way as the original dose as per section [6 Applying the Dose](#)
- 8.1.4 After adding the top-up amount and allowing time for the extra fumigant to circulate, a concentration reading must be taken from the sampling tube that had the lowest reading to verify that the fumigant level is back above the standard concentration.

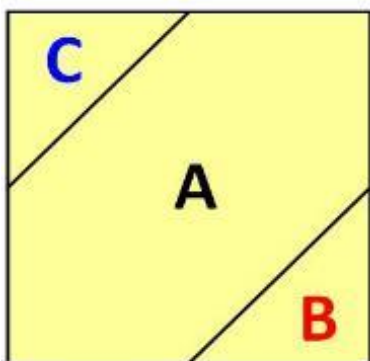
8.1.5 Equilibrium is NOT required.

8.1.6 Details must be recorded on the Record of Fumigation.

8.2 Calculating the top-up amount

8.2.1 To calculate the top-up amount, subtract the lowest concentration reading from the initial dose and multiply by the volume of the enclosure (Figure 4).

Figure 4 Sulfuryl Fluoride minimum concentration requirement and top-up calculation guide



A Standard concentration. B Minimum concentration to allow top-up. C Maximum top-up concentration. See [Appendix 3: Sulfuryl fluoride monitoring tables](#). Note: $(C - \text{lowest concentration reading}) \times \text{enclosure volume} = \text{top-up amount}$.

8.2.2 Round-up. See [5.4 Rounding](#).

8.3 Restrictions on topping-up

8.3.1 Topping-up the concentration is NOT permitted if:

- the lowest concentration reading is below the minimum concentration to allow top-up
- it will result in exposure to excessive concentrations of sulfuryl fluoride that will adversely affect that commodity.

8.3.2 Where the concentration readings at any of the sampling tubes, at any time, is below the minimum concentration to allow top-up, the fumigation has failed and topping-up is not permitted.

8.4 Topping-up during the exposure period

8.4.1 If a top-up is done during the normal exposure period, no extension of the exposure period is required.

8.4.2 Multiple top-ups are permitted during the exposure period.

8.5 Topping-up at the end of the exposure period

8.5.1 Topping-up at the end of the exposure period is not permitted.

9 Ventilating the enclosure

9.1 Threshold limit value – time weighted average (TLV-TWA)

- 9.1.1 The enclosure must be ventilated until the concentration of fumigant within the enclosure falls below the TLV-TWA. The TLV-TWA is 3 ppm unless a lower concentration is imposed by the relevant authorities in the jurisdiction in which the fumigation takes place.
- 9.1.2 The equipment used for measuring TLV-TWA must be fit for purpose and capable of accurately measuring the actual concentration, not just the presence, of sulfuryl fluoride in the range of 1 to 20 ppm.
- 9.1.3 Electronic instruments used to measure TLV-TWA must be calibrated and serviced in accordance with the manufacturer's instructions.

9.2 Releasing the fumigant from the enclosure

- 9.2.1 At the end of the exposure period the fumigant must be fully ventilated from the enclosure in a controlled and safe manner.
- 9.2.2 An assessment of the risks must be done to manage the ventilation process so that unprotected personnel in the vicinity are not exposed to unsafe levels of fumigant. The assessment must take into account:
- prevailing wind direction
 - location and proximity of unprotected personnel
 - establishment of a temporary buffer zone around the enclosure that is sufficient to prevent unprotected personnel in the vicinity from being exposed to unsafe levels of sulfuryl fluoride prevention of unprotected personnel entering the buffer zone during ventilation.
- 9.2.3 Unprotected personnel are not permitted to enter the risk area until the fumigator verifies that concentration in the area and throughout the enclosure is at or below the TLV-TWA.
- 9.2.4 If the consignment is fumigated in the shipping container/s that will be used to transport the goods, then each container must be checked individually to verify gas clearance below TLV-TWA.

9.3 Releasing the consignment from the fumigator's control

- 9.3.1 The consignment can only be released from the fumigator's control once the following conditions have been met:
- The fumigation has been performed in accordance with requirements
- or

- The fumigation has failed and it is subsequently unsuitable for further treatment with sulfuryl fluoride, requiring the consignment to be sent for an alternative treatment option

and

- The fumigant concentrations have been verified to the TLV-TWA or below.

9.3.2 The TLV-TWA readings and the time they were taken must be recorded.

10 Documentation

10.1 Record of Fumigation

10.1.1 The fumigator must record sufficient information to demonstrate that the fumigation complied with the requirements of this methodology and any additional regulatory requirements.

10.1.2 At a minimum the Record of Fumigation must include the following:

- job identification
- client or customer name
- start date of the fumigation
- location – the site address where the fumigation was performed
- a description of the consignment – including quantity
- the target of the fumigation – why is the fumigation being performed
- consignment identification – container number/s, bill of lading or other means to clearly identify the consignment
- a declaration that the consignment is suitable for fumigation with the requirements set out at in section [1. Prior to Fumigation](#)
- type of enclosure and enclosure volume
- the specified dose rate [note: does not apply to treatment providers using an approved third party system]
- CT required [note: only applies treatment providers using an approved third party system]
- exposure period
- the forecast minimum temperature or minimum temperature maintained within the enclosure (if heated)
- the dose – amount of fumigant to be used and the actual dose applied
- the amount and percentage of chloropicrin applied (if applicable)
- the time the injection of the dose into the enclosure was completed
- all concentration readings from each sampling tube and the time they were taken
- the actual CT achieved [note: only applies treatment providers using an approved third party system]
- the TLV-TWA readings and the time they were taken
- the name and signature of the fumigator-in-charge.

Note: See [Appendix 1: Example record of fumigation](#) for an example Record of Fumigation.

- 10.1.3 Treatment providers using an approved third party system must also include the fumigant concentration monitoring output produced by the third party system as an attachment to each Record of Fumigation.
- 10.1.4 The Record of Fumigation must be completed on the fumigation site as the tasks are performed and copies must be maintained for audit purposes for a minimum of two years.
- 10.1.5 Temperature records (see [4.5 Temperature](#)) must be created and maintained for audit purposes for a minimum of two years.
- 10.1.6 Recording of false or misleading information is not permitted under any circumstances.

10.2 Fumigation treatment certificate

- 10.2.1 A fumigation treatment certificate can be issued by a suitably accredited person once the fumigation has been performed in accordance with the requirements.
- 10.2.2 At a minimum the fumigation certificate must include the following:
- treatment provider's letterhead including name and physical address
 - treatment provider's AEI (where applicable)
 - certificate number
 - description of the consignment – including quantity
 - the target of the fumigation (commodity/non-commodity/both)
 - consignment identification/link – container number/s, bill of lading or other means to clearly identify the consignment
 - Country of origin, country of destination and port of loading
 - name and address of exporter
 - name and address of importer
 - date and time the fumigation was completed
 - date and time the ventilation was commenced
 - place of fumigation
 - exposure time period
 - minimum temperature details
 - applied dose rate (does not apply to treatment providers using approved third party systems)
 - CT achieved (only applies to treatment providers using approved third party systems)
 - end point concentration
 - final TLV-TWA reading/s
 - type of fumigation enclosure
 - container number/s (where applicable)
 - a declaration that the consignment met all suitability requirements set out in section [1. Prior to Fumigation](#)
 - a declaration that the fumigation met all of the compliance requirements set out in this methodology

- the name and signature of the fumigator-in-charge.

Note: See [Appendix 2: Example fumigation certificate](#) for an example Fumigation Certificate.

10.2.3 All sections of the fumigation certificate are mandatory and must be filled out accurately.

10.2.5 The fumigation certificate must accompany the consignment to verify that it has been effectively treated for QPS purposes.

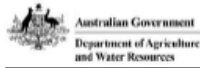
Appendix 1a: Example record of fumigation



Sulfuryl Fluoride - Record of Fumigation

Job Details									
Job Identification		Customer Name			Start Date of Fumigation			Location	
Description of Consignment									
Target of Fumigation					Container Numbers / Consignment Identification				
Fumigation Details									
The consignment complies with the following requirements:									
Adequate free airspace, no impervious surfaces or wrapping, maximum timber thickness & spacing <input type="checkbox"/> Yes <input type="checkbox"/> No									
<input type="checkbox"/> Sheeted Stack		Length = _____			<input type="checkbox"/> Un-sheeted Container		Volume		
<input type="checkbox"/> Sheeted Container/s		Width = _____			<input type="checkbox"/> Chamber				
Size: _____ Qty: _____		Height = _____			<input type="checkbox"/> m ³ or <input type="checkbox"/> ft ³				
Specified Dose Rate		Exposure Period			Forecast Minimum Temp		Fumigation Minimum Temp (if heated)		
<input type="checkbox"/> g/m ³ or <input type="checkbox"/> oz/1000ft ³		hrs			<input type="checkbox"/> °C or <input type="checkbox"/> °F		<input type="checkbox"/> °C or <input type="checkbox"/> °F		
Calculated Dose		Chloropicrin <input type="checkbox"/> N/A			Actual Dose Applied		Time Dosing Finished		
<input type="checkbox"/> g or <input type="checkbox"/> oz		%			<input type="checkbox"/> g or <input type="checkbox"/> oz		<input type="checkbox"/> g or <input type="checkbox"/> oz		
Concentration Readings									
Phase	Time of Reading	Dose rate	Monitor Line Readings by Location					Equilibrium Calculation	Top-up Dose
			1:	2:	3:	4:	5:		
Start								%	NA
								%	NA
During		NA						NA	
End								NA	
								NA	NA
Comments									
Ventilation									
Time commenced		Date commenced			Final TLV reading		Date & time reading taken		
					ppm				
Fumigator in Charge					Government Officer (if supervised)				
Name		Signature			Name		Signature		

Appendix 1b: Example record of fumigation (3rd Party Approved System)



Sulfuryl Fluoride - Record of Fumigation - 3rd Party Approved Systems

Job Details									
Job Identification		Customer Name		Start Date of Fumigation		Location			
Description of Consignment									
Target of Fumigation				Container Numbers / Consignment Identification					
Fumigation Details									
The consignment complies with the following requirements: Adequate free airspace, no impervious surfaces or wrapping, maximum timber thickness & spacing <input type="checkbox"/> Yes <input type="checkbox"/> No									
<input type="checkbox"/> Sheeted Stack		Length = _____		<input type="checkbox"/> Un-sheeted Container		Volume (m ³)			
<input type="checkbox"/> Sheeted Container/s		Width = _____		<input type="checkbox"/> Chamber		<input type="checkbox"/> m ³ or <input type="checkbox"/> ft ³			
Size: _____ Qty: _____		Height = _____							
CT Required		Exposure Period		Forecast Minimum Temp		Fumigation Minimum Temp (if heated)			
<input type="checkbox"/> g ³ /m ³ or <input type="checkbox"/> oz ³ /1000ft ³		hrs		<input type="checkbox"/> °C or <input type="checkbox"/> °F		<input type="checkbox"/> °C or <input type="checkbox"/> °F			
Calculated Dose		Chloropicrin <input type="checkbox"/> N/A		Actual Dose Applied		Time Dosing Finished			
<input type="checkbox"/> g or <input type="checkbox"/> oz		%		<input type="checkbox"/> g or <input type="checkbox"/> oz		<input type="checkbox"/> g or <input type="checkbox"/> oz			
Concentration Readings									
Phase	Time of Reading	Dose Rate	Monitor Line Readings by Location					Equilibrium Calculation	Top-up Dose
			1:	2:	3:	4:	5:		
Start								%	NA
								%	NA
During		NA						NA	
End								NA	
								NA	NA
Actual CT Achieved				Comments					
<input type="checkbox"/> g ³ /m ³ or <input type="checkbox"/> oz ³ /1000ft ³									
Ventilation									
Initial TLV		Date & Time Taken		2 nd TLV reading		Date & Time Taken			
ppm				ppm					
Fumigator in Charge				Government Officer (if supervised)					
Name		Signature		Name		Signature			

Appendix 2a: Example fumigation certificate

COMPANY LETTERHEAD

(including address as it appears on the Australian Department of Agriculture and Water Resources' approved list of offshore Brown Marmorated Stink Bug treatment providers)

BROWN MARMORATED STINK BUG SULFURYL FLUORIDE FUMIGATION CERTIFICATE

Certificate number: AEI:

TARGET OF FUMIGATION DETAILS

Target of fumigation: Commodity Non-commodity (packing) Both
 Target description: Quantity:
 Consignment link:
 Country of origin: Port of loading: Country of destination:
 Name and address of exporter: Name and address of importer:

TREATMENT DETAILS

Date fumigation completed:/...../..... Time fumigation completed:
 Date ventilation commenced:/...../..... Time ventilation commenced:
 Place of fumigation: Exposure period (hours):
 Minimum temperature (°C or °F): Dose rate applied (g/m³ or oz/1000ft³):
 End-point reading (g/m³ or oz/1000ft³): Final TLV reading (ppm):

How was the fumigation conducted? Un-sheeted container Sheeted container/s
 Chamber Sheeted stack

Container number/s (where applicable):

Does the target of the fumigation conform to the plastic wrapping, impervious surface and timber thickness requirements at the time of fumigation? Yes No

DECLARATION

By signing below, I, the accredited fumigator responsible, declare that these details are true and correct and the fumigation has been carried out in accordance with the Department of Agriculture and Water Resources' Sulfuryl Fluoride Fumigation Methodology and the 2018-19 Brown Marmorated Stink Bug Season Measures website.

ADDITIONAL DECLARATIONS

.....

..... Signature Date
 Name of Accredited Fumigator Company stamp

Appendix 2b: Example fumigation certificate (3rd Party Approved System)

COMPANY LETTERHEAD

(including address as it appears on the Australian Department of Agriculture and Water Resources' approved list of offshore Brown Marmorated Stink Bug treatment providers)

BROWN MARMORATED STINK BUG SULFURYL FLUORIDE FUMIGATION CERTIFICATE – 3rd Party Approved Systems

Certificate number: AEI:

TARGET OF FUMIGATION DETAILS

Target of fumigation: Commodity Non-commodity (packing) Both

Target description: Quantity:

Consignment link:

Country of origin: Port of loading: Country of destination:

Name and address of exporter:	Name and address of importer:
---	---

TREATMENT DETAILS

Date fumigation completed: / / Time fumigation completed:

Date ventilation commenced: / / Time ventilation commenced:

Place of fumigation Exposure period (hours):

Minimum temperature (°C or °F): CT achieved (g-h/m³ or oz-h/1000ft³):

End-point reading (g/m³ or oz/1000ft³): Final TLV reading (ppm):

How was the fumigation conducted? Un-sheeted container Sheeted container/s
 Chamber Sheeted stack

Container number/s (where applicable):

Does the target of the fumigation conform to the plastic wrapping, impervious surface and timber thickness requirements at the time of fumigation? Yes No

DECLARATION

By signing below, I, the accredited fumigator responsible, declare that these details are true and correct and the fumigation has been carried out in accordance with the Department of Agriculture and Water Resources' Sulfuryl Fluoride Fumigation Methodology and the 2018-19 Brown Marmorated Stink Bug Season Measures website.

ADDITIONAL DECLARATIONS

.....
.....

..... Signature Date

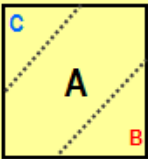
..... Name of Accredited Fumigator Company stamp

Appendix 3: Sulfuryl fluoride monitoring tables

Figure 5 Sulfuryl fluoride monitoring table for a 24 hour exposure period

Time and retention	Concentration (g/m ³)
0 hrs	16
2 hrs 95% or more of initial dose	16 / 15.2 / 11.2
4 hrs 91% or more of initial dose	16 / 14.6 / 10.6
8 hrs 83% or more of initial dose	16 / 13.3 / 9.3
12 hrs 75% or more of initial dose	16 / 12 / 8
18 hrs 63% or more of initial dose	16 / 10.1 / 8
24 hrs 50% or more of initial dose	16 / 8 / 8

Key

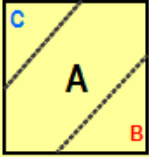


A = standard concentration
B = minimum concentration to allow top-up
C = maximum top-up concentration

Top-up amount = (C – lowest concentration reading) x enclosure volume

Figure 6 Sulfuryl fluoride monitoring table for a 12 hour exposure period

Time	Concentration (g/m ³)
0 hrs	24
2 hrs 91% or more of initial dose	<div style="display: flex; justify-content: space-between;"> 24 21.8 17.8 </div>
4 hrs 83% or more of initial dose	<div style="display: flex; justify-content: space-between;"> 24 19.9 15.9 </div>
8 hrs 67% or more of initial dose	<div style="display: flex; justify-content: space-between;"> 24 16.1 12 </div>
12 hrs 50% or more of initial dose	<div style="display: flex; justify-content: space-between;"> 24 12 12 </div>

Key
 <p>A = standard concentration B = minimum concentration to allow top-up C = maximum top-up concentration</p> <p>Top-up amount = (C – lowest concentration reading) x enclosure volume</p>

Glossary

Ambient temperature	The air temperature of the surrounding area where the fumigation will be conducted.
Buffer zone	The area around the enclosure, outside of which, the concentration levels of sulfuryl fluoride should not exceed the TLV–TWA during ventilation.
Commodity	The item or goods that are being exported or imported.
Concentration	The amount of fumigant present at a certain point in the fumigation enclosure, usually expressed as grams per cubic metre (g/m ³).
Consignment	Refers collectively to the commodity, any packing materials used and the mode of transport such as a shipping container.
Dosage	The cumulative concentration of fumigant in the enclosure over the exposure period. Also referred to as the Concentration by Time Product (CT Product) normally expressed as gram hours per cubic metre.
Dose	The amount of fumigant applied to a fumigation enclosure.
Dose rate	The prescribed concentration of fumigant to be used per unit of volume and the exposure period.
Enclosure	Any gas–tight space intended to contain sufficient concentrations of fumigant for a period of time. Common examples of fumigation enclosures used for QPS fumigations are sealed shipping containers, gas–proof sheets sealed to an impervious floor and purpose–built chambers
Equilibrium	An even distribution of fumigant throughout the enclosure.
Exposure period	The amount of time, in one continuous block, that the consignment must be exposed to sufficient concentration levels of fumigant to be lethal to the targeted pests.
Free air space	Empty space in the enclosure between, above or around a commodity.
Fumigant	A chemical, which at a particular temperature and pressure can exist in a gaseous state in sufficient concentration and for sufficient time to be lethal to insects and other pests
Fumigation sheets	A sheet (or tarpaulin) that is made of material impervious to the fumigant used to create a temporary fumigation enclosure.
ISPM15	International Standards for Phytosanitary Measures No. 15 – Regulation of wood packaging material in International trade
Minimum top-up concentration	The absolute minimum concentration below which levels fumigant concentration must not fall at any time during the exposure period.
Sampling tube	A small diameter tube used to draw a sample of gas/air mixture from within a fumigation enclosure to measure the fumigant concentration.
Pascal (Pa)	The standard international unit for pressure. Standard atmospheric pressure is 101.325 kPa.
Permeability	The rate at which a substance (such as sulfuryl fluoride) passes through a material (such as a fumigation sheet).

Pest	Any animal, plant or other organism that may pose a threat to the community or the natural environment.
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 is being officially controlled.
Quarantine and Pre-shipment (QPS)	<ol style="list-style-type: none"> 1. Quarantine treatment applications are treatments conducted to prevent the introduction, establishment and or spread of quarantine pests. 2. Pre-shipment treatment applications are treatments conducted prior to export to meet the official requirements of the importing or exporting country.
Record of fumigation	A document that records the relevant information to demonstrate the fumigation complied with requirements.
Relevant authority	The government department, ministry or agency responsible for animal and plant biosecurity in the importing or exporting country.
Risk area	The area around the enclosure to which access is restricted to personnel wearing personal protective equipment.
Sheet fumigation	A process of creating a gas-tight enclosure by covering/enclosing the commodities to be fumigated under a gas-proof sheet.
Shipping container	Standardised transportation units that can be moved from one mode of transport to another without needing to unload the contents.
Sorption/sorptive	A physical and chemical action by which one substance becomes attached to another. De-sorption is the reversal of this process.
Standard concentration	The fumigant concentration below which the fumigation will not be effective unless additional fumigation is added to the enclosure to compensate.
Target of the fumigation	The target of the fumigation may be the commodity, packaging material or both.
Treatment	Application of a set of specified requirements intended to kill pests and diseases that may be associated with a consignment.
Treatment Schedule	The specified treatment requirements (initial dose, minimum exposure period, minimum temperature, minimum end point concentration %).
Threshold Limit Value - Time Weighted Average (TLV-TWA)	TLV-TWA is the maximum concentration of fumigant that a person can be repeatedly exposed to in the workplace without harmful effects. This figure is based on an 8 hour day, 40 hour working week.