

CODE OF PRACTICE FOR FUMIGATION PERSONNEL



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- Ministry of Manpower (MOM)
- National Parks Board (NParks)
- Singapore Civil Defence Force (SCDF)
- Singapore Pest Management Association (SPMA)

Foreword

Fumigation involves the use of toxic gases (Hydrogen Cyanide, Methyl Bromide or Hydrogen Phosphide). It is therefore critical that fumigation companies, fumigators and fumigation staff take necessary actions to minimise the exposure of such fumigants to all, including the public. Actions must also be taken to prevent non-essential personnel from entering the unauthorised areas during fumigation operations.

The Code of Practice for Fumigation Personnel serves as a reference for fumigation companies, fumigators, and fumigation staff on precautions to adopt to ensure the safety of relevant personnel and members of the public, during the use of fumigants and related activities.

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National Environment Agency (NEA)
Ministry of Sustainability and the Environment (MSE)
Singapore**

1. Introduction

- 1.1 This Code of Practice serves as a reference for fumigation companies and fumigation personnel (e.g., fumigators and fumigation staff), on precautions to adopt during the conduct of fumigation operations, to ensure the safety of fumigators, fumigation staff and members of public.
- 1.2 Fumigation companies and fumigators should also take reference from the safety measures listed in the fumigant product Safety Data Sheet (SDS) and applicator's manual.
- 1.3 This Code of Practice would be reviewed as and when necessary, in accordance with new technological, legislative, health and safety information which may arise.
- 1.4 This Code of Practice does not attempt to cover every aspect of legislation on fumigation and fumigation-related activities. Compliance with this code does not exempt one of any legal obligation.

2. Definitions

The following definitions shall apply herein, unless the context otherwise requires:

- 2.1 "fumigant" means any pesticide, which is listed under the Hydrogen Cyanide (Fumigation) Regulations, that is capable of releasing an active ingredient in gaseous form at required temperature and pressure.
- 2.2 "fumigation" means the application of a fumigant to an area, including but not limited to any premises or conveyance or part thereof.
- 2.3 "fumigation area" means the premises or any part thereof undergoing fumigation, as defined in the Hydrogen Cyanide (Fumigation) Regulations.
- 2.4 "fumigation staff" refers to any person assisting in fumigation and fumigation-related activities.
- 2.5 "fumigator" refers to a person who is licensed with NEA and is in charge of a fumigation. The fumigator is also the operator, which refers to any person designated in writing by the undertaker to be in charge of the carrying out of a fumigation and is duly licensed under the Hydrogen Cyanide (Fumigation) Regulations.
- 2.6 "hazardous substance" means any substance that is set out in the Schedule of the Environmental Protection and Management (Hazardous Substances) Regulations and/or the Fifth Schedule of the Workplace Safety and Health Act 2006.
- 2.7 "PEL (Long-term)" means the permissible exposure level over an 8-hour working day and a 40-hour work week, as defined in the Workplace Safety and Health (General Provisions) Regulations.
- 2.8 "premises" includes any building, vehicle, ship or enclosed space, as defined in the Hydrogen Cyanide (Fumigation) Regulations.

- 2.9 "risk area" means any part of a building, vehicle, ship or any other enclosed space into which there is any reason to apprehend that the fumigant may penetrate from the fumigation area, and in any case includes those parts of any building, vehicle, ship or enclosed space which are less than 6 metres from the nearest boundary of any fumigation area unless separated therefrom by a yard, street, or other open space not less than 3 metres in width or by a solid wall, or two adjoining walls of a total thickness of not less than 50 centimetres, as defined in the Hydrogen Cyanide (Fumigation) Regulations.
- 2.10 "toxic industrial waste" means any substance that is listed in the Schedule of the Environmental Public Health (Toxic Industrial Waste) Regulations.
- 2.11 "undertaker" refers to any person who, under contract or otherwise, undertakes the carrying out of a fumigation, as defined in the Hydrogen Cyanide (Fumigation) Regulations.
- 2.12 "vessel" includes any ship or boat or air-cushioned vehicle or floating rig or platform used in any form of operations at sea, as defined in the Maritime and Port Authority of Singapore Act 1996.
- 2.13 "warning agent" means any substance or compound that is used in combination with a fumigant, which may enable its detection by the fumigator, undertaker or any other person, before, during or after the application of the fumigant, without the use of any specialised tool or equipment.
- 2.14 "workplace" means any premises where a person is at work or is to work, for the time being works, or customarily works, and includes a factory as defined in the Workplace Safety and Health Act 2006.

3. Legislations

- 3.1 The Hydrogen Cyanide (Fumigation) Act 1947 and Regulations will apply for all fumigations that are conducted in Singapore. Fumigation companies, fumigators, fumigation staff, employers and occupiers must also adhere to other relevant legislations and regulations (e.g., Workplace Safety and Health Act 2006, Control of Plants Act 1993, Environmental Protection and Management Act 1999, Fire Safety Act 1993). Food product-related fumigations must also take note of the Sales of Food Act 1973 and its subsidiary legislations (e.g., regulations on maximum residue limits for food).

4. Fumigator Licence Requirements

- 4.1 [Required]¹ Any person who wishes to carry out and to oversee a fumigation operation must have a fumigator licence issued by NEA.
- 4.2 Application or renewal requirements of a fumigator licence must comply with the Hydrogen Cyanide (Fumigation) Act 1947 and Regulations. Application or renewal is via the GoBusiness platform. (<https://www.gobusiness.gov.sg>)

¹ [Required] Refers to sections that are mandatory requirements under the Hydrogen Cyanide (Fumigation) Act 1947 and Regulations.

4.3 Applicants for the fumigator licence must meet the following licensing requirements:

- pass the Singapore-Cambridge General Certificate of Education Ordinary Level “GCE ‘O’ level”;
- produce a certificate of medical fitness;
- produce a valid first aid certificate;
- have undergone a continuous 18-month period of apprenticeship with a licensed fumigator; and
- pass an examination conducted by NEA (fee for examination is \$180).

4.4 [Required] The fumigator licence is valid until the next 31st December following the date the licence was granted. All licence renewals must be submitted at least two months prior to licence expiry.

4.5 The fee for application/renewal of a fumigator licence per fumigant type is \$170.

5. Fumigation Permit Requirements

5.1 [Required] Any person who wishes to carry out a fumigation operation must have a fumigation permit issued by NEA prior to the operation.

5.2 Applications of fumigation permits must comply with the Hydrogen Cyanide (Fumigation) Act 1947 and Regulations. Application is via the GoBusiness platform. (<https://www.gobusiness.gov.sg>)

5.3 Applications of fumigation permits should be submitted at least one working day (by 5pm of the working day or by 12 noon if the working day is the eve of New Year’s Day, Chinese New Year, Hari Raya Puasa, Deepavali or Christmas) preceding the commencement of the fumigation operation.

5.4 [Required] If the fumigation does not commence within fifteen minutes of the time specified in the fumigation permit, the fumigator must obtain a new fumigation permit from NEA.

5.5 In the event of inclement weather or other justified unforeseen circumstances such as delay in arrival of cargo, commencement of fumigation may be delayed by up to 24 hours from the original time indicated on the fumigation permit. Fumigators must inform NEA Port Health Section (port_health_cro@nea.gov.sg) of the new timing of the fumigation operation before the original time indicated on the fumigation permit and by 5.30pm of a working day. The timing of fumigation operations may only be delayed and cannot be brought forward. For delays of more than 24 hours, fumigators must apply for a new fumigation permit.

5.6 Re-application of a fumigation permit will not be required for replacement of fumigators who are on sick leave. The replacement fumigator must hold a valid fumigator licence for the appropriate fumigant to be used in the fumigation operation. Fumigation companies must inform NEA Port Health Section of the change in fumigator prior to the commencement of the fumigation operation and should send a soft copy of the original

fumigation permit to NEA Port Health Section for amendment of the change in fumigator. The replacement fumigator may proceed before receiving the amended permit so as not to delay the fumigation operation.

5.7 The fee for application of a fumigation permit is \$45.

5.8 [Required] If the fumigation involves a vessel, the undertaker/fumigator must deliver a copy of the notice (Form D set out in the Hydrogen Cyanide (Fumigation) Regulations) to the Port Master of the Maritime and Port Authority of Singapore.

6. Permitted Fumigants and Types of Fumigation

6.1 Fumigants that may be used in Singapore as per the Hydrogen Cyanide (Fumigation) Regulations are:

- Hydrogen Cyanide
- Methyl Bromide²
- Hydrogen Phosphide (Phosphine)

6.2 Fumigation in unenclosed space, in-transit fumigation on vessels, and the fumigation of residences are not to be carried out in Singapore.

7. Fumigation Management Plan

7.1 General

7.1.1 A Fumigation Management Plan (FMP) serves as a documentation of the safety procedures the fumigator and fumigation staff will adhere to during the use of the fumigant, and the procedures to adopt for related emergencies.

7.1.2 The undertaker (e.g., fumigation company) and fumigator should have a site-specific FMP completed prior to the commencement of fumigation. The FMP should be tailored to address the safety risks of the fumigation area and risk area.

7.1.3 The FMP should be made available to all fumigation staff and a copy should be extended to the service buyer (i.e., client who engaged the fumigation services).

7.1.4 The fumigator should ensure that all fumigation staff are familiar with the FMP. If needed, a dry run may be conducted.

7.1.5 The fumigator should, upon NEA's request, provide a copy of the FMP during a fumigation permit application or during NEA's audit of the fumigation operation.

7.1.6 For fumigation operations with a total enclosure size > 1,000m³, fumigators are required to submit a notification to NEA via FormSG at least 1 month in advance. (link: <https://form.gov.sg/64ed898b1025880013dcd1bc>). NEA may request for an advance submission of the FMP for review with the relevant authorities. The fumigation permit will only be issued once the FMP is in order.

² Fumigation with Methyl Bromide is limited to Quarantine and Pre-shipment (QPS) applications.

7.2 Components of a Fumigation Management Plan

7.2.1 A Fumigation Management Plan should consist of the following sections:

<u>Preparation and Planning</u> <ul style="list-style-type: none">• Fumigant selection• Details of essential personnel
<u>Site Preparation</u> <ul style="list-style-type: none">• Site layout map• Risk area and warning signs• Setting up of fumigation site• Communications• Security measures• Safety equipment
<u>Fumigation Operations</u> <ul style="list-style-type: none">• Fumigant application• Monitoring• Top-ups/Re-entry (if applicable)
<u>Post-fumigation Operations</u> <ul style="list-style-type: none">• Ventilation• Monitoring• Declaration of safe for re-entry• Waste disposal
<u>Emergency and Evacuation</u> <ul style="list-style-type: none">• Emergency Response Plan (including first aid measures and fire safety precautions)

8. Preparation and Planning

8.1 Fumigant selection

8.1.1 The selection of the appropriate fumigant (including application dosage) and its type (e.g., pellets, plates etc.) together with its warning agent (if applicable) should be made in reference to the applicator's manual and standards/guidelines (e.g., International Standards for Phytosanitary Measures Publication No. 15: Regulation of Wood Packaging Material in International Trade).

8.1.2 A physical copy of the fumigant product SDS should be available at the fumigation site. During an emergency, the SDS is to be made available to the emergency response staff, if required.

8.2 Details of essential personnel

8.2.1 Information of relevant staff (e.g., fumigation company contact person, fumigator, fumigation staff) should be documented in the FMP. Information to include are:

- Specific roles and responsibilities.
- Names and contact number (including designated point of contact).
- Relevant training/certifications related to the fumigation operation.

8.2.2 [Required] The undertaker must designate in writing the fumigator in charge of the fumigation operation.

8.2.3 [Required] The undertaker must ensure that the persons involved in fumigation should in all cases include at least two persons who are trained in first aid.

8.2.4 Fumigators intending to operate any specialised fumigation system, should be trained and certified by its manufacturer or distributor, where applicable.

9. Site Preparation

9.1 Site layout map

9.1.1 A site layout map in the FMP should minimally demarcate the locations of the following:

- Fumigation area
- Products to be fumigated
- Fumigant introduction points
- Risk area³
- Entry and exit points to fumigation area
- Warning signs
- Gas monitoring points
- Fire-safety equipment (e.g., fire extinguisher)
- First aid equipment (e.g., first aid box)

9.1.2 Depending on the complexity of the fumigation operation, the site layout map may also include the locations of the following:

- Circulation or ventilation fans
- Connecting structures or other significant structures which may affect the fumigation operation
- Emergency shut-off points for gas, chemical, electricity and water supplies

9.2 Risk area and warning signs

9.2.1 [Required] A risk area must be established around the fumigation enclosure. The boundary of the risk area must be minimally 3m from the edges of the fumigation enclosure for a fumigation enclosure located in an open space, and minimally 6m from the edges of the fumigation enclosure if a fumigation enclosure is located indoors.

9.2.2 The fumigator should ensure that the fumigant level[^] at the boundary of the risk area is less than 10% of the PEL (Long Term) level stipulated in the First Schedule of the Workplace Safety and Health (General Provisions) Regulations at all times (see Table 1).

³ The rest area for fumigators and fumigation staff to be located outside of the risk area.

Table 1: Concentration of fumigant (< 10% PEL (long term)) at boundary of risk area

Fumigant	Hydrogen Cyanide	Phosphine	Methyl Bromide
Concentration level	Oppm	<0.03ppm or <0.042mg/m ³	<0.5ppm or <1.9 mg/m ³

^ If a warning gas is used or there are other gases in the fumigant product mixture, the concentration of these gases at the boundary of the risk area should also be less than the 10% PEL (Long Term) level stated in the First Schedule of the Workplace Safety and Health (General Provisions) Regulations.

- 9.2.3 If the fumigant level exceeds the stipulated level in Table 1, the boundary of the risk area should be extended.
- 9.2.4 Risk areas should be clearly demarcated. Demarcation to fence off the risk area could include physical barriers or warning tapes (e.g., red/white tapes).
- 9.2.5 [Required] Warning signs must be affixed at prominent locations (e.g., exit/entrance points) to warn non-essential personnel and members of public against entering the risk area and the fumigation area.
- 9.2.6 [Required] The words “DANGER: POISON GAS: DO NOT ENTER” printed in four languages (English, Malay, Chinese and Tamil) and in block letters not less than 5cm in height, must be included in indelible ink/print on the warning signs.
- 9.2.7 Warning signs should contain easily understood symbols (e.g., Globally Harmonized System “Skull and Crossbones” hazard pictogram) indicating that danger or use of hazardous substances.

9.3 Setting up of fumigation site

- 9.3.1 [Required] The undertaker, together with the fumigator, must rectify possible leakage areas (e.g., openings, cracks, crevices). The mitigation measures taken against leaks (e.g., foam seals, sand snakes) should be documented.
- 9.3.2 [Required] The undertaker, together with the fumigator, must ensure that all non-essential personnel have vacated the fumigation area and risk area prior to commencing the fumigation.
- 9.3.3 [Required] The undertaker, together with the fumigator, must ensure that all fires, naked lights and non-essential electrical equipment in the fumigation area are extinguished/switched off.
- 9.3.4 [Required] The undertaker, together with the fumigator, must ensure the removal of any animals, non-target liquids/food/plants or other materials stored within the fumigation area or risk area.

- 9.3.5 The fumigator should ensure that the materials used for enclosure (e.g., sheets) are gas tight and able to retain the fumigant for the required time.
- 9.3.6 The fumigator should work with the premises occupier/owner to identify equipment within the fumigation area/risk area that may react with the chemicals in the fumigant and/or warning agent and cause undesirable effects (e.g., metals that are sensitive to corrosion or materials with high fumigant sorption). The mitigation measures taken should be documented.
- 9.3.7 The undertaker/fumigator must obtain and comply with relevant licences and permits for the storage and transport of fumigants and/or warning agents.
- 9.3.8 Permanent or temporary structures that serve as storage areas of fumigants in premises should have adequate security measures with restricted access.

9.4 Communications

- 9.4.1 The FMP should document the measures taken to inform relevant stakeholders of the conduct of the fumigation operation.
- 9.4.2 The fumigator (working with the premises occupier if necessary) should inform workers (e.g., maintenance personnel, cleaning vendors, security personnel) whose work scope involves being in the fumigation area or risk area, and other persons within those areas not involved in the fumigation operation, to keep away until the area has been declared safe for re-entry.
- 9.4.3 [Required] The undertaker, together with the fumigator, must ensure that before commencing the fumigation, the relevant personnel are notified of the fumigation operation using Form E of the Hydrogen Cyanide (Fumigation) Regulations:
- For a building or other enclosed space, the notification is to be sent to the occupier of the building or other enclosed space.
 - For a vessel, the notification is to be sent to the ship captain or other person in charge of the vessel.
 - Every occupier and tenant within the fumigation area and risk area.
- 9.4.4 [Required] The undertaker, together with the fumigator, must ensure that the notice (Form E) is in duplicate. The undertaker/fumigator must retain a copy of the notice signed by the receiving party.

9.5 Security measures

- 9.5.1 The FMP should include security measures to prevent unauthorised entry of non-essential personnel into the risk area and fumigation area, during fumigation and ventilation.
- 9.5.2 [Required] The undertaker, together with the fumigator, must ensure restriction of access to the fumigation area and risk area. Doors are to be closed and securely fastened.

9.5.3 Other security measures may include deactivation of access cards, having security gates to the fumigation area or the use of additional locks.

9.5.4 [Required] The fumigator must take charge of all keys within the fumigation area and risk area.

9.5.5 The fumigator should ensure that all access to fumigants and/or warning agents within the site is adequately secured and documented.

9.5.6 The deployment of security officers, guard posts may be considered as additional security measures. The security personnel should be briefed on their roles and responsibilities. The fumigator should be present during the briefing.

9.6 Safety equipment

9.6.1 [Required] The undertaker, together with the fumigator, must ensure all relevant personnel (fumigation staff and fumigators) are equipped with proper Personal Protection Equipment (PPE) and other safety equipment (including an electric torch).

9.6.2 The selection, use and maintenance of PPE and other safety equipment should be based on the recommendations in the PPE product user instructions, fumigant product SDS, applicator's manual, and the prevailing Singapore Standards (where available).

9.6.3 In general, fumigators and fumigation staff should be equipped with the following:

- Breathing apparatus such as gas mask with appropriate filter and/or self-contained breathing apparatus (SCBA)
- Safety goggles
- Safety gloves
- Long sleeved shirt and long pants
- Safety boots
- Electric torch

9.6.4 Relevant personnel should be fit tested, trained and certified (where relevant) in using appropriate PPE.

9.6.5 Appropriate (e.g., sufficient sensitivity) gas monitoring equipment, as recommended in the fumigant product SDS and applicator's manual should be selected.

9.6.6 The list of safety equipment which would be used should be documented in the FMP.

9.6.7 The FMP should document the measures taken to ensure equipment is regularly serviced/maintained (e.g., calibration certificate for gas monitoring equipment, fit test certificate for respirators, maintenance records).

10. Fumigation Operations

10.1 Fumigant application

- 10.1.1 The safety precautions to be taken when handling and discharging the fumigant should be documented in the FMP.
- 10.1.2 Fumigation should not be done alone. Work within the fumigation area and risk area should be conducted at least in pairs.
- 10.1.3 The discharging of the fumigant should be performed using pre-determined routes and points (where applicable).
- 10.1.4 The discharging of the fumigant into the enclosure should be completed as soon as possible.
- 10.1.5 [Required] The undertaker, together with the fumigator, must ensure that the fumigant is discharged appropriately such that any liquid fumigant (if applicable) is not absorbed by the floors, walls, ceilings, or any non-target items.
- 10.1.6 Safety precautions to be adopted when handling the fumigant should take reference from the fumigant product SDS and applicator's manual.
- 10.1.7 Fumigators and fumigation staff should be equipped with personal gas monitoring equipment.
- 10.1.8 The fumigator should ensure full accounting of fumigants, fumigation materials and equipment, before, during and after a fumigation process, and document relevant information (e.g., batch numbers, expiry dates, servicing or maintenance dates, capacities of circulation fans, pressure or temperature of fumigant cylinders, quantities of discharged fumigants/ materials/ equipment).

10.2 Monitoring

- 10.2.1 The fumigant concentration at the fumigation area and risk area should be monitored regularly with the appropriate gas monitoring equipment.
- 10.2.2 Monitoring information of the fumigant level should be documented (e.g., location of reading taken, time of reading, concentration reading).
- 10.2.3 Real-time gas monitoring equipment may be installed. Real-time reporting to relevant authorities may also be required.
- 10.2.4 If a fumigation area is within a multi-storey building, additional monitoring points (e.g., at upper and lower adjacent floors of the fumigation area) should be set up.
- 10.2.5 Fumigant leakage should be monitored using an appropriate measuring equipment of sufficient sensitivity. If a leakage is detected, sealing of the leak should be performed from the exterior of the fumigation enclosure, where possible.
- 10.2.6 The monitoring frequency should be intensified at the beginning of fumigation and may be reduced after the fumigator verifies that fumigant leakage is minimal or absent.

10.3 Top-ups/Re-entry

- 10.3.1 If a re-entry is required (based on assessment by the fumigator) (e.g., no external leak is found but fumigant loss is still detected), the team entering should comprise of at least two persons (including the fumigator).
- 10.3.2 Prior to a re-entry, the fumigant concentration in the fumigation area and risk area should be measured. Appropriate PPE (taking reference from fumigant product SDS and applicator's manual) should be donned before the re-entry.
- 10.3.3 The addition of fumigant (if required) should be performed from the exterior of the fumigation enclosure, where possible.
- 10.3.4 The details of a re-entry should be documented.

11. Post-Fumigation Operations

11.1 Ventilation

- 11.1.1 [Required] The ventilation of a fumigation area must be performed under the supervision of a licensed fumigator.
- 11.1.2 Fumigator should take into consideration factors such as concentration of fumigant, fumigation area, wind, fumigant recapture technology (if used), when determining the rate of ventilation.
- 11.1.3 Mechanical fans (spark proof if required) may be used to speed up the ventilation process where it is safe and necessary to do so.
- 11.1.4 Ventilation should be conducted during off-peak hours, where possible.
- 11.1.5 Appropriate PPE (taking reference from fumigant product SDS and applicator's manual) should be donned before entering the fumigation area and risk area.

11.2 Monitoring

- 11.2.1 The fumigant concentration at the fumigation area and risk area should be monitored regularly with the appropriate gas monitoring equipment.
- 11.2.2 The fumigant level at the boundary of the risk area should be within the levels stated in section 9.2.2.

11.3 Declaration of safe for re-entry

- 11.3.1 [Required] The undertaker, together with the fumigator, must ensure no person other than the fumigator and fumigation staff are permitted to enter the fumigation area and risk area until it is declared safe for re-entry by a licensed fumigator by means of a written declaration (Form G) stated in the Hydrogen Cyanide (Fumigation) Regulations.

11.3.2 [Required] The written Form G must be issued to the persons previously issued with Form E (section 9.4.3).

11.3.3 The fumigator should not provide such a declaration until an appropriate gas monitoring equipment is used to determine that the concentration of fumigant^{^^} within the fumigation area is less than 10% of the PEL (Long Term) level stipulated in the First Schedule of the Workplace Safety and Health (General Provisions) Regulations (see Table 2).

Table 2: Concentration of fumigant (10% of PEL (long term)) for declaration of safe for re-entry

Fumigant	Hydrogen Cyanide	Phosphine	Methyl Bromide
Concentration level	0ppm	<0.03ppm or <0.042mg/m ³	<0.5ppm or <1.9 mg/m ³

^{^^} If a warning gas is used or there are other gases in the fumigant product mixture, the concentration of these gases within the fumigation area should also be less than the 10% PEL (Long Term) level stated in the First Schedule of the Workplace Safety and Health (General Provisions) Regulations.

11.3.4 [Required] All residues of the materials used for fumigation must be removed before declaration of safe for re-entry.

11.3.5 [Required] The following (if applicable) must be completed before declaration of safe for re-entry:

11.3.5.1 All water taps have been turned on for at least one minute and the water allowed to run to waste.

11.3.5.2 All water closet cisterns have been emptied and the pans adequately flushed.

11.3.5.3 All other receptacles containing water or other liquid which is liable to absorb fumigant have been emptied.

11.3.5.4 All bedding, blankets, pillows, clothing, cushions and other articles which are liable to absorb the fumigant are free from dangerous concentration of fumigant.

11.3.6 [Required] The fumigator must keep a record of the fumigation operation in Form H stated in the Hydrogen Cyanide (Fumigation) Regulations.

11.4 Waste disposal

11.4.1 By-products (if any) of fumigation are considered toxic industrial waste.

11.4.2 The undertaker, together with the service buyer where applicable, must ensure compliance to the Environmental Public Health Act 1987 for the management of any industrial waste resulting from fumigation, and engage a licensed toxic industrial waste collector (TIWC) for this work.

- 11.4.3 The undertaker, together with the service buyer where applicable, must ensure compliance to relevant legislations, regulations or international conventions such as the Hazardous Waste (Control of Export, Import and Transit) Act 1997 or the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, for the import, export and transit of hazardous waste.

12. Emergency and Evacuation

12.1 Emergency Response Plan

- 12.1.1 The FMP should contain an emergency response plan (ERP).
- 12.1.2 The undertaker and fumigator should work with the premises occupier/owner on the ERP.
- 12.1.3 The format of the ERP should take reference from SCDF ERP guidelines. (<https://www.scdf.gov.sg>) The ERP for a fumigation operation should minimally include the following:
- Location of premises and its main access road
 - General description of the surroundings and neighbouring premises
 - Layout of premises
 - Fumigation-related emergencies assessment (including safety / emergency control / first aid measures)
 - Emergency actions to be taken:
 - (Phase I) Procedure to notify relevant parties (e.g., site owner/occupiers, MOM, NEA, SCDF and other related agencies) and surrounding premises in the event of an emergency related to the fumigation operation.
 - (Phase II a) Procedure for Emergency Evacuation (including signal/message to premises occupants to evacuate, evacuation route, location of evacuation assembly point, etc.).
 - (Phase II b) Emergency actions to mitigate or contain the emergency.
 - Key Personnel Emergency Contact Numbers
 - Communication plan
- 12.1.4 [Required] The fumigator/undertaker must notify NEA when there is an accident due to the fumigation operation which causes death or injury.
- 12.1.5 The employer/occupier of the workplace must report any accident including fatalities and injuries, dangerous occurrences or occupational diseases to MOM in accordance with the Workplace Safety and Health (Incident Reporting) Regulations.

Contact details for incident reporting

Organisation	Contact Details
NEA	6222 2585
MOM	www.mom.gov.sg/ireport

12.2 First Aid

- 12.2.1 [Required] The undertaker, together with the fumigator, must ensure a first aid kit is available on site during the fumigation operation.
- 12.2.2 The first aid kit should be placed outside of the fumigation area and risk area.
- 12.2.3 The fumigator and fumigation staff should be familiar with the first aid measures for emergencies such as accidental inhalation or skin exposure to fumigant.
- 12.2.4 Fumigators and fumigation staff should take reference from the first aid measures mentioned in the fumigant product SDS and applicator's manual.
- 12.2.5 For accidental inhalation events, check for danger (e.g., ascertain the gas level and don the appropriate PPE) before approaching the victim. Evacuate the victim to a safe place with fresh air and seek medical assistance. If necessary, administer Cardiopulmonary Resuscitation (CPR) and/or Automated External Defibrillator (AED). Use a manual respirator such as an Air Viva, where possible.
- 12.2.6 In general, for skin (dermal) exposure, remove the contaminated clothing and wash the skin with plenty of water.
- 12.2.7 Seek medical attention if the person is suspected to have fumigant poisoning. Symptoms could include breathing difficulty, fatigue, dizziness.
- 12.2.8 Workers who are exposed to the fumigant should be monitored for at least 24 hours. If any of the personnel is diagnosed with fumigant poisoning, both the attending doctor and employer are required to notify MOM via the contact details in section 12.1.5.

12.3 Fire / Hazmat

- 12.3.1 All relevant personnel (e.g., fumigator, undertaker, premises occupier) must comply with relevant legislations, regulations and standards pertaining to fire safety.
- 12.3.2 By-products that result from combustion of fumigants may be toxic and require special handling. Reference should be made to the fumigant product SDS and applicator's manual for the appropriate mitigation measures.
- 12.3.3 Relevant personnel are advised to be equipped with basic fire-fighting knowledge and skills that are specific for the fumigant.
- 12.3.4 Permanent or temporary fire-fighting equipment such as portable fire extinguishers, should be selected, maintained and used according to relevant Singapore Standards.
- 12.3.5 Selection of suitable extinguishing agent (e.g., dry powder) should also take reference from the fumigant product SDS and applicator's manual.
- 12.3.6 Fumigators and fumigation staff should be familiar with the ERP, such as the evacuation route.
- 12.3.7 All emergency exits should have clear signage and be unblocked.

Annex A: Physical and Chemical Properties of Fumigants

(I) ALUMINIUM PHOSPHIDE, MAGNESIUM PHOSPHIDE AND PHOSPHINE

	Aluminium phosphide	Magnesium phosphide	Phosphine
IUPAC Name	alumanylidynephosphane	trimagnesium phosphorus(3-)	phosphane
CAS Registry Number	20859-73-8	12057-74-8	7803-51-2
Chemical family	Inorganic phosphide	Inorganic phosphide	Inorganic phosphide
Physical state	Solid	Solid	Gas
Colour	Greenish grey	Grey	Colourless
Odour	Not available	Not available	Garlic/ decomposing fish. Pure phosphine is odourless.
Molecular formula	AlP	Mg ₃ P ₂	PH ₃
Molecular weight (g/mol)	58	135	34
Boiling point at 1 atm (°C)	>1,000	>1,000	-87.7
Melting point (°C)	>1,000	>1,000	-134
Relative density (g/cm ³) (water = 1)	2.9	2.1	0.8
Solubility in water (ml/ 100ml at 17°C)	Insoluble, reacts with water to form PH ₃	Insoluble, reacts with water to form PH ₃	26
Vapour pressure (mm Hg at 25°C)	0	0	31388
Relative vapour density (air = 1)	Not available	Not available	1.17
Fire Hazard	In contact with water or moist air, releases phosphine gas which is highly flammable and may ignite spontaneously.	In contact with water or moist air, releases phosphine gas which is highly flammable and may ignite spontaneously.	Phosphine is highly flammable and may ignite spontaneously. The gas is heavier than air and may travel along the ground to an ignition source. When heated to decomposition, it emits highly toxic fumes.

Partially adapted from: *Physical and Chemical Properties of aluminium phosphide, magnesium phosphide and phosphine* (Table 1), *Phosphine Risk Characterization Document*, California Environmental Protection Agency, June 2014.

(II) HYDROGEN CYANIDE AND METHYL BROMIDE

	Hydrogen Cyanide	Methyl Bromide
IUPAC Name	formonitrile	bromomethane
CAS Registry Number	74-90-8	74-83-9
Chemical family	Pseudohalide	Organobromine
Physical state	Liquid or gas	Liquid or gas
Colour	Colourless or pale-blue	Colourless
Odour	Bitter, almond-like odour	Usually odourless; sweetish, chloroform-like odour at high concentration
Molecular formula	HCN	CH ₃ Br
Molecular weight (g/mol)	27	95
Boiling point at 1 atm (°C)	25.6	3.56
Melting point (°C)	-13	-94
Relative density (g/cm ³) (water = 1)	0.69	1.7
Solubility in water	Miscible	1.5g/100ml at 20°C
Vapour pressure (mm Hg at 25°C)	742	1620
Relative vapour density (air = 1)	0.93	3.3

Partially adapted from: Compound summaries for PubChem CID 768 (Hydrogen Cyanide) and PubChem CID 6323 (Methyl Bromide), PubChem, U.S. National Library of Medicine, National Center for Biotechnology Information (accessed on 15 Feb 2024)

Annex B: Singapore Standards

- SS 548:2022: Code of practice for the selection, use and maintenance of respiratory protective devices
- SS 513-1:2013: Specification for personal protective equipment - Footwear - Part 1 : Safety footwear
- SS EN 420:2003 (2016): Protective gloves - General requirements and test methods
- SS 473-1:2011: Specification for personal eye-protectors - General requirements
- SS 578-A1:2019: Code of practice for the use and maintenance of portable fire extinguishers

Annex C: Form D

FORM D

Regulation 16(1)

**HYDROGEN CYANIDE (FUMIGATION) ACT
(CHAPTER 132)**

HYDROGEN CYANIDE (FUMIGATION) REGULATIONS

**NOTICE OF INTENTION TO FUMIGATE
BY MEANS OF HYDROGEN CYANIDE, METHYL BROMIDE
OR HYDROGEN PHOSPHIDE**

To:

THE DIRECTOR-GENERAL OF PUBLIC HEALTH,
SINGAPORE

Copy to:

The Port Master,
Maritime and Port Authority of Singapore

Please take notice that it is my intention to fumigate*

by means of +Hydrogen Cyanide/Methyl Bromide/Hydrogen Phosphide on _____

_____ commencing at _____ a.m./p.m.

and to ventilate the fumigant on _____

Name of Fumigator _____

Date: _____

Signed: _____

(Company's name)

*Here state name or number and location of
building, vessel or other enclosed space intended
to be fumigated

+Delete where inapplicable

Annex D: Form E

FORM E

Regulation 17(2)

**HYDROGEN CYANIDE (FUMIGATION) ACT
(CHAPTER 132)**

HYDROGEN CYANIDE (FUMIGATION) REGULATIONS

**FUMIGATION BY MEANS OF HYDROGEN CYANIDE,
METHYL BROMIDE OR HYDROGEN PHOSPHIDE**

To:

Please take notice that it is my intention to fumigate*

by means of †Hydrogen Cyanide/Methyl Bromide/Hydrogen Phosphide on _____

_____commencing at _____a.m. / p.m.

Date: _____

Signed: _____

You are required to acknowledge receipt of this notice by signing the duplicate.

Date: _____

Signed: _____

(Occupier)

*Here state name or number and location of
building, vessel or other enclosed space intended
to be fumigated.

†Delete where inapplicable

Annex E: Form G

FORM G

Regulation 23

**HYDROGEN CYANIDE (FUMIGATION) ACT
(CHAPTER 132)**

**HYDROGEN CYANIDE (FUMIGATION) REGULATIONS
DECLARATION OF SAFETY FOLLOWING FUMIGATION**

To:

Please take notice that * _____

fumigated by me on _____ is now safe for re-entry.

Date: _____

Signed: _____

*Here state name or number and location of
building, vessel or other enclosed space which has
been fumigated

Annex F: Form H

FORM H

Regulation 24

**HYDROGEN CYANIDE (FUMIGATION) ACT
(CHAPTER 132)**

HYDROGEN CYANIDE (FUMIGATION) REGULATIONS

**OPERATOR'S RECORD OF FUMIGATION
BY MEANS OF HYDROGEN CYANIDE, METHYL BROMIDE
OR HYDROGEN PHOSPHIDE**

1. Address of premises fumigated _____

2. Time of commencing fumigation _____

Date: _____ Hour: _____ a.m. / p.m.

3. Notice required by regulations 16 and 17 delivered to

(a)

Date: _____ Time: _____ a.m. / p.m.

How delivered _____

(b) Occupier of building or other enclosed space fumigated or master or other person in charge of vessel fumigated, as the case may be.

Date: _____ Time: _____ a.m. / p.m.

How delivered _____

(c) Occupier and tenants within fumigation and risk area.

Date: _____ Time: _____ a.m. / p.m.

How delivered _____

4. (a) Have the fumigation and risk areas been vacated?

(b) Have all fires and naked lights within the fumigation area been extinguished?

(c) Have all moist food been removed from the fumigation area before fumigation?

(d) Have basement and ground floor windows been securely fastened?

(e) Have all openings been securely sealed?

- (f) Have warning notices been displayed?
- (g) Are efficient masks carried by the fumigating staff?
- (h) Have overalls been worn by fumigating staff?
- (i) Is an efficient electric torch carried by fumigating staff?

5. (a) Has operator been in attendance throughout process of fumigation?
- (b) What tests have been made to establish safety of premises following fumigation?
 - (c) Have residues been safely disposed of?
 - (d) Have water taps and cisterns been flushed?
 - (e) Has bedding, etc., been aired until free from danger?

6. Declaration of safety of premises delivered to _____

on _____ at _____ a.m. /p.m.

Date: _____

Signed: _____
(Operator)

Time: _____