
	<p>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</p> <p><b>24.0 CARGO FUMIGATION</b></p> <p>DRY CARGO MANUAL</p>	<p>Sect : 24.0  Page : 1 of 10  Date : 07-Aug-25  Rev : 10.0  Appr : DPA</p>
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## CONTENTS

<b>CARGO FUMIGATION .....</b>	<b>2</b>
1. GENERAL .....	2
2. KEY RISKS .....	3
3. SAFETY PRECAUTIONS .....	3
4. CREW EVACUATION DURING FUMIGATION IN PORT .....	5
5. ENTRY INTO SPACES UNDER FUMIGATION .....	6
6. VENTILATION PROCEDURES OF VESSEL HOLDS .....	6
7. INTRANSIT FUMIGATION .....	7
8. DISPOSAL OF FUMIGANT RESIDUES .....	8
9. ARRIVAL PORT .....	9
10. DOCUMENTS RELATED TO FUMIGATION .....	10

	<p>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</p> <p><b>24.0 CARGO FUMIGATION</b></p> <p>DRY CARGO MANUAL</p>	<p>Sect : 24.0 Page : 2 of 10 Date : 07-Aug-25 Rev : 10.0 Appr : DPA</p>
---	--	--

## CARGO FUMIGATION

### 1. GENERAL

Fumigation is a procedure that is used to eradicate pests in some cargoes. Fumigants act in a gaseous phase even though they may be applied as solid or liquid formulations from which the gas arises. Effective and safe use requires that the space being treated be rendered gastight for the period of exposure, which may vary from a few hours to several days, depending on the fumigant type, concentration used, the pests, the commodities treated and the temperature.

Ship's crew shall not handle, activate, carry out or assist in fumigation. Since fumigant gases are poisonous to humans and require special equipment and skills in application, it should be used by specialists and not by the ship's crew.

The fumigant gases used to carry out the fumigation process are numerous, but the most commonly used for the treatment of ships cargoes are **phosphine and methyl bromide**.

Fumigation can be done in the hold with fumigation and ventilation completed before sailing OR in the hold prior to sailing with fumigation continued during the voyage (in transit).

Fumigation with Methyl Bromide should be permitted only when the ship is in the confines of a port (either at anchor or alongside) and to disinfest the spaces after the crew members have disembarked. Prior to re-embarkation of the crew, ventilation of the treated spaces should be completed and a gas-free certificate should be issued before personnel are permitted to enter. Most times the vessel is left with a skeleton crew remaining onboard to take care of shipboard matters.


Phosphine-generating formulations are used for in-ship in-transit or at-berth fumigations. Application methods vary widely and include surface-only treatment, probing, perforated tubing laid at the bottom of spaces, recirculation systems and gas-injection systems or their combinations. Treatment times will vary considerably depending on the temperature, depth of cargo and on the application method used.

Fumigation should be permitted in terms of the C/P. If no mention is made, the vessel operator must be consulted.

Fumigation shall not be carried out without the permission of the vessel operator / company.

The Master should be provided with written instructions by the fumigator-in-charge on the type of fumigant used, the hazards involved, and the precautions to be taken, and, in view of the highly toxic nature of all commonly used fumigants, these should be followed carefully. These written instructions must be passed on to your vessel operator.

Master shall follow the guidelines given in the IMO "**Recommendations for the safe use of pesticide in ships applicable to the fumigation of cargo holds**" and the instructions contained in the **Material Data Sheets (MSDS)** of the Pesticide being used.

	<p>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</p> <p><b>24.0 CARGO FUMIGATION</b></p> <p>DRY CARGO MANUAL</p>	<p>Sect : 24.0 Page : 3 of 10 Date : 07-Aug-25 Rev : 10.0 Appr : DPA</p>
---	--	--

Ships staff are also advised to follow procedures as outlined in IMSBC code in the section concerning safe use of pesticides and fumigants. All precautions given in writing by shipper / fumigating team on hold ventilation, access, ventilation are to be followed.

It is the Charterer's / Shipper's responsibility to provide the Master with the equipment for measuring the concentration of fumigant gas on deck and inside the accommodation for the length of the voyage.

## 2. KEY RISKS

The Master shall hold a meeting with Fumigator and discuss fumigation plan, potential risks and safety precautions to be taken. A Risk assessment for fumigation is to be made by ship staff prior fumigation which shall include at least the following hazards:


- **Accidental release of fumigant:** This could result in poisoning of the fumigation operator/s, vessel crew and other persons in the vicinity as well as potentially environmental damage (fumigants are very toxic to aquatic organisms).
- **Release of gas during venting process:** Part of the fumigation process following an infestation treatment is to aerate hatches to allow the remaining fumigant to be released to the environment. There is a risk that the remaining fumigant being heavier than air can drop to work areas where persons may be working. There is also a risk that the fumigant could be blown over and onto a work area.
- **Inappropriate Personal Protective Equipment (PPE):** Fumigants are extremely dangerous to human life and therefore there are specific requirements for PPE for those involved in the fumigation process. See PPE matrix (HSE Procedures Manual - 4.8 – Appendix A)
- **Unauthorised entry into fumigation area:** There is a risk of unauthorised persons entering the fumigation exclusion zone.

## 3. SAFETY PRECAUTIONS

The fumigator in charge is responsible for the supervision of the fumigation and release and ventilation of the fumigant.

The Master shall ensure that the fumigator-in charge carries out a thorough pre-fumigation check to ensure the ship is safe to transport a fumigated cargo. The Master shall obtain in writing of the spaces containing the cargo to be fumigated and also of any other spaces that are considered unsafe to enter during the fumigation. During the application of the fumigant the fumigator-in-charge should ensure that the surrounding areas are checked for safety.

The Master must ensure that personnel involved in the fumigation process are trained in its use and are provided with all the information and protective equipment required. The fumigant must

	<p>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</p> <p><b>24.0 CARGO FUMIGATION</b></p> <p>DRY CARGO MANUAL</p>	<p>Sect : 24.0 Page : 4 of 10 Date : 07-Aug-25 Rev : 10.0 Appr : DPA</p>
---	--	--

only be used in accordance with the manufacturer's instructions with which the trained personnel are to be thoroughly familiar. This is to include knowledge concerning the methods of detection of the fumigant in air, its behaviour and hazardous properties, symptoms of poisoning, relevant first aid and special medical treatment and emergency procedures.


Solid aluminium phosphide (or similar) is often used for fumigation. Aluminium phosphide reacts with water vapour (humidity) in cargo hold atmosphere to produce phosphine which is a **toxic and flammable gas**. Heat is also given off during the reaction. The equipment (e.g. camera, mobile phone and other electronic/electrical equipment etc) which are not intrinsically safe should not be used nor hot work is to be performed on deck when cargo holds are under fumigation.<sup>1</sup>

The following precautions shall be complied with:

- The Master should refer to MSDS and the correct procedures and safety advice, application dangers, method of handling, and requirements for personal protective equipment and monitoring equipment.
- Before fumigation of any kind is carried out it has to be assured that no unauthorized personnel or stevedores are accidentally inside the hold to be fumigated.
- Cargo spaces should be gas tight to prevent leakage of the fumigant. Special attention should be paid to potential problem areas such as hatch coaming drains, bilge and cargo line systems.
- A thorough inspection of all conduit pipes (including any penetrations from last cargo hold to engine room bulkhead), and openings from the main deck to the accommodation to be carried out and sealed if the fumigant gas can find its way through these in to the accommodation.
- Tool box meeting shall be carried out and all the crew shall be briefed on the fumigation process, hazards and emergency procedures before fumigation takes place. This should include primary and secondary evacuation points.
- Communication protocol for fumigation and emergency between fumigator and ship crew to be established.
- The moorings should be adequate to meet any contingencies likely to arise before and during the fumigation. Extra lines should be rigged if weather forecast looks poor.
- All electrical & lighting circuits present within the cargo holds should be isolated.
- Emergency ventilation procedures should be established.
- Fumigation flags to be hoisted (R, S, V, E).
- The accommodation and engine room ventilation must run on recirculation and positive pressure maintained with all doors closed after use until the gas free certificate is issued.
- Deck area to be cordoned off during operations and appropriate signage displayed at the barrier and at the gangway.

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<sup>1</sup> W 41 / 2021

	<p align="center"><i>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</i></p> <p align="center"><b>24.0 CARGO FUMIGATION</b></p> <p align="center"><i>DRY CARGO MANUAL</i></p>	Sect : 24.0 Page : 5 of 10 Date : 07-Aug-25 Rev : 10.0 Appr : DPA
---	---	---

- All hatches, vents, drains, breathers, manholes, adjacent store rooms etc shall be checked and sealed.
- Where fire detection and/or fixed firefighting extinguishing equipment are fitted to the holds, care must be taken to ensure that this equipment does not provide an avenue for leakage of fumigant.
- The fumigator-in-charge should post warning signs at all entrances to places notified to the Master. These warning signs should indicate the identity of the fumigant and the date and time of fumigation
- At an appropriate time after application of the fumigant, the fumigator-in-charge, accompanied by a representative of the Master, should check that accommodation, engine-rooms and other working spaces remain free of harmful concentrations of gas.
- Special care should be taken to ensure fumigant gasses cannot enter the vessel's accommodation.
- A regime of sampling is established at the earliest opportunity, and thereafter throughout the voyage, to detect the presence of fumigant in accommodation spaces and working areas.
- In case of fire, firefighting measures as mentioned in MSDS are to be complied with.

#### **4. CREW EVACUATION DURING FUMIGATION IN PORT**

Evacuation of the space under gas treatment is mandatory and, in some cases, it will be necessary for the whole ship to be evacuated.

Prior to the application of fumigants to cargo holds, the crew should be landed and remain ashore until the ship is certified "gas-free", in writing, by the fumigator-in-charge or other authorized person.


Some ports require minimum crew to be on board during fumigation. In this case, company recommends six crew to be on board during fumigation (At least one Deck Officer / Engine Officer / Deck Rating / Engine Rating and remaining 2 crew as per Masters Discretion)

Crew members remaining on board should remain indoors where possible.

During this period a watchman should be posted to prevent unauthorized boarding or entry, and warning signs should be prominently displayed at gangways and at entrances to accommodation.

Clear instructions must be given to the watchman by the Master or fumigator-in-charge about his / her duties. They must also be advised of what to do in an emergency and contact numbers should an emergency occur.

The fumigator-in-charge should be retained throughout the fumigation period and until such time as the ship is declared gas-free.

	<p>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</p> <p><b>24.0 CARGO FUMIGATION</b></p> <p>DRY CARGO MANUAL</p>	<p>Sect : 24.0 Page : 6 of 10 Date : 07-Aug-25 Rev : 10.0 Appr : DPA</p>
---	--	--

The fumigator-in-charge should notify the Master in writing of any spaces determined to be safe for re-occupancy by essential crew members prior to the aeration of the ship.

In such circumstances, the fumigator-in-charge should monitor, throughout the fumigation and aeration periods, spaces to which personnel have been permitted to return. Should the concentration in any such area exceed the occupational exposure limit values set by the flag State regulations or by the regulations of the port State where the fumigation is carried out, crew members should be evacuated from the area until measurements show re-occupancy to be Safe.

No unauthorized persons should be allowed on board until all parts of the ship have been determined gas-free, warning signs removed and clearance certificates issued by the fumigator-in-charge.

## 5. ENTRY INTO SPACES UNDER FUMIGATION

Entry into spaces under fumigation is not permitted except in the event of an extreme emergency.

All spaces should be padlocked / sealed as feasible to prevent anyone from entering the space. No-one should enter a space that has been fumigated until after it has been thoroughly ventilated.

In case of emergencies, Master is to consult company and for advice. Entry shall be made only after a detailed risk assessment and complying with enclosed space entry procedures has been completed. Also, each crew shall wear adequate protective equipment appropriate for the fumigant used and a safety harness and lifeline. Each lifeline should be tended by a person outside the space, who should be similarly equipped.

## 6. VENTILATION PROCEDURES OF VESSEL HOLDS


At the end of the fumigation period the fumigator will take the necessary action to ensure that the fumigant is dispersed from the space.

As part of the risk assessment, the area to be evacuated and kept clear during ventilation of the hold after fumigation (the 'exclusion zone' or 'risk area'), is to be determined by the fumigator.

It is the fumigator's responsibility to ensure that adequate controls are in place to prevent any person inadvertently entering the risk area during ventilation.

One or two crew may be required to assist the fumigator in opening of the hatch covers and they should be provided with adequate PPE including respiratory protection and adhere strictly to instructions given by the fumigator-in-charge.

Ventilation time shall be in accordance with the nature of fumigant.

	<p>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</p> <p><b>24.0 CARGO FUMIGATION</b></p> <p>DRY CARGO MANUAL</p>	<p>Sect : 24.0 Page : 7 of 10 Date : 07-Aug-25 Rev : 10.0 Appr : DPA</p>
---	--	--

Every effort should be made to prevent a fumigant from accumulating in accommodation or working areas

Gas free certificate is to be issued by fumigator prior to re-embarkation of the crew. Gas-free certificates should only be issued when tests show that all residual fumigant has been dispersed from empty cargo spaces and adjacent working spaces and any residual fumigant material has been removed. Ships should not be permitted to leave port until gas-free certification has been received from the fumigator-in-charge

It must be borne in mind that due to the fact that cargo is well stacked to the top, void spaces may have trapped gases which may not have been removed by surface ventilation and hence precautions shall be taken when entering mast houses, etc.

## 7. INTRANSIT FUMIGATION

As per IMO recommendation, fumigation in transit should only be carried out at the discretion of the Master, on the Shippers Instruction and advice.

The Master and fumigator-in-charge, or their representatives, should complete the in-transit fumigation checklist (provided by the fumigator) jointly.


Methyl bromide should never be used for fumigation in transit (IMO Recommendations, Annex 1D).

The fumigator-in-charge should notify the Master in writing, of the spaces containing the cargo to be fumigated and also of any other spaces that are considered unsafe to enter during the fumigation.

At least two members of the crew (including one officer) should be trained by the fumigator to ensure safe conditions in accommodation, engine room and other working spaces in respect of the fumigation are maintained on board the ship during the voyage. The trained representatives should brief the crew before fumigation takes place and satisfy the fumigator-in-charge that this has been done. The trained representatives should be provided and be familiar with the information in the relevant Material Safety Data Sheet and the instructions for use, e.g., on the fumigant label or package itself, such as the recommendations of the fumigant manufacturer concerning methods of detection of the fumigant in air, its behaviour and hazardous properties, symptoms of poisoning, relevant first aid and special medical treatment and emergency procedures.

The ship should carry:

- i. gas-detection equipment and adequate fresh supplies of service items for the fumigant(s) concerned together with instructions for its use and the occupational exposure limit values for safe working conditions;
- ii. instructions on disposal of residual fumigant material;
- iii. at least four sets of adequate respiratory protective equipment; and

	<p>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</p> <p><b>24.0 CARGO FUMIGATION</b></p> <p>DRY CARGO MANUAL</p>	<p>Sect : 24.0 Page : 8 of 10 Date : 07-Aug-25 Rev : 10.0 Appr : DPA</p>
---	--	--

- iv. a copy of the latest version of the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), including appropriate medicines and medical equipment.

During the application of the fumigant the fumigator-in-charge should ensure that the surrounding areas are checked for safety.

It may be required to keep the cargo hold ventilators completely sealed for fumigation. Ventilator sealing shall be removed when appropriate to do so and on the basis of carriage requirement.

After application of fumigants, the ship should be delayed in port alongside at a suitable berth or at anchorage for such a period as to allow the gas in the fumigated cargo holds to reach sufficiently high concentrations to detect any possible leakage. Special attention should be paid to those cases where fumigants in a solid or liquid form have been applied which may require a long period (normally from 4 to 7 days unless a recirculation or similar distribution system is used) to reach such a high concentration that leakages can be detected. If leakages are detected, the ship should not sail until the source(s) of such leakages is(are) determined and eliminated.

In all cases, ventilation procedures on board the ship during the voyage, should be scrutinized with regard to the possibility of drawing in the fumigant gas such as by incorrect ventilation procedures and settings, vacuum creation due to incorrect closing devices or flap settings, air conditioning and closed loop ventilation of the accommodation.

Gas concentration safety checks shall also be made at all appropriate locations which shall at least include: accommodation; engine-rooms; bridge and frequently visited working areas and stores such as the forecastle head spaces and spaces adjacent to cargo holds being subject to fumigation.

Gas checks shall be continued throughout the voyage at least at eight-hour intervals or more frequently if so advised by the fumigator-in-charge. These readings shall be recorded in the ship's logbook.


## 8. DISPOSAL OF FUMIGANT RESIDUES

Any discharge of active packages producing Phosphine gas represents a significant risk to the public who may encounter them at sea. It should therefore be ensured that all waste and residues are disposed of in an appropriate manner, either by incineration or by disposal on shore, as recommended by the manufacturer. Clear written instructions must be given to the Master and to the receiver of the cargo and to the authorities at the discharging port as to how any powdery residues are to be disposed of. The crew should not handle spent fumigation packages.

The Fumigator should take the necessary action to ensure that the fumigant is dispersed. Any waste packaging, residue containers/ sachets etc. from the fumigation process is to be removed from site and disposed of appropriately by the fumigator.

When Phosphine generating formulations are used to fumigate, any collected residue may ignite and hence necessary precautions are to be taken.



	<p align="center"><i>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</i></p> <p align="center"><b>24.0 CARGO FUMIGATION</b></p> <p align="center"><i>DRY CARGO MANUAL</i></p>	<p>Sect : 24.0  Page : 9 of 10  Date : 07-Aug-25  Rev : 10.0  Appr : DPA</p>
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Disposal of fumigants must be in accordance with the MSDS of the fumigants.

Breathing cartridges used during the operations must be disposed of after use.

## **9. ARRIVAL PORT**

Around 96 hours prior to the arrival of the ship, generally not less than 24 hours in advance, the Master should inform the appropriate authorities of the country of destination and ports of call that fumigation was carried out. The information should include the type of fumigant used, the date of fumigation, the cargo spaces which have been fumigated, and whether ventilation has commenced. Any instructions/requirements received from the Port Authorities must be complied with.


On arrival at the discharge port the Master should not allow discharge of the cargo to commence until he is satisfied that the cargo has been correctly ventilated and phosphide residues that can be removed, have been removed (the crew should not complete this task),

Before entry of fumigated cargo holds, trained personnel from a fumigation company or other authorized persons, wearing respiratory protection, should carry out careful monitoring of the spaces to ensure the safety of personnel. The monitored values should be recorded in the ship's log-book.

Typically, a Chemist attends onboard on arrival at the discharging anchorage or berth to determine if fumigation level is safe prior to the commencement of discharging. Only mechanical unloading that does not necessitate entry of personnel into the cargo holds of such fumigated cargoes should be undertaken. However, when the presence of personnel in cargo holds is necessary for the handling and operation of unloading equipment, continuous monitoring of the fumigated spaces should be carried out to ensure the safety of the personnel involved. When necessary, these personnel should be equipped with the correct and adequate respiratory protection.

During the final stages of discharge, when it becomes necessary for personnel to enter the cargo holds, such entry should only be permitted subsequent to verification that such cargo holds are gas-free.

Upon completion of discharge and when the ship is found free of fumigants and certified as such, all warning signs should be removed. Any action in this respect should be recorded in the ship's log-book.

	<p>HEALTH, SAFETY, ENVIRONMENT AND QUALITY MANAGEMENT SYSTEM</p> <p><b>24.0 CARGO FUMIGATION</b></p> <p>DRY CARGO MANUAL</p>	<p>Sect : 24.0  Page : 10 of 10  Date : 07-Aug-25  Rev : 10.0  Appr : DPA</p>
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## 10. DOCUMENTS RELATED TO FUMIGATION

Following documents (as applicable) related to fumigation to be obtained and filed in **SHAREPOINT 1.2.3**

- Letter of indemnity for fumigation (from charterers)
- Document proving fumigators competence and authorization
- Statement of vessel suitability for fumigation and fumigant application compliance
- Gas suitability statement
- Details of the fumigating agent used
- Fumigation plan
- Pre-fumigation inspection certificate
- MSDS
- Fumigation Safety Checklist (Checklist provided by the fumigator)
- Instructions for the use of the phosphine gas detecting equipment
- Safety and gas monitoring procedures plus any additional control measures that may be required due to the specific properties of the fumigant.
- Crew disembarking statement
- Masters receipt of safety equipment/PPE
- Certificate of fumigation
- Gas free certificate