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**RECOMMENDATIONS ON THE SAFE USE OF PESTICIDES IN SHIPS  
APPLICABLE TO THE FUMIGATION OF CARGO TRANSPORT UNITS**

- 1 The Maritime Safety Committee, at its sixty-second session (24 to 28 May 1993), approved the Recommendations on the safe use of pesticides in ships (MSC/Circ.612), proposed by the Sub-Committee on Containers and Cargoes at its thirty-second session.
- 2 The Maritime Safety Committee, at its eighty-fourth session (7 to 16 May 2008), approved the Recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo transport units, which apply to carriage of packaged dangerous goods in pursuance of the requirements of SOLAS regulation VI/4 and the relevant parts of the IMDG Code, proposed by the Sub-Committee on Dangerous Goods, Solid Cargoes and Containers at its twelfth session, as set out in the annex.
- 3 The Committee agreed that the Recommendations should not apply to the carriage of fresh food produce under controlled atmosphere.
- 4 Member Governments are invited to bring the Recommendations to the attention of competent authorities, mariners, fumigators, fumigant and pesticide manufacturers and others concerned.
- 5 The present circular supersedes MSC/Circ.612, as amended by MSC/Circ.689 and MSC/Circ.746 with regard to the fumigation of cargo transport units.

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## ANNEX

### RECOMMENDATIONS ON THE SAFE USE OF PESTICIDES IN SHIPS APPLICABLE TO THE FUMIGATION OF CARGO TRANSPORT UNITS

#### 1 Introduction

1.1 These recommendations address the hazards to personnel arising from the operations involved in the carriage of fumigated containers. This guidance is aimed at everyone involved in the supply chain. Although the contents of the container may not be subject to the provisions of the International Maritime Dangerous Goods (IMDG) code, the process of fumigating such a container may bring it into the scope of the code. If the container comes within the scope of the code hazard communication provisions are mandatory. Hazard communication measures required by the IMDG Code include:

- .1 warning signs on containers;
- .2 transport documents describing the fumigation method and, if appropriate, ventilation date; and
- .3 requirements to declare fumigated containers on ships' manifests.

1.2 It is generally acknowledged, however, that there is widespread non-compliance with these requirements. Before entering the container all personnel should assess the risk as to whether it is safe to enter and, if appropriate, determine the level of fumigant present. The use of gas detection equipment may be required.

#### 2 Reasons for fumigation

2.1 The presence of insects and rodents on ships is clearly undesirable for various reasons, and in addition to aesthetic and nuisance aspects, they may damage equipment and spread disease and infection, contaminate food in galleys and food stores, and cause damage to cargoes that will result in commercial or other losses.

2.2 The same highly toxic chemicals are used in containers as on board bulk ships. However, when a container that contains fumigant chemicals leaves the place at which it was fumigated, no-one can practically supervise the hazard unless they are aware of the presence of the fumigant. Any person who later enters the container can therefore be unknowingly exposed to dangerous levels of highly toxic chemicals.

##### 2.3 *Insects in containers*

2.3.1 Grubs and larvae of insects and other species can infest cargo, as well as packaging, dunnage, etc., associated with the cargo, at any stage during harvesting, manufacture, processing, storage, packing or transport. These can spoil foodstuffs, textiles, leather goods, furniture, art and antiques, affect electronic equipment, contaminate sterile goods or deface consumer packaging or labelling, making the goods unfit for sale and therefore valueless.

2.3.2 Insect and mite pests of plant and animal products may be carried into the containers with goods (introduced infestation); they may move from one kind of product to another (cross-infestation) and may remain to attack subsequent cargoes (residual infestation). Their control

may be required to comply with phyto-sanitary requirements to prevent spread of pests and for commercial reasons to prevent infestation and contamination of, or damage to, cargoes of human and animal food.

## **2.4 Rodents**

2.4.1 Rodents should be controlled not only because of the damage they may do to cargo or the ship's equipment, but also, as required by the International Health Regulations, to prevent the spread of disease. Importers, particularly those that operate food processing plants, make great efforts to eliminate infestation in order to prevent the invasion of the importer's local storage or processing plant from infestation carried in incoming cargo. Consequently, they regularly fumigate their premises and may insist that goods delivered to their premises are certified free of infestation by means of fumigation.

## **3 Shore-side fumigation operations – fumigated containers**

### **3.1 Fumigated containers which have been ventilated**

3.1.1 It is important to ensure that freight containers are properly ventilated by opening the doors and allowing the gas to escape. This can be a natural process, or can be accelerated by mechanical means such as blowers or extractors. The ventilation process can take many hours.

3.1.2 Freight containers or cargo transport units that have been completely ventilated after fumigation to ensure that no harmful concentration of gas remains should have the warning signs marked to show that it has been ventilated and the date of ventilation (in accordance with Special Provision 902 and Column 17 of the Dangerous Goods list for UN3359 Fumigated Unit) is not subject to the other requirements of the IMDG Code.

3.1.3 Care should be taken even after a container has been declared as ventilated. Gas can be held in packages of cargo, then desorbed over a long period of time, even over many days, raising the level of gas inside the container to above the safe exposure level. Bagged cereals and cartons with large air spaces are likely to produce this effect. Alternatively, gas and the fumigant sachets or tablets can become 'trapped' at the far end of a container by tightly packed cargo.

### **3.2 Containers loaded without ventilation after fumigation (fumigation in transit)**

3.2.1 A freight container or cargo transport unit containing cargo under fumigation should not be allowed on board until sufficient time has elapsed to allow the attainment of a reasonably uniform gas concentration throughout the cargo. Because of variations due to types and amounts of fumigants and commodities and temperature levels, it is recommended that the period to elapse between fumigant application and loading should be determined locally for each country. Twenty-four hours is normally adequate for this purpose.

3.2.2 Carriage of fumigated containers which have not been ventilated before loading must be carried in accordance with the IMDG Code; the text below is reproduced from the 33rd amendment to the IMDG Code. A container which is carried under fumigation is classified as Class 9, assigned a UN Number (UN 3359) and a Proper Shipping Name (Fumigated Unit). The Dangerous Goods List of the IMDG Code also specifies the following for fumigated units. It assigns two Special Provisions:

***Special Provision SP302***

In the Proper Shipping Name, the word “UNIT” means a cargo transport unit.

***Special Provision SP910***

A FUMIGATED UNIT is a closed cargo transport unit containing goods or materials that either are or have been fumigated within the unit. The fumigant gases used are either poisonous or asphyxiant. The gases are usually evolved from solid or liquid preparations distributed within the unit. Fumigated units are subject to the following provisions:

- 1 Cargo transport units shall be fumigated and handled taking into account the provisions of the IMO publication Recommendations on the Safe Use of Pesticides in Ships, as amended.
- 2 Only cargo transport units that can be closed in such a way that the escape of gas is reduced to a minimum shall be used for the transport of fumigated cargo.
- 3 Class 9 placards shall not be affixed to a fumigated unit, except as required for other class 9 substances or articles packed therein (see 5.3.1.3).
- 4 Fumigated units shall be marked with a warning sign affixed to the access door(s) identifying the type and amount of fumigant used and the date and time of fumigation (see 5.3.2.5).
- 5 The transport document for a fumigated unit shall show the type and amount of fumigant used and the date and time of fumigation (see 5.4.4.2). In addition, instructions for disposal for any residual fumigant, including fumigation devices if used, shall be provided.
- 6 A closed cargo transport unit that has been fumigated is not subject to the provisions of this Code if it has been completely ventilated either by opening the doors of the unit or by mechanical ventilation after fumigation and if the date of ventilation is marked on the fumigation warning sign. When the fumigated goods or materials have been unloaded, the fumigation warning sign(s) shall be removed (see also 7.4.3).
- 7 When fumigated units are stowed under deck, equipment for detecting fumigant gas(es) shall be carried on the ship with instructions for their use.
- 8 Fumigants shall not be applied to the contents of a cargo transport unit once it has been loaded aboard the ship.

3.2.3 In column 17 (Properties and Observations) of the Dangerous Goods list for UN 3359, the following information is given:

A ‘FUMIGATED UNIT’ is a closed cargo transport unit containing goods or materials that either are or have been fumigated within the unit. The fumigant gases used are either poisonous or asphyxiant. The gases are usually evolved from solid or liquid preparations distributed within the unit. Fumigants shall not be applied to the contents of a cargo transport unit once it has been loaded aboard the ship. A closed cargo transport unit that has been

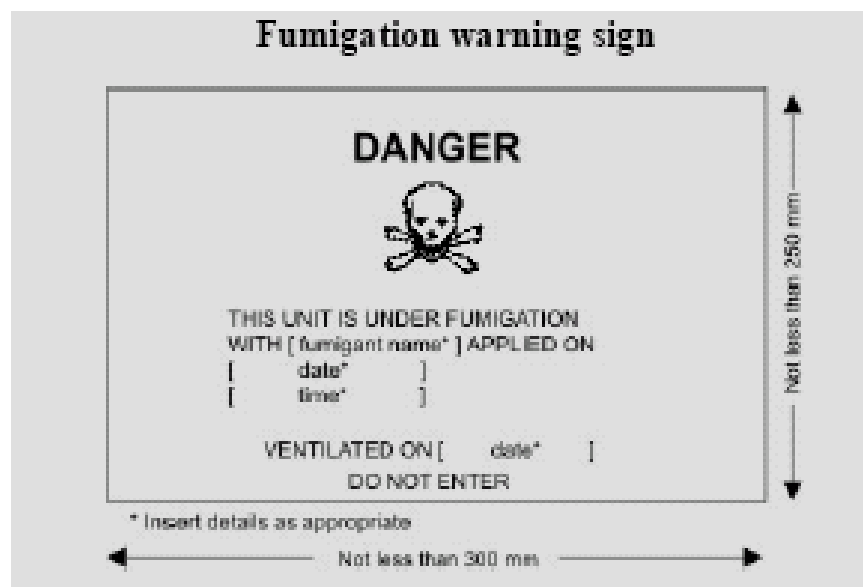
fumigated is not subject to the provisions of this Code if it has been completely ventilated either by opening the doors of the unit or by mechanical ventilation after fumigation and the date of ventilation is marked on the fumigation warning sign (see also Special Provision 910).

### 3.2.4 Marking of the Cargo Transport Unit

3.2.4.1 To meet the requirements of the IMDG Code the container has to be marked in accordance with chapter 5.3 of the IMDG Code, the relevant text is reproduced below:

#### ***Paragraph 5.3.2.5 Fumigated units***

- .1 The marking of the proper shipping name (FUMIGATED UNIT) and the UN number (UN 3359) is not required on fumigated units. However, if a fumigated unit is loaded with dangerous goods, any mark required by the provisions in 5.3.2.0 to 5.3.2.4 shall be marked on the fumigated unit.
- .2 A fumigated unit shall be marked with the warning sign, as specified in .3, affixed in a location where it will be easily seen by persons attempting to enter the interior of the unit. The marking, as required by this paragraph, shall remain on the unit until the following provisions are met:
  - .1 the fumigated unit has been ventilated to remove harmful concentrations of fumigant gas; and
  - .2 the fumigated goods or materials have been unloaded.
- .3 The fumigation warning sign shall be rectangular and shall be not less than 300 mm wide and 250 mm high. The markings shall be in black print on a white background with lettering not less than 25 mm high. An illustration of this sign is given below:



### **Transport documentation for the fumigated cargo transport unit**

3.2.5 To meet the requirements of the IMDG Code the container must be documented in accordance with chapter 5.4 of the Code the relevant text is reproduced below:

***Paragraph 5.4.4.2 Fumigated unit***

The transport document for a fumigated unit shall show the type and amount of fumigant used and the date and time of fumigation. In addition, instructions for disposal of any residual fumigant, including fumigation devices, if used, shall be provided.

**4 Fumigants used**

There are a number of chemicals that are used as fumigants such as Phosphine and Methyl Bromide.

**4.1 Phosphine UN 2199**

4.1.1 This process requires a long period of time to work completely. This can be applied with little technical training as it is supplied in sachets, tablets or pressed plates containing Magnesium Phosphide or Aluminium Phosphide. These generate Phosphine gas when exposed to the moisture in the air. The gas has a slight “fishy garlic” smell and breaks down into a powdery grey residue.

4.1.2 The rate of generation of Phosphine depends on the temperature, the airborne moisture and the degree the generating material is exposed to the air.

4.1.3 Symptoms of poisoning by inhalation of Phosphine include nausea, vomiting, headache, feeling weak, fainting, pain in chest, cough, chest tightness and difficulty breathing. Pulmonary oedema (the presence of excess fluid in the lungs usually due to heart failure) can follow, usually within 24 hours, but sometimes this is delayed for some days.

**4.2 Methyl bromide UN 1062**

4.2.1 Fumigation with Methyl bromide is a relatively rapid process that can normally be completed in less than 48 hours. So these containers are not usually presented for shipment with gas above the toxicity levels (threshold limits) set by national agencies.

4.2.2 Symptoms of poisoning by inhalation of Methyl Bromide include headaches, dizziness, and eye irritation; coughing, nausea, abdominal discomfort, and numbness of feet. Higher exposure will bring about unconsciousness to central nervous system, convulsions, and loss of vision, balance and hearing.

4.2.3 Methyl Bromide is supplied as a gas. So during application, expertise is required to carry out the operation.

**5 Ship-side operations**

**5.1 Fumigation after loading on board a ship**

5.1.1 No person should be allowed by the master to fumigate the contents of a freight container, or cargo transport unit once it has been loaded on board a ship.

## 5.2 *Containers loaded without ventilation after fumigation (fumigation in transit)*

5.2.1 If it is intended that freight containers or cargo transport units containing cargo under fumigation should be taken on board ship without preliminary ventilation, their shipment must be considered as a Class 9 Hazard under the IMDG Code and as such the procedures should conform to the provisions as specified in the entries for FUMIGATED UNIT (UN 3359) of the Code. The following special precautions, incorporating the IMDG provisions, are necessary:

- .1 A freight container or cargo transport unit containing cargo under fumigation should not be allowed on board until sufficient time has elapsed to allow the attainment of a reasonably uniform gas concentration throughout the cargo. Because of variations due to types and amounts of fumigants and commodities and temperature levels, it is recommended that the period to elapse between fumigant application and loading should be determined locally for each country. Twenty-four hours is normally adequate for this purpose. Before loading the container should be checked for leaks and any leakage sealed.
- .2 The master should be informed prior to loading of freight containers and cargo transport units under fumigation. These should be identified with suitable warning signs, incorporating the identity of the fumigant and the date and time of fumigation. Any freight container under fumigation must have the doors substantially secured before loading onto a ship. Plastic or lightweight metal seals are not sufficient for this purpose. The securing arrangement must be such as to allow only authorized entry to the freight container. If container doors are to be locked, the means of locking should be of such a construction that, in case of emergency, the doors could be opened without delay. Adequate instructions for disposal of any residual fumigant material should be provided.
- .3 Shipping documents for freight containers or cargo transport units concerned should show the date of fumigation and the type and amount of fumigant used.
- .4 Stowage on deck should be at least 6 m away from vent intakes, crew quarters and regularly occupied spaces.
- .5 Stowage under deck should only be undertaken when unavoidable and then only in a cargo space equipped with mechanical ventilation sufficient to prevent the build-up of fumigant concentrations above the toxicity levels (threshold limits) set by national agencies. The threshold limit for occupational exposure to the fumigant can be found on the Safety Data Sheet. The ventilation rate of the mechanical ventilation system should be at least two air changes per hour, based on the empty cargo space.
- .6 Equipment suitable for detecting the fumigant gas or gases used should be carried on the ship, with instructions for its use.
- .7 Where the stowage requirements above cannot be met, cargo spaces carrying fumigated freight containers or cargo transport units should be treated as if under fumigation and the provisions below should apply.

5.2.2 Before a fumigated container is loaded to a vessel below deck special precautions are necessary. This includes the following:

- .1 At least an officer and one other are to receive appropriate training and will be designated as the trained representatives of the master. The master, through his representative, is responsible for ensuring safe conditions in the occupied spaces of the vessel.
- .2 The trained representatives should brief the crew before the container is loaded.

5.2.3 The fumigant gas is heavier than air so care should be taken in the holds particularly when working on the tank tops.

5.2.4 The trained representatives of the master should be provided and be familiar with:

- .1 The information in the relevant Safety Data Sheet (SDS), if available.
- .2 The instructions on the packaging itself, such as the recommendations of the fumigant manufacturer concerning methods of detection of the fumigant in air, its behaviour and hazards properties, symptoms of poisoning, relevant first aid and special medical treatment and emergency procedures.

5.2.5 The ship should carry:

- .1 adequate gas-detection equipment for the fumigant concerned, together with instructions for its use;
- .2 instructions on disposal of residual fumigant material;
- .3 at least four sets of adequate respiratory protective equipment; and
- .4 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.

5.2.6 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 in transit is being carried out. The information should include the type of fumigant used; the date of fumigation and cargo spaces carrying fumigated freight containers or cargo transport units.

5.2.7 The instructions 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.

5.2.8 Disposal of any residual fumigant material should be in accordance with suppliers instructions.

## **6 Hazards to personnel**

6.1 If for any reason, the ship's crew or other personnel have to open a container declared as being under fumigation they must be very careful.

6.2 There are no obvious signs when Methyl bromide has been used as a fumigant (e.g., by sight or smell). The container should be left open as long as possible and then checked with the equipment available and should be declared gas free before entry is allowed. In the case of an emergency, entry may be allowed, with full confined space precautions, if there is any gas found to be present.

6.3 If the container is fumigated with Phosphine there are normally visual signs inside the container of the fumigant in the form of sachets, tablets, pressed plates or powder. The state of the packaging depends on the time these have been exposed and the atmosphere that they have been exposed in. It is also possible that the fumigants have moved between cargo items and may not be immediately visible.

6.4 As moisture is required for the reaction to take place, when a container is opened at sea the level of moisture in the air may restart the reaction.

6.5 After the Magnesium or Aluminium Phosphide reacts with moisture to generate Phosphine, a residue of magnesium or aluminium hydroxide remains. This is a light powdery grey substance like ash. Hopefully this has been retained in some kind of packaging so that it can be removed safely. If, however, there is a residue over the cargo, the crew must avoid breathing in this residue or getting it into their eyes or mouth. If not they are still at risk of being poisoned by the residue, which may still be able to generate some Phosphine.

6.6 It should be noted that there are certain commodities (e.g., edible nuts) where a small amount of fumigant is put in cotton wool and placed inside each bag. These items are then dangerous because their handling brings the fumigant close to the face.

6.7 Personnel should be made aware that not every fumigated container is declared and, hence, not marked as such. There are indicators for fumigated containers like tapes on vents or the door joints, a possible "fishy garlic" smell of Phosphine and packets or piles of powdery residue inside the container.

## **7 Fumigation detection**

7.1 The most effective method of protection is to carry out gas tests when the container doors are opened. As a minimum, it is recommended to test for Phosphine and Methyl bromide as the two most common fumigants used. If gas is found the container should be put aside for ventilation.

### *7.1.1 Stain tube gas test equipment*

7.1.1.1 Glass stain tube equipment is simple in design and use, robust and reliable. A test for Phosphine and Methyl bromide can be carried out by a person standing outside the container using a lance inserted into the container doorway. In practice air is drawn by small hand-held bellows through a glass tube containing impregnated crystals which react with the gas for which the test is being done. If the air is contaminated by the gas in question, the crystals change colour. The function is not affected by moisture, but care has to be taken to warm the tubes to above 0°C in

sub zero temperatures. Also a reasonable degree of light is required to detect the colour change of the crystals. The tubes should be used in accordance with the manufacturer's instructions. In particular, they must not be used after their expiry date.

#### *7.1.2 Electronic (photo-ionisation gas testing equipment)*

7.1.2.1 Gas tests can be carried out that detect the presence of gases and their concentration levels. Similarly, equipment can confirm that there is a safe level of oxygen within the container. At the present time the technology is such that both the quantification and discrimination are poor. There are frequent false positives due to cross sensitivities and readings are not accurate enough for determining safe exposure levels. Therefore the use of these instruments at the present time is not recommended.

### **7.2 Personal monitors**

7.2.1 Small electronic personal monitors are available for Phosphine, but not for Methyl Bromide. Phosphine monitors can be placed inside the container while unloaders are working, or worn by individuals on outer garments. The location of an independent monitor is important both to ensure that any fumigant is detected and ensure that the reading is not compromised by ventilation at the door or external contaminants. Monitors issue an audible signal if Phosphine levels reach the pre-set level and are useful as warning devices. However, they should not be used for the initial fumigation detection and measurement process. Also, electronic monitors have the disadvantage that they can respond to a range of harmless substances giving misleading alarm signals.

7.2.2 Personal monitors are also available to show the level of oxygen within the container. This would indicate a deoxygenated atmosphere but would not necessarily indicate that the atmosphere is free from fumigant.

