

Pre-fumigation documentation provided in Nika-Tera, Ukraine

Port: " NIKOLAEV "Date: " 18 " NOVEMBER , 2012M/V: " ARKLOW MEADOW "Flag: " IRELAND "**STATEMENT OF PREFUMIGATION NOTICE COMPLIANCE**

This is to notify that the following phosphine liberating fumigant formulation

Aluminum Phosphide

Magnesium Phosphide

will be applied to the goods in the above referenced ship's holds

No(s): 1,2,3,4

for in-transit fumigation after completion of loading operations.

The fumigant application procedure will be in accordance with the IMO Recommendations on the Safe Use of Pesticides in Ships (IMDG Code Supplement 2008 Edition), the fumigant manufacturer's instructions, local phytosanitary requirements and contractual obligations.

The Master is hereby requested to:

1. provide the fumigator-in-charge with all necessary information regarding ship's specific features (e.g. structural or other systems that may allow the fumigant to leak from one area to another such as coffer dams, pumping systems, all-weather tunnels, keel ducts, bilges, smoke/fire detection or suppression systems, electrical systems, deck lockers etc.) that may be the source of the fumigant leakage from ship's holds;
2. designate two crew members (including one officer) as the trained representatives of the Master;
3. provide the fumigator-in-charge with electrical plugs suitable for connection of necessary number of recirculation fans to ship's power supply (if required);
4. seal off all potential fumigant leakage sources from the cargo holds prior to loading;
5. ensure the hatch covers are fully opened during the fumigant application procedure;
6. close and seal off all hatch covers, manholes, ventilators and other remaining openings to prevent the fumigant leakage from cargo holds following the fumigant application;
7. ensure that there are no stowaways, none of the crew members or other personnel remain in the cargo holds or other spaces to be fumigated;
8. ensure that there are no unaccounted for or unauthorised personnel on board;
9. provide the fumigation team with dressing and shower rooms.

The following information is provided to the Master:

- STATEMENT OF PREFUMIGATION NOTICE COMPLIANCE
- STATEMENT OF THE SHIP SUITABILITY FOR FUMIGATION
- SAFETY INFORMATION
- EMERGENCY PROCEDURES
- MATERIAL SAFETY DATA SHEET
- FUMIGANT LABEL
- SAFETY EQUIPMENT CHECKLIST

Fumigator-in-charge: _____

The Master: _____



Grafta





Port: " NIKOLAEV "

Date: " 18 " NOVEMBER , 2012

M/V: " ARKLOW MEADOW "

Flag: " IRELAND "

STATEMENT OF THE SHIP SUITABILITY FOR FUMIGATION

It is hereby certified that the following cargo holds of the above named vessel to be fumigated with phosphine gas after completion of loading have been inspected prior to loading operations on " 18 " November , 2012 and found as follows:

Check points	Hold No.1	Hold No.2	Hold No.3	Hold No.4	Hold No.5	Hold No.6	Hold No.7	Hold No.8	Hold No.9
Hatch closing mechanism	S	S	S	S					
Hatch rubber seals	S	S	S	S					
Hatch cover securing device	S	S	S	S					
Hold access seals	S	S	S	S					
Ventilation shafts	S	S	S	S					
Bilge covers	S	S	S	S					
Engine room bulkhead	X	X	X	X					
Bilge valves in engine lines	X	X	X	X					
Duct keels in engine room	X	X	X	X					
Below Main Deck Crew Accommodations	X	X	X	X					
Underdeck passageways	X	X	X	X					
Fire Detecting systems	S	S	S	S					
CO2 Fire extinguishing system	S	S	S	S					
Air Conditioning Intakes	X	X	X	X					

"S" –satisfactory; "N" – non-satisfactory (to be improved); "X" – not available

Remarks:

It is further confirmed that the fumigator-in-charge and master have discussed the structure of this ship and it is such that there are no known means for gas to escape from the cargo holds to areas occupied by the crew.

Fumigator-in-charge



The Master :



Port: "NIKOLAEV"M/V: "ARKLOW MEADOW"Date: "18" **NOVEMBER, 2012**Flag: "IRELAND"**SAFETY INFORMATION****SYMPTOMS OF EXPOSURE AND EMERGENCY FIRST AID TREATMENT:**

HYDROGEN PHOSPHIDE (PHOSPHINE - PH₃) IS COLORLESS GAS WITH ODOR OF GARLIC OR COMMERCIAL CARBIDE. THE SPECIFIC GRAVITY IS 1.17 (17% HEAVIER THAN AIR).

Slight or mild poisoning which produces a feeling of fatigue, ringing in the ears, nausea, pressure in the chest, and uneasiness. All those symptoms will normally disappear when the person is removed to fresh air.

Moderate exposure that leads to general fatigue, nausea, gastro-intestinal symptoms accompanied by vomiting, stomach ache, diarrhea, disturbance of equilibrium, strong pains in the chest, and difficulty in breathing.

Exposure to very high concentrations which rapidly produces strong difficulty in breathing, bluish-purple skin color, difficulty in walking or reaching, subnormal blood oxygen content, unconsciousness, and death. Death may be immediate or may be delayed until several days later.

Emergency first aid treatment for inhalation of the gas is: remove the victim to fresh air. Make him lie down and keep him warm. Treat as for shock. Call physician as soon as possible. Make no antidotal use of fats, oils, butter or milk. The following measures are suggested for use by the physician in accordance with his Judgment: Should patient suffer from vomiting or increased blood sugar, appropriate solutions should be administered. Treatment with oxygen breathing equipment is recommended as is the administration of cardiac stimulant. In cases of severe poisoning where pulmonary edema is observed, steroid therapy should be considered and close medical supervision is recommended for a minimum of 48 hours.

FIRE HAZARD AND RESPIRATORY PROTECTION

Fire hazard is a factor that calls for the utmost care in handling and use of aluminum (magnesium) phosphide. To reduce the fire hazard, tablets of aluminum (magnesium) phosphide are coated with paraffin, which slows the penetration of moisture and help "control" the release rate of phosphine. In the event of a fire **DO NOT USE WATER** (this causes the release of additional hydrogen phosphide along with phosphoric acid). **Suffocate the flames with sand, carbon dioxide or dry extinguishing chemicals.**

Hydrogen phosphide (phosphine) gas is toxic to all forms of life, plant and animal, including human. Approved canister respirators can be worn up to 15 ppm, but when the levels exceed 15 ppm or are unknown, a self-contained breathing apparatus (SCBA) should be worn. Safe established threshold limit value (TLV) concentration for hydrogen phosphide is **0.3 ppm.**

REMARK: A threshold limit value (TLV) refers to airborne concentrations of substances and represents an average exposure level to which it is estimated that workers may be repeatedly exposed, 8 hours/day, 5 days/week for the life of the individual with no adverse effects. It is usually expressed in terms of parts per million (ppm) by volume of air.

Fumigator-in-charge

The Master :



Gafta





Port: "NIKOLAEV"

M/V: "ARKLOW MEADOW"

Date: "18" **NOVEMBER, 2012**

Flag: "IRELAND"

SAFETY EQUIPMENT CHECK LIST

It is to certify that the safety equipment and medicines supply on board the above - mentioned vessel has been checked for compliance with the IMO Recommendations on the Safe Use of Pesticides in Ships (IMDG Code Supplement 2008 Edition p. 3.3.2.7, p. 3.4.3.7) and found as follows:

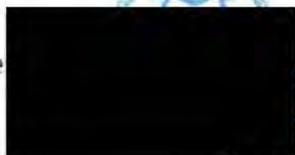
#	ITEMS	QTT	COMPLY	
			Yes	No
1	Portable pump or electronic (digital) gas detector	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Gas-testing tubes for phosphine	20	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	Full face gas mask	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	Filter for phosphine	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5	Self Containing Breathing Apparatus (SCBA)	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6	Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG)	-	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	Appropriate medicines and medical equipment as listed in the MFAG	-	<input checked="" type="checkbox"/>	<input type="checkbox"/>

I, the Master of the above mentioned vessel, hereby confirm that:

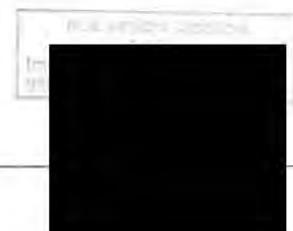
- The ship is ready for in-transit fumigation:**
The safety equipment available on board is in conformity with IMO Recommendations, is in good order and at least two crew members are instructed and trained in their use.
- The ship is not ready for in-transit fumigation:**
*The safety equipment supply does not meet the IMO Recommendations and the missing items should be obtained before completion of loading operations.**

* According to Resolution of the Cabinet of Ministers of Ukraine No. 846 dated 05 August 2009 the ship's equipment can be only supplied by the licensed ship chandlers.

Fumigator-in-charge



The Master :





Port: "NIKOLAEV"

M/V: "ARKLOW MEADOW"

Date: "17" **NOVEMBER, 2012**

Flag: "IRELAND"

STATEMENT OF THE RE-CIRCULATION SYSTEM INSTALLATION

We, the undersigned, Master of the m/v **ARKLOW MEADOW** and the representative of Pro-Tec Ltd. are certifying that according to the Shipper's order the re-circulation system has been installed into the below mentioned cargo holds for the purpose of the fumigant gas penetration improvement into the cargo mass thus reducing the fumigation exposure time as follows:

Hold number	Quantity of blowers Used (pcs)	Permeable tubing Used (m)	Non-permeable tubing Used (m)
№1	1	50	75
№2	1	50	75
№3	1	50	75
№4	1	50	75
№5	----	----	----
№6	----	----	----
№7	----	----	----
TOTAL	4	200	300

We further certify that all above-mentioned electric blowers have been switched on after sealing the fumigated cargo holds.

The Master hereby confirms that:

1. All blowers are running and the re-circulation system is in good working condition.
2. Ship's electrician or other trained crew member appointed by the Master shall check the blowers' condition during the voyage in accordance with instructions provided by the fumigator.

REMARK: re-circulation system installation is for the shipper's account.

Fumigator-in-charge:



The Master :



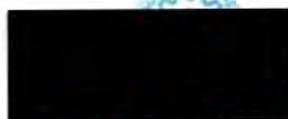
Port: "NIKOLAEV"M/V: "ARKLOW MEADOW"Date: "18" **NOVEMBER, 2012**Flag: "IRELAND"**INSTRUCTIONS FOR THE RE-CIRCULATION SYSTEM OPERATION**

The following instructions should be strictly followed to provide the proper re-circulation system operation:

1. All electric blowers installed into ship's cargo holds should be kept running continuously during the first 72 hours after being switched on.
2. The blowers should be switched off after 72 hours of continuous operation time and switched on again after a minimum 8 hours idle period.
3. The remaining voyage time the blowers should be switched on for a maximum 8 hours continuous running time followed by a minimum 8 hours idle period each day.
4. The blowers working condition should be regularly checked by the ship's electrician or any other trained crew member and their findings should be entered into the ship's logbook.

On arrival to discharge port the re-circulation blowers can be either used by the fumigator of destination country for purposes of cargo degassing or removed from cargo holds for further recycling or disposal.

Fumigator-in-charge:



The Master :



Certificate of Cargo Characteristics

**МОРСЕРВИС****MORSERVICE**

Национальный специализированный оператор по оказанию услуг в области безопасности груза. Единственный оператор в Украине по транспорту Пункт 18
 рн Грузоперевозки №1, Одесса, 68046, Украина. Контакт: 048440-5481, 048440-5482, 048440-5483, 048440-5484, 048440-5485, 048440-5486, 048440-5487, 048440-5488, 048440-5489, 048440-5490, 048440-5491, 048440-5492, 048440-5493, 048440-5494, 048440-5495, 048440-5496, 048440-5497, 048440-5498, 048440-5499, 048440-5500, 048440-5501, 048440-5502, Украина. Fax: 04842-362407, 0264402348, 796 1450 5484, morsk@ukr.net



Система управления качеством сертифицирована и зарегистрирована ИСО 9001:2000 Регистром Свидетельства Украины
 Quality management system certified and registered by ISO 9001:2000 by Register of Ukraine



Морской институт / Maritime Institute. Пункт 18
 Транспортный №1, Одесса, Украина
 The Member of the International Institute of Marine Surveyors, London, Membership 4276

СЕРТИФИКАТ о характеристиках груза на момент погрузки
CERTIFICATE about characteristics of cargo at the loading point

№ S/MS 16047NI-1/8**В ДОПОЛНЕНИЕ К ДЕКЛАРАЦИИ/ IN ADDITION TO THE DECLARATION № 000016047/8**

Коммерческое наименование груза **КУКУРУЗА**
 Trade cargo name **CORN**
 Количество / Quantity **13000±10%mt.**
 Грузоотправитель/Экспедитор **ООО"НЬЮ ВОРЛД ГРЕЙН УКРЕЙН" /ВИВО-ТРАНС**
 Shipper/Forwarder **LLC "NEW WORLD GRAIN UKRAINE" / VIVO-TRANS**

Исследования выполнены 10.11.2012 перед погрузкой навалом на т/х "ARKLOW MEADOW" в порту НИКОЛАЕВ (НИКА-ТЕРА)

Tasting has been fulfilled 10.11.2012 before bulk loading on a board of the m/v "ARKLOW MEADOW" in port of NIKOLAEV (NIKA-TERA)

Объединенная проба составлена из 104 точечных проб и исследовано 3 параллели лабораторной пробы.

An united sample is formed from 104 point samples and is tested with 3 parallels of laboratory sample.

Определены:**Determined:**

Средняя влажность, % **11,5**
 Удельный погрузочный объем (УПО), м³/т **1,4**
 Плотность навалом, кг/м³ **714**
 Температура груза °С **10**
 Угол естественного откоса, ° **32**
 Проницаемость **0,34**

Middle moisture, % **11,5**
 Stowage factor, m³/t **1,4**
 Bulk density, kg/m³ **714**
 Temperature of the cargo °C **10**
 Angle of repose, ° **32**
 Permeability **0,34**

Другие характеристики груза на момент погрузки, которые могут повлиять на безопасность морской транспортировки

Other characteristics of the cargo for the moment of loading which can effect on safety of marine transportation

Не известны

not known

Груз классифицирован как:**The cargo is classified as:**

Зерновая культура. Перевозка осущ-ся по требованиям Международного Кодекса по безопасной перевозке зерна насыпью

It is grain crop. The transportation is carried out in accordance with requirement International Code for the safe carriage of grain in bulk

17644

Настоящим Сертификатом подтверждается соответствие особенностей груза на момент погрузки, заявленным в Декларации на груз и условиям его безопасной перевозки морем. Особенности груза таковы, как указаны в настоящем Сертификате.

The present Certificate confirms the compliance of cargo characteristics declared in the cargo Declaration and conditions of its safety

Properties of cargo are such as specified in present Certificate

от имени Грузоотправителя / On behalf of Shipper

Морского Института, Лондон / Member of Nautical Institute, London

и/или грузового бора / Chief of cargo bureau

«МОРСЕРВИС» Одесса / "MORSERVICE" Odessa

Этот Сертификат выдан по требованию требований Главы VI и VII Международной Конвенции по охране жизни людей в море (SOLAS 1974 с поправками) и удовлетворяет рекомендациям Международной Маринерской Организации (IMO), изложенным в Международном Кодексе Табели Чистоты Грузов - (IMSBC)

The Certificate is worked out to meet the requirements of Chapters VI and VII of international Convention for the Safety of Life at Sea (SOLAS 1974 with amendments) and satisfies the recommendations of the international Maritime Organization (IMO) specified International Maritime Solid Bulk Cargo Code (IMSBC)



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5
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Post-fumigation documentation provided in Nika-Tera, Ukraine

ООО «ПРО-ТЕК»



PRO-TEC LTD.



**I N - T R A N S I T
FUMIGATION CERTIFICATE**

Date: 20 NOVEMBER 2012

No.: **PT12-NK018**

This is to certify that the phosphine-liberating fumigant formulation is applied to the under-mentioned commodity for in transit fumigation aboard the carrying vessel in accordance with IMO/ IMDG Code and the fumigant manufacturer's instructions as follows:

Commodity:	UKRAINIAN CORN, IN BULK
Quantity:	<i>13276.684</i> MT
Vessel's Name:	M/V "ARKLOW MEADOW"
Port of Loading:	NIKATERA, UKRAINE
Destination:	IRELAND
Hold(s) Fumigated No:	1, 2, 3, 4.
Fumigant Used:	ALUMINIUM PHOSPHIDE (ROUND TABLETS - 3g.)
Dosage Applied:	AIP - 4.5 g/m³; (PH₃ - 1.5 g/m³)
Pre-Pack:	RESIDUE DUST RETAINERS
Method Used:	SURFACE APPLICATION, RECIRCULATION SYSTEM
Application Time:	<i>13⁴⁰ - 15⁴⁰</i> LT <u>20 NOVEMBER 2012</u>
Required exposure:	VOYAGE TIME (MIN. 168 HOURS)

Each hold has been properly sealed for in-transit fumigation and checked for leakage before sailing. Aeration of treated cargo holds should be completed and a clearance certificate received before the cargo operations.

This certificate represents our engagement at the time and place of signing only and cannot be considered a guarantee of the goods condition on any further date.

Fumigator in charge



Vessel's Master
(for receipt only)

IMO No 9410277
MMSI 5460KW



Код ЕГРПОУ 33139911 ☐ АКБ «Имексбанк» ☐ р/с 26007015813001 ☐ МФО 388584



Gafla





Port: "NIKOLAEV"

Date: "20" **NOVEMBER, 2012**

M/V: "ARKLOW MEADOW"

Flag: "IRELAND"

VOYAGE SAFETY CHECK LIST

The following documents have been provided and required minimal preparations have been done:

#	Documents and Actions	YES	NO
1.	Prefumigation Notice	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.	Statement Of The Ship Suitability For Fumigation	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.	Fumigant Label	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.	Fumigation Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.	Precautions During Voyage Notice	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6.	Instruction For Aerating The Holds	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7.	Certificate Of Fumigation In Transit	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8.	Statement Of Hand Over Responsibility For Maintaining Safe Conditions	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9.	The crew has been briefed in regards of minimal safety precautions	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10.	Precautions during the voyage have been posted on the information board	<input checked="" type="checkbox"/>	<input type="checkbox"/>
11.	Dangerous areas have been placarded with "DANGER" signs	<input checked="" type="checkbox"/>	<input type="checkbox"/>
12.	The spaces adjacent to the treated cargoes been tested and found to be gas free	<input checked="" type="checkbox"/>	<input type="checkbox"/>
13.	The vessel has been thoroughly checked for stowaways or unauthorised personnel prior to fumigation	<input checked="" type="checkbox"/>	<input type="checkbox"/>
14.	Two crewmembers have been designated as the Master's representative for maintaining safe conditions during the voyage: <i>(print the name and rank)</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	a) _____		
	b) _____		

*Safety of operations requires that all questions should be answered by ticking the appropriate boxes.
If a question is considered to be not applicable write "n/a", explaining why if appropriate.*

Remarks:

Fumigator-in-charge



The Master:



Port: " NIKOLAEV "M/V: " ARKLOW MEADOW "Date: " 20 " **NOVEMBER, 2012**Flag: " IRELAND "**MAINTAINING SAFE CONDITIONS**

The following procedure should be carried out after application of fumigant and closing and sealing of cargo spaces.

SUGGESTED MINIMUM PRECAUTIONS DURING VOYAGE

Generally speaking, crew members are free to move about the ship during the voyage, but the following minimum precautions should be observed:

DO NOT ENTER THE FUMIGATED HOLDS!

Should an odour of hydrogen phosphide (phosphine) be detected or suspected in an occupied area of the ship, evacuate the area, check for the presence of hydrogen phosphide using appropriate respiratory protection equipment and gas testing device. These items are on board and the captain or his designated representative is familiar with their use. Should a leak be found, seal it with tape or caulking on the exterior side of the space under fumigation. Wear respiratory protection during this operation.

AREAS CONSIDERED NON-SAFE DURING VOYAGE

- CARGO HOLDS No(s): 1,2,3,4
- AND ANY OTHER AREA PLACARDED WITH DANGER SIGNS

Except in extreme emergency, cargo spaces sealed for fumigation in transit should never be opened at sea before exposure period is over.

Gas concentration safety checks at all appropriate locations should be continued throughout the voyage beginning from the time of application at intervals as instructed by the Fumigator first three days and at least once an each following day. Safety checks should include accommodation, engine-room, navigation room, forecastle, frequently visited working areas, adjacent to the fumigated holds. Such checks should be recorded in official log book.

AREAS CONSIDERED TO BE SAFE DURING VOYAGE

- LIVING QUARTERS;
- WORKING AREAS NOT PLACARDED WITH DANGER SIGNS.

Although areas listed above considered safe during voyage it is recommended that any accommodations or storage areas next to fumigated areas be periodically monitored with the detection equipment. If phosphine is detected in these areas, evacuate people, ventilate area, find cause of leakage and seal it with tape or caulking on exterior side of the space.

Fumigator-in-charge



The Master :



Port: " NIKOLAEV "M/V: " ARKLOW MEADOW "Date: " 20 " NOVEMBER, 2012Flag: " IRELAND "**INSTRUCTION FOR AERATING THE HOLDS**

Fumigated cargo spaces should be kept sealed until the exposure time stated in the in-Transit Fumigation Certificate is over. Aeration of cargo is recommended to begin immediately after completion of exposure and to continue until ships docking at destination by opening manholes and vent seals of the fumigated cargo spaces and use of mechanical ventilation, if available.

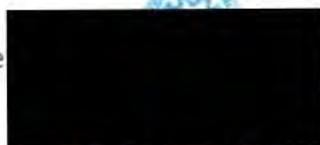
At port of discharging the master of the ship should arrange the following:

1. Before hatches will be opened designate 2 persons to be responsible for opening the cargo holds and provide both with appropriate respiratory protection equipment and gas testing device. Clear the deck of all other personnel.
2. During aeration all superstructure doors and other openings to living and working areas should be closed.
3. Open all fumigated holds. Hydrogen phosphide in the air space above the cargo in the holds will readily dissipate when the hatches are opened. Dissipation from slack holds will take longer and may require forced ventilation. There may be some gas remaining below the surface of the cargo, which will disappear during discharging. Keep in mind that if the fumigated holds will be closed during unloading operations the additional time for aeration should be allowed after hold's re-opening.
4. DO NOT ENTER OR ALLOW ENTRY into any hold until the overspace immediately above the cargo is either free from hydrogen phosphide or is found to be present in levels below permissible limits. After opening of the holds in one hour interval check and record concentration in the ship's log-book until cargo is gas-free.
5. However, should it be necessary to enter fumigated holds, use appropriate respiratory protection equipment and gas testing device. Keep in mind that approved canister respirators can be worn up to 15 ppm, but when the levels exceed 15 ppm or are unknown, a self-contained breathing apparatus (SCBA) should be worn.

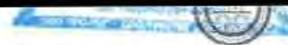
For residue-retaining sleeves fumigation only: Retrieve used residue-retaining sleeves from the fumigated hold after the surface has been aerated to below 0.3 ppm of hydrogen phosphide (PH₃). Use a wire basket or other open-mesh container for collection of the residue-retaining sleeves. Do not confine exposed residue-retaining sleeves by stacking or by placing them in sealed containers. This may lead to build up of dangerous levels of gas, which could flash or cause fire. Keep collected residue-retaining sleeves in dry place in open air away from vent intakes until docking. Arrange with Quarantine Inspection for disposal of residue-retaining sleeves by means and at the site approved by local authority after ship's docking.

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 aluminium phosphide residues that can be removed, have been removed, and that any other requirements of the discharge port have been met (IMDG Code Supplement 2008 Edition p. 3.3.2.17, p. 3.4.3.17)

Fumigator-in-charge



The Master :



Gafta





Port: " NIKOLAEV "

M/V: " ARKLOW MEADOW "

Date: " 20 " **NOVEMBER, 2012**

Flag: " IRELAND "

FUMIGATION PLAN

It is certified that the following phosphine liberating fumigant formulation

Aluminum Phosphide

Magnesium Phosphide

has been applied to the cargo on the above referenced vessel on " 20 " November, 2012.

After the fumigant application all cargo holds were closed and sealed, and warning placards were posted on all entrances to all fumigated holds. The cargo in the following holds was treated at the dosage rate of 4,5 grams per cubic meter of the hold space using method of:

Surface application
 Subsurface application

Residue retaining sleeves
 Loose tablets

Recirculation
 Other

Hold No.1	Hold No.2	Hold No.3	Hold No.4	Hold No.5	Hold No.6	Hold No.7
VOLUME 3132 m ³ ALP 14,25 kgs.	VOLUME 5762 m ³ ALP 26,25 kgs.	VOLUME 5628 m ³ ALP 25,5 kgs.	VOLUME 3587 m ³ ALP 16,5 kgs.	VOLUME m³ ALP kgs.	VOLUME m³ ALP kgs.	VOLUME m³ ALP kgs.
Number of residue retaining sleeves: <u>19</u> (if used)	Number of residue retaining sleeves: <u>35</u> (if used)	Number of residue retaining sleeves: <u>34</u> (if used)	Number of residue retaining sleeves: <u>22</u> (if used)	Number of residue retaining sleeves: <u> </u> (if used)	Number of residue retaining sleeves: <u> </u> (if used)	Number of residue retaining sleeves: <u> </u> (if used)
Total volume: 18,110 m³, Total ALP: 82,5 kgs.						

Total amount of residue retaining sleeves is 110

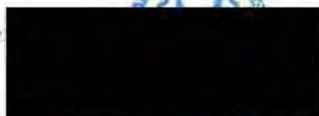
Required minimum exposure time is 168 hours

The fumigated cargo is destined for Ireland

The estimated voyage time to destination is 7 days

It is understood that early termination of the required exposure time by unsealing fumigated cargo holds indicated above is dangerous and may cause fumigation failure.

Fumigator-in-charge



The Master :



Port: "NIKOLAEV"M/V: "ARKLOW MEADOW"Date: "20" **NOVEMBER, 2012**Flag: "IRELAND"

HYDROGEN PHOSPHIDE (PHOSPHINE)
GAS DETECTION PROCEDURES

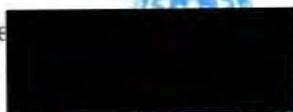
Gas concentration safety checks are carried out by the trained representative of the Master at all appropriate locations which include at least the accommodation, engine room, areas designated for use in navigation of the ship, working areas and stores, such as the forecabin head spaces, standers, mast houses, store room, paint lockers, etc.

Testing for phosphine gas consists of pulling air from the area or space being tested through a gas detector tube with a hand operated pump. The tube contains a special reagent, which will discolor if phosphine gas is present. The concentration of phosphine in the air being tested can then be determined by reading the scale on the tube at the point at which the discoloration stops. If gas is not detected, the tube being used **can be re-used** for a period of 24 hours, provided the tip ends are sealed off with tape between readings. Once gas is detected the tube cannot be re-used. Given below is operating instruction for AM-5 gas detection pump:

1. Break off both tip ends of the detector tube;
2. Insert the detector tube tightly into the hand pump (aspirator) with the flow direction arrow pointing toward the pump;
3. Completely depress the bellows;
4. Release the bellows to allow sucking air through the tube. One stroke takes 60-70 seconds. Repeat **eleven times more (total – 12 strokes for the tube with scale 0.1-1.0 ppm.)**.
5. Flush the pump with air after operation.

If hydrogen phosphide (phosphine) is detected, evacuate the area and ventilate. The trained representative of the Master should locate the origin of the leak by using appropriate gas detection device and respiratory protection equipment and when found, seal off the source of the leak.

Fumigator-in-charge



The Master :



Port: "NIKOLAEV"M/V: "ARKLOW MEADOW"Date: "20" **NOVEMBER, 2012**Flag: "IRELAND"

STATEMENT OF HAND OVER RESPONSIBILITY
FOR MAINTAINING SAFE CONDITIONS

It is to certify that the in-transit fumigation procedure carried out by the Fumigator at loading port is in conformity with IMO Recommendations on the Safe Use of Pesticides in Ships (IMDG Code Supplement 2008 Edition), the fumigant manufacturer's instructions, local phytosanitary requirements and contractual obligations.

It is also certified that the Fumigator together with assigned crew representatives has checked the working spaces and spaces adjacent to treated cargo holds for gas presence and found them free of harmful concentration of gas.

It is understood that due to local regulations in Ukrainian ports the vessel should sail within 2 hours following the fumigant application procedure and the gas in cargo holds have not reached sufficiently high concentrations to detect any possible leakages.

By signing this Statement the Fumigator has handed over and the Master has accepted the responsibility for maintaining safe conditions during in-transit fumigation on board the above named vessel including but not limited to the actions related to:

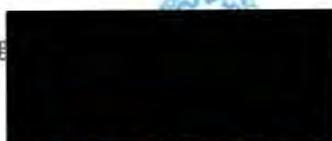
- Regular safety rounds for detection of possible gas leakages as instructed by the Fumigator;
- Keeping record on safety checks findings in the Fumigation Safety Log and ship's log-book;
- Evacuating people, ventilating area, finding cause of leakage and sealing it if phosphine is detected;
- Starting ventilation the cargo holds prior to arrival at destination as instructed by the Fumigator;
- Ensuring that the cargo has been correctly ventilated prior to allowing discharging operations to begin.

According to IMO Recommendations (IMDG Code Supplement 2008 Edition p. 3.3.2.16) not later than 24 hours prior to the arrival at destination the Master is requested to inform the appropriate authorities of the port of discharge that fumigation in transit is being carried out providing the following information:

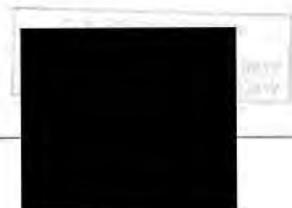
- Holds under fumigation;
- Type of fumigant and dosage;
- Method of application;
- Date of fumigant application;
- Exposure time (in days or hours);
- Ventilation time (in days or hours).

Upon arrival at the port of discharge the Master is also requested to provide the fumigant label and instructions on disposal of residual fumigation material to the local Authorities.

Fumigator-in-charge



The Master :





Port: " NIKOLAEV "

M/V: " ARKLOW MEADOW "

Date: " 20 " **NOVEMBER, 2012**

Flag: " IRELAND "

FUMIGATION SAFETY LOG

The Master is hereby requested to carry out the fumigation safety checks at all appropriate locations and times and fill in the below tables copying same to the ship's log-book while under fumigation and venting.

Fumigation	Day 1								
	01 hour	02 hours	04 hours	06 hours	08 hours	12 hours	16 hours	20 hours	24 hours
Engine Ops Room									
Engine Room									
Bilges/Bulk head									
Mess Room									
Bridge									
Living Area									
AC Intake									
Forecastle									

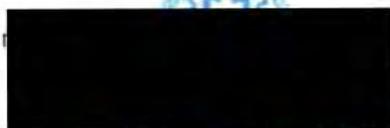
Fumigation	Day 2						Day 3		
	28 hours	32 hours	36 hours	40 hours	44 hours	48 hours	56 hours	64 hours	72 hours
Engine Ops Room									
Engine Room									
Bilges/Bulk head									
Mess Room									
Bridge									
Living Area									
AC Intake									
Forecastle									

Fumigation safety checks following the day 3 of the exposure time should be made at 8 hour intervals and findings entered into ship's log-book. Upon ventilation start the below table should be complete.

Ventilation	Day 1			Day 2			Day 3		
	01 hours	08 hours	16 hours	24 hours	32 hours	40 hours	48 hours	56 hours	64 hours
Engine Ops Room									
Engine Room									
Bilges/Bulk head									
Mess Room									
Bridge									
Living Area									
AC Intake									
Forecastle									

Please fax or e-mail these records to PRO-TEC LTD

Fumigator-in-charge



The Master :





Port: " NIKOLAEV "

M/V: " ARKLOW MEADOW "

Date: " 20 " **NOVEMBER, 2012**

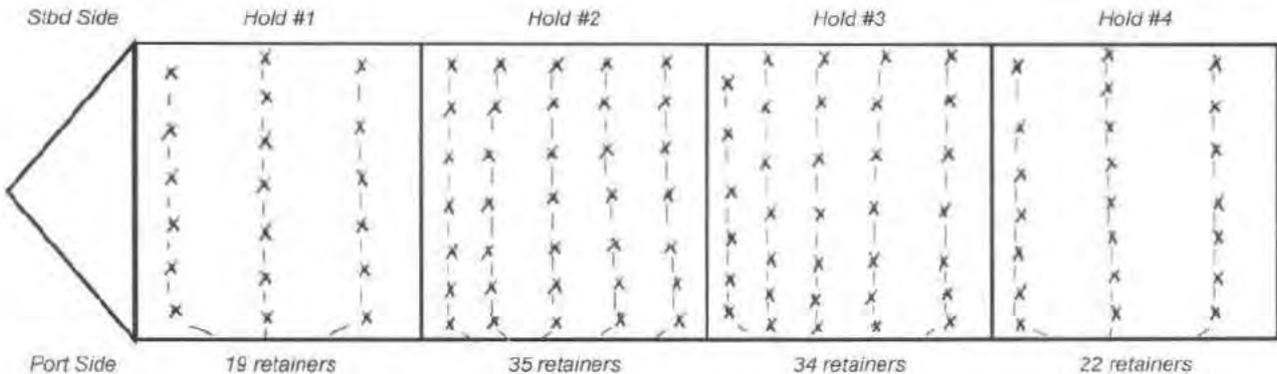
Flag: " IRELAND "

FUMIGANT DOSAGE AND QUANTITY

Hold #	Volume, m ³	AIP dosage, g/m ³	AIP used, kg	Retainers QTT, pcs	Average per one retainer, kg
1	3,132	4.5	14.25	28	0.75
2	5,762	4.5	26.25	52	0.75
3	5,628	4.5	25.50	50	0.75
4	3,587	4.5	16.50	32	0.75
Total:	18,110	-	82.5	110	-

RETAINERS PLAN

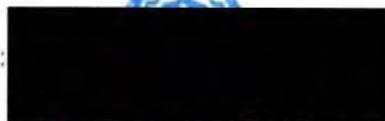
(View from above)



Remarks: All retainers are connected with polypropylene lines secured at aft corner of each cargo hold on **port / starboard** side.

ATTENTION! Retainers should NOT be removed from the cargo holds without the prior permission of the cargo Receiver.

Fumigator-in-charge:



The Master :



Atmospheric Gas Test Certificate



Fumigation Safety Precautions

Top Working or Inspection
From
Outside of Space

Atmospheric Test Report

Atmospheric Gas Test Certificate

ARKLOW MEADOW
Arklow
IMO SPARS 277
Off No: 404070
GRT 9882-KW 5400

Issue No: 001



Fumigation Safety Precautions	Atmospheric Test Report	Atmospheric Gas Test Certificate: No 001
Ship Name: ARKLOW MEADOW	IMO No: 404070 966017	Flag State 1A15A
Container Type: N/A	No: N/A	Working / Inspection from Outside of Space

Shipper, Agent or Contractors' Name: Samuel Stewart & Co Ltd
 Address: The Docks Warrenpoint Newry Co Down BT34 3JR
 Work Site Address: Warrenpoint Bulk Discharge Berth
 Exact Location of Work: Cargo Holds No 1 - No 2 - No 3 - No 4,
 Type of Entry: Accommodation, Engine room, Open Deck, Cargo Space Entry, Tanks, Container Space Entry

Fumigation History

Application		Aeration	
Load Port	NKATERA UKRAINE	Discharge Port	WARRENPOINT
Certificate	PT12 NK018	Method	Fan Assist and Natural
Fumigation Type	Aluminium phosphide (Rd Tablets)	Atmosphere Temperature	5°C
Date	20 th November 2012	Date	4/5 th December 2012

The readings obtained at the time of the test are indicated as follows and are valid at the time of issue

Parameters of Alarm Settings

Oxygen (O ₂)	Explosive (CH ₄)	Toxic Gas (Hydrogen Sulphide) H ₂ S	Fumigant Gas Phosphine
High 23.50 %	LEL High 40.00%	High 50.00 PPM	High 0.10 to 1.0 PPM
Low 19.00 %	LEL Low 20.00%	Low 5.00 PPM	Low 0.01 to 0.3 PPM

Record of Periodic Atmospheric Test Readings

Time	Date	Oxygen %	Explosive%	Toxic PPM	Fumigant
08:25	STABLE	20.8 %O ₂	0.0 % LEL	0.0 PPM	0.0 - 0.2 PPM
		%O ₂	% LEL	PPM	PPM
		%O ₂	% LEL	PPM	PPM
		%O ₂	% LEL	PPM	PPM

The Above Test Was Personally Tested By Me: [Redacted] (Print Name)

Authorised Signature: [Redacted] Date: 5th Dec 2012

Instrument Details

Make: Crowcon Model: Triple Plus + Serial No: 13672

Calibration Details: Factory Set Expiry Date: 28th May 2013

Drager Tube Details

Batch: DD-0541 No: 8101611 Expiry Date: November 2014



General information on aluminium phosphide issued by the Health Protection Agency



Aluminium Phosphide

General information

Key Points

- Toxic by inhalation and ingestion
- Chemical classification: very toxic
- Inhalation causes irritation of the nose, mouth, throat and respiratory tract. Chest pains, cough, nausea, vomiting, diarrhoea, muscle pain and headache, dizziness and confusion may occur.
- Ingestion causes stomach pain, nausea, vomiting, diarrhoea, swelling of lips, mouth and throat. Chest tightness, cough, headache, dizziness, anxiety and restlessness may also occur
- Contact with skin may cause sweating and irritation
- Eye contact may cause irritation, lacrimation and increased sensitivity to light

Background

Aluminium phosphide is a yellow or dark grey crystalline solid that is non-flammable and has a garlic-like odour. On contact with water or air, aluminium phosphide releases phosphine gas, hence it is used as a fumigant to control rodents, and an insecticide for agricultural crops. Symptoms of phosphine poisoning are non-specific and include irritation of the respiratory tract, headaches, dizziness, abdominal pain, sickness, and vomiting.



It can also be used to make semiconductor materials such as light emitting diodes when combined with other chemicals.



Exposure to aluminium phosphide occurs primarily in an occupational setting, either during its manufacture or its application as a fumigant or insecticide. Because it rapidly degrades under most environmental conditions and residual levels in foodstuffs are minimal, it is unlikely that the general population will be exposed to sufficient levels to cause harmful effects.

If exposed to aluminium phosphide, the potential adverse health effects that may occur depend on the way people are

exposed and the amount they are exposed to. In most cases, the toxic effects are largely caused by phosphine gas rather than aluminium phosphide itself.

Breathing phosphine can cause irritation of the nose, mouth, throat and lungs; headaches, dizziness, stomach pain, sickness and vomiting. Severe phosphine poisoning can cause convulsions, damage to the lungs, heart, liver and kidney and death. Eating aluminium phosphide can cause stomach pain, nausea, vomiting, diarrhoea, swelling of lips, mouth and throat. Contact with the skin may cause sweating and irritation and eye contact may cause irritation, watering eyes and increased sensitivity to light.

Children exposed to aluminium phosphide are expected to have the same symptoms of poisoning as adults. There are no data on the effects of aluminium phosphide on the unborn child but phosphine is not likely to cause harm.

Aluminium phosphide and phosphine are not thought to cause cancer in humans.

Frequently Asked Questions

What is aluminium phosphide?

Aluminium phosphide is a yellow or dark grey crystalline solid that is non-flammable and has a garlic-like odour.

What is aluminium phosphide used for?

Aluminium phosphide is used as a fumigant to control rodents and an insecticide for agricultural crops. It can also be used to make semi-conductor materials such as light emitting diodes when combining it with other chemicals.

How does aluminium phosphide get into the environment?

Exposure to aluminium phosphide occurs primarily in an occupational setting, either during its manufacture or its application as a fumigant or insecticide.

How will I be exposed to aluminium phosphide?

Exposure to aluminium phosphide occurs primarily in an occupational setting either during its manufacture or use as a fumigant. It degrades rapidly in the environment under most environmental conditions and residual levels in foodstuffs are minimal. As a result, it is very unlikely that the general population will be exposed to sufficient levels of aluminium phosphide to cause harmful effects.

If there is aluminium phosphide in the environment will I have any adverse health effects?

The presence of aluminium phosphide in the environment does not always lead to exposure. Clearly, in order for it to cause any adverse health effects you must come into contact with it. You may be exposed by breathing or drinking the substance, or by skin contact. Following exposure to any chemical, the adverse health effects you may encounter depend on several factors, including the amount to which you are exposed (dose), the way you are exposed, the duration of exposure, the form of the chemical and if you were exposed to any other chemicals.

In most cases, the toxic effects are largely caused by phosphine gas rather than aluminium phosphide itself. Breathing phosphine can cause irritation of the nose, mouth, throat and lungs; headaches, dizziness, stomach pain, sickness and vomiting. Severe phosphine poisoning can cause convulsions, damage to the lungs, heart, liver and kidney, and death. Eating aluminium phosphide can cause stomach pain, nausea, vomiting, diarrhoea, swelling of lips, mouth and throat. Contact with the skin may cause sweating and irritation and eye contact may cause irritation, watering eyes and increased sensitivity to light.

Can aluminium phosphide cause cancer?

Aluminium phosphide and phosphine are not thought to cause cancer in humans,

Does aluminium phosphide affect children or damage the unborn child?

Children exposed to aluminium phosphide are expected to have the same symptoms of poisoning as adults. There are no data on the effects of aluminium phosphide on the unborn child but phosphine is not likely to cause harm.

What should I do if I am exposed to aluminium phosphide?

You should remove yourself from the source of exposure.

If you have got aluminium phosphide on your skin, remove soiled clothing, wash the affected area with lukewarm water and soap for at least 10-15 minutes and seek medical advice.

If you have got aluminium phosphide in your eyes remove contact lenses if necessary, wash the affected area with lukewarm water for at least 10 – 15 minutes and seek medical advice.

If you have inhaled or ingested aluminium phosphide seek medical advice.

This document will be reviewed not later than 3 years or sooner if substantive evidence becomes available.

General information on phosphine issued by the Health Protection Agency



Phosphine

General information

Key Points

Fire

- Gas, extremely flammable and spontaneously flammable in air
- Reacts violently with air, oxygen, halogens and other oxidants causing fire and is an explosion hazard
- Decomposes on heating or burning, releasing toxic phosphorus oxides fumes
- In the event of a fire involving phosphine, use fine water spray and liquid-tight chemical protective clothing and breathing apparatus

Health

- Extremely flammable
- Very toxic by inhalation; symptoms usually occur within a few hours of exposure
- Phosphine is irritating to the mucous membranes of the nose, mouth, throat and respiratory tract
- Inhalation may result in weakness, chest tightness and pain, dry mouth, cough, sickness, vomiting, diarrhoea, chills, muscle pain, headache, dizziness, ataxia, confusion and lung damage. These symptoms may develop 2-3 days after exposure
- Severe poisoning may result in increased heart rate, low blood pressure, convulsions, coma, heart damage and death. These symptoms usually within 4 days but may be delayed up to 1-2 weeks
- Exposure to the eyes or skin may cause irritation
- Long-term exposure may cause anaemia, bronchitis, gastrointestinal disorders, speech and motor problems, toothache, weakness, weight loss, swelling and damage of the jaw bone and spontaneous fractures
- Phosphine has not been associated with cancer
- Phosphine is not likely to cause reproductive or developmental effects

Environment

- Dangerous for the Environment
- Inform Environment Agency of substantial release incidents

Background

Phosphine is a colourless gas, which is slightly heavier than air. It usually smells of garlic or rotting fish due to the presence of contaminants but pure phosphine is odourless. Phosphine is extremely flammable and highly reactive with air, copper and copper-containing alloys.

Phosphine is rarely found in nature. Small amounts can be formed during the breakdown of organic matter, although it is rapidly degraded.

Phosphine is released into the air via emissions from various manufacturing processes and from the use of metal (magnesium, aluminium and zinc) phosphide fumigants and pesticides, which release phosphine on contact with water or acid.

The major uses of phosphine are as a fumigant during the storage of agricultural products such as nuts, seeds, grains, coffee and tobacco, and in the manufacture of semi-conductors. Phosphine is also used in the production of some chemicals and metal alloys and is an unintentional by-product in the illegal manufacture of the drug methamphetamine.



Phosphine is rapidly broken down in the environment and it is very unlikely that the general population will be exposed to sufficient levels of phosphine to cause health effects. However, people may be exposed to very small amounts of phosphine present in air, food and water.

Workers employed as fumigators, pest-control operators, transport workers and those involved in the production or use of phosphine and metal phosphides (welding, metallurgy, semi-conductors), may be

exposed to higher levels of phosphine, although occupational incidents involving exposure to phosphine are rare, and safety levels are in place to protect employees.



Inhalation is the most likely route of exposure to phosphine, although ingestion of metal phosphides may also occur. Symptoms are non-specific and include irritation of the respiratory tract, headaches, dizziness, abdominal pain, sickness, and vomiting. Severe phosphine poisoning can cause convulsions, damage to the lungs, heart, liver and kidney, and death. Long-lasting effects of single dose exposure are unlikely, most symptoms clearing within a month.

Long-term exposure to phosphine, while unlikely to occur, can cause bronchitis, gastrointestinal, visual, speech and motor problems, toothache, swelling of the jaw, anaemia and spontaneous fractures.

Children exposed to phosphine will have the same symptoms of poisoning as adults.

Phosphine is not likely to cause harm to the unborn child as acute effects are not known to cause developmental effects.

Phosphine has not been associated with cancer and has not been reviewed by the International Agency for Research on Cancer.

Production and Uses

Key Points

- Phosphine is present in emissions from some industrial processes such as the manufacture of some chemicals and metal alloys
- Phosphine is used as a chemical dopant, fumigant and as a rodenticide (in the form of metal phosphides) and as a catalyst and in the production of polymers

The main uses of phosphine are as a chemical dopant in the manufacture of semi-conductors for the electronics industry, and in the fumigation (in the form of metal phosphides) of stored agricultural products such as cereal grains and tobacco. Phosphine is also used as a condensation catalyst and in the manufacture of some polymers. Zinc phosphide is used as a rodenticide in the form of a pellet or as a paste mixed with food.

Small amounts of phosphine are produced in the production of chemicals such as phosphonium halide and acetylene gas.

Frequently Asked Questions

What is phosphine?

Phosphine is a colourless gas which is highly flammable and explosive in air. Pure phosphine is odourless, although most commercially available grades have the odour of garlic or decaying fish. Small amounts of phosphine can occur naturally, formed during the anaerobic degradation of organic matter. Phosphine is corrosive towards metals, in particular copper and copper-containing alloys.

What is phosphine used for?

A major use of phosphine is as a semi-conductor doping agent by the electronics industry. Metal (aluminium, magnesium and zinc) phosphides, which release phosphine on contact with moisture and acid, are used as rodenticides and fumigates during storage of agricultural commodities such as grain e.g. cereals, and tobacco. Phosphine is also used as a catalyst and in the production of polymers.

How does phosphine get into the environment?

Small amounts of phosphine occur naturally during the decomposition of phosphorous-containing organic matter e.g. in marsh gas. Emissions and effluents from the manufacture of some chemicals and metal alloys, as well the production or use of phosphine and metal phosphides (welding, metallurgy, semi-conductors, rodenticides and fumigants), release phosphine into the air.

How will I be exposed to phosphine?

It is unlikely that the general population will be exposed to significant amounts of phosphine, since it is degraded quickly in the environment; the half-life of phosphine in the air is about one day or less. However, people may be exposed to very small amounts by inhaling air, drinking water and eating food containing phosphine. Workers involved with industries and processes where phosphine is used, e.g. fumigation and pest control, may be exposed to higher levels of phosphine. People living nearby sites where phosphine is being used may also be exposed to small amounts of phosphine in the air. Phosphine gas does not present a risk of secondary contamination, although solid phosphides may pose some risk. Absorption through the skin is not considered a significant route of exposure.

If there is phosphine in the environment will I have any adverse health effects?

The presence of phosphine in the environment does not always lead to exposure. Clearly, in order for phosphine to cause any adverse health effects you must come into contact with it. You may be exposed by breathing, eating, or drinking the substance or by skin contact. Following exposure to any chemical, the adverse health effects you may encounter depend on several factors, including the amount to which you are exposed (dose), the way you are exposed, the duration of exposure, the form of the chemical and if you are exposed to any other chemicals.

Exposure to phosphine or metal phosphides can be irritating to the respiratory tract and can cause weakness, chest pain and tightness, dry mouth, cough, sickness, vomiting, diarrhoea, chills, muscle pain, headache, dizziness, ataxia and confusion. Severe cases may lead to lung damage, convulsions, damage to the heart, liver and kidney, and death.

Long-term exposure to low levels of phosphine can cause anaemia, bronchitis, gastrointestinal problems, visual, speech and motor problems, toothache, swelling of the jaw and spontaneous fractures.

Can phosphine cause cancer?

The Governmental Committee on Mutagenicity recently reviewed the available data on carcinogenicity of phosphine and concluded that it did not cause cancer in animal studies.

Phosphine has not been reviewed by the International Agency for Research on Cancer (IARC), and the US Environmental Protection Agency (US EPA) considers phosphine as not classifiable as to human carcinogenicity, due to inadequate animal studies and a lack of human tumour data.

Does phosphine affect children or damage the unborn child?

Children who ingest metal phosphides or inhale phosphine gas are expected to have similar symptoms as adults, e.g. sickness, vomiting, headache, dizziness, in severe cases leading to damage to the lungs, heart, liver and kidney and death.

There is no evidence to suggest that maternal exposure to phosphine affects the health of the unborn child.

What should I do if I am exposed to phosphine?

It is very unlikely that the general population will be exposed to a level of phosphine high enough to cause adverse health effects.

This document from the HPA Centre for Radiation, Chemical and Environmental Hazards reflects understanding and evaluation of the current scientific evidence as presented and referenced in this document.

Food and Environment Research Agency report on the excessive quantities of residual aluminium phosphide following the fumigation of maize cargo on board *Arklow Meadow*

A report on excessive quantities of residual aluminium phosphide following the fumigation of maize in the holds of a vessel from the Ukraine

[REDACTED]

FOOD AND ENVIRONMENT RESEARCH AGENCY

Food and Environmental Safety Program

Study Number: W5ZS

Author: [REDACTED]

Testing Facility: Processing Contaminants Team
Food and Environment Research
Agency
Sand Hutton, York
North Yorkshire
YO41 1LZ
United Kingdom

Sponsor: Marine Accident Investigation Branch
Mountbatten House
Grosvenor Square
Southampton
SO15 2JU

Period of investigation: Study Initiation: February 2013
Study Completion: March 2013

Date of issue of report: March 2013

Number of pages in report:

CONTRACT REPORT

A report on excessive quantities of residual aluminium phosphide following the fumigation of maize in the holds of a vessel from the Ukraine.

A report on excessive quantities of residual aluminium phosphide following the fumigation of maize in the holds of a vessel from the Ukraine

██████████.

CONFIDENTIALITY

The Food and Environment Research Agency (Fera) will not publish this report, either wholly or in part, or review or quote it in any publication without the prior authorisation of the sponsor.

DISTRIBUTION OF REPORT

1. Marine Accident Investigation Branch (as unsigned PDF file).
2. Account Manager.



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1. Executive Summary

Following an in-transit fumigation of maize, 110 socks containing phosphine producing fumigation tablets were removed from the holds of a ship. Some were initially placed onto the deck which was wet due to rain, where they began to smoke. They were then moved to a dry platform where they stopped smoking. The socks were collected and placed into a bag which began to smoke heavily causing the vessel to be evacuated.

The tablets contain aluminium phosphide which reacts with moisture in the air to produce phosphine gas which burns when its concentration exceeds its lower flammable limit of 1.8% in air. The smoke generated by the socks on the deck and in the bag indicates the presence of large quantities of residual aluminium phosphide in the socks which produced sufficient phosphine to exceed 1.8% on the wet deck. This suggests that the formulation had not completely broken down.

Three factors have been identified which could have caused a slower than usual release of phosphine resulting in large quantities of residual aluminium phosphide:

1. Too much product contained in socks of low volume. This makes it difficult for water vapour present in the air to penetrate to the centre of the sock.
2. Unusually dry commodity causing low relative humidity.
3. Low temperature in maize slowing the production of phosphine.

It is not possible to determine which the most important factor was in this case. However, the available evidence suggests that both 1 and 2 were significant.

A total of eight persons were sent to hospital for suspected inhalation/exposure to phosphine gas. It is not possible to determine whether this exposure was due to phosphine generated from the residual aluminium phosphide or from the phosphine generated in-transit.

2. Full Report

It is common practice to fumigate stored products in ships holds during transit. This is usually done using formulations containing phosphides of metallic elements which react with moisture in the air to produce phosphine. Both phosphine and the phosphine producing formulations are toxic and should be handled by trained personnel.

In the Ukraine, 13,277 MT of maize had been loaded into the four holds of a general cargo vessel. Prior to loading, a recirculation system consisting of hoses and fans was fitted to each of the holds (Figure 1). The temperature of the maize on loading was 10°C and the maize had a middle moisture content of 11.5%. In the sealed hold the moisture content of the maize will be at equilibrium with the moisture in the surrounding air. This means that at 10°C, the relative humidity (r.h.) of the air in the hold will be between 45 and 50% (Pixton and Warburton, 1970). In the UK it is recommended that cereals are stored at 14.5% moisture content (HGCA 2011). At

equilibrium this will give rise to a significantly higher r.h. of 62 to 66% depending on temperature and commodity.



Figure 1 – hose fitted to the holds

A total of 110 socks containing Aluminium Phosphide fumigation tablets each weighing 0.75kg were placed on the top of the cargo (See Figures 2 & 3). The hatches were then closed and sealed for the voyage. The recirculation fans were then switched on and remained on for 72 hours. Figure 2 shows a sock measuring approximately 16 inches in length. The Aluminium Phosphide tablets each weighed 3g; therefore each sock contained approximately 250 tablets. The sock shown in figure 2 is rounded and over-full. This makes it less likely that water vapour will penetrate to the centre of the sock. The sock should lie flat so that there are only a few layers of tablets. This can be achieved using longer socks or a greater number of socks.



Figure 2 - A fumigant retainer (Sock).

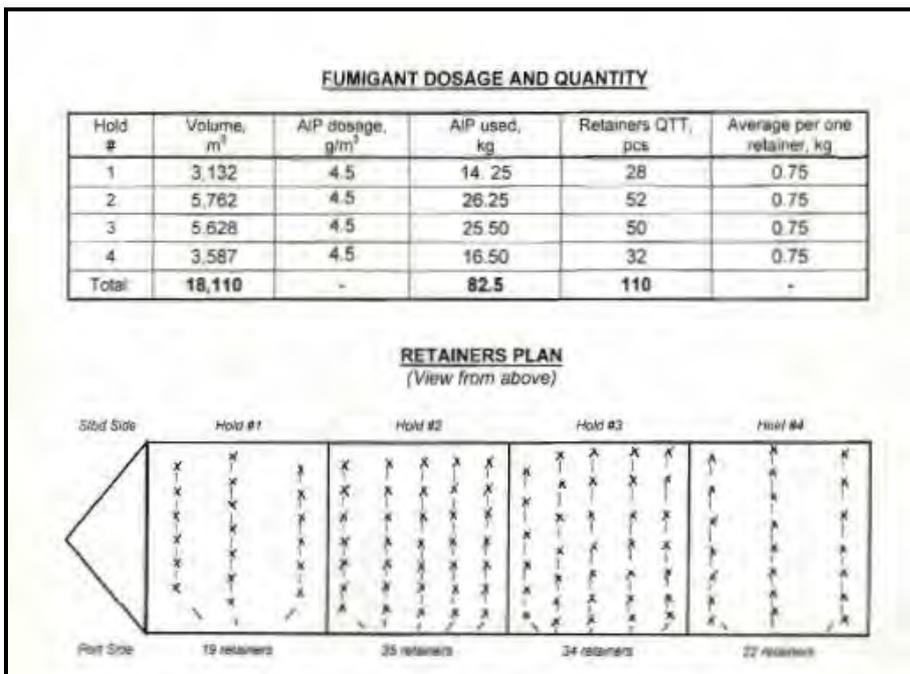


Figure 3: Plan showing position of the socks

The certificate of quality for the fumigant tablets is shown in Figure 4; this was provided by the fumigator in the Ukraine. Figure 3 shows that 82.5 kg of tablets were used and the certificate shows that each tablet weighs 3 g. This means that 27,500 tablets were used. Each tablet is designed to produce 1 g of phosphine so if all the tablets had been spent a total of 27.5 kg of phosphine would have been liberated. This would give rise to a concentration of 1060 ppm in the hold which had a total volume of 18,109 m³.

CERTIFICATE OF QUALITY

Product: Gin tablets
 Active substance: Aluminium Phosphide, 560 g/kg
 Date: 10.02.2012
 Part number: 20120210

	Standard	Test results
Contents (%)	≥ 56.0	56.6
Tablet weight, (g)	3.0 +/- 0.1	3.00
Appearance	Yellow-green tablets	Yellow-green tablets
Density, (kg)	≥ 7.0	9.2
Tablet particles (dust)	max 1.5%	0.4%

This is to confirm the above mentioned information authenticity.

Person in charge _____ Sign & stamp _____

Figure 4: Fumigant CQQ

After the initial 72 hours, the recirculation fans were switched on from 0800 until 1600 each day for the remainder of the 13 day voyage. The exposure time for the fumigant was quoted in the accompanying documentation (Figure 5).

Total amount of residue retaining sleeves is	110
Required minimum exposure time is	168 hours
The fumigated cargo is destined for	Ireland
The estimated voyage time to destination is	7 days

Figure 5: Exposure time

The temperatures encountered during the vessel’s voyage are given in Appendix A. The initial temperature of the bulk of 10°C will not have altered significantly due to changing ambient conditions during the 13 day voyage due to the specific heat capacity of the maize. The action of the recirculation pump may have introduced a small amount of heat to the bulk but this is unlikely to have been significant.

It is not recommended that phosphine fumigation is undertaken below 10°C. However, this is for reasons of efficacy rather than the effect of temperature on the reaction between aluminium phosphide and atmospheric moisture.

The holds were first opened when the vessel arrived off the discharge port within the UK. The initial readings of phosphine concentration were 0.7ppm and so the holds were vented for an hour until the levels were reading 0.2 ppm or lower. The hatches were then closed due to rain. A certificate was issued permitting the working of the holds from outside the space and the vessel berthed. The initial reading of 0.7 ppm is surprisingly low and unlikely to be accurate given the amount of phosphine found in the hold later on.

About 5 hours later, the hatches were again opened and cargo discharge commenced. Shortly after the start of discharge, a member of the ship's crew removed the socks from two of the holds. These were initially placed onto the deck, where they began to smoke. The crew member moved the socks to a dry platform and they stopped smoking. Some socks were inadvertently discharged directly from the hold into a shore side hopper. Later, these were spotted and removed. At this time, the crew were instructed to place the socks stowed on the platforms into a bag. The bag then began to smoke heavily causing the vessel to be evacuated. A total of eight persons were sent to hospital for suspected inhalation/exposure to phosphine gas.

Following the incident, a commercial fumigator vented the holds. Table 1 below shows the readings that he obtained:

Phosphine (ppm)	Hold 1	Hold 2	Hold 3	Hold 4
Highest Day 1	122	270	150	153
Lowest Day 1	77	174	145	132
Highest Day 3	100	220	176	Gas Free
Lowest Day 3	2	15	76	Gas Free
Highest Day 4	Gas Free	Gas Free	110	
Lowest Day 4	Gas Free	Gas Free	58	
Highest Day 5			Gas Free	
Lowest Day 5			Gas Free	

Table 1: Hold readings

As stated above, the holds were initially vented for an hour. This was not long enough as demonstrated by the data supplied by the commercial fumigator. Although the level of phosphine in the free space above the maize will have dropped quite quickly to give readings of 0.2 ppm or less, the levels lower down in the hold would still have been dangerously high. During venting by the commercial fumigator there was still dangerous levels of gas present after three days of venting.

After venting for an hour the hatches were closed for five hours because of rain. In those five hours the concentration of phosphine in the free space is likely to have increased to potentially dangerous levels from two sources:

1. phosphine from within the bulk could have diffused into the free space and
2. phosphine may have been generated from residual aluminium phosphide following the introduction of humid ambient air during venting.

After discharge had begun a member of the crew removed the fumigant retainers from two of the holds. If this crew member entered the hold it is to be hoped that the atmosphere in the hold was checked for the presence of phosphine or that he wore breathing apparatus.

If all the aluminium phosphide had reacted to form phosphine a concentration of 1060ppm would have been established. Much of the phosphine would have been lost during venting and discharging. When the fumigator arrived he found 270 ppm of phosphine still present in one of the holds which is a significant fraction of the theoretical concentration. That so much phosphine was still present when the fumigator arrived indicates that some of the aluminium phosphide must have broken down to produce phosphine.

However, the fumigant was still very active despite an exposure time of 13 days as shown by the smoke produced when the socks were placed on the wet deck. Phosphine burns when its concentration exceeds its lower flammable limit of 1.8% volume by volume in air. Therefore there must have been a significant amount of aluminium phosphide left when the socks were removed because of the amount of phosphine liberated on deck.

Unfortunately it is not possible to estimate how much aluminium phosphide had reacted to form phosphine and how much remained at the end of the voyage on available information.

The socks that had been removed and discharged from the hold were collected and placed in a bag. Even if the tablets had behaved normally there would be some residual aluminium phosphide at the end of the fumigation and so placing large quantities of spent phosphine producing formulations in a limited space is a dangerous practice as concentrations above 1.8% may be achieved. This is more likely to be the case if they are wet. Given that there was enough residual aluminium phosphide to cause the socks to smoke on an open deck it is not surprising that the concentration in the bag rose to spontaneously flammable levels causing smoke and the evacuation of the ship.

Three factors have been identified which could have resulted in the slow release of phosphine resulting in large quantities of residual aluminium phosphide:

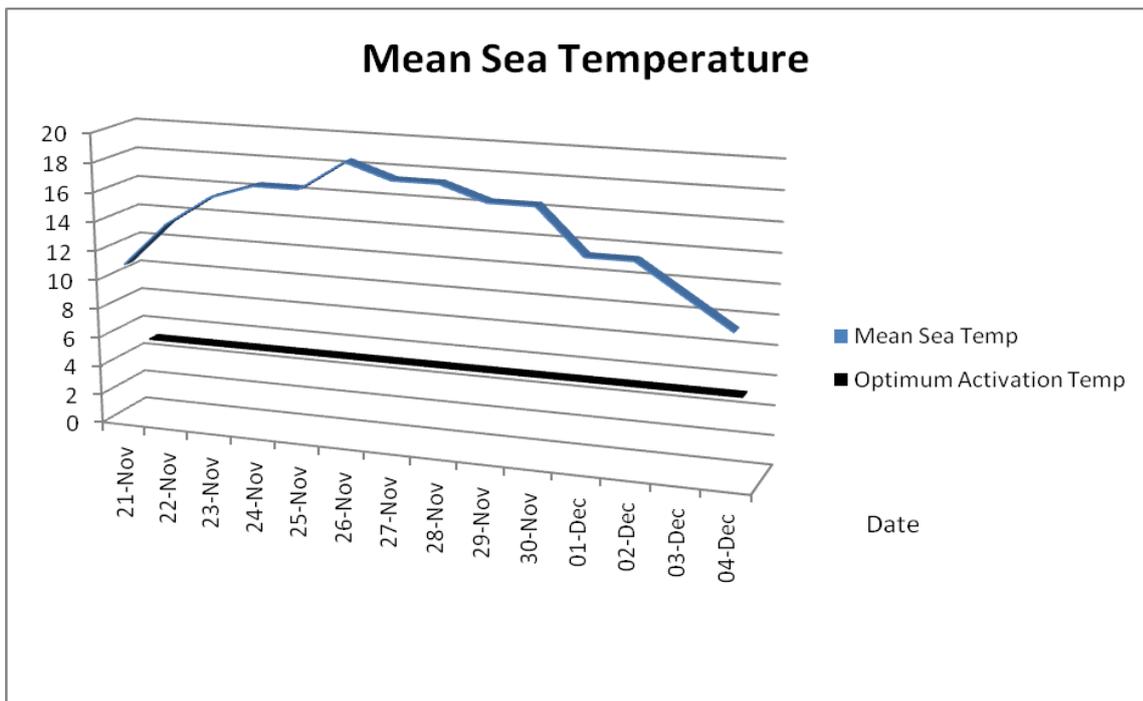
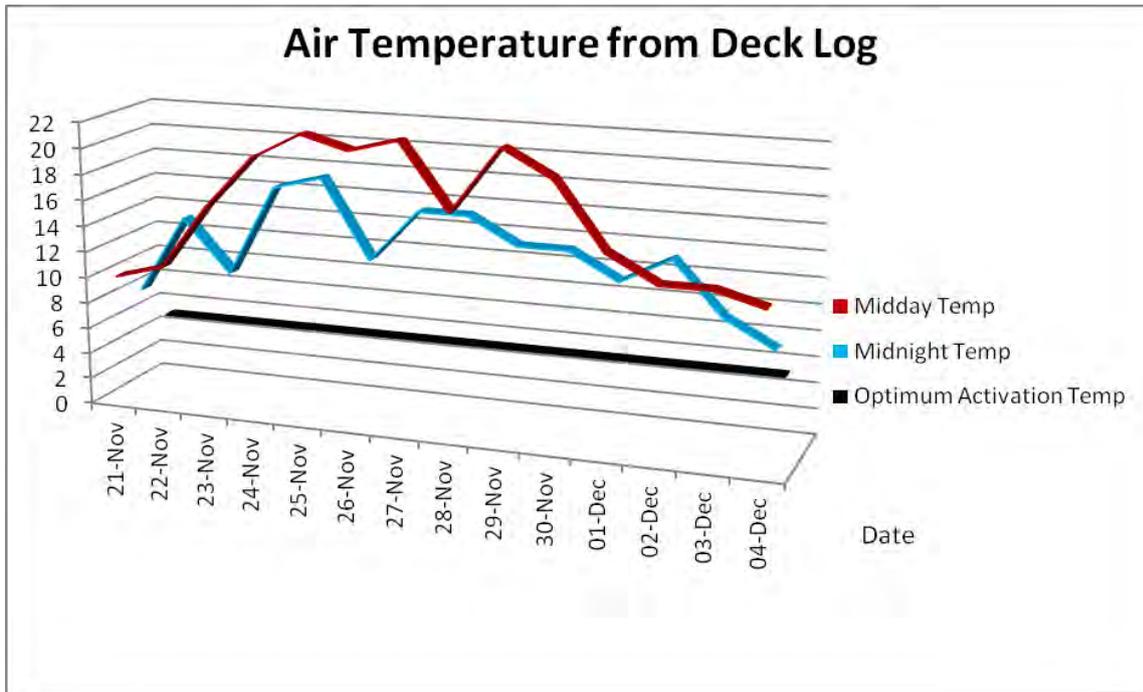
1. Too much product contained in socks of low volume. This makes it difficult for the water vapour present in the air to penetrate to the centre of the sock.
2. Unusually dry commodity causing low relative humidity.
3. Possibility of low temperature in maize slowing the production of phosphine.

It is not possible to determine which the most important factor was in this case. However, the available evidence suggests that both 1 and 2 were significant. As the temperature was only 10°C, it is possible that 3 was a contributing factor.

A total of eight persons were sent to hospital for suspected inhalation/exposure to phosphine gas. It is not possible to determine whether this exposure was due to

phosphine generated from the residual aluminium phosphide or from the phosphine generated in-transit.

Appendix A



3. References

Pixton and Warburton (1971). Moisture Content/Relative Humidity Equilibrium of some cereal grains at different temperatures. *J. Stored Prod. Res.*, Vol 6, pp. 283-293.

HGCA (2011). Grain storage guide for cereals and oilseeds, 3rd edition, Home-Grown Cereals Authority, Stoneleigh.

IMO MSC.1/Circ.1264 - Recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo holds



IMO

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Ref. T3/1.01

MSC.1/Circ.1264
27 May 2008

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

- 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 holds, which apply to carriage of solid bulk cargoes including grain in pursuance of the requirement of SOLAS regulation VI/4, proposed by the Sub-Committee on Dangerous Goods, Solid Cargoes and Containers at its twelfth session, 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 holds.

ANNEX

RECOMMENDATIONS ON THE SAFE USE OF PESTICIDES IN SHIPS APPLICABLE TO THE FUMIGATION OF CARGO HOLDS

1 INTRODUCTION

1.1 Insect and mite pests of plant and animal products may be carried into the cargo holds 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 phytosanitary 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 both raw and processed materials. Although fumigants may be used to kill rodent pests, the control of rodents on board ships is dealt with separately. In severe cases of infestation of bulk cargoes such as cereals, excessive heating may occur.

1.2 The following sections provide guidance to shipmasters in the use of pesticides* with a view to safety of personnel. They cover pesticides used for the control of insect** and rodent pests in empty and loaded cargo holds.

2 PREVENTION OF INFESTATION

2.1 Maintenance and sanitation

2.1.1 Ship cargo holds, tank top ceilings and other parts of the ship should be kept in a good state of repair to avoid infestation. Many ports of the world have rules and by-laws dealing specifically with the maintenance of ships intended to carry grain cargoes; for example, boards and ceilings should be completely grain-tight.

2.1.2 Cleanliness, or good housekeeping, is as important a means of controlling pests on a ship as it is in a home, warehouse, mill or factory. Since insect pests on ships become established and multiply in debris, much can be done to prevent their increase by simple, thorough cleaning. Box beams and stiffeners, for example, become filled with debris during discharge of cargo and unless kept clean can become a source of heavy infestation. It is important to remove thoroughly all cargo residue from deckhead frames and longitudinal deck girders at the time of discharge, preferably when the cargo level is suitable for convenient cleaning. Where available, industrial vacuum cleaners are of value for the cleaning of cargo holds and fittings.

2.1.3 The material collected during cleaning should be disposed of, or treated, immediately so that the insects cannot escape and spread to other parts of the ship or elsewhere. In port it may be burnt or treated with a pesticide, but in many countries such material may only be landed under phytosanitary supervision. If any part of the ship is being fumigated the material may be left exposed to the gas.

* The word *pesticide* as used throughout the text means fumigants. Examples of some commonly used pesticides are listed in appendix 1.

** The word *insect* as used throughout the text includes mites.

2.2 Main sites of infestation

2.2.1 *Tank top ceiling*: If, as often happens, cracks appear between the ceiling boards, food material may be forced down into the underlying space and serve as a focus of infestation for an indefinite period. Insects bred in this space can readily move out to attack food cargoes and establish their progeny in them.

2.2.2 *'Tween-deck centre lines, wooden feeders and bins* are often left in place for several voyages and because of their construction are a frequent source of infestation. After unloading a grain cargo, burlap and battens covering the narrow spaces between the planks should be removed and discarded before the holds are cleaned or washed down. These coverings should be replaced by new material in preparation for the next cargo.

2.2.3 *Transverse beams and longitudinal deck girders* which support the decks and hatch openings may have an L-shaped angle-bar construction. Such girders provide ledges where grain may lodge when bulk cargoes are unloaded. The ledges are often in inaccessible places overlooked during cleaning operations.

2.2.4 *Insulated bulkheads near engine-rooms*: When the hold side of an engine-room bulkhead is insulated with a wooden sheathing, the airspace and the cracks between the boards often become filled with grain and other material. Sometimes the airspace is filled with insulating material which may become heavily infested and serves as a place for insect breeding. Temporary wooden bulkheads also provide an ideal place for insect breeding, especially under moist conditions, such as when green lumber is used.

2.2.5 *Cargo battens*: The crevices at the sparring cleats are ideal places for material to lodge and for insects to hide.

2.2.6 *Bilges*: Insects in accumulations of food material are often found in these spaces.

2.2.7 *Electrical conduit casings*: Sometimes the sheet-metal covering is damaged by general cargo and when bulk grain is loaded later, the casings may become completely filled. This residual grain has often been found to be heavily infested. Casings that are damaged should be repaired immediately or, where possible, they should be replaced with steel strapping, which can be cleaned more easily.

2.2.8 Other places where material accumulates and where insects breed and hide include:

The area underneath burlap, which is used to cover limber boards and sometimes to cover tank top ceilings.

Boxing around pipes, especially if it is broken.

Corners, where old cereal material is often found.

Crevices at plate landings, frames and chocks.

Wooden coverings of manholes or wells leading to double-bottom tanks or other places.

Cracks in the wooden ceiling protecting the propeller shaft tunnel.

Beneath rusty scale and old paint on the inside of hull plates.

Shifting boards.

Dunnage material, empty bags and used separation cloths.

Inside lockers.

3 CHEMICAL CONTROL OF INSECT INFESTATION

3.1 Methods of chemical disinfection

3.1.1 *Types of pesticides and methods of insect control*

3.1.1.1 To avoid insect populations becoming firmly established in cargo holds and other parts of a ship, it is necessary to use some form of chemical toxicant for control. The materials available may be divided conveniently into two classes: contact insecticides and fumigants. The choice of agent and method of application depend on the type of commodity, the extent and location of the infestation, the importance and habits of the insects found, and the climatic and other conditions. Recommended treatments are altered or modified from time to time in accordance with new developments.

3.1.1.2 The success of chemical treatments does not lie wholly in the pesticidal activity of the agents used. In addition, an appreciation of the requirements and limitations of the different available methods is required. Crew members can carry out small-scale or “spot” treatments if they adhere to the manufacturer’s instructions and take care to cover the whole area of infestation. However, extensive or hazardous treatments including fumigation and spraying near human and animal food should be placed in the hands of professional operators, who should inform the master of the identity of the active ingredients used, the hazards involved and the precautions to be taken.

3.1.2 *Fumigants*

3.1.2.1 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 and concentration used, the pests, the commodities treated and the temperature. Additional information is provided on two of the most widely used fumigants, Methyl bromide and Phosphine, in appendix 1.

3.1.2.2 Since fumigant gases are poisonous to humans and require special equipment and skills in application, they should be used by specialists and not by the ship’s crew.

3.1.2.3 Evacuation of the space under gas treatment is mandatory and in some cases it will be necessary for the whole ship to be evacuated (see 3.3.1 and 3.3.2 below).

3.1.2.4 A “fumigator-in-charge” should be designated by the fumigation company, government agency or appropriate authority. He should be able to provide documentation to the master proving his competence and authorization. The master should be provided with written instructions by the fumigator-in-charge on the type of fumigant used, the hazards to human health 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. Such instructions should be written in a language readily understood by the master or his representative.

3.2 Disinfestation of empty cargo holds

3.2.1 An empty cargo hold may be fumigated. Examples of some commonly used pesticides are listed in appendix 1. (For precautions before, during and after fumigation of cargo holds see 3.3 below.)

3.3 Disinfestation of cargoes and surrounds

3.3.1 *Fumigation with aeration (ventilation) in port*

3.3.1.1 Fumigation and aeration (ventilation) of empty cargo holds should always be carried out in port (alongside or at anchorage). Ships should not be permitted to leave port until gas-free certification has been received from the fumigator-in-charge.

3.3.1.2 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. 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. A specimen of such a warning sign is given in appendix 2.

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

3.3.1.4 At the end of the fumigation period the fumigator will take the necessary action to ensure that the fumigant is dispersed. If crew members are required to assist in such actions, for example in opening hatches, they should be provided with adequate respiratory protection and adhere strictly to instructions given by the fumigator-in-charge.

3.3.1.5 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.

3.3.1.6 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, crew members should be evacuated from the area until measurements show re-occupancy to be safe.

3.3.1.7 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.

3.3.1.8 Clearance certificates should only be issued when tests show that all residual fumigant has been dispersed from empty cargo holds and adjacent working spaces and any residual fumigant material has been removed.

3.3.1.9 Entry into a space under fumigation should never take place except in the event of an extreme emergency. If entry is imperative the fumigator-in-charge and at least one other person should enter, each wearing 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.

3.3.1.10 If a clearance certificate cannot be issued after the fumigation of cargo in port, the provisions of 3.3.2 should apply.

3.3.2 *Fumigation continued in transit*

3.3.2.1 Fumigation in transit should only be carried out at the discretion of the master. This should be clearly understood by owners, charterers, and all other parties involved when considering the transport of cargoes that may be infested. Due consideration should be taken of this when assessing the options of fumigation. The master should be aware of the regulations of the flag State Administration with regard to in-transit fumigation. The application of the process should be with the agreement of the port State Administration. The process may be considered under two headings:

- .1 fumigation in which treatment is intentionally continued in a sealed space during a voyage and in which no aeration has taken place before sailing; and
- .2 in-port cargo fumigation where some aeration is carried out before sailing, but where a clearance certificate for the cargo hold(s) cannot be issued because of residual gas and the cargo hold(s) has been re-sealed before sailing.

3.3.2.2 Before a decision on sailing with a fumigated cargo hold(s) is made it should be taken into account that, due to operational conditions, the circumstances outlined in 3.3.2.1.2 may arise unintentionally, e.g., a ship may be required to sail at a time earlier than anticipated when the fumigation was started. In such circumstances the potential hazards may be as great as with a planned in-transit fumigation and all the precautions in the following paragraphs should be observed.

3.3.2.3 Before a decision is made as to whether a fumigation treatment planned to be commenced in port and continued at sea should be carried out, special precautions are necessary. These include the following:

- .1 at least two members of the crew (including one officer) who have received appropriate training (see 3.3.2.6) should be designated as the trained representatives of the master responsible for ensuring that safe conditions in accommodation, engine-room and other working spaces are maintained after the fumigator-in-charge has handed over that responsibility to the master (see 3.3.2.12); and
- .2 the trained representatives of the master should brief the crew before a fumigation takes place and satisfy the fumigator-in-charge that this has been done.

3.3.2.4 Empty cargo holds are to be inspected and/or tested for leakage with instruments so that proper sealing can be done before or after loading. The fumigator-in-charge, accompanied by a trained representative of the master or a competent person, should determine whether the cargo holds to be treated are or can be made sufficiently gastight to prevent leakage of the fumigant to the accommodation, engine-rooms and other working spaces in the ship. Special attention should be paid to potential problem areas such as bilge and cargo line systems. On completion of such inspection and/or test, the fumigator-in-charge should supply to the master for his retention a signed statement that the inspection and/or test has been performed, what provisions have been made and that the cargo holds are or can be made satisfactory for fumigation. Whenever a cargo

hold is found not to be sufficiently gastight, the fumigator-in-charge should issue a signed statement to the master and the other parties involved.

3.3.2.5 Accommodation, engine-rooms, areas designated for use in navigation of the ship, frequently visited working areas and stores, such as the forecastle head spaces, adjacent to cargo holds being subject to fumigation in transit should be treated in accordance with the provisions of 3.3.2.13. Special attention should be paid to gas concentration safety checks in problem areas referred to in 3.3.2.4.

3.3.2.6 The trained representatives of the master designated in 3.3.2.3 should be provided and be familiar with:

- .1 the information in the relevant Safety Data Sheet; and
- .2 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.

3.3.2.7 The ship should carry:

- .1 gas-detection equipment and adequate fresh supplies of service items for the fumigant(s) concerned as required by 3.3.2.12, together with instructions for its use and the occupational exposure limit values set by the flag State regulations for safe working conditions;
- .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.

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

3.3.2.9 If cargo holds are to be fumigated in transit:

- .1 After application of the fumigant, an initial check should be made by the fumigator-in-charge together with trained representatives of the master for any leak which, if detected, should be effectively sealed. When the master is satisfied that all precautions detailed in 3.3.2.1 to 3.3.2.12 have been fulfilled (refer to model checklist in appendix 3) then the vessel may sail. Otherwise, provisions outlined in 3.3.2.9.2 or 3.3.2.9.3 are to be followed.

If the provisions of 3.3.2.9.1 are not satisfied,

either:

.2 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. After ascertaining that the ship is in a safe condition to sail, i.e. no gas leakages are present, the fumigator-in-charge should furnish the master with a written statement that:

.2.1 the gas in the cargo hold(s) has reached sufficiently high concentrations to detect any possible leakages;

.2.2 spaces adjacent to the treated cargo hold(s) have been checked and found gas-free; and

.2.3 the ship's representative is fully conversant with the use of the gas-detection equipment provided.

or:

.3 After application of the fumigants and immediately after the sailing of the ship, the fumigator-in-charge should remain on board for such a period as to allow the gas in the fumigated cargo hold or spaces to reach sufficiently high concentrations to detect any possible leakage, or until the fumigated cargo is discharged (see 3.3.2.20), whichever is the shorter, to check and rectify any gas leakages. Prior to his leaving the ship, he should ascertain that the ship is in a safe condition, i.e. no gas leakages are present, and he should furnish the master with a written statement to the effect that the provisions of 3.3.2.9.2.1, 3.3.2.9.2.2 and 3.3.2.9.2.3 have been carried out.

3.3.2.10 On application of the fumigant, the fumigator-in-charge should post warning signs at all entrances to places notified to the master as in 3.3.2.8. These warning signs should indicate the identity of the fumigant and the date and time of fumigation. A specimen of such a warning sign is given in appendix 2.

3.3.2.11 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.

3.3.2.12 Upon discharging his agreed responsibilities, the fumigator-in-charge should formally hand over to the master in writing responsibility for maintaining safe conditions in all occupied spaces. The fumigator-in-charge should ensure that gas-detection and respiratory protection equipment carried on the ship is in good order, and that adequate fresh supplies of consumable items are available to allow sampling as required in 3.3.2.13.

3.3.2.13 Gas concentration safety checks at all appropriate locations, which should at least include the spaces indicated in 3.3.2.5, should be continued throughout the voyage at least at eight-hour intervals or more frequently if so advised by the fumigator-in-charge. These readings should be recorded in the ship's log-book.

3.3.2.14 Except in extreme emergency, cargo holds sealed for fumigation in transit should never be opened at sea or entered. If entry is imperative, at least two persons should enter, wearing adequate protection equipment and a safety harness and lifeline tended by a person outside the space, similarly equipped with protective, self-contained breathing apparatus.

3.3.2.15 If it is essential to ventilate a cargo hold or holds, every effort should be made to prevent a fumigant from accumulating in accommodation or working areas. Those spaces should be carefully checked to that effect. If the gas concentration in those areas at any time exceeds the occupational exposure limit values set by the flag State regulations, they should be evacuated and the cargo hold or cargo holds should be re-sealed. If a cargo hold is re-sealed after ventilation it should not be assumed that it is completely clear of gas and tests should be made and appropriate precautions taken before entering.

3.3.2.16 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, the cargo holds which have been fumigated, and whether ventilation has commenced. Upon arrival at the port of discharge, the master should also provide information as required in 3.3.2.6.2 and 3.3.2.7.2.

3.3.2.17 On arrival at the port of discharge the requirements of receiving countries regarding handling of fumigated cargoes should be established. 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. In case of need or emergency the master may commence ventilation of the fumigated cargo holds under the conditions of 3.3.2.15, having due regard for the safety of personnel on board. If this operation is to be done at sea, the master should evaluate weather and sea conditions before proceeding.

3.3.2.18 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 adequate respiratory protection.

3.3.2.19 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.

3.3.2.20 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.

4 REGULATIONS FOR THE USE OF PESTICIDES

4.1 National and international controls on pesticide usage

4.1.1 In many countries the sale and use of pesticides are regulated by governments to ensure safety in application and prevention of contamination of foodstuffs. Among the factors taken into account in such regulations are the recommendations made by international organizations such as FAO and WHO, especially in regard to maximum limits of pesticide residues in food and foodstuffs.

4.1.2 Examples of some commonly used pesticides are listed in appendix 1. Pesticides should be used strictly in accordance with the manufacturer's instructions as given on the label or package itself. National regulations and requirements vary from one country to another; therefore particular pesticides which may be used for treatment of cargo holds and accommodation in ships may be limited by the regulations and requirements of:

- .1 the country where the cargo is loaded or treated;
- .2 the country of destination of the cargo, especially in regard to pesticide residues in foodstuffs; and
- .3 flag State of the ship.

4.1.3 Ships' masters should ensure that they have the necessary knowledge of the above regulations and requirements.

5 SAFETY PRECAUTIONS – GENERAL

5.1 Fumigation

5.1.1 Ship's personnel should not handle fumigants and such operations should be carried out only by qualified operators. Personnel allowed to remain in the vicinity of a fumigation operation for a particular purpose should follow the instructions of the fumigator-in-charge implicitly.

5.1.2 Aeration of treated cargo holds should be completed and a clearance certificate issued as in 3.3.1.8 or 3.3.1.10 before personnel are permitted to enter.

5.2 Exposure to pesticides resulting in illness

5.2.1 In the case of exposure to pesticides and subsequent illness, medical advice should be sought immediately. Information on poisoning may be found in the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG) or on the package (manufacturer's instructions and safety precautions on the label or the package itself).

APPENDIX 1

FUMIGANTS SUITABLE FOR SHIPBOARD USE

The materials listed should be used strictly in accordance with the manufacturer's instructions and safety precautions given on the label or package itself, especially in respect of flammability, and with regard to any further limitations applied by the law of the country of loading, destination or flag of the ship, contracts relating to the cargo, or the shipowner's instructions.

1 Fumigants against insects in empty cargo holds

TO BE APPLIED ONLY BY QUALIFIED OPERATORS

- Carbon dioxide
- Nitrogen
- Methyl Bromide and carbon dioxide mixture
- Methyl Bromide
- Hydrogen cyanide
- Phosphine

2 Fumigants against insects in loaded or partially loaded cargo holds

CARE IS NEEDED IN SELECTING TYPES AND AMOUNTS OF FUMIGANTS FOR TREATMENT OF PARTICULAR COMMODITIES

- Carbon dioxide
- Nitrogen
- Methyl Bromide and carbon dioxide mixture
- Methyl Bromide
- Phosphine

3 Fumigant information

3.1 *Methyl Bromide*

Methyl Bromide is used in situations where a rapid treatment of commodities or space is required. It should not be used in spaces where ventilation systems are not adequate for the removal of all gases from the free space. In-ship in-transit fumigations with Methyl Bromide should not be carried out. 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 before discharge, once crew members have disembarked (see 3.1.2.3). Prior to discharge, ventilation must be done, forced if necessary, to reduce the gaseous residues below the occupational exposure limit values set by the flag State regulations in the free spaces. (See procedures for ventilation in 3.3.2.17 to 3.3.2.19).

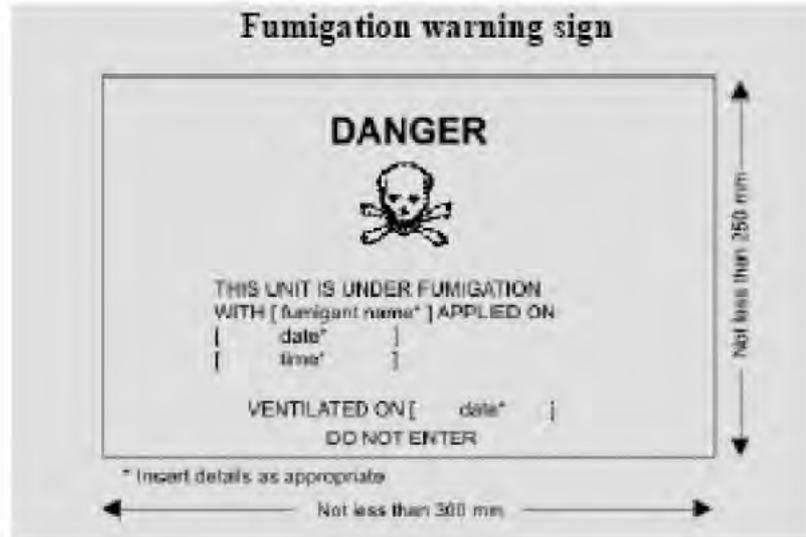
3.2 *Phosphine*

3.2.1 A variety of 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.

3.2.2 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 of the ship, 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.**

3.2.3 These will vary with each formulation and the method of application. Prior to discharge, ventilation must be done, forced if necessary, to reduce the gaseous residues below the occupational exposure limit values set by the flag State regulations in the free spaces (see procedures for ventilation in 3.3.2.17 to 3.3.2.19). For safety aspects during the voyage see 3.3.2.3.

APPENDIX 2



APPENDIX 3
MODEL CHECKLIST FOR IN-TRANSIT FUMIGATION

Date:

Port: Terminal/Quay:

Ship's name:

Type of fumigant: Method of application:

Date & time fumigation commenced:

Name of fumigator/company:

The master and fumigator-in-charge, or their representatives, should complete the checklist jointly. The purpose of this checklist is to ensure that the responsibilities and requirements of 3.3.2.11, and 3.3.2.12 are carried out fully for in-transit fumigation under section 3.3.2.9.

Safety of operations requires that all questions should be answered affirmatively by ticking the appropriate boxes. If this is not possible, the reason should be given and agreement reached upon precautions to be taken between ship and fumigator-in-charge. If a question is considered to be not applicable write "n/a", explaining why, if appropriate.

PART A: BEFORE FUMIGATION

	SHIP	FUMIGATOR- IN-CHARGE
1 The inspection required before loading has been performed (3.3.2.4)	[]	[]
2 All the cargo holds to be fumigated are satisfactory for fumigation	[]	[]
3 Spaces, where found not to be satisfactory, have been sealed	[]	[]
4 The master or his trained representatives have been made aware of the specific areas to be checked for gas concentrations throughout the fumigation period	[]	[]
5 The master or his trained representatives have been made familiar with the fumigant label, detection methods, safety procedures and emergency procedures (refer to 3.3.2.6)	[]	[]
6 The fumigator-in-charge has ensured that gas-detection and respiratory protection equipment carried on the ship is in good order, and that adequate fresh supplies of consumable items for this equipment are available to allow sampling as required by 3.3.2.13.	[]	[]
7 The master has been notified in writing of:		
(a) the spaces containing cargo to be fumigated	[]	[]
(b) any other spaces that are considered unsafe to enter during the fumigation	[]	[]

PART B: AFTER FUMIGATION

The following procedure should be carried out after application of fumigant and closing and sealing of cargo holds.

	SHIP	FUMIGATOR- IN-CHARGE
8 Presence of gas has been confirmed inside each hold under fumigation	[]	[]
9 Each hold has been checked for leakage and sealed properly	[]	[]
10 Spaces adjacent to the treated cargo holds have been checked and found gas-free	[]	[]
11 The responsible crew members have been shown how to take gas readings properly when gas is present and they are fully conversant with the use of gas-detection equipment provided	[]	[]
12 Methods of application:		
(a) Surface application method	[]	[]
Initial rapid build-up of the gas in the upper regions of hold airspace with subsequent penetration downward of the gas over a longer period		
or		
(b) Deep probing	[]	[]
More rapid dispersion of gas than in (a) with lower concentrations in upper regions of airspace in the hold		
or		
(c) Recirculation	[]	[]
Rapid dispersion of gas throughout hold but at lower initial gas levels with subsequent build-up of gas levels which, however, may be lower due to even distribution		
or		
(d) Other	[]	[]
13 The master or trained representatives have been briefed fully on the method of application and the spread of the gas throughout the hold	[]	[]
14 The master or trained representatives have been made:		
(a) aware that even though the initial check may not indicate any leaks, it is essential that monitoring is to be continued in the accommodation, engine-room, etc. because gas concentrations may reach their highest levels after several days	[]	[]
(b) aware of the possibility of the spreading of gas throughout the duct keel and/or ballast tanks	[]	[]
15 The fumigator-in-charge has supplied a signed statement to the master conforming to the requirements of 3.3.2.12 for his retention	[]	[]
The above has been agreed:		
Time:		Date:
For Ship:		Fumigator-in-charge:
Rank:		

MGN 284 (M+F) - Recommendations for ships carrying fumigated bulk cargoes

RECOMMENDATIONS FOR SHIPS CARRYING FUMIGATED BULK CARGOES

Notice to operators, shipowners, charterers, masters, agents, port and harbour authorities, shippers, bulk terminal operators, fumigators, fumigant manufacturers and all persons responsible for fumigating bulk cargoes.

This MGN should be read in conjunction with MSN 1718, MGN 86 and the Merchant Shipping (Carriage of Cargoes) Regulations 1997 (as amended)

Summary

This guidance note advises on:

- (1) the importance of safe and proper procedures when fumigants are used in bulk cargoes on board ships;
- (2) the appropriate application of the IMO Recommendations on the Safe Use of Pesticides in ships carrying fumigated bulk cargoes; and
- (3) the likely application of other related requirements or guidance that would be applicable to ships carrying fumigated bulk cargoes.

1.0 Introduction/ Background

- 1.1 This MGN has been produced to bring to the attention of ship's masters, owners, agents and port or terminal operators the dangers involved in the transportation and discharge of fumigated solid bulk cargoes.

2.0 Main points

IMO at DSC/Circ11 (available at the IMO website: <http://www.imo.org>) highlights the following points:

- 2.1 There may be an incorrect assumption that the concentration of the toxic fumigant in the holds and access ways of the ship is sufficiently low to avoid safety and health risks to ship and shore personnel or enforcement officers when the ship arrives in the port of discharge;
- 2.2 There are reported incidents where employees have been exposed to the fumigant, usually phosphine, causing health problems; and
- 2.3 Ships containing bulk cargo under fumigation, unlike in container transport units (CTUs), have no requirement to be labelled as such, and therefore may not be visibly recognised as a potential

health and safety risk. It should be noted that there is a requirement in the 'Code of Safe Practice for Merchant Seamen' to ensure that fumigation warning signs are conspicuously displayed on cargo units or spaces under fumigation.

3.0 The safe use of pesticides on ships

- 3.1. The International Convention for the Safety of Life at Sea (SOLAS) regulation VI/4, requires that appropriate precautions are taken in the use of pesticides in ships, in particular for the purposes of fumigation.
- 3.2. The Merchant Shipping (Carriage of Cargoes) Regulations 1997 require that where pesticides are used in the cargo spaces of ships prior to, or following a voyage, the IMO publication *Recommendations on the Safe Use of Pesticides in Ships* (2002 Edition) must be complied with. These regulations define 'the use of pesticides' to include the fumigation of cargo spaces and of cargo, in port, or in transit, and in any part of the ship or cargo so affected as a consequence of their application or use, as referred to in the 'Recommendations'.
- 3.3. To ensure compliance with the *Recommendations* detailed in 3.2 above all ships proceeding to a port within the United Kingdom, carrying solid bulk cargoes under fumigation, even if ventilation of the cargo has taken place during the voyage, must prior to arrival and in general not less than 24 hours in advance, inform either the port authority or terminal operator of the port or bulk terminal of destination that the bulk cargo has been fumigated. This information must be provided by either the ship's master, owner or the agent.
- 3.4. In cases where the presence of personnel in cargo spaces is required to ensure that fumigation tablets have fully decomposed before arrival at the discharge port, it is important that the Ship's master ensures that adequate respiratory protection (e.g. self contained compressed air breathing apparatus) is worn until all fumigation residues have been removed and the spaces have been thoroughly ventilated.
- 3.5. On arrival at any port within the United Kingdom where fumigated bulk cargo is to be discharged the master must establish the requirements of the port or bulk terminal regarding the handling of fumigated cargoes before any cargo is discharged. Before entry of fumigated cargo spaces, trained personnel from a fumigation company or other competent persons, wearing respiratory protection, must carry out careful monitoring of the spaces to ensure the safety of personnel. The monitoring values must be entered in the ships log book. The fumigation is not complete until the holds and cargo have been ventilated and tested and a certificate issued by a competent person stating that the cargo and holds are free from harmful concentrations of gas,
- 3.6. When the ship is found to be 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
- 3.7. The precautions and procedures detailed in the 'Code of Safe Working Practises for Merchant Seamen' with regard to the entering of enclosed spaces should be taken in account.
- 3.8. The Merchant Shipping (International Safety Management (ISM) Code) Regulations 1998 require ships to develop plans for key shipboard operations concerning the safety of the ship and the prevention of pollution. These plans must include safety procedures for fumigation if the ship is likely to carry solid bulk cargo that may require fumigation.

4.0 Further Information

Further information on the contents of this MGN can be obtained from colin.thomas@mcga.gov.uk

(or the address at the end of this Notice)

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Safer Lives, Safer Ships, Cleaner Seas



ISO 9001:2000
FS 34835

Department for
Transport

*The MCA is an executive agency
of the Department for Transport*

MGN 1718 (M) - The safe use of pesticides in ships

THE SAFE USE OF PESTICIDES IN SHIPS

Notice to operators, shipowners, charterers, masters, agents, port and harbour authorities, shippers, container and vehicle packers, cargo terminal operators, fumigators and fumigant and pesticide manufacturers and all persons responsible for the unloading of freight containers

(This notice supersedes Merchant Shipping Notice M.1534 and takes immediate effect)

This Merchant Shipping Notice is an integral part of the Merchant Shipping (Carriage of Cargoes) Regulations 1997¹. It supersedes Merchant Shipping Notice No.1534 setting out the conditions for the use of pesticides in the cargo spaces of ships in accordance with regulation 8 of these Regulations.

Summary

The purpose of this Merchant Shipping Notice under the Merchant Shipping (Carriage of Cargoes) Regulations 1997 is to specify:

- (1) The requirements for the safe use of pesticides in cargo spaces on board ships when loaded or intended to be loaded with any cargo, with the exception of liquids in bulk or gases in bulk.
- (2) The relevant aspects of the IMO Recommendations on the Safe Use of Pesticides in Ships which are mandatory for the purposes of (1) above.

1. In accordance with the Merchant Shipping (Carriage of Cargoes) Regulations 1997, where pesticides are used in the cargo spaces of ships prior to, during, or following a voyage, the IMO publication "RECOMMENDATIONS ON THE SAFE USE OF PESTICIDES IN SHIPS" (1996 Edition, IMO267E), available from IMO, Publications Section, 4 Albert Embankment, London SE1 VSR where relevant thereto shall be complied with. The contents of this publication are also incorporated into the Supplement to the International Maritime Dangerous Goods (IMDG) Code. The use of pesticides includes the fumigation of cargo spaces and of cargo, in port, or in-transit, and any part of the ship or cargo so affected as a consequence of their application or use, as referred to in the Recommendations. The Regulations cover all

cargoes, including bulk cargo except for liquids and gases in bulk and the further exclusion of dangerous goods, where these are covered by the IMDG Code and the Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997.

2. Fumigation which is to continue during a voyage must only be carried out with the agreement of the ship's master. The master may choose to allow an in-transit fumigation only after first referring to the requirements of the ship's own national administration. The proposed fumigation process must be acceptable to the administration of the state of the vessel's next port of call or destination. If these approvals have not been received, the fumigation process must not be undertaken. In any event, prior to the arrival of the vessel

¹ S.I. 1997/No.19 as amended

- and in general not less than 24 hours in advance, the Master must inform the Port Authorities of the port of destination and ports of call that a fumigation in transit is being carried out.
3. Where fumigation in transit is undertaken on short sea voyages, it is likely that the fumigant tablets may not have fully decomposed before arrival at the discharge port. In such cases, when the presence of personnel in cargo spaces is required, it is important that adequate respiratory protection (e.g. self-contained compressed air breathing apparatus) is worn until all fumigant residues have been removed and the spaces have been thoroughly ventilated.
 4. Responsibility for the fumigation process, including, if appropriate, the provision of means to remove any residues, lies with the fumigator. However, where fumigation in transit is to take place, the responsibility to provide safe working conditions on board ship rests with the master. He must ensure that at least two members of his crew including one officer have received the appropriate training. They must be familiar with the recommendations of the fumigant manufacturer 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.
 5. If fumigant tablets are applied to a cargo in a retrievable form, their residues, whether completely spent or not, must be immediately removed from the cargo spaces upon arrival at the discharge port. In cases where no means of retrieval are provided, a vessel must not discharge her cargo until safe working conditions have been established both on board the vessel and ashore where the receiver must make provision for receiving partially decomposed tablets. Under no circumstances are residues to be removed from ships' cargo spaces or from cargo transport units during the voyage, or disposed of overboard at sea.
 6. Some of the gases and other agents commonly used for fumigation are flammable and, unless used strictly in accordance with manufacturer's instructions, may create a fire hazard. All the recommended fumigants are highly toxic and must be used only by qualified operators. It should be noted that because the Threshold Limit Values (TLV) for vapours in air (Annex 2 to the Recommendations refers) are based on a normal eight hour day, they do not provide precise divisions between "safe" and "dangerous" concentration levels for the seafarer. Therefore, it is important that exposure to fumigation agents is kept to a minimum practicable level and below the TLV².

² In the United Kingdom the Control of Substances Hazardous to Health Regulations 1988 and the associated Health & Safety Executive Approved Code of Practice "Control of substances hazardous to health in fumigation operations" refers to the Maximum Exposure Limit (MEL) and the Occupational Exposure Standard (OES).

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August 1998

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*An executive agency of the Department of the
Environment, Transport and the Regions*

MGN 86 (M) - Recommendations on the safe use of pesticides in ships



Maritime and Coastguard Agency

RECOMMENDATIONS ON THE SAFE USE OF PESTICIDES IN SHIPS

Notice to operators, shipowners, charterers, masters, agents, port and harbour authorities, shippers, container and vehicle packers, cargo terminal operators, fumigators, fumigant and pesticide manufacturers and all persons responsible for the unloading of freight containers

(This notice takes immediate effect)

Summary

The purpose of this guidance note is to advise on:

- (1) the importance of safe and proper procedures when pesticides are used on board ships;
- (2) the appropriate application of the IMO Recommendations on the Safe Use of Pesticides in Ships both to cargo and to cargo spaces; and
- (3) to indicate the likely application of other related requirements or guidance which would be applicable to the use of, handling or transport of pesticides.

1. In accordance with the Merchant Shipping (Carriage of Cargoes) Regulations 1997¹, where pesticides are used in the cargo spaces of ships prior to, during, or following a voyage, the IMO publication "RECOMMENDATIONS ON THE SAFE USE OF PESTICIDES IN SHIPS" (1996 Edition, IMO267E), available from IMO, Publications Section, 4 Albert Embankment, London SE1 7SR where relevant thereto shall be complied with. The contents of this publication are also incorporated into the Supplement to the International Maritime Dangerous Goods (IMDG) Code. The use of pesticides includes the fumigation of cargo spaces and of cargo, in port, or in-transit, and any part of the ship so affected by their use, as contained in the Recommendations.
2. The Maritime and Coastguard Agency, in conjunction with the Ministry of Agriculture, Fisheries and Food, the Scottish Office, Agriculture, Environment and Fisheries Department and the Health and Safety Executive, considers that it is essential that adequate precautions are taken by all those responsible for the commissioning of pest control on board ships. MCA strongly recommends observance of all the provisions contained in the Recommendations, but the necessity for the master and crew to cooperate with shore-based fumigation personnel in compliance with other safety requirements should be recognised. In the United Kingdom the Health and Safety Executive (HSE) is the relevant shore-based authority.

¹ S.I. 1997/No.19 as amended

3. Mandatory requirements cover the conditions for preparation and carriage of cargo transport units under fumigation. These are classified as Class 9 dangerous goods with the proper shipping name "CARGO TRANSPORT UNIT UNDER FUMIGATION" in the International Maritime Dangerous Goods (IMDG) Code, ("cargo transport unit" being any freight container or vehicle shipped under fumigation). The Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997 require compliance with the IMDG Code for packaged dangerous goods for aspects such as declaration, stowage, segregation, marking, labelling and the display of a fumigation warning sign.
4. Pesticides, when not in use and carried as cargo may also be subject to the Regulations specified in paragraph 3 above and the IMDG Code.
5. The Recommendations regarding fumigation practice were written as a result of consultations with experts on pest control, pesticide safety and ship operation.
6. In one case, failure to comply with the recommended procedures caused a number of people to be hospitalised after exposure to phosphine gas generated in a cargo of grain fumigated with Aluminium Phosphide during the sea passage. The fumigant tablets were not fully decomposed and, hence, the fumigation process was not fully completed before the vessel arrived at the discharge port. There have also been a number of other incidents involving containerised cargoes arriving under fumigation at United Kingdom ports with no accompanying documentation on the ship or at the port of discharge regarding the nature of the cargo.
7. Merchant Shipping Notice MSN 1718 should be referred to for the statutory requirements on the safe use of pesticides (including fumigants), in cargo spaces on board ships when they are loaded or intended to be loaded with cargo. Although extensively referred to in these requirements, the scope and application of the IMO Recommendations is generally wider, providing, for example, guidance on the disinfection of food stores, galleys and crew and passenger accommodation.
8. As pesticides are hazardous substances their handling and application and exposure to them are subject to regulations affecting the health and safety of workers at work. For further information other related documents should be referred to, e.g. Chapter 27 of the "Code of Safe Working Practices for Merchant Seamen"² and the Health and Safety Executive Approved Code of Practice (Control of Substances Hazardous to Health in Fumigation Operations"³.

² Available from The Stationery Office
ISBN 0 11 5518363

³ HSE Books ACOP L86 and also Guidance note on Fumigation CS22.

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*An executive agency of the Department of the
Environment, Transport and the Regions*

MAIB flyer to the shipping industry

FLYER TO THE SHIPPING INDUSTRY

Crew evacuated following exposure to phosphine gas



Arklow Meadow: smoke from fumigant residue during discharge of maize cargo

NARRATIVE

On 5 December 2012, a fumigated cargo of maize was being discharged from the general cargo vessel *Arklow Meadow* in Warrenpoint, Northern Ireland when it became apparent that the fumigant (aluminium phosphide), which had been placed on top of the cargo before the vessel sailed from the Ukraine 14 days earlier, was still active.

Before the vessel's arrival in Warrenpoint, the atmosphere at the tops of the cargo holds had been tested and was less than 0.2ppm. Cargo operations had started and a number of fumigant retainers had been landed into hoppers and stores ashore before the remainder were removed from the cargo by ship's crew.

The fumigant retainers removed by the crew were initially placed on the wet deck, where they started to smoke. The smoking soon stopped when the retainers were moved to the holds' observation platforms. Meanwhile, a number of fumigant retainers had spilled onto the ground when they were being taken out of a hopper by a stevedore.

At this point, cargo operations were stopped and the spilled fumigant on the quay (**Figure 1**) was cordoned off. The fumigant retainers that remained by the vessel's holds were also collected and placed inside plastic bags. However, these soon started to smoke, so the crew were evacuated ashore. The local fire brigade was alerted and they reacted quickly to arrive on the scene. A 50 metre cordon was established around the vessel and houses and retail premises surrounding the port area were evacuated as a precautionary measure. Eight of *Arklow Meadow's* crew and a stevedore who had potentially been exposed to phosphine gas were taken to hospital for observation and decontamination.



Figure 1: Fumigant retainers and spilled fumigant



Figure 2: Disposal of the fumigant

A total of 89 fumigant retainers were recovered from the vessel and shore areas, leaving 21 fumigant retainers unaccounted for. The recovered retainers were neutralised by immersing them in water (**Figure 2**). It took 5 days for the level of phosphine gas in the vessel's cargo holds to reduce to an acceptable level.

SAFETY LESSONS

Fumigants are dangerous if not handled correctly and appropriate precautions are not taken. To improve the safety of ships' crews and shore workers when handling fumigated grain cargoes, vessel owners, managers and crews, shippers and port authorities are strongly advised to take into account the lessons to be learned from this accident. In particular:

- A number of factors may cause a fumigant to remain active, regardless of the length of voyage. Where possible, all fumigant residues should be removed from the cargo holds before cargo discharge commences.
- The removal and disposal of fumigant and fumigant residues is potentially hazardous and should, wherever possible, be undertaken by a qualified fumigator.
- Owners and ship managers should ensure that comprehensive procedures and guidance covering the carriage of fumigated cargoes is provided on board their vessels.
- Masters must take responsibility for the safety of their crews when carrying fumigated cargoes. This requires compliance with the appropriate international recommendations, national requirements, and the instructions provided by the fumigator at the load port.
- Port authorities handling fumigated cargoes need to develop and implement procedures and emergency plans for the handling of fumigated cargoes, including: maintaining a list of accepted fumigators, the briefing of stevedores and other shore workers, and the safe disposal of fumigant (active and expired).

This flyer and the MAIB's investigation report are posted on our website:
www.maib.gov.uk

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