

MGN 309(F) *Fishing Vessels —The Dangers of Enclosed Spaces*

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## Fishing Vessels – The Dangers of Enclosed Spaces

Notice to all Owners, Builders, Employers, Skippers and Crews of Fishing Vessels.

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### Summary

This note warns of the unseen risks from the build-up of gases in “enclosed” spaces including refrigerated Salt Water (RSW) tanks and provides guidance on the avoidance of such risks and of the safe entry into enclosed spaces.

#### Key Points

- Be aware that unless absolutely necessary, avoid enclosed spaces whilst at sea
- Be aware of what constitutes a dangerous enclosed space
- Be aware of the procedures for preventing toxic gases in RSW tanks

If entry to enclosed space is necessary

- Be aware of the procedures for prevention of risk
- Be aware of how to test the atmosphere
- Be aware of the preparations required before entering
- Be aware of how to work while in an enclosed space
- Be aware how to leave

### 1. Introduction

1.1 Whilst on board a United Kingdom fishing vessel operating off the west coast of Africa three crew members tragically lost their lives.

1.2 The Marine Accident Investigation Branch (MAIB) report identified the release of dangerous gases from decaying fish, fish waste or offal as the cause of the accident. The source of the gases was a Refrigerated Salt Water (RSW) tank.

1.3 The tank had not been cleaned or chilled after use and a residue of fish and sea water remained. Hydrogen, cyanide, hydrogen sulphide and carbon dioxide gas accumulated over a period of several days; the effect being accelerated in tropical temperatures.

1.4 Gases were released into an occupied working space and inhaled when a side door to the RSW tank was opened, with fatal consequences to three of the crew and injuries to others.

1.5 In another case a vessel's engineer lost his life as a result of high carbon monoxide (CO) poisoning. A portable, petrol-engined pump was being used with the pump exhausting directly into the engine room.

1.6 These incidents further highlight:

- .1 that all spaces receiving little or no ventilation, including RSW tanks, should be treated as potentially dangerous;
- .2 the need for proper training in the use of plant and equipment; and
- .3 the importance of completing a thorough safety risk assessment and of informing the crew of the measures taken for their safety and health (see MGN20).

## **2. WHAT IS MEANT BY A DANGEROUS "ENCLOSED SPACE"?**

2.1 A dangerous enclosed space:

- .1 One that is poorly ventilated or sealed with the oxygen reduced to low levels; or
- .2 where toxic and/or flammable gases have built up to dangerous levels.

2.2 Many forms of chemical reaction can cause low oxygen levels or dangerous gases to build up, for example the decay of waste material or the exhaust from machinery, one common source is corrosion or rusting, which can significantly reduce the oxygen content in a space. All enclosed spaces therefore need to be treated with caution before opening or entering.

2.3 Examples of such spaces on fishing vessels are:

- .1 RSW tanks;
- .2 Fuel tanks;
- .3 Fish holds containing decaying fish, fish waste or offal;
- .4 Fresh water tanks;
- .5 Sea or fresh water ballast tanks;
- .6 Void spaces; and
- .7 Stores containing chemicals.

## **3. OPENING OR ENTERING AN ENCLOSED SPACE**

3.1 Unless it is absolutely necessary, **DO NOT** open or enter enclosed spaces whilst at sea. It is better to wait until the vessel is in port. Then "Call in the specialists" to certify that the air in the space is safe.

3.2 If entry is necessary, the following procedures are recommended prior to opening or entering, together with others that may be identified as a result of risk assessment:-

## **4. PREVENTION OF RISK**

4.1 **Ensure** tanks are empty and not under pressure. **Be patient** and make sure that tanks are **completely empty**.

4.2 **Ensure** filling pipes to tanks are isolated, that all valves are shut and notices are put up to prevent tanks from being filled by someone else.

4.3 **Ventilate spaces THOROUGHLY**. Mechanical or natural means of ventilation may be used, with more time given for natural ventilation.

## **5. TESTING THE ATMOSPHERE**

5.1 A **person competent** in the use of the equipment should test the atmosphere (air) inside a space.

5.2 When testing the air for the first time, **breathing apparatus should be worn**.

5.3 An **oxygen meter should be used**, with a steady reading of 20% before entry is considered.

5.4 A **combustible gas indicator** ("explosimeter") **should be used** to test for combustible gases where these are suspected, especially where this may be a build up of hydrogen (e.g. in fuel tanks).

5.5 **Toxic gases should also be tested for where any risk is suspected**, the test equipment being specific to the gas (e.g. for unclean RSW tanks, test for hydrogen sulphide and hydrogen cyanide).

### **REMEMBER**

**IF TESTING APPARATUS IS NOT ON BOARD AND DOUBT EXISTS ABOUT THE SAFETY OF THE SPACE, DO NOT ENTER!**

## **6. PREPARING TO ENTER**

6.1 The following should be carried out before entry.

6.2 **Ensure the space is well lit**, including the entrance.

6.3 **Remove sources of ignition** from clothing, such as matches or lighters.

6.4 **Position appropriate rescue equipment at the entrance**, such as breathing apparatus, (intrinsically safe) torches, life lines and hoists.

6.5 **Limit** the number of persons entering the space.

6.6 **Place an attendant at the entrance**, who should remain there until everyone has left the space.

6.7 **Agree and test** a suitable means of communication.

## **7. DURING ENTRY TO A SPACE**

7.1 Whilst inside the enclosed space, the following procedures should be observed.

7.2 **Regular communication** should be maintained.

7.3 **Continue ventilating** the space.

7.4 Every so often, **re-test the atmosphere** in the tank and **if any doubt exists, stop the operation**.

7.5 **Should an emergency occur**, the attendant at the entrance should raise the alarm and should **NOT ENTER** the space himself until help has arrived.

7.6 **Breathing apparatus MUST be worn during any rescue** from a space. Once making contact with a casualty, he must be removed to safety and given first aid as necessary.

## **8. LEAVING A SPACE**

8.1 After completion of the operation, everyone should leave the space and the entrance should be resealed (unless further entry is required).

## **9. RSW TANKS**

9.1 MAIB commissioned research into the toxic gases produced by fish as they decay. The study revealed that:-

**.1 Temperature influences the level of toxic gases** produced by decaying fish in sea water;

**.2 At 45°C**, a “half and half” mix of rotting fish and sea water produced dangerous levels of hydrogen cyanide, hydrogen sulphide and carbon dioxide after only 24 hours;

**.3 At 35°C**, similar results to 45°C were obtained;

**.4 At 20°C**, a “half and half mix” of rotting fish and sea water produced dangerous levels of hydrogen cyanide, hydrogen sulphide and carbon dioxide after just 64 hours;

**.5 At 5°C**, **only** traces of the three gases were measured after 10 days.

9.2 The research identifies the importance of the following procedure for the RSW tanks, particularly when operating in warmer waters:-

**.1 Immediately clean all un-chilled RSW tanks after use, removing all residues.**

**.2 If cleaning has not occurred immediately and a mixture of fish and sea water has been left for more than a few hours, flush the tank through (using the appropriate sea water pump) and fully ventilate the tank.**

**.3 Ensure adequate ventilation exists in spaces adjacent to RSW tanks.**

**.4 On no account open or enter RSW tanks known to contain sea water/decaying fish unless the full procedures for entry into an enclosed space have been carried out ( see paragraphs 4-8 above).**

## **10. FURTHER ADVICE**

10.1 Crew of vessels that operate at sea for longer periods, particularly on those of 24 metres and over in registered length may have need to enter enclosed spaces whilst at sea. Further guidance on enclosed spaces may be found elsewhere, such as the Code of Safe Working Practices for Merchant Seamen.

## Further Information

Further information on the contents of this Notice can be obtained from:

Fishing Vessel Safety Branch  
Bay 2/05  
Maritime and Coastguard Agency  
Spring Place  
105 Commercial Road  
Southampton  
SO15 1EG

Tel : +44 (0) 23 8032 9163

Fax : +44 (0) 23 8032 9447

e-mail: 

General Inquiries: 24 Hour Infoline  
[infoline@mcga.gov.uk](mailto:infoline@mcga.gov.uk)  
0870 600 6505

MCA Website Address: [www.mcga.gov.uk](http://www.mcga.gov.uk)

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Department for*  
**Transport**

Extract of *Sunbeam's* Safety Folder including risk assessment Form G12 – Maintenance Work

# SUNBEAM – FR487

## SAFETY FOLDER

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## PREFACE

This document has been prepared for the **SUNBEAM – FR487**, and has been compiled following an initial meeting/training session where safety details regarding the vessel were confirmed.

Whilst we are confident that this SAFETY FOLDER contains the relevant details required to comply with regulations, it remains the responsibility of the Person Responsible for the Health and Safety (See Section 1), to ensure that the information is correct and accurate for your vessel. Please ensure that the required signatories are obtained to complete your SAFETY FOLDER.

### Regulations

The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 which came into force 31st March 1998 requires vessel operators to :-

- Prepare a written statement of their general policy with respect to health and safety and revise this as often as may be appropriate (Applies on all vessels with more than five workers).
- Carry out risk assessments to identify the risks of health and safety of workers in the normal course of their activities or duties (Applies on all vessels on which any worker is employed).

This document has been produced to comply with the Merchant Shipping and Fishing (Health and Safety at Work) Regulations 1997, and to the guidance given in MCA Marine Guidance Note MGN20 (based on the Safety Folder supplied by Seafish Industry Authority).

### Controlled Document

The distribution of this document is strictly limited. The document should not be divided. Responsibility will only be accepted for the maintenance (by issue of amendments or revisions) of the original documents issued by the document owner.

### Review and Update

This manual will be subject to regular review and update, when all copy holders will have the opportunity to express opinions and suggest improvements. However, the document control system allows for continuous update of this document. As such, any user may at any time identify an error or suggest an improvement by using the Comments Sheet.

### Copy Holder's Responsibilities

It is the responsibility of the registered copy holder to maintain the accuracy of this document by ensuring that all updates are promptly incorporated and acknowledged.

We recommend that you make this SAFETY FOLDER accessible onboard your vessel, and discuss the contents with crewmembers (for example the Emergency Procedure for fire can be tested and updated during your onboard fire drill practices).

Your decision to compile this SAFETY FOLDER is a initial step towards a new SAFETY CULTURE, and as this develops the contents of your SAFETY FOLDER will reflect your commitment to the safety practices aboard your vessel.

Thank you for selecting Cabern Ltd., to assist you to compile your SAFETY FOLDER. Your SAFETY CULTURE is a continuing process, and Cabern Ltd., will be pleased to offer our services for future developments ( ).

## Sunbeam FR487 - Risk Assessment Review ~~2017~~

2018

This risk assessment and health and safety folder in connection with this vessel has been approved and checked by the following persons:

Name	Position	Date	Signed
[REDACTED]	SKIPPER	26/04/18	[REDACTED]
[REDACTED]	MATE	26/04/18	[REDACTED]

### Crewmember Statement

The safety equipment and procedures have been explained to me and I have been informed of the risk assessments that have been made, and will comply fully with all requirements for health and safety in connection with this vessel.

Print Name	Date	Signed
[REDACTED]	26/04/18	[REDACTED]
[REDACTED]	26/04/18	[REDACTED]
[REDACTED]	26-4-18	[REDACTED]
[REDACTED]	26/4/18	[REDACTED]
[REDACTED]	26/04/18	[REDACTED]
[REDACTED]	26/4/18	[REDACTED]
[REDACTED]	26/04/18	[REDACTED]
[REDACTED]	26/04/18	[REDACTED]
[REDACTED]	26/07/18	[REDACTED]

AUTHORISATION FOR ISSUE

FR487

Name:	[REDACTED]
Address:	[REDACTED] [REDACTED]
Telephone:	[REDACTED]
Signed: .....	[REDACTED] Date: 11.9.00

FR487

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COPY NUMBER	HOLDER'S POSITION or RESPONSIBLE PERSON
1	Vessel Skipper

AMENDMENT RECORD

AMENDMENT NO.	DATE	PAGES AFFECTED	SIGNATURE

## SECTION 1

# FISHING VESSEL SAFETY POLICY STATEMENT

The following section contains the Safety Policy,  
Responsible Person information, and vessel  
details.

**FISHING VESSEL SAFETY POLICY STATEMENT**

This Safety Policy Statement sets out how we intend to operate this vessel in compliance with the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 and other health and safety regulations, to minimise the risk of accidents and ill health. Included in this statement are safety equipment, emergency measures, and risk assessments for activities and areas of the vessel. These will be reviewed every 12 months (or sooner if significant changes have been made). Personal and Protective Equipment (PPE), information, training, and the operating procedures necessary for the safety of the vessel and crew will be provided as required by the regulations.

Name:	[REDACTED]
Address:	[REDACTED]
Telephone:	[REDACTED]
Signed:	[REDACTED] ..... Date: 11.9.00

Person responsible for Health and Safety (if different from above) :	[REDACTED]
Address:	[REDACTED]
Telephone:	[REDACTED]
Signed: ..	[REDACTED] ..... Date: 11.9.00

## SECTION 5

# RISK ASSESSMENT

The following section contains the Risk Assessment sheets for this vessel. Spare sheets, Action Lists, and Risk Assessment information.



Vessel Name: SUNBEAM

Vessel Registration: FR487

Reference No : G012

Standard Risk Assessment Form			MAINTENANCE WORK			
Activity or area	Possible hazards	Possible consequences	F/P	S	F/P x S	Control measures necessary with respect to your vessel
Maintenance Work (Cont.)	Electrical tools and equipment	Fatal electric shock/injuries	1	3	3	All tools must be in a safe condition, with effective controls, guards and other safety features correctly in place. Extension cables must be in good condition and carefully rigged to avoid damage or persons tripping over them. Safety circuit breakers should be used to give protection. Correct PPE to be used.
	Chemicals	Eye damage, chemical burns, Respiratory problems	1	3	3	When using chemicals ensure that the safety information supplied with the chemical is studied and all precautions followed. Correct PPE to be used.
	Refrigerant gases	Suffocation	1	3	3	Ensure that only trained experienced people are permitted to maintain refrigeration systems. Correct PPE to be used. Ensure that all persons are aware of the possible dangers.
	Liquid propane gas (LPG)	Suffocation and explosion	N/A	N/A	N/A	Not applicable to this vessel.
	Electrical work	Electric shock, fire	1	3	3	Ensure that electrical fittings are in good order and that fuses or circuit breakers are correctly rated. Only competent persons should be allowed to work on electrical systems.
	Enclosed spaces may have an unsafe atmosphere	Deaths	1	3	3	All enclosed spaces must be treated with caution. 1. Ensure adequate ventilation when operations such as painting are taking place and make sure that all persons involved wear a suitable respirator. Allow sufficient time after painting for thorough ventilation of fumes before allowing free access. 2. In enclosed spaces, such as tanks that have held fuel or oil, do not enter until checks have been made to ensure that it is free of explosive gases and has a safe atmosphere. 3. Do not enter any space that has been sealed without first making checks that it is safe. Ensure that crewmembers are aware of the dangers and the procedures to follow.
Other						

Assessor Name

Assessor Signature

Date Assessed: 11.9.00

**Frequency/Probability (F/P)**  
(How likely that harm may occur)

- 1 Very unlikely
- 2 Unlikely
- 3 Likely

**Severity (S)**  
(How harmful)

- 1 Slightly harmful
- 2 Harmful
- 3 Very harmful

**Risk Factors (F/P x S)**

- 1 - No action is needed
- 2 - Can be tolerated, but make sure that it does not become worse
- 3/4 - Take action but subject to it being reasonable and sensibly possible
- 6 - Must be attended to, you must reduce the risk
- 9 - Cannot be accepted and work/activity must not continue

### Electrical Tools and Equipment

All tools must be in a safe condition, with effective controls, guards and other safety features correctly in place. Extension cables must be in good condition and carefully rigged to avoid damage or persons tripping over them. Safety circuit breakers should be used to give protection.

### Chemicals

If chemicals are being used for cleaning or other treatments you should ensure that the safety information supplied with the chemical is studied and all precautions followed.

### Refrigerant gases

Refrigerant gases should be treated with caution as a leakage may displace the oxygen from the atmosphere rendering persons unconscious. In liquid form, they will burn the skin. Only trained experienced people should be permitted to maintain refrigeration systems.

### Liquid propane gas (LPG) known as 'Calor Gas'

Leakage of LPG is liable to result in an explosion and fire. Being heavier than air, the gas will collect in the bottom of the vessel and hence may be undetected. Aside from the danger of explosion, the gas may also suffocate. Great care is needed with LPG equipment and portable cylinders should be stored in a well ventilated area. Ensure that all persons are aware of the dangers.

### Electrical work

Only competent persons should be permitted to carry out electrical maintenance work. High power systems can give fatal electric shocks and 12 or 24 V systems can cause fires if badly maintained.

### Enclosed spaces

All enclosed spaces must be treated with caution.

- i. Ensure adequate ventilation when operations such as painting are taking place and make sure that all persons involved wear a suitable respirator. Allow sufficient time after painting for thorough ventilation of fumes before allowing free access.
- ii. In enclosed spaces, such as tanks that have held fuel or oil, do not enter until checks have been made to ensure that it is free of explosive gases and has a safe atmosphere.
- iii. Do not enter any space that has been sealed without first making checks that it is safe.

Ensure that crewmembers are aware of the dangers and the procedures to follow. A permit to work system should be adopted as appropriate.

MAIB Safety Bulletin 4/2018

**Extracts from  
The United Kingdom  
Merchant Shipping  
(Accident Reporting and  
Investigation) Regulations  
2012**

**Regulation 5:**

“The sole objective of a safety investigation into an accident under these Regulations shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of such an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame.”

**Regulation 16(1):**

“The Chief Inspector may at any time make recommendations as to how future accidents may be prevented.”

**Press Enquiries:**

**01932 440015**

**Out of hours:**

**020 7944 4292**

**Public Enquiries:**

**0300 330 3000**

**NOTE**

This bulletin is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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Fax: 023 8023 2459

## Working in refrigerated salt water tanks

### Fatal enclosed space accident on board the fishing vessel

*Sunbeam (FR487)*

at Fraserburgh, United Kingdom

on 14 August 2018



## MAIB SAFETY BULLETIN 4/2018

This document, containing safety lessons, has been produced for marine safety purposes only, based on information available to date.

*The Merchant Shipping (Accident Reporting and Investigation) Regulations 2012* provide for the Chief Inspector of Marine Accidents to make recommendations at any time during the course of an investigation if, in his opinion, it is necessary or desirable to do so.

The Marine Accident Investigation Branch is carrying out an investigation into a fatal enclosed space accident on board the fishing vessel *Sunbeam* on 14 August 2018.

The MAIB will publish a full report on completion of the investigation.



**Andrew Moll**  
**Chief Inspector of Marine Accidents**

### NOTE

This bulletin is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall not be admissible in any judicial proceedings whose purpose, or one of whose purposes, is to apportion liability or blame.

This bulletin is also available on our website: [www.gov.uk/maib](http://www.gov.uk/maib)

Press Enquiries: 01932 440015; Out of hours: 020 7944 4292

Public Enquiries: 0300 330 3000

## BACKGROUND

*Sunbeam* (**Figure 1**) was a 56m UK registered pelagic trawler. Its home port was Fraserburgh, Scotland, and it was typically manned by a crew of eleven. In the weeks prior to the accident, it had been fishing for herring in the North Sea and landing its catch in Lerwick, Shetland. The vessel had nine refrigerated salt water (RSW) tanks for storing its catch.

On 10 August 2018, *Sunbeam* arrived at Fraserburgh. It had caught and landed its seasonal quota of herring and was being prepared for a planned refit period. During the refit the vessel's owner intended to replace *Sunbeam*'s refrigeration plant.



**Figure 1:** FV *Sunbeam*

## INITIAL FINDINGS

At about 0900 on 14 August, *Sunbeam*'s crew arrived at the vessel's berth ready to begin work. The vessel's refrigeration plant had been shut down after landing the final catch at Lerwick, and its RSW tanks had been pumped out and tank lids opened in preparation for deep cleaning. At some time between 1200 and 1350, *Sunbeam*'s second engineer entered the aft centre RSW tank (**Figure 2**) and collapsed.

At about 1350, the second engineer was seen lying unconscious at the aft end of the tank by a crewmate, who immediately raised the alarm. Three of the vessel's crew entered the tank and tried to resuscitate the second engineer but they soon became dizzy, confused and short of breath. One of the crew managed to climb out of the tank unaided, the other two crewmen and the second engineer were recovered onto the open deck by two crewmen wearing breathing apparatus. The two crewmen made a full recovery, but the second engineer could not be resuscitated and died.

It is unclear when and why the second engineer entered the tank. However, evidence indicated that his intention was to sweep the residual seawater that had settled at the aft end of the tank forward in to the tank's bilge well. No safety procedures for entering or working in RSW tanks had been completed before he entered the tank.





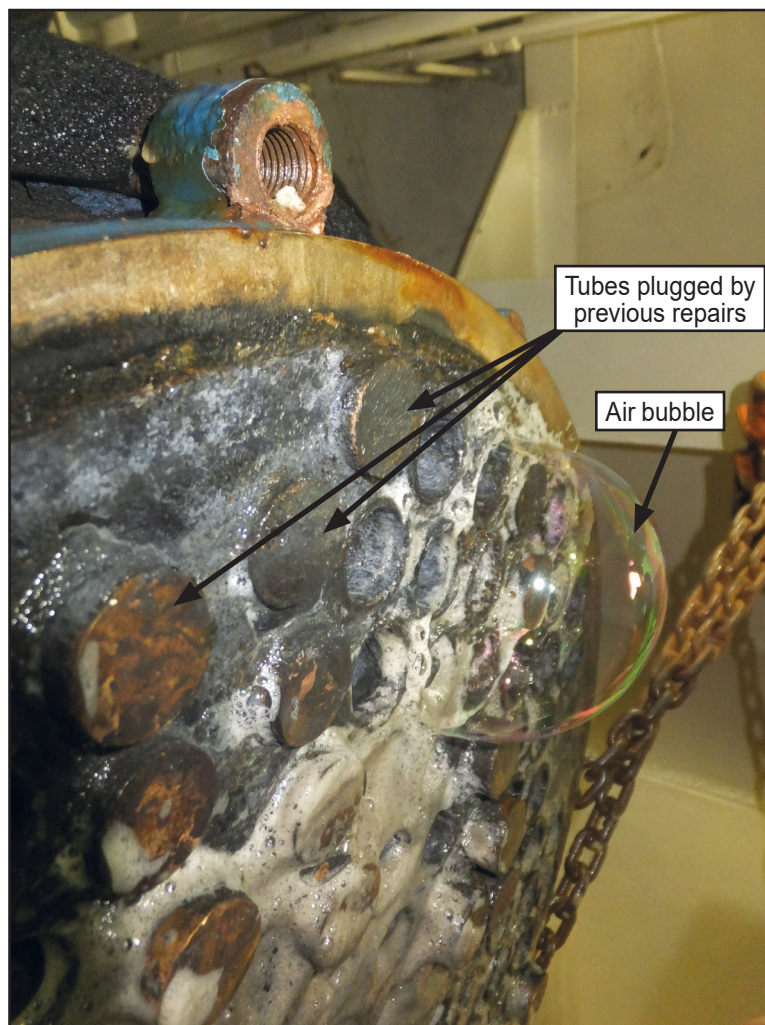
**Figure 2:** Aft centre RSW tank

Tests of the atmosphere in the tank following the accident showed that the level of oxygen at the bottom was less than 6% (normal level should be 20.9%). Further tests of both the tank atmosphere and residual water samples showed the presence of Freon R22, the refrigerant gas used in the RSW tank's refrigeration plant.

The MAIB's initial investigation identified that the refrigeration plant sea water evaporators had suffered several tube failures resulting in a number of repairs (**Figure 3**). It is likely that the refrigerant leaked through one or more failed tubes into the seawater system, and was released into the RSW tank. Freon R22 is four times heavier than air so it will displace oxygen at the bottom of an enclosed space, such as an RSW tank. It is a toxic, tasteless and mostly odourless gas. If it is deeply inhaled, it can cut off vital oxygen to blood cells and lungs.

## **SAFETY LESSONS**

The RSW tanks on board *Sunbeam* were, by design, enclosed spaces that did not have a fixed means of positive ventilation. Such spaces can become dangerously hazardous to life. The atmosphere in the tanks can become oxygen deficient through the effects of corrosion, or toxic through the decomposition of sludge or fish, or, as in this case, the accidental release of gas. Other hazards, such as flooding and heat exhaustion can also be a threat to life.



**Figure 3:** Starboard evaporator tube leak

It is the responsibility of vessel owners/operators to ensure that suitable measures are taken to safeguard the crew. All work activities should be subject to risk assessment and safe systems of work should be put in place. Working in enclosed spaces is particularly hazardous, and procedures for entering and working in them should be robust and understood. Similarly, rescue plans need to be put in place and fully understood and should be practised.

Widely recognized safety controls for working in enclosed spaces include:

- Atmosphere testing.
- Provision of positive ventilation.
- Safety sentry at entry point.
- Breathing apparatus available for rescue team.
- Safety harness and means of recovering an unconscious person.

It is also the responsibility of crew members to behave in a safe manner. This is particularly important when working alone.



This was a tragic accident, which nearly resulted in multiple fatalities. The crew did not appreciate the levels of risk they were taking, even after the second engineer had collapsed. The Maritime and Coastguard Agency provides further guidance in its Marine Guidance Note MGN 309 (F) Fishing vessels: the dangers of enclosed spaces, and the Fishermen's Safety Guide. The findings from an investigation into a similar accident on board the pelagic trawler *Oileán An Óir*, in Ireland in 2015, which resulted in two fatalities, also highlight the potential dangers of RSW tanks.<sup>1</sup>

## RECOMMENDATION

*Sunbeam's* owners are recommended to:

**S2018/129** Conduct risk assessments specifically for entering and working in RSW tanks and provide safe operating procedures for its crew to follow and appropriate levels of safety equipment to use.

Safety recommendations shall in no case create a presumption of blame or liability

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<sup>1</sup> The Department of Transport, Tourism and Sport in Ireland issued Marine Notice No.43 of 2016.

MAIB Safety Flyer to the Fishing Industry

## SAFETY FLYER TO THE FISHING INDUSTRY

**Fatal enclosed space accident, on board the pelagic trawler *Sunbeam* on 14 August 2018**



*Sunbeam*

### Narrative

During the afternoon of 14 August 2018, a second engineer working on board the pelagic trawler *Sunbeam* was found collapsed inside a refrigerated salt water (RSW) tank. *Sunbeam* was in Fraserburgh and the crew were preparing for a refit; the evidence suggested that the second engineer had entered the RSW tank to sweep away residual water.

When the second engineer was found, other members of the crew rushed to his aid, including three others who entered the tank, one of whom also collapsed. The crew members in the tank were rescued by *Sunbeam*'s mates, who were wearing breathing apparatus; only three of the four crew who entered the tank survived.

### Safety Lessons

1. *Sunbeam*'s RSW tanks were enclosed spaces because they had limited openings, no ventilation and were not intended for continual worker occupation. The accident happened because the second engineer entered the tank without any of the safety precautions normally associated with such a hazard being in place, specifically: the atmosphere was not monitored, there was no plan for the work or a rescue, and the second engineer was working alone without means of communication.

2. Entering *Sunbeam's* RSW tanks without safety precautions having been implemented had become normalised by the crew as this had been completed without consequence over many years of the vessel's operations. However, on this occasion the atmosphere could not support life as refrigerant gas (Freon in this case) had leaked into the space through failed evaporator tubes in one of the vessel's refrigeration plants.
3. While a leak of refrigerant gas might have been less foreseeable than hazards such as oxygen depletion from corrosion or hydrogen sulphide from rotting fish, it simply serves to underpin the critical need for atmosphere monitoring in enclosed spaces.
4. All work activities should be subject to risk assessment and safe systems of work. Working in enclosed spaces is particularly hazardous, and procedures for entering and working in them should be robust and understood. Similarly, rescue plans need to be put in place and rehearsed.

This flyer and the MAIB's investigation report are posted on our website: [www.gov.uk/maib](http://www.gov.uk/maib)

For all enquiries:  
Marine Accident Investigation Branch  
First Floor, Spring Place  
105 Commercial Road  
Southampton  
SO15 1GH

Email: [maib@dft.gov.uk](mailto:maib@dft.gov.uk)  
Tel: 023 8039 5500

**Publication date: December 2020**

**Extract from The United Kingdom Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 – Regulation 5:**

“The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an such investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame.”

**NOTE**

This safety flyer is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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