ACCIDENT REPORT

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

Report on the investigation of

carbon monoxide poisoning

on board the fishing vessel

Eshcol

resulting in two fatalities

Whitby

on 15 January 2014

VERY SERIOUS MARINE CASUALTY REPORT NO 14/2014 JUNE 2014

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 investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report 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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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AC	-	Alternating Current
BS	-	British Standard
BSS	-	Boat Safety Scheme
C	-	Carbon
cm	-	centimetre
CO	-	Carbon Monoxide
CO_2	-	Carbon Dioxide
CoGDEM	-	Council of Gas Detection and Environmental Monitoring
COHb	-	Carboxyhaemoglobin
DC	-	Direct Current
EN	-	European Norm
EPIRB	-	Emergency Position Indicating Radio Beacon
H_2O	-	Water
Hb	-	haemoglobin
ILO	-	International Labour Organization
LBP	-	Length Between Perpendiculars
LOA	-	Length Overall
LPG	-	Liquid Petroleum Gas
m	-	metre
m^3	-	cubic metre
MH_z	-	Megahertz
LOLER	-	Lifting Operations and Lifting Equipment Regulations
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MSN	-	Marine Shipping Notice
ppm	-	parts per million

PUWER	-	Provision and Upkeep of Work Equipment Regulations
R	-	Registered Length
Seafish	-	Sea Fish Industry Authority
UKLPG	-	United Kingdom Liquid Petroleum Gas
UTC	-	Universal Co-ordinated Time
V	-	volt

Times: All times in this report are UTC unless otherwise stated.

SYNOPSIS

During the morning of 15 January 2014, two fishermen were found dead in their bunks on board the scallop-dredger *Eshcol* in Whitby, North Yorkshire. The men had died from carbon monoxide poisoning as a result of leaving the grill of a butane-fuelled gas cooker lit when they went to bed. The grill was being used to warm the wheelhouse and sleeping area.

The investigation identified a number of contributing factors, including:

- The metal gauze in the grill was holed and corroded, causing extraordinarily high levels of CO emissions.
- The cooker was 4 years old and had probably never been serviced.
- The wheelhouse door and windows were closed and the sleeping area had no other means of ventilation.
- No carbon monoxide alarm was fitted.
- Neither the guidance for the installation of gas appliances on board small fishing vessels nor the cooker manufacturer's instructions had been followed when the cooker was fitted.
- Prior to the accident, the deceased were extremely tired and cold.
- The vessel was not equipped for overnight sleeping.
- The heaters provided on board did not work or were damaged.
- The management of the vessel was ineffective.

Recommendations have been made to the Maritime and Coastguard Agency which are intended to ensure that: the accommodation areas in all small fishing vessels are fitted with a carbon monoxide alarm; and the circumstances of this accident are taken into account during the intended alignment of the regulations for small fishing vessels with other commercially operated vessels of a similar size. A recommendation has been made to the Sea Fish Industry Authority, which is intended to raise the general awareness of the dangers of carbon monoxide among fishermen and measures designed to raise the standard of safety management across his fleet have been recommended to the owner of *Eshcol*.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *ESHCOL* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Eshcol*
Flag	United Kingdom
Classification society	Not applicable
IMO number/fishing numbers	M220
Type	Scallop dredger
Year of build	2005
Registered owner	Private
Manager(s)	Not applicable
Construction	Steel
Length overall	9.95m
Registered length	9.2m
Gross tonnage	10.48
Minimum safe manning	Not applicable
Authorised cargo	Fish
VOYAGE PARTICULARS	
Port of departure	Whitby
Port of arrival	Whitby
Type of voyage	Coastal
Cargo information	N/A
Manning	3
MARINE CASUALTY INFORMATION	
Date and time	Between 0300 on 14 January 2014 and 0935 on 15 January 2014
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	Whitby, United Kingdom
Place on board	Accommodation
Injuries/fatalities	2 fatalities
Damage/environmental impact	None
Ship operation	Alongside
Voyage segment	Alongside
External & internal environment	Air temperature between 3°C and 4°C. Wind speed 12kts
Persons on board	2

Eshcol

1.2 NARRATIVE

On the evening of 14 January 2014, *Eshcol*'s owner arrived on the fish quay **(Figure 1)** at Whitby with his van and trailer to collect the catch from three scallop dredgers he owned: the other vessels were *Accord* and *JMT*. At 2350 *Accord* moored alongside and the crew unloaded 30 bags of scallops into the owner's trailer, which took just under 1 hour. At about 0045 on 15 January, *Accord* was manoeuvred off the fish quay to enable *Eshcol* to berth alongside, port side to the quay. Once *Eshcol* was secured, *Accord* tied up outboard of *Eshcol*.

Eshcol's skipper, Mark Arries, and the vessel's two deckhands then started to transfer *Eshcol*'s catch of 26 bags of scallops to the owner's trailer. At about the same time, one of *Accord*'s crew (the son of the vessels' owner), connected a shore power cable between *Accord* and the quay. He asked Mark if he wanted a shore power connected on board *Eshcol*. Mark declined.

At 0115, *JMT* entered Whitby and secured alongside the fishing vessel *Progress*, which was moored directly astern of *Eshcol.* By 0145, Mark and his crew had unloaded *Eshcol*. All three men were very tired. One of *Eshcol's* deckhands then left in a taxi to visit his girlfriend in Scarborough, leaving Mark and the remaining deckhand, Edward Ide, on the quayside.

By about 0230, *JMT*'s crew had finished transferring their vessel's catch of 35 bags of scallops into the owner's trailer. The owner then drove clear of the quay accompanied by a crewman from *Accord*.

Between 0230 and about 0300, *JMT*'s skipper and the owner's son visited *Eshcol's* wheelhouse on separate occasions. *JMT*'s skipper chatted to Mark and Edward and noticed that the cooker grill had been lit to provide heat. The owner's son only chatted with Edward. During these conversations both Mark and Edward commented that they were cold. By about 0310, *JMT*'s and *Accord*'s crews were on board their vessels. Shortly afterwards, *Eshcol*'s main engine shut down.

At 0737 a road tanker arrived at the fish quay with fuel for *Eshcol, JMT* and *Accord*, but the lorry driver was unable to wake any of the crews. By 0830, *JMT*'s skipper had been made aware of the road tanker and moved his vessel to the northern end of the fish quay in order to refuel. *JMT* returned alongside *Progress* at 0855. *Accord* slipped from alongside *Eshcol* **(Figure 2)** 5 minutes later, to also fuel from the tanker. At 0917, both the owner's son and *JMT*'s skipper called Mark on his mobile telephone in order to let him know that the tanker was waiting for him; there was no response to either call. The owner's son called Edward 2 minutes later, but again there was no answer. At 0930, *Accord* moored on the southern end of the fish quay, rather than re-secure alongside *Eshcol*, to enable *Eshcol* to shift berth and refuel.

At about 0937, *JMT*'s skipper realised he had not seen any of Eshcol's crew that morning so he boarded the vessel via the quayside ladder. *Eshcol*'s wheelhouse door was locked and the wheelhouse windows were shut. *JMT*'s skipper tried to call Mark on his mobile telephone but there was no answer. The skipper looked through the wheelhouse windows and saw the boat's keys and a mobile telephone lying on the work surface next to the cooker. At 0942, *JMT*'s skipper was joined on board *Eshcol* by the owner's son. Both men sensed that something was wrong.

Image courtesy of http://yorkshireports.co.uk/content/whitby.aspx

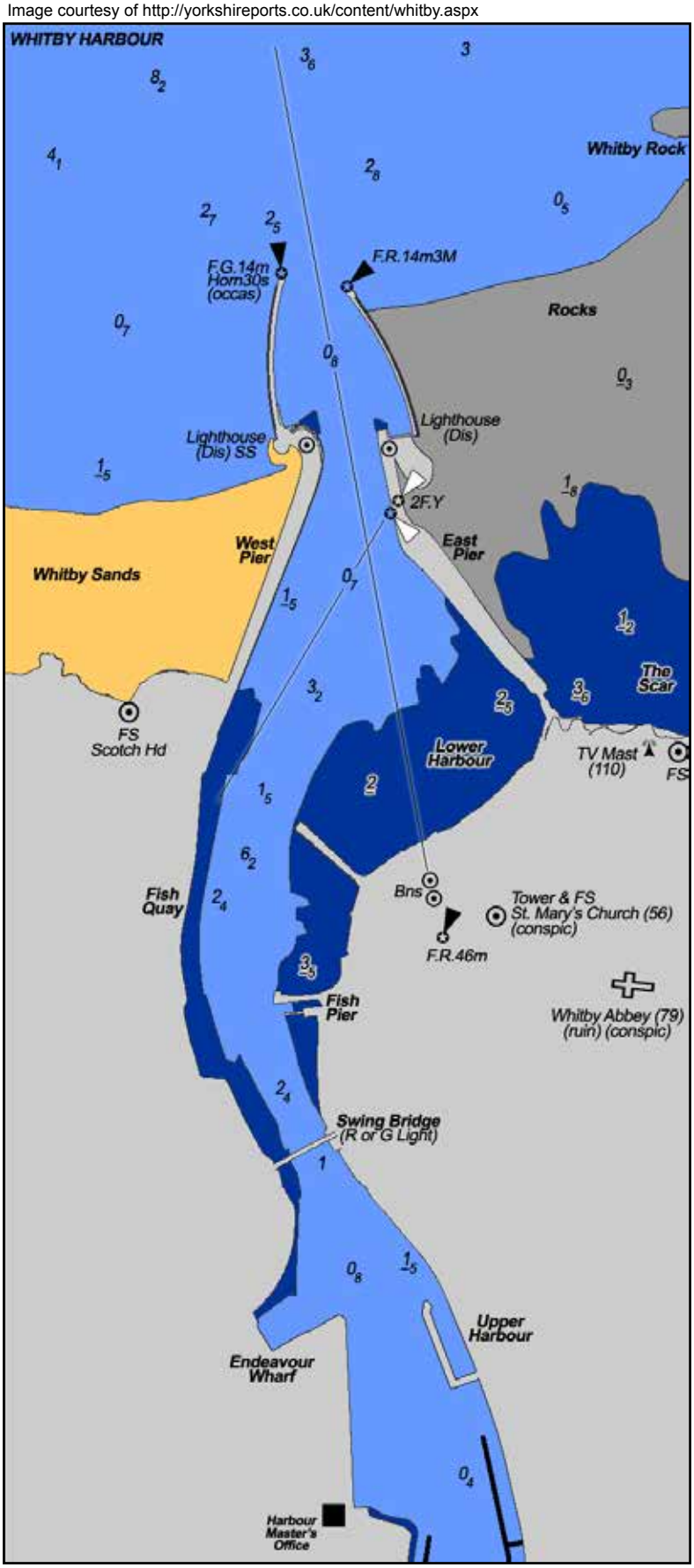


Figure 1: Whitby Harbour

Figure 2: *Accord* moving to refuel at 0900

JMT's skipper used a screwdriver to prise open the lock on the wheelhouse door. As the door opened, the skipper immediately felt heat coming from the wheelhouse. He saw that the cooker grill was lit and turned it off by using the appropriate knob on the front of the cooker. Other than a wire tray, there was nothing under the grill.

JMT's skipper then looked forward into the crew sleeping quarters and saw Mark and Edward in sleeping bags on their bunks. Mark was lying in the lower starboard bunk and Edward in the upper port bunk. Both men were dressed in their work clothes. *JMT*'s skipper shouted at Mark and Edward, but neither responded. At 0947, the skipper alerted the emergency services by dialling 999 on his mobile telephone.

Within minutes, two paramedics from the North Yorkshire Ambulance Service arrived at the fish quay in an ambulance and were directed towards *Eschol*. Soon after, an instruction from the fire service was received on the ambulance's mobile data terminal instructing the paramedics not to go on board.

Once on the quay, the paramedics passed their first-aid equipment down to *JMT*'s skipper, who then briefed them on the situation. One of the paramedics climbed down to *Eshcol* and entered the wheelhouse. He then went down to the sleeping area. The inside of the wheelhouse and sleeping area was still warm and had a strange odour.

Neither Mark nor Edward were showing any signs of life. As the paramedic checked for any cardiac activity, he also requested further assistance.

At 0953, the fire service and a second ambulance arrived at the scene **(Figure 3)**. By this time, the paramedic had determined that both Mark and Edward were dead. The on-scene commander from the fire service boarded *Eshcol* and instructed the paramedics to leave the vessel.

Figure 3: Arrival of the fire service at 0953

1.3 POSTMORTEM

Postmortem examinations on Mark and Edward identified that they had both died from carbon monoxide (CO) poisoning. The saturation of carboxyhaemoglobin (COHb)[1] in Mark's blood was 62%; Edward had a saturation of 68%. The only other positive finding of toxicology was that Mark had taken codeine. Neither man was under the influence of alcohol or illegal drugs at the time of their deaths.

1.4 CREW

Eshcol's crew joined the vessel on 8 January 2014 in Whitby. The vessel's owner recruited Mark Arries via the internet[2]. Mark then hired Edward and the other deckhand. The crew were engaged on a 'share' basis in which the owner gave the crew 33% of the proceeds from the sale of the catch (before costs). Mark received 13% and the deckhands 10% each.

[1] COHb is a stable complex of CO and haemoglobin (hb) that forms in red blood cells upon contact with CO. Large quantities of CO hinders the ability of hb to deliver oxygen to the body.

[2] www.findafishingboat.com

When the crew arrived on the vessel they were met by the owner's son, who had already opened up the vessel and started its engine. The crew first completed forms they were given which required their personal details and the details of the Sea Fish Industry Authority (Seafish)[3] courses they had attended. None were required to show proof of their qualifications or of the training they had completed.

Mark Arries was 26 years old and had been a fisherman since leaving school aged 16. He completed the mandatory Seafish training courses in fire-fighting, first-aid, safety awareness and sea survival in the autumn of 2003. Mark was experienced in potting, prawn fishing and scallop-dredging. He was in good health, although he was suffering from toothache.

Mark had previously skippered *Eshcol* over the summer of 2013 when the vessel was fishing out of Amble. During that period, *Eshcol* sailed to and from Amble each day and Mark slept at home overnight.

During the morning of 15 January 2014, in addition to the calls from the owner's son and *JMT*'s skipper at 0917, Mark missed calls on his mobile telephone at 0903 and 0913.

Edward Ide was 21 years old and had been a fisherman since leaving school. He completed the Seafish sea survival course in 2008 and the fire-fighting and first-aid courses in 2009. Edward had not completed either the Seafish safety awareness or health and safety courses. This was reflected on the crew information form he filled in when he joined *Eshcol*.

Edward had worked on various types of fishing vessels, but during the last year he had worked only on potters and scallop dredgers operating out of Blyth and Amble. During this time, he had returned home to sleep when his vessel was alongside.

On 15 January 2014, Edward received three text messages on his mobile telephone (0422, 0814 and 0819); all were unread. He also missed calls on his mobile telephone at 0733, 0817 and 0846.

The second deckhand was 40 years old and had worked most of his working life at sea on a variety of fishing vessel types. He completed the Seafish courses in sea survival, fire-fighting, first-aid and health and safety in May 2012.

All of the crew were smokers and usually smoked in the wheelhouse and on deck. It was not usual practice to smoke in the sleeping area.

1.5 WHEELHOUSE AND SLEEPING AREA

1.5.1 Wheelhouse

Access to *Eshcol*'s wheelhouse was via a door from the working deck **(Figure 4)**. The wheelhouse, was above the engine room and contained a liquid petroleum gas (LPG) cooker which housed two hob rings on the top, a grill and an oven. A grill pan and several roasting tins were kept inside the oven space. The cooker was installed in the port aft corner of the wheelhouse, close by the door and next to a sink **(Figure 5)**. The cooker was also below a window that could be opened.

[3] Under a Memorandum of Understanding with the MCA, Seafish is responsible for the development, delivery and certification of mandatory fishermen's safety training. **See paragraph 1.12**.

Figure 4: Wheelhouse doorway

Figure 5: Position of the cooker in the wheelhouse

The helm, engine controls, navigational equipment, fish-finder, electrical distribution panel and gas alarm panel were sited on the starboard forward corner of the wheelhouse **(Figure 6)**. A chair by the control console was fixed to the deck. The wheelhouse also contained a television.

Image courtesy of North Yorkshire Constabulary

Figure 6: Wheelhouse control console

1.5.2 Sleeping area

The sleeping area was forward of the wheelhouse **(Figure 7)**. Access to the sleeping area from the wheelhouse was via an opening (55cm wide, 90cm high) in the wheelhouse's forward bulkhead **(Figure 8)**. The deck of the sleeping area was approximately 50cm below the level of the deck in the wheelhouse.

The sleeping area contained two bunks on each side **(Figure 9)**. The upper bunks and the lower bunk on the starboard side were used by *Eshcol*'s crew. The port, lower bunk was used for storage **(Figure 10)**.

1.5.3 Power supplies

The domestic power sockets in the wheelhouse and sleeping area were intended for use with a 240V alternating current (AC) supply. This could be provided from shore via a dedicated power cable or by the vessel's generator. The generator supplied 240V direct current (DC) that was converted to AC by an inverter. The shore power cable was stored on the lower bunk on the port side **(Figure 10)**.

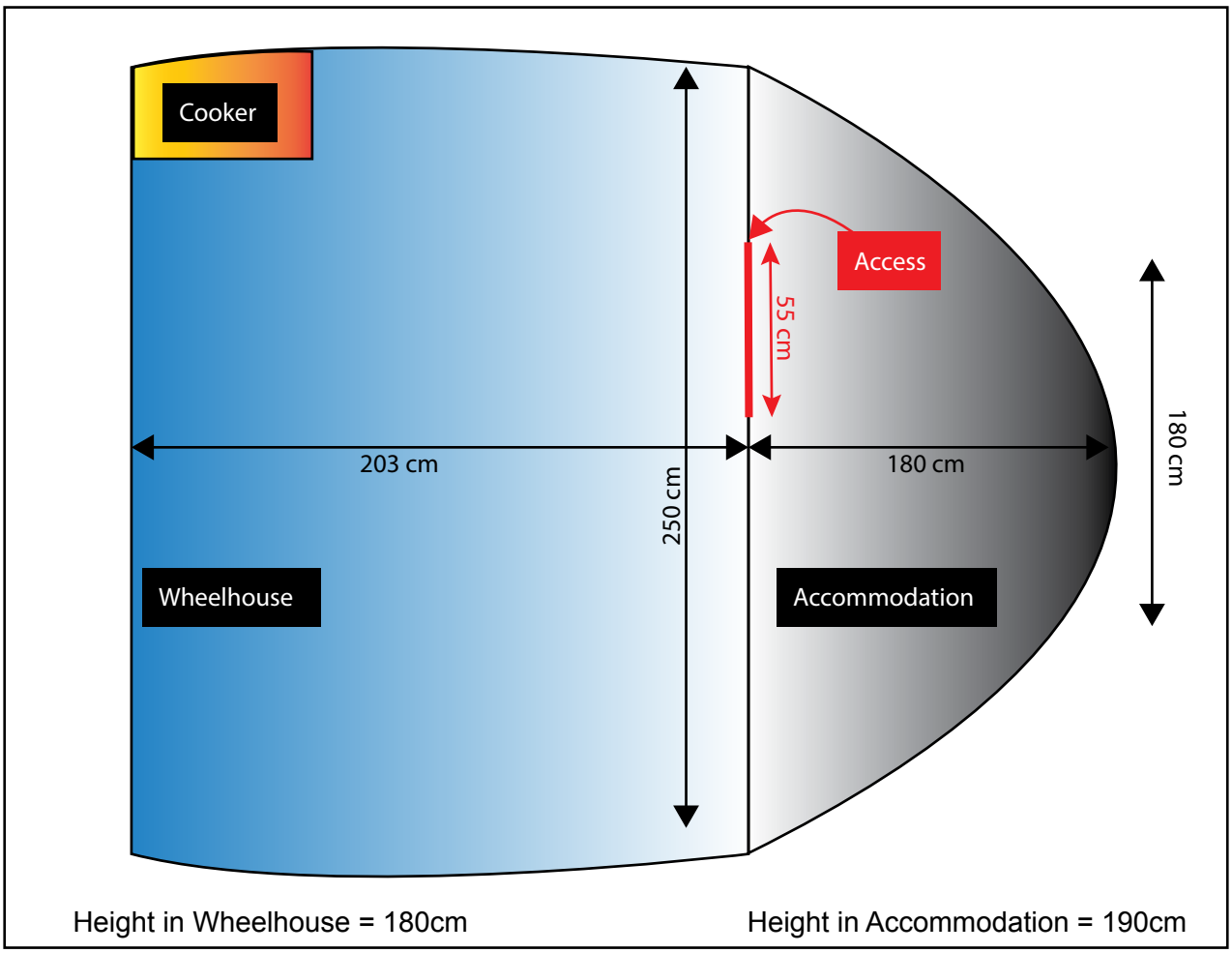


Figure 7: Diagram of wheelhouse and sleeping area

Figure 8: Access to the sleeping area from the wheelhouse

Figure 9: Bunk arrangement

Figure 10: Stores on bunk

1.6 POST-ACCIDENT INSPECTIONS

1.6.1 Maritime and Coastguard Agency

On 16 January 2014, a Maritime and Coastguard Agency (MCA) surveyor inspected *Eshcol* in Whitby. The inspection report **(Annex A)** detailed 34 deficiencies, which resulted in the vessel's detention. The vessel was released from detention on 24 February when the vessel was re-inspected and its owner demonstrated to the attending MCA surveyors that the deficiencies identified had been addressed.

1.6.2 MAIB

MAIB inspectors visited *Eshcol* at the same time as the MCA surveyor. In-situ tests showed that when the grill was lit the resulting flames were predominantly yellow in colour **(Figure 11)**. The grill was soon turned off following the activation of a personal gas detector which indicated that high levels of carbon monoxide were being emitted. Close inspection of the grill showed that the grill's steel mesh was corroded and holed in several places **(Figure 12)**.

The butane cylinder that supplied the gas cooker was stored on the main deck on the port side of the wheelhouse adjacent to the engine room access **(Figure 13)**. Markings on the cylinder indicated that it had been purchased in Wales.

Figure 11: Yellow flames under the grill

Figure 12: Gas cooker grill metal gauze

Figure 13: Butane gas cylinder stowage

Other observations (additional to the information provided in the MCA surveyor's inspection report at **Annex A**) included:

- There was no fixed natural or mechanical ventilation to the wheelhouse or sleeping area, other than the wheelhouse door and wheelhouse windows that opened.

- An electric heater fixed to the wooden panelling on the side of the lower starboard bunk **(Figure 14)** did not work.

Figure 14: Heater secured on side of bunk

- A small electric fan heater was found in the sleeping area under a pile of clothing. The heater was damaged **(Figure 15)** but appeared to function when connected to a power source and switched on.

- The smoke detector fitted on the deckhead in the sleeping area did not function because its battery had been removed **(Figure 16)**.

- The sleeping area was generally untidy and used for storage; few personal possessions or clothes were carried on board.

- The deck between the sleeping area and the engine room was not gas tight.

- Four automatic inflating lifejackets were stored in cupboards in the sleeping area. Two of the lifejackets were manufactured in 2005 and two in 2009. There was no record of the lifejackets being serviced and they had clearly not been used for some considerable time.

Figure 15: Electric fan heater

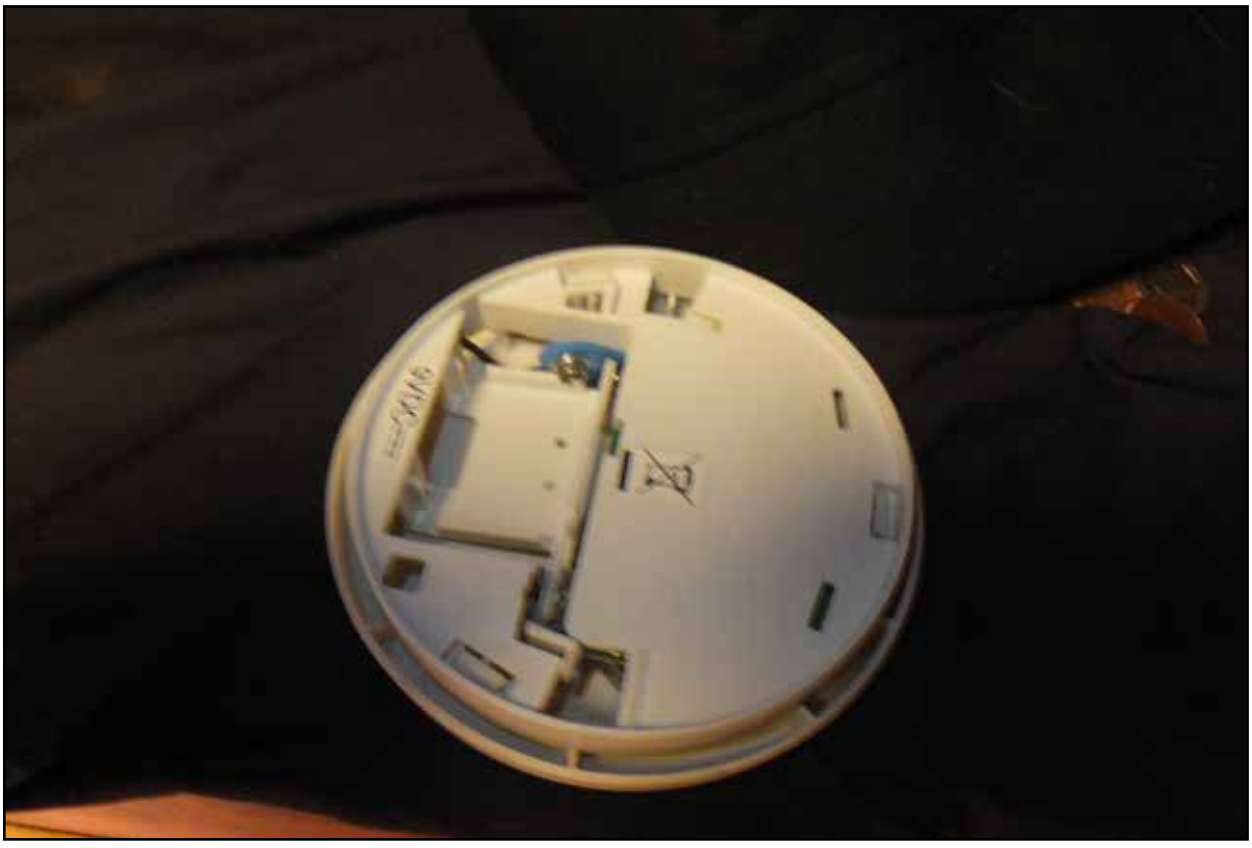


Figure 16: Smoke detector in sleeping area

- The Emergency Position Indicator Beacon (EPIRB)[4] was secured to the wheelhouse roof with a tie-wrap. The EPIRB was still registered in the name of the previous owner.

- Several empty packets of painkillers were found in the wheelhouse and on the deck.

- There was no toilet.

- There was no fridge.

On 17 January 2014, the gas cooker was disconnected and removed by a Gas Safe[5] registered engineer. The gas cooker, butane cylinder and regulator were taken to Kiwa Gastech at CRE[6], in order to be tested.

1.7 COOKER TESTS

The Kiwa Gastech at CRE test report **(Annex B)** noted that:

The combustion of the individual burners was measured and they were all within the limit of the BSEN203-1:2005+A1:2008 standard[7] with the exception of the grill. The combustion of the grill with and without the grill pan failed the limit stated in the standard (0.1%),

With the grill pan by a factor of:- Times 1.9

Without the grill pan by a factor of:- Times 3.1

This was probably because the metal gauze was badly corroded and actually holed in four places. The latter should have been obvious during any reasonable service and/or inspection.

A vitiation test of the grill was performed both with and without the grill pan and the results revealed extra-ordinary high levels of CO.

Both with and without the grill pan, the CO concentration in the room reached its limit of failure (200ppm) (based on vitiation test for Oxygen Depletion Device in BSEN509:2000) in about 37 minutes. When the test was performed for nearly 3 hours (without the grill pan) the CO concentration reached 2300ppm.

The volume of the Kiwa Gastec vitiation room (17.5m^3) is by co-incidence broadly similar to the Wheelhouse and the Accommodation of the Eshcol (15.3m^3).

[4] An EPIRB alerts rescue services by transmitting a coded message on the 406 MHz distress frequency via satellites. An EPIRB can usually be activated manually or automatically.

[5] From 1 April 2009, the Gas Safe Register became the official list of engineers who are qualified to work safely and legally on gas appliances.

[6] Kiwa Gastech at CRE is a United Kingdom Accreditation Service (UKAS) accredited product testing consultancy based in Cheltenham.

[7] MAIB explanatory note: BSEN203-1:2005+A1:2008 is the British Standard (BS) for 'Gas heated catering equipment' which implements the European Standard Norme Europeenne (EN) 203-1:2005+A1:2008

Due to the very high of carbon monoxide measured both with and without the grill pan (and the level with the frying pan is also expected to be very high) unless Eshcol was unusually well ventilated (compared to the forward cabin of most boats) it would seem extremely likely that the levels of CO that arose were considerably above the 100ppm usually injurious to health and were very likely to exceed the 800ppm that is usually regarded as fatal within a few hours. [sic]

1.8 GAS COOKER

The gas cooker fitted on board *Eshcol* was a Neptune 25002-4 (serial number 915916) which was manufactured in 2009 by Leisure Products (Bolton) Ltd. The cooker was then supplied to Plastimo and was purchased online by *Eshcol*'s owner at the time. The cooker was then installed on the vessel. The manufacturer's instructions for the installation and use of the Neptune 2500 gas cooker **(Annex C)** included:

THESE APPLIANCES MUST BE INSTALLED BY A COMPETENT PERSON (e.g. a Gas Safe registered gas fitter) [sic]

Adequate ventilation must be provided to ensure the cooker unit works in a safe and efficient manner. If fixed ventilation is not provided two ventilation openings of 70cm^2 (11 square ins) must be provided, one near floor level and one near ceiling level. Do not install cookers and hobs in areas subjected to strong draughts. [sic]

It is recommended that this appliance is professionally serviced at least every 2 years.

Do not use this appliance to heat the vehicle or craft.

Turn off the grill once the grill pan has been removed.

Leisure Products (Bolton) Ltd and its Neptune 2500 model were certified to meet the essential requirements of Directive (90/396/EEC) – Directive on appliances burning gaseous fuels **(Annex D)**.

1.9 VESSEL OWNERSHIP AND INSPECTION

Eshcol was built in Belfast, Northern Ireland and was first registered on 16 June 2005. The vessel was sold 4 months later to a Scottish-based owner. *Eshcol* changed hands again in 2008 and operated from Northern Irish and Scottish ports until being sold in February 2013. The vessel's registration was then changed from Belfast to Milford Haven.

Eshcol predominantly dredged the fishing grounds off Amble, Northumberland, for most of 2013. In October 2013, the vessel was sailed back to Milford Haven to be sold. Between 2005 and October 2013, *Eshcol* had predominantly fished during the day and stayed alongside overnight, except when on passage.

Eshcol was last sold on 21 November 2013 for £100,000. The new owner, however, had started to work on the vessel in Milford Haven in the last week of October. This work included repairing the generator and the fitting of topping winches and a liferaft; the new owner also supplied four new solid foam-filled lifejackets. During the change of ownership, *Eshcol* was inspected by an MCA surveyor in Milford Haven on 29 October 2013. The surveyor was aware that the vessel had been inspected 9 months previously and focused mainly on the vessel's lifesaving and safety equipment. No deficiencies were identified.

The owner intended to operate *Eshcol* until the summer 2014 when he planned to refit the vessel in Milford Haven. The refit plan included the replacement of the gas cooker with an electric cooker.

1.10 RECENT OPERATION

When *Eshcol*'s owner purchased the vessel, he already owned *Accord*, which he bought for £65,000 in February 2013, and *JMT*, for which he paid £60,000 in July 2013. Both *Accord* and *JMT* were fitted with electric cookers, but neither had CO alarms. The owner spent about an additional £90,000 refitting *Accord* and *JMT* in Milford Haven before he operated the vessels commercially.

Eshcol, *Accord* and *JMT* fished out of Milford Haven during November 2013 with the owner and his son crewing *Eshcol*. However, the weather and fishing were poor, so in early December 2013 the vessels moved into the North Sea via the Caledonia Canal and fished out of Whitby. *Eshcol*'s crew now comprised a skipper, which the owner had engaged through *www.findafishingboat.com* and two deckhands.

On about 20 December 2013, the owner visited his vessels in Whitby and found that *Eshcol*'s crew had been selling some of the vessel's catch and keeping the money raised, and that they were no longer on board. The owner was unable to contact the crew and, when he tried to move *Eshcol*, he discovered that its main engine had seized due to a lack of oil.

The owner remained on board *Eshcol* over the Christmas period and stripped down its main engine. The engine was then rebuilt after Christmas with the assistance of a marine engineer. The owner then returned to his home in Wales for the New Year. To keep warm during his time on board *Eshcol* in Whitby, the owner used a portable generator to power the electric fan heater carried on board **(Figure 15)**. He also used the gas cooker oven to heat food; he did not use the grill.

Eshcol remained alongside in Whitby until Mark and his crew joined on 8 January 2014. The vessel's fishing pattern between 8 and 15 January 2014 is at **Table 1**.

Date	Sail from Whitby	Arrive Whitby	Bags of Scallops Landed	Time at sea	Time alongside
8 January	1325			18hrs 20 mins	
9 January		0745	15		26hrs 10mins
10 January	0955			28hrs 35mins	
11 January		1430	0 (weather)		6hrs 20 mins
11 January	2050			18hrs 20mins	
12 January		1510	35		20hrs 55mins
13 January	1205			36hrs 40mins	
15 January (until 0045)		0045	26		

Table 1: *Eshcol*'s fishing pattern between 8 and 15 January 2014

When fishing, *Eshcol*'s crew took turns in the wheelhouse. The duration of each tow was between 1 and 1.5 hours, with the crew taking about 30 minutes to sort the catch. Only very brief periods of sleep were possible. The time taken to unload the catch in Whitby was about 1 hour.

Between 8 and 15 January, the cooker was used to heat the wheelhouse on several occasions. On 13 January, the second deckhand vomited shortly after he had been in the wheelhouse with the gas cooker lit. The crew were not aware that the fan heater was working and had never connected the vessel to the shore power when alongside in Whitby. The generator was only started on one occasion, but it was quickly stopped because fumes leaked from its exhaust inside the engine room and spread into the wheelhouse and sleeping area.

The crew used a bucket on the vessel's deck as a toilet when at sea. When alongside in Whitby, they used public toilets in public houses and in the fish market.

Although *Eshcol*, *Accord* and *JMT* were fishing out of Whitby, only the landing of their catch was co-ordinated. The skippers made their own decisions on where to fish. Any issues or requirements that skippers needed to raise with the owner were channelled through the owner's son on board *Accord*. When the owner met *Accord* in Whitby on 14 January 2014, he provided two recently-purchased halogen heaters which his son had requested.

1.11 CARBON MONOXIDE POISONING

CO is a by-product of combustion appliances burning fossil fuels and has almost the same density as air. CO has no smell or taste and for this reason it is sometimes referred to as the 'silent killer'. CO poisoning occurs by inhalation. CO binds tightly to haemoglobin[8] to form COHb. This process displaces oxygen and deprives the tissues and organs of normal oxygen supply.

[8] Haemoglobin in the blood carries oxygen from the lungs to the rest of the body.

While a person is exposed to CO, the levels of COHb in the blood continue to rise. However, once the exposure to CO is stopped, the level of CO is reduced through exhalation as COHb reverts back to oxyhemoglobin. The removal of CO from the bloodstream can be quickened by the breathing of pure oxygen or the use of a hyperbaric chamber.

High saturation levels of CO in the blood can cause death; lower saturation levels cause illness. The effects of CO poisoning on adults are shown at **Table 2**. The most recognisable symptoms are:

- headaches
- vomiting
- tiredness and confusion
- stomach pain
- shortness of breath and difficulty breathing.

Effects of carboxyhaemoglobin on human beings			
% CO	**Parts per million (ppm)**	**Effects on adults**	**% Saturation of CO in blood stream**
0.01	100	Slight headache in 2-3 hrs.	13%
0.02	200	Mild headache, dizziness, nausea and tiredness after 2-3 hrs.	20% - 30%
0.04	400	Frontal headache and nausea after 1-2 hrs.; risk to life if over 3hrs exposure	36%
0.08	800	Severe headaches, dizziness, convulsions within 45 minutes; unconsciousness and death possible after 2-3hrs	50%
0.16	1600	Headaches, dizziness and nausea within 20 minutes; collapse, unconsciousness and death possible within 1-2hrs	68%
0.32	3200	Headache, dizziness and nausea within 5-10 minutes	70% - 75%
0.64	6400	Severe symptoms within 1-2 minutes; death within 15 minutes	80%
1.28	12800	Immediate symptoms; death within 1-3 minutes	85% - 90%

Table 2: Symptoms of carbon monoxide poisoning[9]

[9] Essential Gas Safety Manual-Domestic. Sixth Edition: Published March 2012

It is estimated that 50 people in the UK are killed by CO poisoning each year. At least a further 4,000 people are treated for CO poisoning in hospital. However, the number of people poisoned by CO is likely to be much higher than these figures indicate, as CO poisoning is very difficult to diagnose because symptoms are often similar to common illnesses like flu and food poisoning.

1.12 SAFETY TRAINING AND RISK ASSESSMENT

1.12.1 Training

Seafish is responsible for the development, delivery and certification of mandatory fishermen's training. All fishermen are required to undertake mandatory safety training in sea survival, fire-fighting, first-aid, and health and safety within 3 months of first going to sea. In addition, fishermen with 2 years of experience must also attend a safety awareness course.

The specification of the health and safety course includes a session on safe working which, among other things, teaches fishermen to:

- *List common dangers associated working on a fishing vessel* [sic]
- *Identify the ways to minimise the risks associated with the common dangers.*

In support of each of the mandatory courses, Seafish issues a digital presentation to its trainers. The presentation for the health and safety course includes a slide on '*How Safe is the galley'* **(Figure 17)**, but the course does not specifically cover the risks of using gas or other fossil-burning fuels on board. The presentation for the safety awareness course includes slides covering 'working below deck' which prompt instructors to refer to the guidance regarding the dangers of CO poisoning. However, the presentation does not specifically cover the risk of CO poisoning from domestic appliances.

Figure 17: Presentation slide from the Seafish health and safety course

1.12.2 Fishing Vessel Safety folder

To help fishing vessel owners and skippers to safely manage their vessels, Seafish supplies its Fishing Vessel Safety Folder, which includes: checklists for inspections and emergencies; crew details and induction training; plans and risk assessments. Record templates to assist owners to conform with the Provision and Upkeep of Work Equipment Regulations (PUWER) and the Lifting Operations and Lifting Equipment Regulations (LOLER) are also included. The folder is available in hard copy and is supplied to fishermen attending the Seafish safety awareness course. Alternatively, it can be completed and maintained online.[10]

The risk assessment section of the folder includes:

Risk id	***Work process/action undertaken in area***	***Hazard associated with activity***
2.16	*Galley*	*Fire leading to vessel loss, death or serious injury* *Poor hygiene practices leading to illness*
2.17	*Enclosed spaces*	*Uncontrolled entry leading to death or serious injury*
2.18	*Below deck ventilation and temperature*	*Poor air quality leading to illness*

The safety folder does not include the risks and hazards associated with the use of gas or other fossil fuel burning appliances.

1.13 CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS

1.13.1 Merchant Shipping Notice (MSN) 1813(F)

The code of practice for UK registered fishing vessels of less than 15m length overall (LOA) is contained in Merchant Shipping Notice (MSN) 1813(F) - The Fishing Vessels Code of Practice for the Safety of Small Fishing Vessels. This Code is associated with the Fishing Vessels (Code of Practice for the Safety of Small Fishing Vessels) Regulations 2001.

Among other things, the Code sets out requirements on vessel owners with regard to the carriage of safety equipment and self-inspection. The minimum safety equipment to be carried on board vessels of less than 10m LOA is at **(Annex E)**.

Guidance on the Code's requirements provided to surveyors, inspectors and fishermen at Annex 3 to the Code includes:

[10] The www.safetyfolder.co.uk website was developed and is maintained by Rockall Marine, which is responsible for its operation and content. The website facilitates the completion of the Seafish safety folder online and helps fishing vessels comply with UK and European Maritime laws. Email is used to remind vessel owners of routine tasks and equipment services, which is particularly useful for small vessels.

Gas Detector

Suitable means for detecting the leakage of gas (i.e. Liquefied Petroleum Gas, Butane, Propane or other flammable gases) should be provided in a compartment containing a gas-consuming appliance or in any adjoining space or compartment into which the gas, of greater density than air, may seep.

The Code does not include any requirements or guidance on the installation or use of LPG appliances.

1.13.2 Marine Guidance Note 502(F)

In February 2014, the MCA issued Marine Guidance Note (MGN) 502(F) – *The Code of Practice for the Safety of Small Fishing Vessels – Standards which can be used to prepare for your MCA Inspection.* The Note was based on MSN 1813(F), revised to take into account MAIB findings from its investigations.

The Code contained within MGN 502(F) sets out the full text of the proposed revision to MSN 1813(F) which will become mandatory within 2 years. Until that time, the extant MSN 1813(F) provides the reference against which vessels are considered to comply with the Regulations. However, fishing vessel owners and skippers are permitted to use the Code contained in MGN 502(F) when preparing for mandatory inspections. During MCA inspections, compliance with this Code is treated as a demonstration of compliance with the Regulations and MSN 1813(F).

The differences between MGN 502(F) and MSN 1813(F) primarily concern the carriage of liferafts, vessel survey, vessel inspection, emergency drills, radar reflectors, bilge alarms and structural modifications. MGN 502(F) contains no additional requirements or guidance on the installation and use of gas-burning appliances.

1.14 USE OF LPG ON BOARD FISHING VESSELS

1.14.1 Marine Guidance Note 312(F)

MGN 312(F) – Use of Liquid Petroleum Gas (LPG) and Diesel Fuelled Appliances on Fishing Vessels **(Annex F)** was published by the MCA in 2006. The note provides advice on reducing the risk of explosion or CO poisoning from the fitting and use of LPG cookers and heaters and ‘closed flame’ diesel heaters. It includes:

4. For LIQUID PETROLEUM GAS (LPG) HEATERS AND COOKERS. The following summarises the main requirements of MSN 1770 The Code of Safe Working Practice for the Construction and Use of 15m LOA to Less Than 24 metre Registered Length Fishing Vessels.

- *Installations using LPG should be safely fitted and protected from damage. BS EN (ISO) 10239 provides guidance on this.*
- *LPG Cylinders/Bottles should be stored on deck or in a well ventilated compartment on deck*
- *Spaces containing LPG appliances should not have openings leading directly below to accommodation spaces or their passageway (unless specific provision is made for mechanical exhaust and supply ventilation).*

- *Spaces containing an LPG appliance should be adequately ventilated.*

- *Spaces containing an LPG appliance should be provided with a gas detector with an audible alarm and control unit outside the space. In sleeping quarters the alarm should be located inside the compartment.*

- *A device should be fitted in the supply pipe from the gas container to the appliance that will automatically shut off the gas in the event of a loss in pressure in the supply line. Manual resetting of this device must be the only means of restoring the supply.*

- *An automatic flame failure device shall be fitted on appliances burning LPG.*

- *LPG heating appliances used in any accommodation space (in addition to sleeping quarters) should be fitted with a flue to the exterior of the vessel via a clear unblocked exhaust.*

- *Carbon monoxide monitoring devices should be fitted in all compartments where LPG heating appliances are fitted.*

The MGN strongly recommends that these requirements also be applied to fishing vessels of 15m LOA and under.

The MGN also highlights that the use of LPG or diesel oil systems to heat accommodation spaces is not permitted on vessels of 24m registered length (R) or over. It also warns that where such systems are used on fishing vessels less than 24m in registered length, death and injury may result from the incorrect installation or maintenance of such systems.

1.14.2 Marine Guidance Note 425(M+F)

MGN 425(M+F) – *Assessment of Risks for those sleeping on "Dead Ship"* was published by the MCA in September 2010 to draw the attention of fishing vessel owners and crew to the dangers on vessels not properly equipped for overnight sleeping. The main points of the MGN are:

- *Ensuring a risk assessment is carried out and procedures are in place to deal with any emergencies;*

- *Ensuring that escape routes are kept clear and are known by the crew;*

- *Checking that alarm systems work both on shore and ship's power and that the crew know how to check that they are;*

- *Ensuring that fire precautions are being adhered to.*

The MGN states that:

> *3.3 It is strongly recommended that the alarm systems be capable of detecting, not only smoke and high level bilge levels but noxious and flammable gases.*

It also includes, under fire precautions:

7.1.2 Wherever possible LPG and diesel open flame or catalytic heaters should be avoided. If these are permitted and installed is the installation in compliance with MGN 312 (storage of gas and ventilation)? [sic]

7.1.4 Are gas and carbon monoxide detectors provided?

7.1.8 Are unapproved cooking or heating appliances being used (e.g. some crew have been found cooking with portable gas cookers in their cabins)?

7.1.9 Free standing heaters should not be used.

7.1.10 Are all electrical appliances safe, with correct wiring, fuses (e.g. radios, TV's, toasters, kettles, phone chargers etc.).

1.15 USE OF LPG ON OTHER SMALL COMMERCIAL VESSELS

Small commercially-operated vessels which are registered in the UK must comply with the applicable code of practice for the sector in which they are engaged. The existing Codes are:

- The Safety of Small Commercial Motor Vessels – A Code of Practice.
- The Safety of Small Commercial Sailing Vessels – A Code of Practice.
- The Code of Practice for the Safety of Small Workboats & Pilot Boats.
- The Code of Practice for the Safety of Small Vessels in Commercial Use for Sport or Pleasure Operating from a Nominated Departure Point (NPD).

In 2004, the MCA issued MGN 280 (M) Small Vessels in Commercial Use for Sport or Pleasure, Workboats and Pilot Boats – Alternative Construction Standards, in order to rationalise the existing small vessel codes. This Code, which is known as the SCV Code, has not yet been established in law but is accepted as an equivalent standard to the other Codes.

Annex 5 of the SCV Code details the requirements for LPG installations intended for domestic use **(Annex G)**.

1.16 PROVISION AND USE OF WORK EQUIPMENT

The Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006 came into force on 24 November 2006. The Regulations implement, in part, overarching European Directives. MGN 331 (M+F) – The Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006, provides details and guidance on the interpretation of the Regulations. It also provides general safety advice and advises on compliance with the law. MGN 331 states:

These Regulations and this Marine Guidance Note are aimed at the prevention of accidents arising through mechanical failure, corrosion, fatigue, inappropriate repairs or modifications and poor maintenance as all of these can contribute to reduced safety margins. [sic]

MGN 331 (M+F) highlights the general legal obligations and what employers must do and includes:

3. INSPECTION OF WORK EQUIPMENT

3.1 Where the safety of work equipment depends on the manner in which it was installed it should be inspected by a competent person after installation and before being brought into use. [sic]

3.2 It is strongly recommended that the maximum interval between inspections should be 5 years for work equipment, or such shorter period as is recommended by the manufacturer. Further guidance on inspections should be aligned with equipment manufacturers' recommendations. [sic]

3.3 A "competent person" should carry out all inspections.

The Annex to MGN 331 (M+F) details each of the Regulations and provides guidance on their interpretation and implementation. With regard to Regulation 4 – Application, the MGN states:

8. Where on any ship or fishing vessel the crew comprises self-employed persons wholly or in part, the person responsible for the operation of that ship or fishing vessel shall be responsible for compliance with the provisions of these Regulations as if those self-employed persons were workers and shall ensure compliance by those persons as if they were workers for the purposes of these Regulations.

1.17 ACCOMMODATION STANDARDS

1.17.1 Fishing vessels less than 15m LOA

(MSN) 1813(F) - The Fishing Vessels Code of Practice for the Safety of Small Fishing Vessels does not specify any accommodation standards for vessels of less than 15 LOA.

1.17.2 Fishing vessels between 15m LOA and 24m (R)

The accommodation standards required for fishing vessels between 15m LOA and 24m (R) are detailed in MSN 1770. For vessels constructed after 1995 it includes:

10.1.1.1 The crews living quarters, where they exist, should be such as to minimise noise, vibration, the effects of motion and acceleration and unpleasant odours from other parts of the vessel.

10.1.1.2 On vessels with crew accommodation, toilets, wash basins and if possible a shower should be installed and the respective areas should be properly ventilated.

10.1.1.5 A refrigerator or other low temperature storage should be provided.

10.1.2.7 Crew accommodation spaces should be properly ventilated to ensure a constant supply of fresh air and to prevent condensation.

With regard to existing fishing vessels of less than 18m in length between perpendiculars (LBP), MSN 1770(F) recommends:

> *10.1.3.1 When a vessel is intended to be at sea for more than 24 hours and adequate standard of accommodation should be provided on board. In considering such accommodation, the primary concern should be directed towards providing facilities that contribute to the health and welfare aspects of those on board i.e. the sleeping accommodation, the ventilation, the sanitary facilities, the lighting and fresh water and galley services. Wherever possible, consideration should be given to providing the facilities that are detailed in section 10.1.1.* [sic]

1.17.3 Other small commercial vessels

With regard to accommodation standards, the SCV Code includes similar requirements to MSN 1770(F).

1.18 FISHING VESSEL WORKING TIME REGULATIONS

The Fishing Vessels (Working Time: Sea Fishermen) Regulations 2004 apply to UK fishing vessels but they do not apply to the self-employed, including share fishermen. MSN 1786(F) Application of The Fishing Vessels (Working Time: Sea Fishermen) Regulations 2004 explains the requirements of the Regulations which, inter alia:

- Specify that a worker's working time shall not exceed 48 hours per 7 day period averaged over 52 weeks;
- Entitle a worker to adequate rest, and the total hours of rest are to be not less than 10 hours in any 24 hour period and 77 hours for each 7 days;
- Permit exceptions to the limits on hours of rest for objective and technical reasons or reasons concerning the organisation of work.
- Permit a skipper to require a worker to work any hours in an emergency.

Annex 1 to MSN 1786(F) contains the Fishing Industry Code of Practice on Working Time Standards, which states that although the Code cannot be enforced against self-employed fishermen, it should be used as a benchmark to avoid excessive hours. The Code was drawn up in recognition of the 'hunting' aspect of fishing, together with weather and tidal constraints, that make it difficult for fishermen to comply with rigid hours of work and rest.

1.19 INTERNATIONAL LABOUR ORGANIZATION CONVENTION 188

The International Labour Organization (ILO) Convention 188 (C188) – Work in Fishing Convention, 2007, details requirements for crew welfare facilities on board fishing vessels. The Convention details, inter alia, minimum requirements for work on board fishing vessels, conditions of service and medical care, health protection and social security.

With regard to manning and hours of rest, ILO C188 states:

- *For fishing vessels regardless of size remaining at sea for more than three days, after consultation and for the purpose of limiting fatigue, establish the minimum hours of rest to be provided to fishers. Minimum hours of rest shall not be less than:*

  (i) Ten hours in any 24 hour period

  (ii) 77 hours in any 7 day period

The Convention allows exceptions to these requirements in specific situations and for Flag States to establish alternative equivalent requirements.

ILO C188 also includes requirements for fishing vessel accommodation. These requirements are at **Annex H**.

ILO C188 is not yet in force (it will come into force internationally 12 months after it has been ratified by 10 countries, including at least 8 with a coastline), but is widely supported by governments, fishermen's organisations and fishing vessel owner organisations. As of April 2014, the Convention had been ratified by Argentina, Morocco, Bosnia and Herzegovina and South Africa.

1.20 MCA WORK PROGRAM

1.20.1 Guidance on crew welfare facilities on board fishing vessels

In response to recent accidents on board fishing vessels, the MCA is working towards publishing guidance on accommodation and welfare provisions that it expects to be made available on new and existing fishing vessels. The guidance will take into account the requirements of ILO C188 and is scheduled to be published, following consultation, during 2014.

1.20.2 Strategy to eliminate preventable deaths in the UK commercial fishing industry

In MAIB's *Analysis of UK Fishing Vessel Safety 1992 to 2006*[11], recommendations to the MCA included:

In developing its plan to address the unacceptably high fatality rate in the fishing industry, identified in its study of statistics for the years 1996 to 2005, in addition to delivering the actions outlined at 6.2, the MCA are recommended to consider the findings of this safety study, and in particular to:

- *Work towards progressively aligning the requirements of the Small Fishing Vessel Code, with the higher safety standards applicable under the Workboat Code.*

In response, an objective identified in its medium term fishing vessel strategy and formalised in its 2014-2016 business plan is:

[11] http://www.maib.gov.uk/cms_resources.cfm?file=/FishingVesselSafetyStudy.pdf)

Objective	*Comment*
Developing an Under 15m Code based on the Small Commercial Vessel and Pilot boat Code	*To review the Small Commercial Vessel and Pilot Boat Code and consider, with industry, what aspects can and should be applied to Under 15m Fishing Vessels.*

The target date for the development and issue of alternative small fishing vessel standards based on the SCV Code is April 2016.

1.21 CO POISONING ON RECREATIONAL CRAFT

The Boat Safety Scheme (BSS)[12] records data of CO related incidents concerning boats on inland waterways and also on boats having similar characteristics to inland craft. **Table 3** shows data for a 20 year period, up to February 2014, in which 30 boat-related CO fatalities were recorded. The largest number of fatalities was caused by portable petrol generators.

Source of CO	Fatalities
Portable petrol generator	9
LPG Appliance	8
Solid/multi fuel appliance	6
Petrol outboard engine	5
Oil fired (diesel) stove	1
Portable diesel generator	1

Table 3: BSS data – CO fatalities

In order to raise the awareness of owners of craft using inland waterways, the BSS, in partnership with the Council of Gas Detection and Environmental Monitoring (CoGDEM), has published a leaflet aimed at boaters - '*Carbon Monoxide Safety On Boats*' **(Annex I)**. This includes advice on the symptoms of CO poisoning and on the purchasing and siting of an alarm. A number of other organisations have also been involved in increasing awareness of the dangers of CO in the marine environment and promoting the use of CO monitors on board boats. These include the Gas Safe Register and United Kingdom Liquefied Petroleum Gas (UKLPG).

1.22 CO ALARMS

CO detectors are designed to trigger an alarm based on an accumulation of CO over time or a sudden rise in CO. Detectors may operate by a chemical reaction causing a colour change, an electrochemical reaction that produces current to trigger an alarm, or a semiconductor sensor that changes its electrical resistance in the presence of CO. Most CO detectors require a continuous power supply, so if the power cuts off, or the batteries fail or are removed, then the alarm becomes ineffective. If a boat has CO alarms connected to the boat's power supply, it is good practice to use 'stand-alone' alarms in addition. This will ensure that the occupants

[12] The BSS is a public safety initiative owned by the Canal & River Trust and the Environment Agency. Its purpose is to help minimise the risk of boat fires, explosions, or pollution harming visitors to the inland waterways, the waterways' workforce and any other users.

are protected should the boat's power fail or become disconnected. CO alarms meeting the safety standard EN 50291-2:2010 are intended for use in a marine environment.

The leaflet published by the BSS and CoGDEM **(Annex I)** advises:

Try to place the alarm:

- *in living quarters between 1m and 3m (on plan view) from the appliance*
- *in living quarters fix alarms high up on a wall, but at least 150mm from the ceiling and where the indicator lights can be seen*
- *in sleeping quarters have the alarm in the "breathing zone", i.e. near the bed head*
- *before fixing, test that you can hear an alarm from any position in the boat (or buy an additional alarm).*

Persons are most at risk when they are asleep. For this reason the 'black spot' detectors that change colour when CO is present are not suitable for boats that are to be used overnight as they do not produce an audible alarm.

The set points at which alarm indicators and audible alarms must operate simultaneously to comply with the safety standard EN 50291-1[13] are at **Table 4**. Once activated the alarm should continue to operate at carbon monoxide concentrations above 50 ppm.

CO concentration	Without alarm before[14]	With alarm before[15]
30 ppm	120 min	-
50 ppm	60 min	90 min
100 ppm	10 min	40 min
300 ppm	-	3 min

Table 4: EN 50291-1 alarm conditions

CO detectors intended for use in a marine environment are tested to the more rigorous safety standard EN 50291-2[16] and will function as effectively on a boat as in the home.

The threat of CO poisoning is becoming more widely recognised in the UK, with stricter legislation recently being introduced for new dwellings and new caravans. Buildings regulations introduced in 2010 for new dwellings require a CO alarm to be fitted in the same room as a new or replacement fixed solid fuel heating appliance. CO alarms compliant with BS EN 50291 have also been required in new touring caravans and motorhomes since 1 September 2011.

[13] BS EN 50291-1:2010+A1:2012 – Electrical apparatus for the detection of carbon monoxide in domestic premises. Part 1: Test methods and performance requirements.

[14] 'Alarm must not activate before'

[15] 'Alarm must activate before'

[16] BS EN 50291-2:2010 - Electrical apparatus for the detection of carbon monoxide in domestic premises. Part 2: Electrical apparatus for continuous operation in a fixed installation in recreational vehicles and similar premises including recreational craft – Additional test methods and performance requirements.

1.23 PREVIOUS SIMILAR ACCIDENTS

Unnamed canal boat

In January 2014, a portable generator was used to provide electric power for domestic equipment on board a 40ft long narrow boat being used on inland waterways as a permanent home. The generator was operated under a tonneau cover, which allowed CO to accumulate and enter the accommodation area through unsealed doorways. The boat's owner was found dead on board. Postmortem examination determined that the cause of death was CO poisoning. The boat was not fitted with a CO alarm.

Arniston

On 1 April 2014, a mother and her 10 year old daughter were fatally poisoned by CO on board *Arniston*, a Bayliner motor cruiser[17]. The CO was exhausted from a portable generator installed in the motor cruiser's engine bay. The generator's exhaust, which had been modified to take the exhaust fumes out of the vessel via a through-hull fitting, had failed. The exhaust fumes spread into the cabin where the mother and her daughter were sleeping. The vessel had been fitted with two carbon monoxide alarms at build, but they were out of date for replacement and had been disconnected from the vessel's power supply. The Safety Bulletin covering the immediate safety issues highlighted from the accident is at **Annex J**.

Starlight Rays

In August 2011, one crewman died and two more crewmen required evacuation to hospital by helicopter for medical treatment when they were poisoned by CO on board the 23m fishing vessel *Starlight Rays*[18]. The vessel was acting as a guard vessel, more than 100 miles from land.

Two crewmen took a petrol engine-driven salvage pump into the fish hold to pump oily water from the bow thruster space. The petrol engine ran for more than an hour in a compartment with no mechanical ventilation allowing CO from the engine's exhaust to build up to fatal levels. The crewman who worked close to the engine was overcome by the poisonous fumes. Three other crewmen risked their lives to try and save him.

Following the accident, the MCA undertook to, inter alia:

Request that Seafish:

- *Ensures that the dangers of enclosed spaces and the difficulties of rescuing crewmen are in the syllabi and discussed in the fire-fighting and safety awareness courses.*

Submit the following issues for discussion at Fishing Industry Safety Group:

- *Ensure that the Communications Sub Committee discusses the lessons learnt from this investigation and transmits these lessons to fishermen.*

[17] *MAIB Report xx/14 – to be published*

[18] MAIB Report 15/2012 http://www.maib.gov.uk/publications/investigation_reports/2012/starlight_rays.cfm

In addition to its investigation report, the MAIB also issued a Safety Flyer to the fishing industry **(Annex K)**.

Goole Star

In December 2009, a crewman on board the self-powered barge *Goole Star* was found dead in the vessel's forward store. He had collapsed next to a portable petrol powered generator. Ambulance crews could not revive the crewman and the postmortem examination determined that he had very high levels of carbon monoxide in his blood.

The generator was not part of the vessel's equipment and was found to have been brought on board by the crewman for his own purposes. There was still petrol in the generator's fuel tank and the controls were set to allow it to run. Ventilation openings to the forward store were still closed in the sea going position and, although the hatch was partially open, it is likely that carbon monoxide in the exhaust fumes built up quickly and overcame the crewman when he attempted to run the generator.

Pamela S

In January 2006, a crewman on board the 16m potter *Pamela S* died from carbon monoxide poisoning. He was using the vessel as temporary accommodation while he sought permanent accommodation ashore, and had placed a portable petrol-driven generator into the adjacent fish hold to provide power to the cabin area. The bulkhead between the spaces was not gas-tight, and the crewman died from inhaling exhaust fumes as he slept.

Mariama K

In June 2000, an engineer on board the 29m fishing vessel *Mariama K* died from CO poisoning after a portable petrol-driven engine was used inside the engine room to pump the vessel's bilges prior to leaving port[19]. The engineer was found unconscious, slumped over the pump, which was still running. The crew and the emergency services tried to resuscitate the engineer, but their attempts were unsuccessful and he was later declared to be deceased. While lifting the engineer out of the engine room, members of the emergency services and two of the vessel's crew were also badly affected by CO.

Every year a number of near misses are also reported to the MAIB. In almost all of these cases the occupants of the vessel were unaware they were being poisoned by CO because they did not have a functioning CO alarm.

[19] MAIB report 12/2001 http://www.maib.gov.uk/publications/investigation_reports/2001/fv_mariama_k_fr242.cfm

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 POISONING MECHANISM AND TIME FRAME

Postmortem examinations determined that Mark and Edward died from CO poisoning; their CO saturation levels measured at 62% and 68% respectively. These levels were extremely high and indicate that the concentration of CO in the atmosphere of *Eshcol*'s sleeping area during the early hours of 15 January 2014, was at least 1600ppm **(Table 2)**.

The source of the CO was, without question, the lit grill of the butane-fuelled cooker. The only other sources of CO on board *Eshcol* were the main engine, which was shut down at about 0310, and the diesel generator. Although the generator's exhaust was defective and its fumes had the potential to spread into the sleeping area, the generator had been run only briefly on one occasion in the previous week.

As the wheelhouse door and windows were closed and the wheelhouse and sleeping area were not ventilated by any other means, very little fresh air would have been able to enter the compartment.

The results of the vitiation tests on the gas grill **(Paragraph 1.7** and **Annex B)** show that, without a grill pan in place, the concentration of the CO from the lit grill in the vitiation chamber reached the life-threatening level of 800ppm in 1 hour and 30 minutes. A CO concentration of 2300ppm was reached in 2 hours and 50 minutes.

The volume of the vitiation chamber used for the tests was 17.5m^3 whereas the volume of the wheelhouse and sleeping area on board *Eshcol* was approximately 15.3m^3 **(Figure 7)**. Therefore, even less time would have been required for the concentration of CO to reach these levels on board *Eshcol*[20]. As the wheelhouse and sleeping area were connected by a large open access **(Figure 8)**, they were effectively a single compartment.

Table 2 shows that exposure to such high concentrations of CO can lead to death in less than 2 hours. Mark and Edward probably went to bed shortly after 0310, therefore they had been in the sleeping area for nearly 7 hours by the time they were found. This was ample time for the CO poisoning to cause their deaths.

2.3 GAS COOKER INSTALLATION AND CONDITION

The gas cooker installation on board *Eshcol* did not follow the recommendations for vessels less than 15m LOA detailed in MGN 312(F) **(Paragraph 1.14.1)**. The installation also did not comply with the manufacturer's instructions **(Paragraph 1.8** and **Annex C)**. In particular:

[20] The volume of 15.3m^3 is also probably an over-estimate as it does not take into account the fixtures and fittings inside the wheelhouse and sleeping area such as the bunks.

- The sleeping area led directly from the wheelhouse where the cooker was sited; it was also on a lower level.

- The sleeping area was not ventilated.

- No CO monitoring devices were fitted.

- The cooker was positioned by the door and under a window, an area in which strong draughts were inevitable.

- It is evident from the cooker's condition **(Figure 12** and **Annex B)** that it had never been properly serviced since it was fitted in 2009.

Consequently, the gas cooker fitted on board *Eshcol* was not fit for purpose and was a danger to the vessel's crew. The levels of CO emitted from its grill were potentially hazardous to health, even with the wheelhouse door being frequently opened. It is possible that the deckhand's sickness on 13 January 2014 was a symptom of CO poisoning. With the wheelhouse door and windows closed, and without any other means of ventilation, the grill's CO emissions over several hours were lethal.

The high levels of CO emitted from the lit grill were the result of incomplete combustion. Fossil fuels such as butane contain carbon (C) and hydrogen (H). During complete combustion carbon and hydrogen combine with oxygen (O_2) to produce carbon dioxide (CO_2) and water (H_2O). During incomplete combustion part of the carbon is not completely oxidized, producing soot or carbon monoxide (CO). Incomplete combustion can occur for several reasons, including:

- insufficient mixing of air and fuel

- insufficient air supply to the flame

- insufficient time to burn

- cooling of the flame temperature before combustion is complete.

Typical reasons for incomplete combustion in gas appliances include: gas orifices being too large or too small (usually too large); rust, scale, or soot on the burner; incorrect installation of the burner; and insufficient combustion air.

In this case, the Kiwa Gastech at CRE test report **(Annex B)** highlighted that the high levels of CO emitted by the lit grill resulted from the corrosion and holes in the grill's metal gauze **(Figure 12)**. However, the lack of ventilation would also have been a contributory factor. The yellow flames produced by the lit grill **(Figure 11)** were typical of incomplete combustion, although this is not always the case.

Notwithstanding the high level of CO emissions from the grill, Mark and Edward's deaths could have been avoided had a properly positioned and functioning CO detector been fitted. A CO alarm would have alerted the crew as soon as concentration of CO started to rise. This would have given Mark and Edward ample time to take action. Indeed, noting how quickly the MAIB inspector's personal gas alarm activated on 16 January, it is likely that a CO alarm would have activated shortly after the grill was lit.

2.4 USE OF THE COOKER AS A HEATER

2.4.1 Decision-making

Two heaters were carried on board *Eshcol*. The heater fitted on the side of the bunk in the sleeping area **(Figure 14)** and the portable fan heater **(Figure 15)**, both of which required a 240V AC power supply. At sea, this was provided by the vessel's diesel generator; in port, power from ashore could also be used if available. However, it is evident that *Eshcol*'s crew did not ever use the heaters between 8 and 15 January 2014. Instead, on several occasions they had used the gas cooker to heat the wheelhouse.

The heater by the bunk did not work. However, it cannot be determined with any certainty why the crew did not use the fan heater, which worked when switched on by MAIB inspectors on 16 January. It could be that it was easier to light the gas cooker than to run the diesel generator (which had a leaking exhaust) or to connect shore power. However, in view of the fact that Mark turned down the offer of having *Eshcol*'s shore power cable connected while he unloaded the catch, it is more likely that the crew were under the impression that neither of the heaters worked, particularly as the fan heater was clearly damaged.

When *Eshcol*'s main engine was shut down shortly after 0310 on 15 January, it can only be assumed that Mark and Edward went directly to their bunks, leaving the gas grill lit, although, the possibility that they went to bed with the intention of turning off the grill later cannot be discounted. Either way, it seems that neither of the fishermen recognised the danger of leaving an open flame unattended or the danger of closing the wheelhouse door and windows in an otherwise unventilated space with the grill still lit. The need for warmth and sleep were clearly their overriding objectives.

2.4.2 Fatigue

Mark and Edward were extremely tired. From joining *Eshcol* on 8 January 2014 until going to bed at around 0310 on 15 January 2014, they had spent over 100 hours at sea. Given the short time-frame, it is impossible to determine whether the crew's hours of work and rest were in keeping with the spirit of the Fishing Industry Code of Practice on Working Time Standards **(Paragraph 1.18)**. However, the vessel's trip of over 28 hours in rough seas followed by only 6 hours respite alongside on 11 January, along with a final trip of over 36 hours, would have been particularly debilitating. Moreover, during their time on board, the men had very little chance to sleep other than for very brief periods, if at all. As the crew's bunks were in the forepeak and above the engine room, the noise of the engine and vessel's motion would have made sleeping very difficult. Given the unventilated atmosphere and the cramped and untidy conditions on board, the men would also have found it difficult to get good quality sleep even when *Eshcol* was alongside.

Research has shown that alertness and performance tend to be at their lowest during the early hours of the morning. This 'dip' in alertness, together with Mark and Edward's undoubted fatigue through a lack of sleep, particularly over the previous 39 hours, potentially affected their decision-making regarding the use of the gas grill. Their fatigue would have almost certainly led to them falling asleep very soon after going to bed.

2.5 AWARENESS OF THE DANGERS OF CO

Inhaling CO can be fatal but it is evident from this, and other similar accidents **(Paragraph 1.23** and **Table 3)**, that many professional and recreational mariners and members of the emergency services remain unaware of its characteristics and dangers. Cookers, heaters, internal combustion engines and barbeques all have the potential to cause CO poisoning, particularly if they are incorrectly installed, poorly maintained, or used inappropriately. It is a common misconception that CO is heavier than air and will tend to lie towards the bottom of a compartment. CO is about the same density as air and therefore mixes with air at all levels.

In this case, although *JMT*'s skipper and the owner's son acted with very good intent, it was fortunate that they were not affected by the CO when they forced their way into the wheelhouse. In high concentrations, CO can quickly incapacitate people in enclosed spaces. Although the fire service recognised the potential dangers of the situation and sent instructions to the paramedics not to go on board the vessel, the paramedics were on the scene so quickly that the message on the mobile display terminal was missed.

The action being taken by the BSS, CoGDEM and other organisations in order to raise the awareness of the dangers of CO to the owners and users of recreational craft, is positive. However, the BSS is targeting the owners of the 80,000 or so privately owned boats on the UK's inland waterways. The responsibility for raising the awareness of CO among the UK fishermen lies principally with the MCA and Seafish.

The MCA, through MGN 312(F) and MGN 425(M+F) in particular, has tried to raise the awareness of all fishermen to the precautions that need to be taken with regard to LPG installations and sleeping on board vessels that are not equipped for overnight sleeping. On this occasion, *Eshcol*'s owner and its crew had not followed the published guidance, notably the fitting of alarms covering noxious as well as flammable gases, probably because they did not know that such guidance existed. Fishermen's lack of awareness of available guidance is a long-standing problem that has proven difficult to overcome.

Raising fishermen's awareness of the dangers of CO may be best achieved through education during their mandatory safety training. Mark had attended the Seafish safety awareness course and the surviving crewman had attended the health and safety course. Therefore, had the sources and dangers of CO, and the importance of servicing gas appliances, been covered in more detail on the Seafish health and safety and safety awareness courses it is possible this tragic accident might have been avoided. The inclusion of the risk of CO poisoning in the template risk assessments contained in the Seafish fishing vessel safety folder would have been extremely beneficial.

2.6 REGULATIONS FOR THE USE OF LPG ON BOARD FISHING VESSELS

The requirements for LPG gas installations on board fishing vessels between 15m (LOA) and 24m (R) are summarised in MGN 312(F) **(Paragraph 1.14.1** and **Annex F)**. Although these requirements are also recommended for LPG installations on board fishing vessels less than 15m (LOA), they are not mandatory. The only mandatory requirement for vessels less than 15m LOA fitted with an LPG appliance is the fitting of a gas detector **(Paragraph 1.13.1** and **Annex E)**.

The Codes recognise the dangers of flammable gases (shown by the deaths of three fishermen on board *Tullaghmurry Lass* in 2002[21]). Such a difference in the application of mandatory requirements for LPG installations based on vessel length is not warranted considering that vessels less than 15m LOA are likely to have more confined accommodation areas and fewer options in terms of fuel and/or power.

In view of fishermen's lack of awareness of, or adherence to, current guidance on gas installations, the need to ensure that fishermen on board small fishing vessels are protected from CO to the same degree as those on larger vessels is compelling. As a minimum in the short term, and bearing in mind the various sources of CO, it is important that small fishing vessels are fitted with a CO alarm. However, for the reasons described in **Paragraph 1.22** and the BSS leaflet '*Carbon Monoxide Safety on Boats'*, it is important that all CO alarms fitted on board fishing vessels must at least comply with safety standard EN 50291-2:2010, which is suitable for marine use, and be properly sited.

MGN 502(F), issued in February 2014, sets out a revised Code for small fishing vessels, taking into account the lessons learned from accidents. In order to learn the lessons from the deaths of Mark and Edward, it is important that there is a requirement for a CO alarm to be fitted in the sleeping areas on all small fishing vessels when the revised Code comes into force in 2016, if not sooner. As a CO alarm can be purchased for as little as about £20, financial cost is not a valid argument against its regulatory requirement. The fitting of a CO alarm on a small fishing vessel is also no less important and no more onerous than fitting a CO alarm on board larger fishing vessels, new dwellings and caravans where their use is already mandatory.

2.7 LIVING CONDITIONS

Although *Eshcol* was fitted with four bunks in the sleeping area forward **(Figure 9)** the vessel was not appropriately equipped for crew to live onboard. The sleeping area was cramped and was also used to store equipment. There was no toilet or refrigerator on board, and the crew's only washing facility was the sink in the wheelhouse.

For much of its in service life, other than when on passage, *Eshcol* had been 'day running'. For example, when Mark had skippered the vessel during the summer of 2013, he had mainly sailed to and from Amble and had returned home to sleep overnight. Consequently, it is likely that the bunks on board *Eshcol* were used infrequently when the vessel was alongside in port. Immediately after the vessel's change of ownership in the autumn of 2013, *Eshcol* had fished off the Welsh coast. However, the vessel was then moved around to the North Sea with *Accord* and *JMT* to seek better weather and more productive fishing. This resulted in the vessels' crews having to sleep on board overnight when in port.

Unlike the 15m-24m fishing vessel and the SCV Codes, the Code for fishing vessels of less than 15m LOA (MGN 1813(F) does not detail any requirements whatsoever regarding crew accommodation **(paragraph 1.17)**. However, the incidence of small fishing vessels moving around the coast in search of better fishing or to take advantage of open fishing grounds appears to be increasing. More fishermen are having to live away from home and are sleeping overnight in port on board vessels

[21] MAIB report 4/2003 http://www.maib.gov.uk/publications/investigation_reports/2003/fv_tullaghmurry_lass_n246.cfm

that are not suitably equipped. In addition, as in this case **(Table 1)**, many of the small fishing vessels are also staying at sea for periods exceeding 24 hours when fishing. In order to protect the welfare of the crews on board small fishing vessels operating in this manner, the introduction of minimum accommodation standards on board small fishing vessels is now warranted. The proposed guidance on crew welfare facilities based upon the requirements of ILO C188 **(Paragraphs 1.19 and 1.20.1)**, which the MCA intends to publish in the near future, is a step in the right direction. However, evidence from previous accidents suggests that many fishing vessel owners will not be aware such guidance exists.

Should fishing vessel owners be alerted to revised guidance in accommodation standards there are a number of reasons why they might not comply. In particular, the limited space on board small fishing vessels often makes it very difficult to install toilets and other basic welfare facilities. Consequently, fishermen frequently accept the hardship of living on board a small fishing vessel as part of their way of life. It is usually not impossible to provide basic facilities, but owners tend not to due to the financial cost and the lack of any compelling regulatory requirement.

Irrespective of these reasons, it is unacceptable for commercial fishermen in the 21st Century to have to live and work in the conditions found on board *Eshcol* and similar vessels. There were obvious health implications from the crew members having to use a bucket on deck for a toilet, and from the lack of food storage facilities. Indeed, although it is possible that the deckhand's sickness on board on 13 January was due to the effects of CO, it is just as likely to have been caused by poor food hygiene or cleanliness.

2.8 VESSEL MANAGEMENT

2.8.1 Crewing, safety and upkeep

When *Eshcol* was inspected by the MCA in Milford Haven on the vessel's change of ownership in October 2013, no deficiencies were identified. Yet, when the vessel was inspected in Whitby on 16 January 2014, 34 deficiencies were identified and *Eshcol* was detained. Such an apparent deterioration in the vessel's condition in just over 2 months was probably due to the fact that the inspection in October 2013 focused mainly on the vessel's lifesaving and safety equipment.

Although variations in the standard of fishing vessel inspections are of concern and have been raised in previous investigation reports, the responsibility for *Eshcol*'s seaworthiness and compliance with the applicable regulations rested with its owner. In this case, the number and the nature of the deficiencies identified on board the vessel following the accident, along with others identified during the course of this investigation, indicate that the safey management of the vessel and its crew had been ineffective. Examples include:

- Edward had worked on board *Eshcol* without having completed the mandatory Seafish health and safety or safety awareness courses. As with the rest of the crew, he had not been required to provide any details of his training until he arrived on board the vessel. Even then, the shortfall in his training does not seem to have been recognised or acted upon.

- The solid-filled lifejackets had been removed from the vessel and the working lifejackets had not been worn recently or serviced. Consequently, there were no reliable personal flotation devices on board.

- The battery had been removed from the smoke detector fitted in the sleeping area **(Figure 16)**. Although this might have been because the battery needed to be replaced, it is also possible that it was done to prevent the sensor from alarming due to cigarette smoke. In any event, the detector was rendered useless.

- The securing of the EPIRB with a tie-wrap meant that it could not float free if the vessel sank. In addition, because the registered details of the EPIRB had not been amended following the vessel's change of ownership, the coastguard would have been unable to immediately contact the owner following activation in order to verify the vessel's area of operation or obtain details of the crew on board. Both pieces of information could prove essential to mounting an effective search and rescue operation.

The owner was geographically dislocated from *Eshcol*, *JMT* and *Accord* for much of the time, and he was therefore dependent on the vessels' skippers to ensure that the vessels were properly maintained. The owner's experience leading up to Christmas 2013, when *Eshcol*'s previous skipper left the vessel with its engine seized, combined with the vessel's condition on 16 January 2014, shows that such a strategy was prone to failure. However, the owner's reliance on his skippers was typical of the way many small fishing vessels are managed.

2.8.2 Crew welfare

Before *Accord* and *JMT* were put into service after being purchased in 2013, the owner spent about £90,000 refitting the vessels, and had fitted electric cookers on both. After buying *Eshcol* he then provided shore power cables to enable the crews on board all three of his vessels to use the 240V domestic facilities on board when in port without having to run a generator. The owner also gave his son two halogen heaters on 14 January 2014, which showed that he was concerned about the crews' wellbeing to some degree.

Although *Eshcol*'s owner intended to install an electric cooker during the vessel's planned refit during the summer of 2014, it is evident that he considered that the gas cooker would suffice in the interim period. The cooker was already installed when the owner bought *Eshcol*. The cooker worked, and the owner was not aware of any need to get it serviced. He certainly would not have known about the high levels of CO emitted from the grill and he would not have expected the cooker to be used as a heater.

Nonetheless, the heating provided on board *Eshcol* was inadequate. The fixed heater did not work and the front vents of the fan heater were missing **(Figure 15)**, leaving the heating elements exposed. The fan heater was therefore a potential danger in terms of both fire risk and electric shock.

It is not clear whether equipment that is provided for the welfare of crews of small fishing vessels is work equipment and covered by PUWER. The fact that the crew were share fishermen, and therefore self-employed, does not seem to remove an owner's obligations under these regulations **(Paragraph 1.16 re Regulation 4)**.

However, even if the equipment provided for crew welfare is not considered to be work equipment, it is common sense for such equipment to be fit for purpose by applying the principles of PUWER, such as periodic inspection by a competent person.

Materials can corrode much more quickly in a marine environment, and inspection and servicing frequently needs to be completed more often than ashore. In the case of *Eshcol*, the problems with the heaters were self-evident, but the corrosion of the grill's metal gauze, and the resulting CO hazard would probably only have been identified by a Gas Safe engineer.

2.9 ALIGNMENT WITH OTHER COMMERCIAL CODES

In its medium term strategy to eliminate preventable deaths in the UK fishing industry, the MCA has an objective to develop a code for fishing vessels less than 15m LOA based on the SCV Code. This is being done in co-operation with the fishing industry bodies and is due to be completed in 2016.

The circumstances of this accident again reinforces the need for a closer alignment between the standards required on board small fishing vessels and those generally more stringent standards applied to other small commercial vessels. The lack of regulation regarding LPG installations, accommodation requirements and hours of rest, which are required to varying degrees for other commercial vessels **(Paragraphs 1.14, 1.15 and 1.17** and **Annex G)**, was certainly contributory in this case. The increased regulation of small fishing vessels will inevitably meet with considerable resistance, but until standards are raised through the harmonisation of the small fishing vessel code with the SCV Code, improvement in vessel and crew safety is likely to remain slow.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. *Eshcol*'s skipper and deckhand died from CO poisoning. The grill of the butane-fuelled cooker in the vessel's wheelhouse produced extraordinary high levels of CO emissions, and had been left lit overnight. [2.2]

2. The wheelhouse door and windows were closed and the wheelhouse and sleeping area were not ventilated by any other means. Therefore, very little fresh air would have been able to enter the compartment. [2.2]

3. Neither the recommendations for vessels less than 15m LOA detailed in MGN 312(F) nor the cooker manufacturer's instructions were followed when the gas cooker was installed in 2009. [2.3]

4. The deaths of the skipper and deckhand could have been prevented if a CO detector had been fitted. [2.3]

5. The high levels of CO emitted from the lit grill were the result of incomplete combustion caused primarily by the corrosion on the grill's metal gauze. [2.3]

6. The crew were probably using the grill to heat the wheelhouse and sleeping area because they thought that neither of the heaters carried on board *Eshcol* were working. [2.4.1]

7. Neither of the deceased recognised the danger of leaving an open flame unattended or the danger of closing the wheelhouse door and windows in an otherwise unventilated space with the grill lit. [2.4.1]

8. Both of the deceased were extremely tired. Their fatigue potentially affected their decision-making and would have caused them to fall asleep as soon as they went to their bunks. [2.4.2]

9. Many professional and recreational mariners and members of the emergency services remain unaware of the characteristics and dangers of CO. [2.5]

10. *Eshcol*'s owner and crew were probably unaware of the guidance provided by the MCA regarding the precautions that need to be taken with regard to LPG installations and sleeping on board vessels that are not equipped for overnight sleeping. Raising fishermen's awareness of these issues will possibly be best achieved through education. [2.5]

11. The need to ensure that fishermen on board small fishing vessels are protected from CO to the same degree as those on larger vessels is compelling. [2.6]

12. The number and the nature of the deficiencies identified on board the vessel following the accident, along with others identified during the course of this investigation, indicate that the management of the vessel and its crew was ineffective. [2.8.1]

13. The heating provided on board *Eshcol* was inadequate. The fixed heater did not work and the fan heater was damaged and was probably a potential danger in terms of both fire risk and electric shock. [2.8.2]

14. It is common sense for equipment provided for crew welfare, such as cookers and heaters, to be inspected periodically by a competent person. The dangers of the corrosion of the grill's metal gauze, and the resulting CO hazard would probably only have been identified by a Gas Safe engineer. [2.8.2]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. Due to changes in the way small fishing vessels are being operated, many fishermen are now sleeping on board vessels that are not equipped for overnight sleeping. The inclusion of minimum accommodation standards in the small fishing vessel Code is warranted. [2.7]

2. The circumstances of this accident again reinforces the need for a closer alignment between the standards required on board small fishing vessels and the generally more stringent standards applied to other small commercial vessels. [2.9]

SECTION 4 - ACTION TAKEN

4.1 MAIB ACTIONS

The MAIB has:

Issued Safety Bulletin 1/2014 **(Annex L)** in February 2014 in order to highlight its initial findings and to raise fishermen's awareness of the dangers of fossil fuel burning appliances and the symptoms of CO poisoning. It also advised that CO alarms should be fitted on board fishing vessels.

4.2 ACTIONS TAKEN BY OTHER ORGANISATIONS

***Eshcol*'s owner has:**

Refitted *Eshcol* and returned the vessel to service. The gas cooker has been replaced with an electric microwave oven and a CO alarm has been fitted on board. CO alarms have also been installed on board *Accord* and *JMT*.

SECTION 5 - RECOMMENDATIONS

The **Maritime and Coastguard Agency** is recommended to:

120/2014 At the earliest opportunity, include in the Code of Practice for the Safety of Small Fishing Vessels a requirement for a carbon monoxide detector to be fitted in the accommodation on all vessels.

121/2014 In developing a Code of Practice for the Safety of Small Fishing Vessels based on the Small Commercial Vessel and Pilot Boat Code, and in implementing the requirements of International Labour Organization Convention C188 in national regulations (when in force), take into account the circumstances of this accident, including, inter alia:

- The disparity in the requirements for Liquid Petroleum Gas installations on board small fishing vessels and other small commercial craft and larger fishing vessels.
- The need for suitable accommodation to be provided when crew are expected or required to stay on board overnight.
- The operating patterns of small fishing vessels and the need to protect fishermen from fatigue.

The **Sea Fish Industry Authority** is recommended to:

122/2014 Take action to raise the awareness of fishermen to the dangers of carbon monoxide, including its sources, the symptoms of poisoning and the importance of its detection by:

- Broadening the scope of the specifications of the health and safety and safety awareness courses, and
- Include the risks and hazards of carbon monoxide in its fishing vessel safety folder.

The **owner of *Eshcol*** is recommended to:

123/2014 Improve the safety management on board his vessels by using aids such as the online Seafish fishing vessel safety folder and, in addition, ensure that:

- All crew have completed the mandatory safety training.
- Equipment provided is fit for purpose and routinely inspected.
- Equipment requiring inspection and servicing by a specialist is identified.
- Every effort is made to improve the standard of onboard accommodation.
- Work and rest hours of crew are monitored and managed to prevent fatigue.

MCA Inspection report

SIAS

UK & DT Inspection/Survey Details

Ship Details

Ship ID 62670 **Next ID** **Group ID** 54896

Ship Name ESHCOL
IMO Number 0000000 **Official Number** C18470
FV Number M220 **Call Sign** MKMC2

Ship Type F1 - Fishing Vessel - Steel
Flag 670 - UNITED KINGDOM
Class. Society 0 - NONE
Owner [redacted]
Year of Build 2005 **UK Class Code** X
Kw 123 **Dead Weight**
Length(m) 9.2 **Gross Tonnage** 10.48

Inspection Details

Marine Office Tyne
Inspection Date 16/01/2014 **Input Date** 17/01/2014
Detained? Y **Release Date** 17/01/2014
Country UNITED KINGDOM
Place Whitby
Inspection Type Additional **Inspected at Sea?** N
MACRIS Codes
Comments [redacted]

Ship Actions

Inspection has no ship actions

Survey Details

Inspection has no surveys

ILO Survey Details

Inspection has no ILO Survey

Certificate Details

Inspection has no certificates

Deficiency Details

Code	Surveyor's Description	Regulation Ref	Relates to survey?	Actions
551	GAS COOKER DEFECTIVE (TO BE REMOVED)		I	30
1250	ER HATCH TO MAKE WATER TIGHT.		I	17
1499	ENGINE EXHAUST HOLED (OUT SIDE) + IN ENGINE ROOM (TO RENEW).		I	17
988	WHOLE DECK TO BE SCALED AND N.D.T. THICKNESS TESTED.		I	17

1250	FWD DECK HATCH TO RE-RUBBER.	I	17
988	HOLE IN DECK BESIDE ENGINE EXHAUST.	I	17
899	SHORT ARM (SCTCH POLES) PINS TO RENEW ARMS TO PATCH.	I	17
1250	FISH HATCH TO MAKE WATER TIGHT.	I	17
1199	LOWER + PUWER RECORDS TO SIGHT.	I	17
199	RISK ASSESSMENT TO SIGHT.	I	17
999	PART OF ALUMIN DECK HOUSE DETACHED.	I	17
1020	FIRE ALARMS INOPERABLE.	I	17
720	FIRE EXTINGUISHERS TO REFERB/RENEW AS REQUIRED.	I	17
371	FIRST AID KIT TO PROVIDE.	I	17
1099	GAS ALARM NOT WORKING.	I	17
660	LIFE JACKETS TO SERVICE OR RENEW. (18 CONDEMMED.) LIGHTS TO FIT.	I	17
650	BUOYS TO HAVE NAMES & NUMBERS	I	17
1230	P SIDE RAIL TO FAIR.	I	16
1199	DISCHARGE ROOM TO SCALE/PAINT REFERB TEST/HEEL PIN TEST/MARK SWL.	I	17
1260	WHEEL HOUSE FRONT CORRODED WINDOWS INSECURE.	I	17
999	PORT SIDE DECK HOUSE SET IN (IN WAY OF E.R. HATCH).	I	16
1440	FISH ROOM BILGE P/P AND ALARM NOT WORKING.	I	17
1499	EXHAUST MAINFOLD RELAG (WHEN RENEWED)	I	17
1499	AUX GEN EXHAUST LEAKING (RELAG).	I	17
1499	ME EXH. TO RENEW IN E.R.	I	17
1440	OIL TO CLEAN FROM E.R. BILGES (PUMPS TO TEST WHEN CLEAN).	I	17
1099	ER BILGE ALARM NOT WORKING	I	17
1499	OIL BEING KEPT IN PLASTIC DRUMS IN E.R. (TO BE REMOVED).	I	17
1020	ER FIRE ALARM NOT WORKING ACCOM FIRM ALARM NOT WORKING.	I	17
1499	FUEL LEAK ON ME. F.O. SUPPLY PIPE.	I	17
1440	HAND BILGE PUMP NOT WORKING.	I	17
299	CREW CERTS TO PROVIDE.	I	17
1541	MAG COMPASS TO SUPPLY/CHARTS.	I	17
1550	HORN TO TEST	I	17

Return to main menu Back

Kiwa Gastech at CRE Report on the Neptune 25002 - Serial Number 915916

GASTEC at CRE

kiwa
Partner for progress

Report

Neptune 25002-4
Serial Number 915916
From the fishing vessel Eshcol

UKAS TESTING
0692

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

Report Number: 221662
Date: January 2014

APPLIANCE AND MANUFACTURERS DETAILS

Manufacturer	**Leisure Products (Bolton Ltd)**
Address	[redacted]

Appliance Type And Name	**Neptune 2500-4**
Appliance Serial Number	**915916**
Gas Type	**Butane G30**
Gas Category	**I_{3+}**

Comments:

This testwork has been carried out in a cooker removed from the fishing vessel Eshcol following a double fatality in Whitby Docks.

The tests were conducted using the butane cylinder and regulator provided from the vessel. There was no visual damage to the cylinder or regulator. The regulator found to be in good working order. The rating of the grill was found to be 1.6kW, which is normal for this type of the products. Therefore; no comments on the rating of the grill.

The flame safety device shut down time was within the limit 60sec.

The combustion of the individual burners was measured and they were all within the limit of the BSEN203-1:2005+A1:2008 standard with exception of the grill. The combustion of the grill with and without the grill pan failed the limit stated in the standard (0.1%),
With grill pan by a factor of :- Times 1.9
Without grill pan by a factor of :-Times 3.1
This is probably because the metal gauze was badly corroded and actually holed in four places. The latter should have been obvious during any reasonable inspection and/or service.

A vitiation test of the grill was performed both with and without the grill pan and the results revealed extra-ordinary high levels of CO.
Both with and without the grill pan, the CO concentration in the room reached its limit of failure (200 ppm) (based on vitiation test for Oxygen Depletion Device in BSEN509:2000) in about 37 minutes. When the test was performed for nearly 3 hours (without grill pan) the CO concentration reached 2300ppm.
The volume of the Kiwa Gastec vitiation room (17.5m^3) is by co-incidence broadly similar to the

Wheelhouse and the Accommodation of the Eshcol (15.3m^3).

Due to the very high of carbon monoxide measured both with and without the grill pan (and the level with the frying pan is also expected to be very high) unless the Eshcol was unusually well ventilated (compared to the forward cabin of most boats) it would seem extremely likely that the levels of CO that arose were very considerably above the 100ppm usually injurious to health and were very likely to exceed the 800ppm that is usually regarded as fatal within a few hours.

HEAT INPUTS

Approximate calculation of the heat input rating of the grill

Appliance name	Grill
Gas used	Commercial
Pressure (mbar)	28
Injector Marking	Not measured
Setting of gas tap	**Full**
Gas Consumption l	1
Time s	78.16
Gas consumption (m^3/hr)	0.0461
Barometric pressure (mbar)	1004
Meter pressure (mbar)	27.6
Burner pressure (mbar)	23.6
Density of test gas	~2.075
Temperature of gas (°C)	16
Gas consumption (m^3/hr)	0.046
Heat Input Hs (kW)	1.62

Flame Safety Device Shut Down time

Burner	Hob FR	Hob FL	Grill	Oven
Time sec	30	30	27	55

According to the standard the limit is 60 second and they are all within the limit.

COMBUSTION PERFORMANCE –

Full rate; Commercial Butane gas
According to the BSEN203-1:2005+A1:2008 standard

Burner	CO (ppm)	CO_2 (%)	CO/CO2 ratio	*CO_2 max. (%)	**CO (%) at 0% O_2
Hob FR @ 25mbar	8.5	2.3	0.00037	14	0.0052
Hob FL @ 26.3mbar	11	1.8	0.00061	14	0.0086
Grill + pan @ 27.6mbar	**150**	**1.11**	**0.01351**	**14**	**0.1892**
Grill @ 27.6mbar	**222**	**0.99**	**0.02242**	**14**	**0.3139**
Oven @ 28mbar	30	2.8	0.00107	14	0.015

*is the percentage of CO2 in the dry, air-free products of combustion of Butane gas
**is the percentage CO concentration of the dry, air-free products of combustion

According to the standard the CO concentration of the dry, air-free products of combustion shall not exceed 0.10% for reference gas under normal pressure.

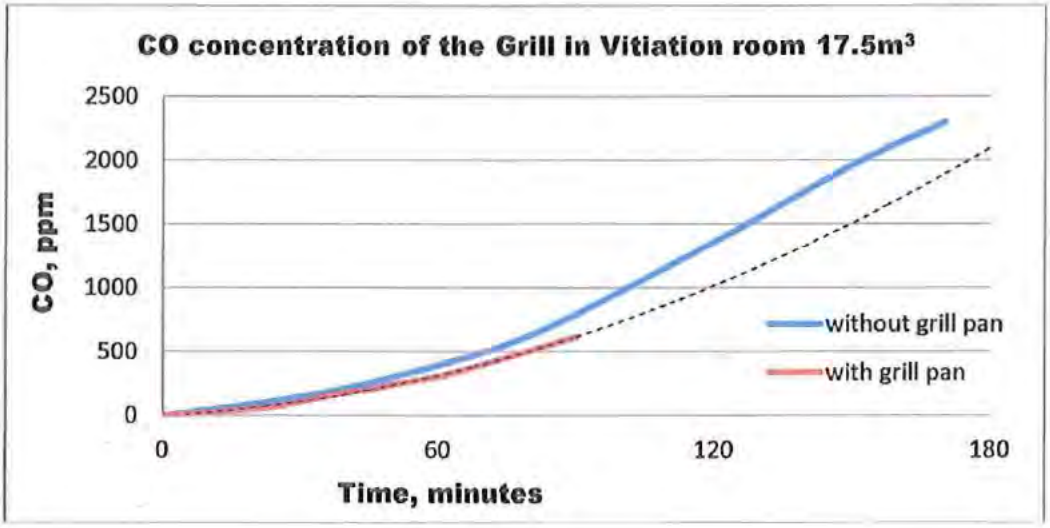
The grill pan and a frying pan were within the oven cavity. It is possible that the frying pan was used under the grill. The photographs shows that the grill pan and grill tray have not been used, however; there is some oil residue in the frying pan which suggests it had been used. Could have been used either under the grill or on the hobs,

CO Concentration of the Grill in Vitiation Room

Without grill pan

Time min	CO ppm
0	0
5	18
10	44
15	64
30	146
45	254
60	395
75	560
90	797
120	1362
150	1964
170	2300

The volume of the Wheelhouse and the Accommodation in the boat was calculated to be approximately15.3m^3 and the volume of the Kiwa vitiation room, where the grill was tested is 17.5m^3 that is about 12% larger that the volume of the Wheelhouse and the Accommodation.
Consequently this will reduce the time taken for the CO concentration to reach the level stated below



Prepared By:

[redacted] Date: 05/02/2014

Approved By

[redacted] Date: 5/2/2014

Manufacturer’s instructions

If the appliance does not operate correctly
contact your supplier

Or

Leisure Products (Bolton) Ltd
Holly Street, Bolton, BL1 8QR. England.

For further details see also www.marinecooker.co.uk

HOW TO USE YOUR 2500 RANGE L.P.G. COOKER OR HOB UNIT

CLEANING

1. Each time the hob has been used it should be wiped over with a damp cloth and if greasy a little mild liquid cleaner.
2. Stubborn marks can generally be removed with one of the commercial cleaners. Do not use harsh abrasive materials as these will leave scratch marks.
3. The interior of the oven should be cleaned with a damp cloth but if it becomes necessary to use a cleaner then choose one which is approved for Vitreous Enamel.
4. All spillages should be wiped up immediately before they "burn on".

We recommend that you occasionally remove the enamelled top to your burner and clean the cap and burner ring ensuring the flame ports are free from dirt and grease. When reassembling, the fixing screw should only be finger tight. Over tightening may cause the screw to seize in place.

If properly adhered to, these few simple suggestions should extend the life of your cooker.

MAINTENANCE

Before attempting any maintenance work make sure that the gas supply is turned off at the cylinder and disconnected from the unit. If the spillage tray is removed care must be taken to ensure that the gas joints are not stressed as this may result in a gas leak. NO GAS JOINT SHOULD BE BROKEN.

The gas valves fitted to this unit are not to be stripped for re-greasing or maintenance purposes. If required, the whole of the valve must be replaced. If any part of the gas system on appliance needs servicing or replacement this work should be carried out by a competent person (e.g. a Gas Safe registered gas fitter).

It is recommended that this appliance is professionally serviced at least every 2 years.

SPARE PARTS

Description	**Part No.**
Oven Thermocouple	180-1
ECO Hob Thermocouple	181-4
Grill Thermocouple	181-2
Tap Knob 3254	252-1
Oven Shelf	212-1
Pan Support	213-1
Door Seal	237-1

More details for spares can be found at www marinecooker.co.uk

It is essential that you quote the DATA PLATE details (on rear of cooker) and the model type when ordering spares

CAUTION

These instructions must be read and understood before proceeding with the installation and to avoid any possibility of accident it is essential that the appliances are installed and operated in accordance with these instructions.

This unit should be installed according to the current standards in practice in the country of installation.

For marine use, gas regulators should comply with EN 12864 Annex M. Use of inappropriate regulators may invalidate any warranty.

No unit should be installed in a room, van or craft if fixed ventilation is not provided.

No alterations or adjustments should be made to the burners or gas supply pressure by unauthorised or unskilled persons. In the event of a failure or breakdown of a unit itself, turn off the gas supply at the cylinder or isolating cock valve for the unit and contact the supplier.

Do not remove any parts from the appliance or substitute alternatives as this may affect the performance and safety of the appliance.

The installation should be carried out in accordance with the appropriate codes of practice for the country in which the installation is done.

If aluminium foil is used in the oven, then it must not be allowed to block the oven flue outlet or smother the burner.

Do not spray aerosols in the vicinity of these appliances while they are in operation.

Do not use this appliance to heat the vehicle or craft.

Turn off the grill once the grill pan has been removed.

Be sure appliance taps are closed before opening cylinder valve.

Be sure to apply ignition source to burner before opening appliance valve.

If you wish to drill the sides for your own gimbals you must first remove the left hand side for drilling as there is a gas pipe behind this panel.

When a flexible hose is used do not allow the hose to come into contact with the back panel.

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience or knowledge, unless they have been given supervision or instruction concerning the use of the appliance by a person responsible for their safety.

In any communication, it is essential to quote the model and number marked on the data badge on the back of the appliance.

This product is under continual improvement and subject to change without prior notice.

INSTALLATION INSTRUCTIONS

This unit should be installed according to the current standards in practice in the country of installation.

BS 5482 :	Part 2 Installations in caravans and non-permanent dwellings Part 3 Installations in boats, yachts and other vessels.
EN ISO 10239:2000:	Small craft - Liquid petroleum gas (LPG) systems
BS 6172 :	Code of practice for installation of domestic gas cooking appliances.

THESE APPLIANCES MUST BE INSTALLED BY A COMPETENT PERSON (e.g. a Gas Safe registered gas fitter)

VENTILATION

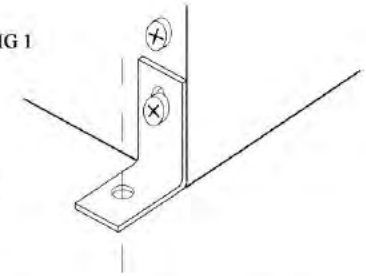
Adequate ventilation must be provided to ensure the cooker unit works in a safe and efficient manner. If fixed ventilation is not provided two ventilation openings of 70 cm^2 (11 square ins) must be provided, one near floor level and one near ceiling level. Do not install cookers and hobs in areas subjected to strong draughts.

INSTALLATION

This unit must be fixed in place using either fixing feet or a gimbal system.

Adjustable feet can be supplied to secure the appliance in position. These are fixed at the existing screw points at each corner of the unit and to the base of the cabinet. (FIG. 1)

FIG 1

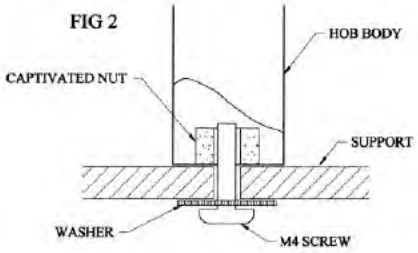


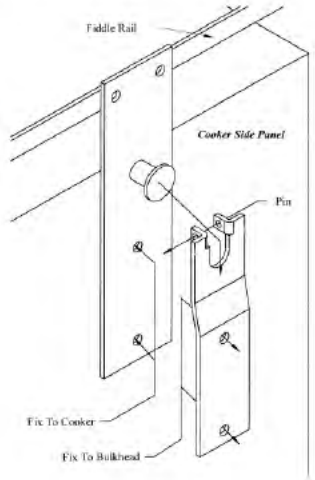
The hob only units have captivated nuts fitted to the base. These are to take M4 machine screws. Screw through the unit support to fix the unit in place. (FIG 2)

If using a gimballing system, ensure the bulkhead is of sufficient strength to hold the weight of the unit and that the gas inlet pipe is free to move with the unit and at no time will become stressed or damaged

.

FIG 2





COOKER ACCESSORIES (SUPPLIED ACCORDING TO MODEL)

Oven Shelf - To fit an oven shelf, place the upstand on the shelf to the back of the cooker, ensuring that the two hooks pass under the oven shelf runners and lift the notches above the runners. If the shelf is correctly fitted it will not tip when pulled forward. (FIG 7)

Pan Support - The pan support is located in 4 studs on the main hob. The pan support is sprung into place to prevent rattling

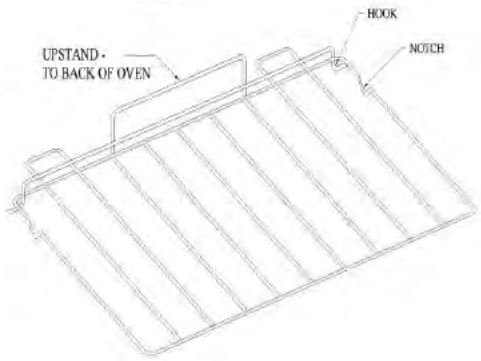
Door Catch - Certain cookers are fitted with a door catch which is fitted to the side of the unit. This will catch the door when closed and the door can then be opened by pushing the catch with a finger or thumb.

Baking Tray

Grill Pan and Trivet

Feet - Used to fix the unit in place. See the installation instructions at the front of the booklet.

FIG 7



GRILL

CAUTION: Accessible parts may be hot when the grill is in use. Young children should be kept away.

It is recommended that an oven glove is used when using the grill as the grill pan handle may become hot if the pan is placed too far under the grill. It is not necessary to preheat the grill but if a preheat period is used the empty grill pan should be placed under the grill to protect the grill base.

The grill pan trivet is reversible giving a choice of two grilling heights.

OVEN

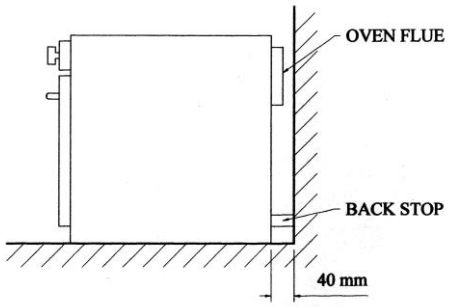
The best results will be obtained by pre-heating the oven for about 15/20 minutes at the required gas setting. The tap has 8 marked settings which correspond to the temperature given below. Intermediate temperatures can be obtained by turning the knob to the appropriate setting.

The oven will cook a wide range of food from a rich fruit cake, using a low setting to bread or Yorkshire pudding using the higher settings. The cooking time and temperature may vary depending on the quantities, types of food you are cooking and the surrounding temperatures.

Setting 1	110°C
Setting 2	130°C
Setting 3	150°C
Setting 4	170°C
Setting 5	190°C
Setting 6	210°C
Setting 7	230°C
Setting 8	250°C

An air gap of 40 mm (1½") must be allowed at the rear of each cooker and a back stop is fitted on oven units to ensure that this gap is maintained. (FIG 3)

FIG 3

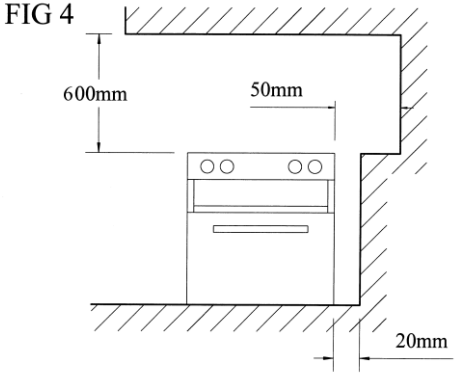


There should be no obstruction above the hob burners for a minimum height of 600 mm (24"). (FIG 4)

Where cookers are to be fitted into a recess or built in to a unit an air gap of 20 mm (¾") must be kept at each side (FIG 4). Do not fit the unit such that wall panels extend past the hob height on **both** sides of the unit. Use a non-combustible material for the surround such as 0.5 mm sheet steel.

Ensure that no obstruction to the units air flow is permitted at the base, sides or back. Obstruction of the air flow can cause inefficient combustion in the oven.

FIG 4



The unit should only be installed in the countries indicated on the dataplate using the correct gas at the indicated pressure as detailed below. (Table 1)

The use of a gas cooking appliance results in the production of heat and moisture in the room in which it is installed. Ensure that the kitchen is well ventilated: Keep natural ventilation holes open or install a mechanical ventilation device (mechanical extractor hood).

Prolonged intensive use of this appliance may call for additional ventilation, for example the opening of a window, or more effective ventilation, for example increasing the level of mechanical ventilation where present.

Table 1

Category	Gas	mbar	Country
I_{3+}	G30	28	GB,IE,FR,IT,ES,BE
$I_{B/P}$	G30	30	NL,SE,FI
$I_{B/P}$	G30	50	DE,AT

UNIT DIMENSIONS

Measurements	Neptune	Pacific	Caribbean	Neptune Hob	Gulf
Width (mm)	450	450	450	450	450
Depth (mm)	416	416	416	385	385
Height (mm)	497	417	390	175	110

GAS CONNECTION

These appliances are strictly for use on liquid petroleum gases at the following pressures to the inlet

28 mbar (11.2 in w.g.) for Butane (G30)
37 mbar (14.8 in w.g.) for Propane (G31)

The gas inlet is located at the rear, top left hand side of the appliance. The gas inlet connection fitting to the appliance should be in accordance with installation requirements according to destination country and gas type as given in EN30-1 table A6. It is recommended that the connecting pipe is, where possible, copper, also that an isolating cock valve is installed in the supply pipe to the unit. For units requiring a flexible pipe a suitable armored pipe should be used.

Care should be taken during installation to prevent the supply pipe from being held against the back panel of the body.

The unit is fitted with a pressure test point, located next to the connection inlet. To check the supply pressure, remove the screw and fit a pressure gauge.

For marine use, gas regulators should comply with EN 12864 Annex M. Use of inappropriate regulators may invalidate any warranty.

Once installed the gas connection should be tested for any gas leakage. If a suitable leak detection meter is not available the connections should be tested using a suitable foaming agent (e.g. mild soapy water). DO ensure the area is well ventilated and DO NOT test for a long period; if there is a leak, a build up of gases may occur.

BURNER RATES

All burners are supplied ready for use on BUTANE (G30 @ 28/30 mbar) / PROPANE (G31 @ 30/37 mbar). NO Adjustment of the Burners is required

Heat Input :

Hob Burner	1.65 kW.
Grill Burner	1.65 kW.
Oven	1.25 kW.

OPERATING INSTRUCTIONS

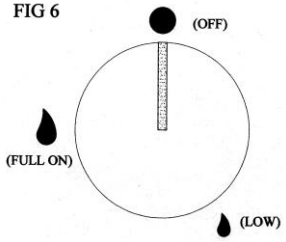
MAKE SURE THAT THE GAS IS TURNED ON AT THE CYLINDER. IT IS RECOMMENDED THAT A SPARK IGNITION DEVICE IS USED RATHER THAN A NAKED FLAME.

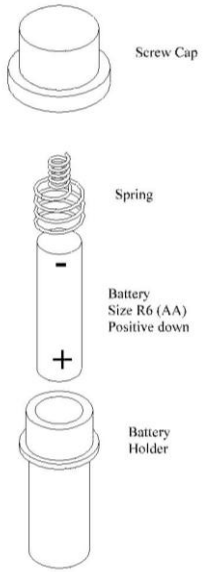
All burners are fitted with a Flame Failure Safety Shut Off Device (FFD). In the event of the flame being extinguished the gas supply will be cut off to the burner.

The flame should be blue although it may have some yellow tipping. The flame height should be level and stable.

To light a burner push in the appropriate knob, rotate anti-clockwise to the full on position (the large flame symbol (FIG 6), setting 8 for the oven valve) and apply a spark to the burner. It should light immediately, but continue to hold the knob in for a further 15 seconds. If the burner goes out when the knob is released repeat the procedure but hold the knob in for longer before releasing. The tap can then be rotated to the desired setting (high through to low). If any of the burners on the appliance are found to have become extinguished then the valve must be switched off and the unit left for a period of 1 minute to allow any unburnt gases to escape, before attempting to re-light the burner. If the oven burner has been extinguished the oven door should be opened as well.

FIG 6





Some models are fitted with a spark ignition system. These use a 1 × R6 (AA) battery. The spark system will only work if the battery is correctly inserted into the holder (Fig.5). The battery holder is located to the bottom right hand side of the cooker. Lighting a burner is as described above. The spark to light the burner is applied by pressing the switch on the front right hand side of the facia panel.

To turn off the gas, rotate the knob clockwise until you reach the off position (the ● symbol vertically above the knob).

HOBS

Any required setting between full and low/simmer can be obtained by positioning the knob between these two settings. The hob burners are suitable for pan sizes ranging from 10 cm to 22 cm base diameter (4" to 8 ").

Cooker certification

Certificate GB96/9267

The management system of

Leisure Products (Bolton) Ltd

Holly Street, Astley Bridge,
Bolton, Lancs, BL1 8QR, UK

has been assessed and certified as meeting the requirements of

Directive 90/396/EEC

Annex II.3

This certificate is valid from 27 August 2006 until 27 August 2010
Issue 6. Certified since 09 December 1996
Scope of registration appears on page 2 of this certificate

Notified Body Number 0120

Authorised by

[redacted]

CE
0120

SGS United Kingdom Ltd Systems & Services Certification
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Leisure Products (Bolton) Ltd

Directive 90/396/EEC

Annex II.3

Issue 6

Manufacture of small LPG cookers and hobs

Appliance	Certificate Number	PIN Number
Atlantic Plus Cooker	GASTEC E4560	0063AR4560
Caribean 3000	GASTEC E4560	0063AT5110
Gulf 2500	GASTEC E4560	0063AQ4560
Gulf 2550	GASTEC E4560	0063AQ4560
Gulf 3000	GASTEC E4560	0063AT5110
Neptune 2500	GASTEC E4560	0063AQ4560
Neptune 2550	GASTEC E4560	0063AQ4560
Neptune 3000	GASTEC E4560	0063AT5110
Neptune Hob 2500	GASTEC E4560	0063AQ4560
Neptune Hob 2550	GASTEC E4560	0063AQ4560
Neptune Hob 3000	GASTEC E4560	0063AT5110
Pacific 2500	GASTEC E4560	0063AQ4560
Pacific 2550	GASTEC E4560	0063AQ4560
Pacific 3000	GASTEC E4560	0063AT5110
Tasman 2500	GASTEC E4560	0063AQ4560
Tasman 2550	GASTEC E4560	0063AQ4560
Tasman 3000	GASTEC E4560	0063AT5110
Voyager 2500	GASTEC E4560	0063AQ4560
Voyager 2550	GASTEC E4560	0063AQ4560
Voyager 3000	GASTEC E4560	0063AT5110

CE
0120

CERTIFICATE

Number **E 4560**

CE 0063

GASTEC Certification B.V. hereby declares that the
Domestic cooking appliances burning gas fuel, types

Voyager 2500, Voyager 2550
Neptune 2500, Neptune 2550
Pacific 2500, Pacific 2550
Tasman 2500, Tasman 2550
Gulf 2500, Gulf 2550
Neptune Hob 2500, Neptune Hob 2550

made by **Leisure Products (Bolton) Ltd.**

in **Astley Bridge, Bolton,**
United Kingtom

meet the essential requirements as described in the
Directive on appliances burning gaseous fuels (90/396/EEC).

PIN	: 0063AQ4560
Report number	: 160014/04
Appliance types	: A

Mentioned products have been approved for:

AT	$I_{3B/P}$	BE	I_{3+}	DK	$I_{3B/P}$	DE	$I_{3B/P}$
ES	I_{3+}	FR	I_{3+}	SE	$I_{3B/P}$	FI	$I_{3B/P}$
GB	I_{3+}	IE	I_{3+}	IT	I_{3+}		
NL	$I_{3B/P}$	NO	$I_{3B/P}$	PT	I_{3+}		

Apeldoorn, 14 June 2005

[redacted]

General Manager.

GASTEC Certification

Gastec Certification BV
P.O. Box 137
7300 AC Apeldoorn

Wilmersdorf 50
7327 AC Apeldoorn
The Netherlands

RvA C 009 PRODUCTS

Annex E

MSN 1813 (F) Checklist for decked vessels of less than 10m Registered Length

ANNEX 1.4

CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS: CHECK LIST OF REQUIREMENTS

Equipment need not be MCA approved provided it is fit for its intended purpose.

DECKED Vessels of less than 10m Registered Length

"Decked vessels" means a vessel with a continuous watertight weather deck that extends from stem to stern and has positive freeboard throughout, in any condition of loading the vessel.

Item	Remarks/compliance	Expiry/Service Date
Lifejackets - 1 per person		
2 Lifebuoys (1 with 18m buoyant line attached) or 1 Lifebuoy (fitted with 18m buoyancy line) +1 Buoyant Rescue Quoit		
3 Parachute Flares		
2 Hand-held Flares		
1 Smoke Signal (buoyant or hand held)		
1 Multi-purpose Fire Extinguisher (fire rating 5A/34B)		
Gas Detector		
1 Fire Blanket (light duty) in galley or cooking area (if applicable)		
Smoke Alarms		
1 Fire Pump + Hose or 1 Fire Bucket and lanyard		
1 Multi-purpose Fire Extinguisher for oil fires (fire rating 13A/113B)		
VHF Radio – fixed (DSC) or hand held		
For distress and urgency communications, it is recommended that VHF DSC is fitted. Coastguard Maritime Rescue Co-ordination Centres maintain a listening watch only on VHF Channel 16 via loudspeaker. The primary means of distress and urgency alerting should be via VHF DSC.		
Bilge Pump		
Bilge Level Alarm		
Navigation Lights & Sound Signals		
Anchor and cable/warp		
Compass		
Waterproof Torch		
Medical Kit		

Note: The checklist represents the minimum safety equipment requirements. Owners should in addition to the above consider carrying additional safety equipment. A radar reflector is recommended for vessels constructed of wood or glass reinforced plastic (GRP) and vessels with no significant steel upper works or masts. Carriage of a liferaft with release mechanism and EPIRB are also recommended.

MGN 312 (F) Use of Liquid Petroleum Gas (LPG) and Diesel Fuelled Appliances on Fishing Vessels

Maritime and Coastguard Agency

MARINE GUIDANCE NOTE

MGN 312 (F)

USE OF LIQUID PETROLEUM GAS (LPG) AND DIESEL FUELLED APPLIANCES ON FISHING VESSELS.

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

This notice supersedes MGN192 (F)

Summary

This note gives advice on reducing the risk of explosion or Carbon Monoxide Poisoning from the fitting and use of the following for heating accommodation spaces on board fishing vessels:

- Liquid Petroleum Gas (LPG) heaters and cookers
- "Closed flame" Diesel heaters

Introduction/ Background

1. The use of LPG or Diesel oil as a direct means of heating crew accommodation is not permitted in fishing vessels of 24 metres registered length or over. The main heating system on such vessels must be supplied by steam, hot water, electricity or alternatively by a system supplying warm air (i.e. fans/ducting).

2. On vessels less than 24 metres in registered length, LPG and Diesel fuelled heating systems may be used. If these systems are not installed and maintained correctly, death or serious injury may occur as a result of a fire, explosion or carbon monoxide poisoning.

3. The Code of Safe Working Practice for The Construction and Use of 15m LOA to Less Than 24 metre Registered Length Fishing Vessels contains the following requirements, the MCA strongly recommends that these requirements also be applied to vessels of 15m LOA and under.

4. For LIQUID PETROLEUM GAS (LPG) HEATERS AND COOKERS. The following summarises the main requirements of MSN 1770 The Code of Safe Working Practice for The Construction and Use of 15m LOA to Less Than 24 metre Registered Length Fishing Vessels.

- Installations using LPG should be safely fitted and protected from damage. BS EN (ISO) 10239 provides guidance on this.

- LPG Cylinders/Bottles should be stored on deck or in a well ventilated compartment on deck

- Spaces containing LPG appliances should not have openings leading directly below to accommodation spaces or their passageways (unless specific provision is made for mechanical exhaust and supply ventilation).

- Spaces containing an LPG appliance should be adequately ventilated.

- Spaces containing an LPG appliance should be provided with a gas detector with an audible alarm and control unit outside the space. In sleeping quarters, the alarm should be located inside the compartment.

- A device should be fitted in the supply pipe from the gas container to the appliance that will automatically shut off the gas in the event of a loss in pressure in the supply line. Manual resetting of this device must be the only means of restoring the supply.

- An automatic flame failure device shall be fitted on all appliances consuming LPG.

- LPG heating appliances used in any accommodation space (in addition to sleeping quarters) should be fitted with a flue to the exterior of the vessel via a clear unblocked exhaust.

- Carbon monoxide monitoring devices should be fitted in all compartments where LPG heating appliances are fitted.

5. Crew members should be aware of the action to take in the event of gas leakage. A suitable notice should be displayed prominently in the vessel, detailing the action to be taken when a gas alarm activates or a leak is suspected. The notice should include the following information:

- All gas-consuming appliances should be SHUT OFF at the main supply from the container(s)
- NO SMOKING should be permitted until it is safe to do so
- NAKED LIGHTS should never be used as a means of locating gas leaks.

CLOSED FLAME DIESEL HEATERS AND COOKERS

6. Heaters consist of a closed combustion chamber, used to heat air supplied by an (integral) electric fan. Combustion air inlet and exhaust lines are fitted in isolation to the heating air.

7. The Construction and Use of 15m LOA to Less Than 24 metre Registered Length Fishing Vessels permits the use of such installations as heating appliances. The requirements are:-

- The fuel tank is to be fitted outside the space containing the heating appliance. Fuel supply lines should be made of steel.

- The supply of oil shall be capable of being controlled outside that space (i.e. a remote operated valve shall be fitted).

- Means should be provided to shut off the fuel supply automatically at the cooking range in the event of a fire or if the combustion air supply fails. Manual resetting of this device is then necessary to restore the fuel supply.

- The fuel is to have a flash point of at least 60^{o}C. The use of petrol is not permitted.

- The fuel tank must be fitted with an air pipe, including anti- flash gauze.

- Adequate means shall be provided for filling the tank and preventing overpressure.

In addition to the requirements above, the following provisions are strongly recommended:

- Combustion air intakes and exhaust should lead to outside the vessel and be positioned a sufficient distance apart.
- The exhaust should be suitably lagged.

In all instances, the manufacturer's installation instructions must be followed.

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: robb.bailey@mcga.gov.uk

General Inquiries: 24 Hour Infoline
infoline@mcga.gov.uk
0870 600 6505

MCA Website Address: www.mcga.gov.uk

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ISO 9001: 2000 FS 34835

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MGN 280 (M) Small Vessels in Commercial Use for Sport or Pleasure, Workboats and Pilot Boats - Alternative Construction Standards - Annex 5

ANNEX 5

LIQUID PETROLEUM GAS INSTALLATION FOR DOMESTIC USE

1. General Information

1.1 This guidance is based on ISO 10239 and a system constructed to the requirements of this standard or equivalent will be acceptable as long as additionally there is suitable gas detection equipment fitted.

1.2 Possible dangers arising from the use of liquid petroleum gas (LPG) open flame appliances in the marine environment include fire, explosion and asphyxiation due to leakage of gas from the installation.

1.3 Consequently, the siting of gas consuming appliances and storage containers and the provision of adequate ventilation to space containing them is most important.

1.4 It is dangerous to sleep in spaces where gas-consuming open-flame appliances are left burning, because of the risk of carbon monoxide poisoning.

1.5 LPG is heavier than air and if released, may travel some distance whilst seeking the lowest part of a space. Therefore, it is possible for gas to accumulate in relatively inaccessible areas, such as bilges, and diffuse to form an explosive mixture with air, this is also the case with petrol vapours.

1.6 A frequent cause of accidents involving LPG installations is the use of unsuitable fittings and improvised "temporary" repairs.

2. Stowage of Gas Cylinders

2.1 LPG cylinders, regulators and safety devices should be stowed on the open deck (where leakage will not accumulate) or in a compartment that is vapour-tight to the vessels interior and fitted with a vent and drain, so that gas which may leak can disperse overboard.

2.2 The vent and drain should not be less than 19 mm in diameter, run to the outside of the craft and terminate 75 mm or more above the 'at rest' waterline. The drain and locker ventilation should be 500 mm or more from any opening to the vessels interior.

2.3 The cylinders and associated fittings should be positively secured against movement and protected from damage in any foreseeable event.

2.4 Any electrical equipment located in cylinder lockers should be certified safe for use in the potential explosive atmosphere.

3. Cylinders and Attachments

3.1 Each system shall be fitted with a readily accessible, manually operated isolating valve in the supply pressure part of the system.

3.2 In multiple cylinder installations, in addition to each cylinder shutoff valve there should be non-return valves near the stop valves. Where there is a change over device (automatic or manual) it should be provided with non-return valves to isolate any depleted container.

3.3 When more than one container can supply a system, the system should not be used with a container removed unless the unattached pipe is fitted with a suitable gas tight plug arrangement.

3.4 Containers not in use or not being fitted into an installation should have the protecting cap in place over the container valve.

4. Fittings and Pipework

4.1 For rigid pipework systems, the pipes should be made from solid drawn copper alloy or stainless steel tube. Steel tubing or aluminium or any materials having a low melting point should not be used.

4.2 Connection between rigid pipe sections should be made with hard solder (minimum melting point 450ºC), appropriate compression or screwed fittings are recommended for general use for pipework in LPG installations.

4.3 Where a flexible hose is used length should be kept to a minimum, it should be protected from inadvertent damage where appropriate, it should meet the requirement of EN 1763 or equivalent and be installed in a manner that gives access for inspection along its whole length.

4.4 There should be no joints in the pipework in the engine spaces.

5. Appliances

5.1 All unattended appliances should be of the room sealed type.

5.2 Cookers and hobs are not considered to be unattended appliances.

5.3 All gas burners and pilot flames should be fitted with a flame supervision device which will shut off the gas supply to the burner or pilot flame in the event of flame failure.

6. Ventilation

6.1 The ventilation requirements of a space containing a LPG appliance should be assessed against an appropriate standard (e.g. Annex B of ISO 10239) and should take into account gas burning equipment and persons occupying that space.

6.2 Where ventilators required for LPG appliances in intermittent use can be closed, there should be appropriate signs at the appliance warning of the need to have those ventilators open before the appliance is used.

7. Gas Detection

7.1 Suitable means for detecting the leakage of gas should be provided in a compartment containing a gas-consuming appliance or in any adjoining space or compartment into which the gas, of greater density than air, may seep.

7.2 Gas detectors heads should be securely fixed in the lower part of the compartment in the vicinity of the gas-consuming appliance and other space(s) into which gas may seep. In areas where the detector head is susceptible to damage in the lowest part of the compartment (e.g. engine space bilge) the detector head should at least be fitted below the lowest point of ignition.

7.3 A gas detector system of a suitable type should, preferably, be actuated promptly and automatically by the presence of a gas concentration in air of not greater than 0.5 per cent

(representing approximately 25 per cent of the lower explosive limit). The detection system should incorporate a visible and audible alarm, which can be heard in the space concerned and the control position with the vessel in operation.

7.4 Gas detection system components (i.e. gas detector head) likely to be in an explosive air/gas atmosphere should not be capable of igniting that atmosphere.

7.5 In all cases, the arrangements should be such that the detection system can be tested frequently whilst the vessel is in service and should include a test of the detector head operation as well as the alarm circuit, in accordance with the manufacturer's instructions.

7.6 The detection equipment should be maintained in accordance with the manufacturer's requirements.

8. Emergency Action

8.1 A suitable notice, detailing the action to be taken when an alarm is given by the gas detection system, should be displayed prominently in the vessel.

The information given should include the following:-

.1 The need to be ever alert for gas leakage; and

.2 When leakage is detected or suspected, all gas-consuming appliances should be shut off at the main supply from the container(s). NO SMOKING should be permitted until it is safe to do so (i.e. the gas leakage has been eliminated and the spaces fully ventilated)

.3 NAKED LIGHTS SHOULD NEVER BE USED AS A MEANS OF LOCATING GAS LEAKS.

9. Owner/Operator Testing

It is strongly recommended that LPG systems are tested for leakage regularly. All connections should be checked by;

.1 routine observation of the bubble leak detector (if fitted),

.2 observation of the pressure gauge for pressure drop with the appliance valves closed and cylinder valve opened then closed (if fitted with gauge on supply pressure side),

.3 visual inspection,

.3 manual leak testing, (without breaking into the system)

.4 testing with soapy water or detergent solution (with appliance-burner valves closed, and cylinder and system valves open). CAUTION - Do not use solutions containing ammonia

If leakage is present, close the cylinder valve and have the system repaired before further use. WARNING - NEVER USE A NAKED FLAME TO CHECK FOR LEAKS.

Annex H

Extracts from the International Labour Organization Convention 188

Part IV. Conditions of service

Manning and hours of rest

Article 13

Each Member shall adopt laws, regulations or other measures requiring that owners of fishing vessels flying its flag ensure that:

- (a) their vessels are sufficiently and safely manned for the safe navigation and operation of the vessel and under the control of a competent skipper; and
- (b) fishers are given regular periods of rest of sufficient length to ensure safety and health.

Article 14

- 1. In addition to the requirements set out in Article 13, the competent authority shall:
  - (a) for vessels of 24 metres in length and over, establish a minimum level of manning for the safe navigation of the vessel, specifying the number and the qualifications of the fishers required;
  - (b) for fishing vessels regardless of size remaining at sea for more than three days, after consultation and for the purpose of limiting fatigue, establish the minimum hours of rest to be provided to fishers. Minimum hours of rest shall not be less than:
    - (i) ten hours in any 24-hour period; and
    - (ii) 77 hours in any seven-day period.
- 2. The competent authority may permit, for limited and specified reasons, temporary exceptions to the limits established in paragraph 1(b) of this Article. However, in such circumstances, it shall require that fishers shall receive compensatory periods of rest as soon as practicable.
- 3. The competent authority, after consultation, may establish alternative requirements to those in paragraphs 1 and 2 of this Article. However, such alternative requirements shall be substantially equivalent and shall not jeopardize the safety and health of the fishers.
- 4. Nothing in this Article shall be deemed to impair the right of the skipper of a vessel to require a fisher to perform any hours of work necessary for the immediate safety of the vessel, the persons on board or the catch, or for the purpose of giving assistance to other boats or ships or persons in distress at sea. Accordingly, the skipper may suspend the schedule of hours of rest and require a fisher to perform any hours of work necessary until the normal situation has been restored. As soon as practicable after the normal situation has been restored, the skipper shall ensure that any fishers who have performed work in a scheduled rest period are provided with an adequate period of rest.

Part V. Accommodation and food

Article 25

Each Member shall adopt laws, regulations or other measures for fishing vessels that fly its flag with respect to accommodation, food and potable water on board.

Article 26

Each Member shall adopt laws, regulations or other measures requiring that accommodation on board fishing vessels that fly its flag shall be of sufficient size and quality and appropriately equipped for the service of the vessel and the length of time fishers live on board. In particular, such measures shall address, as appropriate, the following issues:

- (a) approval of plans for the construction or modification of fishing vessels in respect of accommodation;
- (b) maintenance of accommodation and galley spaces with due regard to hygiene and overall safe, healthy and comfortable conditions;
- (c) ventilation, heating, cooling and lighting;
- (d) mitigation of excessive noise and vibration;
- (e) location, size, construction materials, furnishing and equipping of sleeping rooms, mess rooms and other accommodation spaces;
- (f) sanitary facilities, including toilets and washing facilities, and supply of sufficient hot and cold water; and
- (g) procedures for responding to complaints concerning accommodation that does not meet the requirements of this Convention.

Article 27

Each Member shall adopt laws, regulations or other measures requiring that:

- (a) the food carried and served on board be of a sufficient nutritional value, quality and quantity;
- (b) potable water be of sufficient quality and quantity; and
- (c) the food and water shall be provided by the fishing vessel owner at no cost to the fisher. However, in accordance with national laws and regulations, the cost can be recovered as an operational cost if the collective agreement governing a share system or a fisher's work agreement so provides.

Article 28

- 1. The laws, regulations or other measures to be adopted by the Member in accordance with Articles 25 to 27 shall give full effect to Annex III concerning fishing vessel accommodation. Annex III may be amended in the manner provided for in Article 45.
- 2. A Member which is not in a position to implement the provisions of Annex III may, after consultation, adopt provisions in its laws and regulations or other measures which are substantially equivalent to the provisions set out in Annex III, with the exception of provisions related to Article 27.

Annex III

Fishing vessel accommodation

General provisions

- 1. For the purposes of this Annex:
  - (a) "new fishing vessel" means a vessel for which:
    - (i) the building or major conversion contract has been placed on or after the date of the entry into force of the Convention for the Member concerned; or
    - (ii) the building or major conversion contract has been placed before the date of the entry into force of the Convention for the Member concerned, and which is delivered three years or more after that date; or
    - (iii) in the absence of a building contract, on or after the date of the entry into force of the Convention for the Member concerned:
      - - the keel is laid, or
      - - construction identifiable with a specific vessel begins, or
      - - assembly has commenced comprising at least 50 tonnes or 1 per cent of the estimated mass of all structural material, whichever is less;
  - (b) "existing vessel" means a vessel that is not a new fishing vessel.
- 2. The following shall apply to all new, decked fishing vessels, subject to any exclusions provided for in accordance with Article 3 of the Convention. The competent authority may, after consultation, also apply the requirements of this Annex to existing vessels, when and in so far as it determines that this is reasonable and practicable.

- 3. The competent authority, after consultation, may permit variations to the provisions of this Annex for fishing vessels normally remaining at sea for less than 24 hours where the fishers do not live on board the vessel in port. In the case of such vessels, the competent authority shall ensure that the fishers concerned have adequate facilities for resting, eating and sanitation purposes.
- 4. Any variations made by a Member under paragraph 3 of this Annex shall be reported to the International Labour Office under article 22 of the Constitution of the International Labour Organisation.
- 5. The requirements for vessels of 24 metres in length and over may be applied to vessels between 15 and 24 metres in length where the competent authority determines, after consultation, that this is reasonable and practicable.
- 6. Fishers working on board feeder vessels which do not have appropriate accommodation and sanitary facilities shall be provided with such accommodation and facilities on board the mother vessel.
- 7. Members may extend the requirements of this Annex regarding noise and vibration, ventilation, heating and air conditioning, and lighting to enclosed working spaces and spaces used for storage if, after consultation, such application is considered appropriate and will not have a negative influence on the function of the process or working conditions or the quality of the catches.
- 8. The use of gross tonnage as referred to in Article 5 of the Convention is limited to the following specified paragraphs of this Annex: 14, 37, 38, 41, 43, 46, 49, 53, 55, 61, 64, 65 and 67. For these purposes, where the competent authority, after consultation, decides to use gross tonnage (gt) as the basis of measurement:
  - (a) a gross tonnage of 75 gt shall be considered equivalent to a length (L) of 15 metres or a length overall (LOA) of 16.5 metres;
  - (b) a gross tonnage of 300 gt shall be considered equivalent to a length (L) of 24 metres or a length overall (LOA) of 26.5 metres;
  - (c) a gross tonnage of 950 gt shall be considered equivalent to a length (L) of 45 metres or a length overall (LOA) of 50 metres.

Planning and control

- 9. The competent authority shall satisfy itself that, on every occasion when a vessel is newly constructed or the crew accommodation of a vessel has been reconstructed, such vessel complies with the requirements of this Annex. The competent authority shall, to the extent practicable, require compliance with this Annex when the crew accommodation of a vessel is substantially altered and, for a vessel that changes the flag it flies to the flag of the Member, require compliance with those requirements of this Annex that are applicable in accordance with paragraph 2 of this Annex.

- 10. For the occasions noted in paragraph 9 of this Annex, for vessels of 24 metres in length and over, detailed plans and information concerning accommodation shall be required to be submitted for approval to the competent authority, or an entity authorized by it.
- 11. For vessels of 24 metres in length and over, on every occasion when the crew accommodation of the fishing vessel has been reconstructed or substantially altered, the competent authority shall inspect the accommodation for compliance with the requirements of the Convention, and when the vessel changes the flag it flies to the flag of the Member, for compliance with those requirements of this Annex that are applicable in accordance with paragraph 2 of this Annex. The competent authority may carry out additional inspections of crew accommodation at its discretion.
- 12. When a vessel changes flag, any alternative requirements which the competent authority of the Member whose flag the ship was formerly flying may have adopted in accordance with paragraphs 15, 39, 47 or 62 of this Annex cease to apply to the vessel.

Design and construction

Headroom

- 13. There shall be adequate headroom in all accommodation spaces. For spaces where fishers are expected to stand for prolonged periods, the minimum headroom shall be prescribed by the competent authority.
- 14. For vessels of 24 metres in length and over, the minimum permitted headroom in all accommodation where full and free movement is necessary shall not be less than 200 centimetres.
- 15. Notwithstanding the provisions of paragraph 14, the competent authority may, after consultation, decide that the minimum permitted headroom shall not be less than 190 centimetres in any space - or part of any space - in such accommodation, where it is satisfied that this is reasonable and will not result in discomfort to the fishers.

Openings into and between accommodation spaces

- 16. There shall be no direct openings into sleeping rooms from fish rooms and machinery spaces, except for the purpose of emergency escape. Where reasonable and practicable, direct openings from galleys, storerooms, drying rooms or communal sanitary areas shall be avoided unless expressly provided otherwise.
- 17. For vessels of 24 metres in length and over, there shall be no direct openings, except for the purpose of emergency escape, into sleeping rooms from fish rooms and machinery spaces or from galleys, storerooms, drying rooms or communal sanitary areas; that part of the bulkhead separating such places from sleeping rooms and external bulkheads shall be efficiently constructed of steel or another approved material and shall be watertight and gas-tight. This provision does not exclude the possibility of sanitary areas being shared between two cabins.

Insulation

- 18. Accommodation spaces shall be adequately insulated; the materials used to construct internal bulkheads, panelling and sheeting, and floors and joinings shall be suitable for the purpose and shall be conducive to ensuring a healthy environment. Sufficient drainage shall be provided in all accommodation spaces.

Other

- 19. All practicable measures shall be taken to protect fishing vessels' crew accommodation against flies and other insects, particularly when vessels are operating in mosquito-infested areas.
- 20. Emergency escapes from all crew accommodation spaces shall be provided as necessary.

Noise and vibration

- 21. The competent authority shall take measures to limit excessive noise and vibration in accommodation spaces and, as far as practicable, in accordance with relevant international standards.
- 22. For vessels of 24 metres in length and over, the competent authority shall adopt standards for noise and vibration in accommodation spaces which shall ensure adequate protection to fishers from the effects of such noise and vibration, including the effects of noise- and vibration-induced fatigue.

Ventilation

- 23. Accommodation spaces shall be ventilated, taking into account climatic conditions. The system of ventilation shall supply air in a satisfactory condition whenever fishers are on board.
- 24. Ventilation arrangements or other measures shall be such as to protect non-smokers from tobacco smoke.
- 25. Vessels of 24 metres in length and over shall be equipped with a system of ventilation for accommodation, which shall be controlled so as to maintain the air in a satisfactory condition and to ensure sufficiency of air movement in all weather conditions and climates. Ventilation systems shall be in operation at all times when fishers are on board.

Heating and air conditioning

- 26. Accommodation spaces shall be adequately heated, taking into account climatic conditions.
- 27. For vessels of 24 metres in length and over, adequate heat shall be provided, through an appropriate heating system, except in fishing vessels operating exclusively in tropical climates. The system of heating shall provide heat in all conditions, as necessary, and shall be in operation when fishers are living or working on board, and when conditions so require.

- 28. For vessels of 24 metres in length and over, with the exception of those regularly engaged in areas where temperate climatic conditions do not require it, air conditioning shall be provided in accommodation spaces, the bridge, the radio room and any centralized machinery control room.

Lighting

- 29. All accommodation spaces shall be provided with adequate light.
- 30. Wherever practicable, accommodation spaces shall be lit with natural light in addition to artificial light. Where sleeping spaces have natural light, a means of blocking the light shall be provided.
- 31. Adequate reading light shall be provided for every berth in addition to the normal lighting of the sleeping room.
- 32. Emergency lighting shall be provided in sleeping rooms.
- 33. Where a vessel is not fitted with emergency lighting in mess rooms, passageways, and any other spaces that are or may be used for emergency escape, permanent night lighting shall be provided in such spaces.
- 34. For vessels of 24 metres in length and over, lighting in accommodation spaces shall meet a standard established by the competent authority. In any part of the accommodation space available for free movement, the minimum standard for such lighting shall be such as to permit a person with normal vision to read an ordinary printed newspaper on a clear day.

Sleeping rooms

General

- 35. Where the design, dimensions or purpose of the vessel allow, the sleeping accommodation shall be located so as to minimize the effects of motion and acceleration but shall in no case be located forward of the collision bulkhead.

Floor area

- 36. The number of persons per sleeping room and the floor area per person, excluding space occupied by berths and lockers, shall be such as to provide adequate space and comfort for the fishers on board, taking into account the service of the vessel.
- 37. For vessels of 24 metres in length and over but which are less than 45 metres in length, the floor area per person of sleeping rooms, excluding space occupied by berths and lockers, shall not be less than 1.5 square metres.
- 38. For vessels of 45 metres in length and over, the floor area per person of sleeping rooms, excluding space occupied by berths and lockers, shall not be less than 2 square metres.

- 39. Notwithstanding the provisions of paragraphs 37 and 38, the competent authority may, after consultation, decide that the minimum permitted floor area per person of sleeping rooms, excluding space occupied by berths and lockers, shall not be less than 1.0 and 1.5 square metres respectively, where the competent authority is satisfied that this is reasonable and will not result in discomfort to the fishers.

  Persons per sleeping room

- 40. To the extent not expressly provided otherwise, the number of persons allowed to occupy each sleeping room shall not be more than six.
- 41. For vessels of 24 metres in length and over, the number of persons allowed to occupy each sleeping room shall not be more than four. The competent authority may permit exceptions to this requirement in particular cases if the size, type or intended service of the vessel makes the requirement unreasonable or impracticable.
- 42. To the extent not expressly provided otherwise, a separate sleeping room or sleeping rooms shall be provided for officers, wherever practicable.
- 43. For vessels of 24 metres in length and over, sleeping rooms for officers shall be for one person wherever possible and in no case shall the sleeping room contain more than two berths. The competent authority may permit exceptions to the requirements of this paragraph in particular cases if the size, type or intended service of the vessel makes the requirements unreasonable or impracticable.

  Other

- 44. The maximum number of persons to be accommodated in any sleeping room shall be legibly and indelibly marked in a place in the room where it can be conveniently seen.
- 45. Individual berths of appropriate dimensions shall be provided. Mattresses shall be of a suitable material.
- 46. For vessels of 24 metres in length and over, the minimum inside dimensions of the berths shall not be less than 198 by 80 centimetres.
- 47. Notwithstanding the provisions of paragraph 46, the competent authority may, after consultation, decide that the minimum inside dimensions of the berths shall not be less than 190 by 70 centimetres, where it is satisfied that this is reasonable and will not result in discomfort to the fishers.
- 48. Sleeping rooms shall be so planned and equipped as to ensure reasonable comfort for the occupants and to facilitate tidiness. Equipment provided shall include berths, individual lockers sufficient for clothing and other personal effects, and a suitable writing surface.
- 49. For vessels of 24 metres in length and over, a desk suitable for writing, with a chair, shall be provided.

- 50. Sleeping accommodation shall be situated or equipped, as practicable, so as to provide appropriate levels of privacy for men and for women.

Mess rooms

- 51. Mess rooms shall be as close as possible to the galley, but in no case shall be located forward of the collision bulkhead.
- 52. Vessels shall be provided with mess-room accommodation suitable for their service. To the extent not expressly provided otherwise, mess-room accommodation shall be separate from sleeping quarters, where practicable.
- 53. For vessels of 24 metres in length and over, mess-room accommodation shall be separate from sleeping quarters.
- 54. The dimensions and equipment of each mess room shall be sufficient for the number of persons likely to use it at any one time.
- 55. For vessels of 24 metres in length and over, a refrigerator of sufficient capacity and facilities for making hot and cold drinks shall be available and accessible to fishers at all times.

Tubs or showers, toilets and washbasins

- 56. Sanitary facilities, which include toilets, washbasins, and tubs or showers, shall be provided for all persons on board, as appropriate for the service of the vessel. These facilities shall meet at least minimum standards of health and hygiene and reasonable standards of quality.
- 57. The sanitary accommodation shall be such as to eliminate contamination of other spaces as far as practicable. The sanitary facilities shall allow for reasonable privacy.
- 58. Cold fresh water and hot fresh water shall be available to all fishers and other persons on board, in sufficient quantities to allow for proper hygiene. The competent authority may establish, after consultation, the minimum amount of water to be provided.
- 59. Where sanitary facilities are provided, they shall be fitted with ventilation to the open air, independent of any other part of the accommodation.
- 60. All surfaces in sanitary accommodation shall be such as to facilitate easy and effective cleaning. Floors shall have a non-slip deck covering.
- 61. On vessels of 24 metres in length and over, for all fishers who do not occupy rooms to which sanitary facilities are attached, there shall be provided at least one tub or shower or both, one toilet, and one washbasin for every four persons or fewer.

- 62. Notwithstanding the provisions of paragraph 61, the competent authority may, after consultation, decide that there shall be provided at least one tub or shower or both and one washbasin for every six persons or fewer, and at least one toilet for every eight persons or fewer, where the competent authority is satisfied that this is reasonable and will not result in discomfort to the fishers.

Laundry facilities

- 63. Amenities for washing and drying clothes shall be provided as necessary, taking into account the service of the vessel, to the extent not expressly provided otherwise.
- 64. For vessels of 24 metres in length and over, adequate facilities for washing, drying and ironing clothes shall be provided.
- 65. For vessels of 45 metres in length and over, adequate facilities for washing, drying and ironing clothes shall be provided in a compartment separate from sleeping rooms, mess rooms and toilets, and shall be adequately ventilated, heated and equipped with lines or other means for drying clothes.

Facilities for sick and injured fishers

- 66. Whenever necessary, a cabin shall be made available for a fisher who suffers illness or injury.
- 67. For vessels of 45 metres in length and over, there shall be a separate sick bay. The space shall be properly equipped and shall be maintained in a hygienic state.

Other facilities

- 68. A place for hanging foul-weather gear and other personal protective equipment shall be provided outside of, but convenient to, sleeping rooms.

Bedding, mess utensils and miscellaneous provisions

- 69. Appropriate eating utensils, and bedding and other linen shall be provided to all fishers on board. However, the cost of the linen can be recovered as an operational cost if the collective agreement or the fisher's work agreement so provides.

Recreational facilities

- 70. For vessels of 24 metres in length and over, appropriate recreational facilities, amenities and services shall be provided for all fishers on board. Where appropriate, mess rooms may be used for recreational activities.

Communication facilities

- 71. All fishers on board shall be given reasonable access to communication facilities, to the extent practicable, at a reasonable cost and not exceeding the full cost to the fishing vessel owner.

Galley and food storage facilities

- 72. Cooking equipment shall be provided on board. To the extent not expressly provided otherwise, this equipment shall be fitted, where practicable, in a separate galley.
- 73. The galley, or cooking area where a separate galley is not provided, shall be of adequate size for the purpose, well lit and ventilated, and properly equipped and maintained.
- 74. For vessels of 24 metres in length and over, there shall be a separate galley.
- 75. The containers of butane or propane gas used for cooking purposes in a galley shall be kept on the open deck and in a shelter which is designed to protect them from external heat sources and external impact.
- 76. A suitable place for provisions of adequate capacity shall be provided which can be kept dry, cool and well ventilated in order to avoid deterioration of the stores and, to the extent not expressly provided otherwise, refrigerators or other lowtemperature storage shall be used, where possible.
- 77. For vessels of 24 metres in length and over, a provisions storeroom and refrigerator and other low-temperature storage shall be used.

Food and potable water

- 78. Food and potable water shall be sufficient, having regard to the number of fishers, and the duration and nature of the voyage. In addition, they shall be suitable in respect of nutritional value, quality, quantity and variety, having regard as well to the fishers' religious requirements and cultural practices in relation to food.
- 79. The competent authority may establish requirements for the minimum standards and quantity of food and water to be carried on board.

Clean and habitable conditions

- 80. Accommodation shall be maintained in a clean and habitable condition and shall be kept free of goods and stores which are not the personal property of the occupants or for their safety or rescue.
- 81. Galley and food storage facilities shall be maintained in a hygienic condition.
- 82. Waste shall be kept in closed, well-sealed containers and removed from foodhandling areas whenever necessary.

Inspections by the skipper or under the authority of the skipper

- 83. For vessels of 24 metres in length and over, the competent authority shall require frequent inspections to be carried out, by or under the authority of the skipper, to ensure that:
    - (a) accommodation is clean, decently habitable and safe, and is maintained in a good state of repair;

- (b) food and water supplies are sufficient; and
- (c) galley and food storage spaces and equipment are hygienic and in a proper state of repair.

The results of such inspections, and the actions taken to address any deficiencies found, shall be recorded and available for review.

Variations

- 84. The competent authority, after consultation, may permit derogations from the provisions in this Annex to take into account, without discrimination, the interests of fishers having differing and distinctive religious and social practices, on condition that such derogations do not result in overall conditions less favourable than those which would result from the application of this Annex.

Carbon Monoxide Safety on Boats

CARBON MONOXIDE SAFETY ON BOATS

How to protect you, your crew, your visitors and pets on your boat from the 'Silent Killer' - Carbon Monoxide

CoGDEM

The Council of Gas Detection and Environmental Monitoring

Boat Safety Scheme

Go boating - Stay safe

Carbon monoxide... what's the risk?

Investigations start following the death of two people from CO poisoning.

Each year boaters die or are made seriously ill from carbon monoxide (CO) poisoning.

Boats are built to keep water out, but this also makes them good containers for gases and fumes.

When carbon-based, appliance and engine fuels, such as gas, LPG, coal, wood, paraffin, oil, petrol and diesel don't burn completely, CO is produced.

CO build-up in the cabin can occur with one or a mix of these factors:

- Faulty, badly maintained or misused appliances
- Exhaust fumes from a boat's engine or generator
- Escaped flue gases from solid fuel stoves
- Blocked ventilation or short supply of air - fuel needs oxygen to burn safely

In recent years, solid fuel stoves and engine or generator exhaust gases have been responsible for most deaths of boaters from CO poisoning.

How the silent killer works!

CO can kill in minutes - be prepared to act quickly if you think you are being poisoned!

CO is a highly poisonous gas that weighs about the same as air.

At high concentrations, CO can kill without warning, sometimes in only minutes.

It cannot be seen, smelt, tasted, or felt, that's why it's known as the silent killer!

When you breathe in CO, it replaces the oxygen in your bloodstream, preventing essential supplies to your body tissues, heart, brain and other vital organs.

Where victims survive severe CO poisoning, they can be left with long-term brain damage such as poorer concentration, or mood swings, etc.

But even breathing-in lower levels of CO over a longer period, you can still suffer serious effects such as memory problems and difficulty concentrating.

If CO is in your cabin space, everyone is at risk, no one is immune!

Some people will be affected much more quickly:

- Pregnant women and unborn babies
- Babies and young children
- Older people
- People with respiratory problems or heart conditions

For other reasons, some people may be at higher risk:

- Those who have been doing something active and are breathing more rapidly and deeply and have a greater need for oxygen
- Those who have been drinking heavily - because the symptoms may be masked

CO poisoning can creep up on you – recognise the signs

If you are asleep, you may not notice any symptoms as they develop.

Even if you are awake, early symptoms of CO poisoning can easily be mistaken for the flu, food poisoning, a hangover or general tiredness.

We have listed some of the common symptoms, but not everyone suffering CO poisoning will have all of them.

Common symptoms include:

- Headache and bad temper
- Feeling sick and dizzy
- Feeling tired and confused
- Stomach pains and being sick

The greater the amount of CO there is in air, or the longer you are breathing in CO, the worse your symptoms may get:

- Drowsiness, lethargy, extreme tiredness, difficulty concentrating
- A feeling of general weakness, difficulty in walking or moving
- Loss of balance and sight and memory problems

...and with very high CO levels

- Chest pains
- Increased heart rate
- Difficulty breathing or breathlessness
- Seizures
- Collapse, unconsciousness and death

For more information visit the NHS website
http://www.nhs.uk/conditions/carbon-monoxide-poisoning/pages/introduction.aspx
or telephone NHS Direct on 0845 4647.

If you think you are suffering – ACT QUICKLY

Fast action could save your life. Ask yourself 'Are people ill on my boat, but feel OK ashore?'

If you suspect you have carbon monoxide poisoning or the CO alarm activates, you need to act fast.

Get all people and pets out to fresh air as quickly as you can. Stay in the fresh air.

If you can, on your way out, turn off appliances and engines…

…also leave doors, windows and awnings open to allow fresh air to flow through the boat.

Seek medical help

Don't delay, see a doctor and say you may have suffered carbon monoxide poisoning.

If other crew members, or pets, are feeling ill or have the symptoms, they need medical help too.

Anyone with severe symptoms needs to get to hospital as quickly as possible!

Severe CO poisoning needs immediate medical treatment.

CO poisoning can only be tested shortly after exposure as its traces begin to disappear as soon as you start breathing clear air.

If CO poisoning is confirmed - get a properly qualified person to find and fix the appliance or engine before it is used again.

If you can, turn off engines & fuel supplies

Know any danger signs on your boat

Check routinely that your boat's fuel-burning appliances and engines are safe.

Any of the following could be signs that CO is filling your boat:

- Staining, sooty smears, or discolouration on surfaces around an appliance or its flue
- Appliances that are difficult to light, keep lit or burn weakly
- Burners with yellow or orange or 'floppy' flames that threaten to go out
- An unfamiliar or burning smell when an LPG or oil appliance is on
- Smelling or seeing smoke escaping regularly into the cabin when running your wood-burner or coal stove

Flue gases from solid fuel stoves can have up to 100 times the concentrations of CO found in gas burners.

- Smelling engine exhaust fumes regularly inside the cockpit or cabin

How to prevent CO on your boat

CO can be prevented. Take a few sensible steps to reduce the risk dramatically.

Only buy appliances that meet the latest standards and are suitable for use in boats.

Have appliances properly installed and serviced routinely by competent fitters.

Annual servicing of appliances is recommended where the boat is used frequently or for longer periods.

Ensure all repairs use proprietary components. Make no mistake, gash fixes or bodge jobs bring risks.

Good air supply in the cabin is vital to running appliances.

The required ventilation can be calculated by using the formula in Ch.8 of the BSS Essential Guide.

Check the cabin vents for blockages and build-ups of spiders' webs and debris.

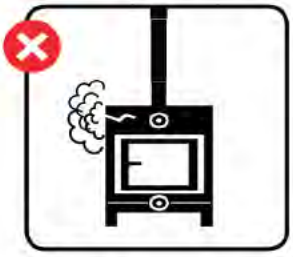
Open windows for extra ventilation when cooking, especially when using large pans on LPG hobs.

Check solid fuel stoves for cracks, missing cover plates, warped doors and poor condition rope seals.

Follow appliance instructions - burn the right fuel for your stove, in the right way.

Burning damp fuel or plastic rubbish can cause clogging of the flue.

When removing hot ashes and embers, use a metal ash bucket with lid and keep outside in the open.



Keep flue pipes and terminals in tip top condition!

Crushing your boat's chimney terminal on a bridge arch can damage more than your pocket.

Ensure all flue or exhausts outlets are outside of awnings, covered decks or cratches.

A clean flue pipe kept in good condition will help keep a good draw and help the boat keep free from toxic flue gasses.

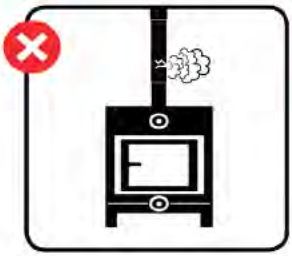
Ensure solid fuel stove chimneys are swept at least annually, or even several times a year - the more a stove is used, the more often the chimney needs cleaning.

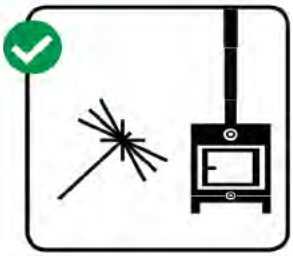
Check all appliance flue pipes routinely for rusting, pitting, blockages, loose or missing connections.

Look for signs of leaks. A sooty smear at a flue joint is a bad sign.

Check that vents and flue terminals, especially on cabin tops, are not damaged, blocked or restricted by stowed equipment, ropes, tarpaulins or decorative objects.

Fix all problems without delay and before the equipment is used again!





Beware of engine exhaust gases in the cabin space!

Petrol generators and outboard motors can produce dangerously high levels of carbon monoxide, but don't forget, diesel engine exhaust fumes have also been linked to illness and deaths.

Check the boat's exhaust system routinely. Inspect every part for leaks or problems including; manifolds, pipes, joints, hoses, clamps, silencers, and through-hull fittings.

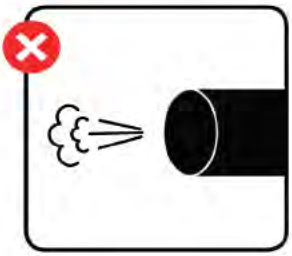
Do not install or fix a portable generator inside any accommodation space.

Proprietary conversion kits must be used if adapting a portable generator to fixed use.

Inefficient petrol engine performance, running the engine cooler than its design temperature or using contaminated or stale fuel, can increase the concentration of CO in exhaust fumes.

Whether the boat is moving or moored, under certain running and or wind conditions CO at dangerous levels can be deflected or drawn in from engine exhausts.

Be a good neighbour; see if you can avoid running your engine when moored in a crowded marina, particularly when the air is still.



Steer clear of danger, never do these things

Never block cabin ventilators.

Never leave LPG appliances on overnight, unless they are designed to be left on and/or are the room sealed type.

Never use mobile (cabinet) gas heaters - they are not suitable for use in boats and create extra fire safety hazards.

Never bring lit or cooling barbecues into a cabin or covered cockpit area – hot charcoal gives off dangerous amounts of CO. Charcoal is only safe when it's stone-cold.

Never block an appliance's air inlet or heat outlet.

Never run a solid fuel stove with its doors open, apart from when refuelling.

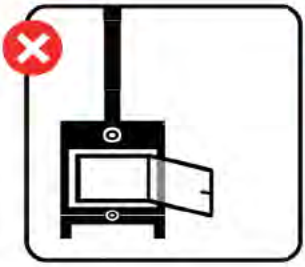
Never use an appliance you think is faulty or unsafe.

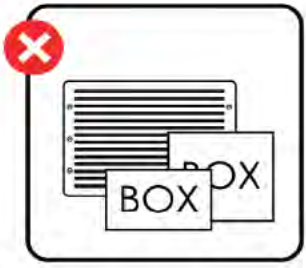
Never use an appliance that has a crushed flue terminal.

Never run portable generators in a cabin or covered cockpit area, or close to any door, opening or ventilator that opens into the boat.

Never run a boat's petrol engine with the exhaust outlet restricted in any way including when the craft moored against a high-sided object such as a wall, another boat or inside a lock.

Never swim near to boats with their engines running – many boats' exhausts are at low level and can create a toxic atmosphere at water level .





CO alarms save lives

Take the belt and braces approach but note this, CO alarms are not a substitute for the good installation, regular servicing and proper maintenance of fuel burning appliances and engines.

If you have any fuel burning appliances aboard, an engine or generator, fit a suitable audible carbon monoxide alarm for an added re-assurance.

'Black-spot' colour-changing indicator cards are not good enough. You won't have an instant warning of dangerous CO levels and there's no alarm to wake you up.

Fit alarms approved as meeting BS EN 50291; these are best suited for boats. Alarms with life-long batteries are available.

If in doubt about the choice of alarm, call the manufacturer's or supplier's support line for more advice.

If there is potential for CO poisoning on your boat, it is better to have an alarm, than not.

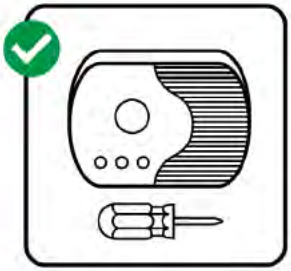
Alarms and warning devices for people with hearing loss are available.

British Standard Kitemark

LPCB

Look out for these symbols when buying alarms

Top tip



Fit alarms to stay safe

Where should you place your CO alarm?

All cabins with a fuel burning appliance should have a CO alarm fitted.

If fuel burning appliances, generators or engines are used whilst people sleep, all sleeping quarters will need their own alarms.

If the boat has a single multi-use cabin, one alarm is OK.

Never fit an alarm directly above a source of heat or steam.

For the best protection, follow the alarm manufacturer's installation instructions as far as the space and nature of the boat allow.

But if the placement directions are difficult to meet on your boat, these are the 'best practice' points.

Try to place the alarm:

- In living quarters between 1m and 3m (on plan view) from the appliance
- In living quarters fix alarms high up on a wall, but at least 150mm from the ceiling and where the indicator lights can be seen
- In sleeping quarters have the alarm in the "breathing zone", i.e. near the bed head
- Before fixing, test that you can hear an alarm from any position in the boat (or buy an additional alarm)

Living with your CO alarm

Test the alarms when you first board the boat. Test the alarm weekly when the boat is in use.

CO alarms do not last forever and have a replacement date marked on them. Do not use the alarm beyond that date and if in any doubt, replace it earlier.

When working on the boat with paints, solvents, degreasers or strong chemicals cover or remove the alarm temporarily to protect the sensor, but remember to remove the cover or replace the alarm as soon as the air clears and before you use any appliance or engine.

Consider removing the alarm from a winterised boat because long periods of sub-zero temperatures may affect its sensor and battery.

Always re-install any alarm after winterisation. Then test the alarm before any appliance or engine is used.

Note these points:

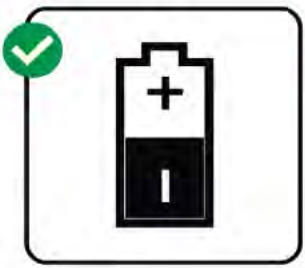
CO alarms only detect, they cannot prevent the dangerous build-up of carbon monoxide

CO alarms may not fully safeguard individuals with specific medical conditions

CO alarms will not detect fires, smoke or leakages of petrol or LPG fuel vapours

A CO alarm can activate if it senses the explosive gas hydrogen; e.g. from the boat's batteries gassing off when under charge, perhaps indicating a charging problem

Test it



Change it

Replace it

If you are a tenant afloat

The law provides several additional protections for tenants including this:

If your landlord has provided LPG appliances, he/she must arrange for an annual gas safety check to be carried out by a Gas Safe registered engineer.

If you are a tenant in a rented boat with concerns about CO, raise the issues with your landlord or letting agent without delay If your concerns are not dealt with, go to the local council for help If you feel unwell get medical help straightaway.

Go to www.hse.gov.uk/gas/domestic/faqtenant.htm for more information for tenants and the health and safety in privately rented accommodation page on www.direct.gov.uk

Further information on CO and boating

For more information on CO and fire safety on boats and routine safety check items - Boat Safety Scheme: www.boatsafetyscheme.org/co

For alarm information - Council of Gas Detection and Environmental Monitoring (CoGDEM)
http://cogdem.org.uk/CoGDEMCOsite/index.html

For general CO advice Health & Safety Executive (HSE) Gas Safety Advice Line 0800 300 363 www.hse.gov.uk/gas/domestic/co.htm

Gas Safe Register for gas fitters www.gassaferegister.co.uk

British Marine Federation for local boatyards www.britishmarine.co.uk

Charities with an interest in CO

The Carbon Monoxide and Gas Safety Society
www.co-gassafety.co.uk/

CO-Awareness
www.co-awareness.com/

Gas Safety Trust
www.gas-safety-trust.org.uk/

Gas Safe Charity
www.gassafecharity.org.uk/

CO-Angels
www.co-angels.co.uk/

Acknowledgements

The leaflet content and production is supported by five CoGDEM member companies that produce CO alarms: Ei Electronics, FireHawk Alarms, Honeywell, Kidde, and Sprue - www.cogdem.org.uk

CoGDEM is the UK trade body for companies and experts in the field of gas detection. CoGDEM provides its expertise to UK, European and global standards-writing bodies, and provides technical guidance and support to all CO awareness-raising projects and organisations, including the HSE.

The authors gratefully acknowledge the assistance of the Health Protection Agency staff especially linked to the medical information.

The authors acknowledge the HSE leaflet 'Gas Appliances - Get them checked, Keep them Safe' ref: INDG238 (rev2) and the Department of Health leaflet 289814/'Carbon monoxide: Are you at risk?' as source documents.

Design based on Fire Safety On Boats leaflet with permission from Fire Kills (www.direct.gov.uk/firekills)

Leaflet artwork by Safelincs
www.safelincs.co.uk, suppliers of smoke and CO alarms and other safety equipment

Safelincs®
Fire Safety Products

CO threatens lives – stay safe, stay aware:

Install fuel burning appliances properly

Maintain appliances and engines routinely

Use the equipment correctly

Don't allow engine fumes into the cabin space

Deal with problems immediately

Don't allow bodged repairs and maintenance

Install a CO alarm

Test the alarm routinely

Never remove the batteries

Know the signs of CO poisoning and how to react

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MAIB Safety Bulletin 2/2013 (*Arniston*)

MAIB SAFETY BULLETIN 2/2013

Carbon monoxide poisoning on board the
Bayliner 285 motor cruiser
Arniston
on Windermere, Cumbria
resulting in two fatalities

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

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

MAIB SAFETY BULLETIN 2/2013

This document, containing safety lessons, has been produced for marine safety purposes only, on the basis of 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 the deaths of two persons on board the motor cruiser *Arniston* on 1 April 2013.

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

Steve Clinch
Chief Inspector of Marine Accidents

This bulletin is also available on our website: www.maib.gov.uk

Press Enquiries: 020 7944 3387/6433; Out of hours: 020 7944 4292
Public Enquiries: 0300 330 3000

BACKGROUND

A bank holiday weekend on board an 11 year old Bayliner 285 motor cruiser ended tragically when a mother and her 10 year old daughter died. Initial findings indicate the deceased were poisoned by carbon monoxide.

INITIAL FINDINGS

A “suitcase” type portable petrol-driven generator **(Figure 1)** had been installed in the motor cruiser’s engine bay to supply the boat with 240v power. The generator had been fitted with an improvised exhaust and silencer system which had become detached from both the generator and the outlet on the vessel’s side **(Figures 2** and **3)**. As a result, the generator’s exhaust fumes filled the engine bay and spread through gaps in an internal bulkhead into the aft cabin where the mother and daughter were asleep. When the owner of the boat awoke in the boat’s forward cabin, he was suffering from carbon monoxide poisoning but was able to raise the alarm. The mother and daughter could not be revived.

The boat’s carbon monoxide sensor system did not alarm because it was not connected to a power supply.

Figure 1

Figure 2

Figure 3

SAFETY ISSUES

1. Portable air-cooled petrol generators are readily available and inexpensive, but they are usually intended for use in the open air. The use or permanent installation of these engines on boats, particularly in enclosed spaces or below decks, increases the risk of carbon monoxide poisoning.

2. It is essential that engine exhaust systems are fitted and maintained to direct poisonous fumes outside the vessel clear of ventilation intakes and accommodation spaces. Work on these systems should therefore only be undertaken by suitably qualified marine service engineers using approved parts and following the equipment manufacturer's instructions for marine installations.

3. Carbon monoxide is a lethal gas, which has no smell, no taste, is colourless and is extremely difficult for human senses to detect. All boaters need to be vigilant and recognise the signs of carbon monoxide poisoning, which can include: headaches, dizziness, nausea, vomiting, tiredness, confusion, stomach pain and shortage of breath.

4. Carbon monoxide is a silent killer that is just as lethal afloat as it is ashore. The correct positioning and the regular testing of any carbon monoxide sensors, whether powered by a boat's electrical supply or self-contained, is essential. Carbon monoxide sensor alarms that do not work correctly should be replaced. When selecting a carbon monoxide alarm preference should be given to those marked as meeting safety standard EN 50291-2:2010 which are intended for use in a marine environment.

Further advice on how to avoid carbon monoxide poisoning on boats and more detail about carbon monoxide alarms, produced by the Boat Safety Scheme (BSS) and the Council of Gas Detection and Environmental Monitoring (CoGDEM), can be found at:

http://www.boatsafetyscheme.org/stay-safe/carbon-monoxide-(co)

Issued May 2013

MAIB Safety Flyer (*Starlight Rays*)

MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

FLYER TO THE FISHING INDUSTRY

Fatal accident to a crewman while operating a petrol engine-driven pump in a fishing vessel's fish hold

Figure 1: The petrol engine-driven salvage pump

Figure 2: Warning notice on pump

Background

One crewman died and two more crewmen required evacuation to hospital by helicopter for medical treatment when they were poisoned by carbon monoxide on board a 23m fishing vessel, which was acting as a guard vessel, more than 100 nautical miles from land.

Two crewmen took a petrol engine-driven salvage pump **(Figure 1)** into the fish hold to pump oily water from the bow thruster space overboard. One of the crewmen started the engine, but the pump would not prime; he persevered for over an hour to get the pump to work, and the engine was running for most of this time.

The fish hold had no forced ventilation system and the hatches, except for a small access hatch, were closed. The pump was labelled *'The engine emits toxic carbon monoxide. Do not use in an enclosed space'* **(Figure 2)**.

Analysis

The petrol engine produced poisonous carbon monoxide that built up to fatal levels in the unventilated fish hold. The first crewman continued to work in the fish hold space, close to the engine for enough time for him to be overcome by the poisonous gas.

As the fishing vessel did not have a gas monitor on board, the crew were not able to check whether the fish hold was safe to enter, and they had no breathing apparatus to allow them to enter the toxic atmosphere safely. Consequently, the three remaining crewmen risked their lives in their attempt to rescue the collapsed crewman.

Safety lessons

Before using petrol or diesel-driven portable pumps, owners, skippers and crewmen working on fishing vessels should ensure that:

- The pumps are not used in enclosed spaces, such as fish holds, unless the engine exhaust is vented to fresh air outside the space.
- They fully understand the risks of carbon monoxide poisoning.
- They think about the risks involved and ensure that the potential hazards are removed or any adverse effects are reduced.
- They consider how to rescue safely a crewman who has collapsed in the toxic atmosphere of an enclosed space.

This flyer and the MAIB's investigation report are posted on our website:

www.maib.gov.uk

For all other enquiries:

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Marine Accident Investigation Branch
June 2012

MAIB Safety Bulletin 1/2014 (*Eshcol)*

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

SAFETY BULLETIN

SB1/2014 February 2014

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:
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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.

All bulletins can be found on our website:
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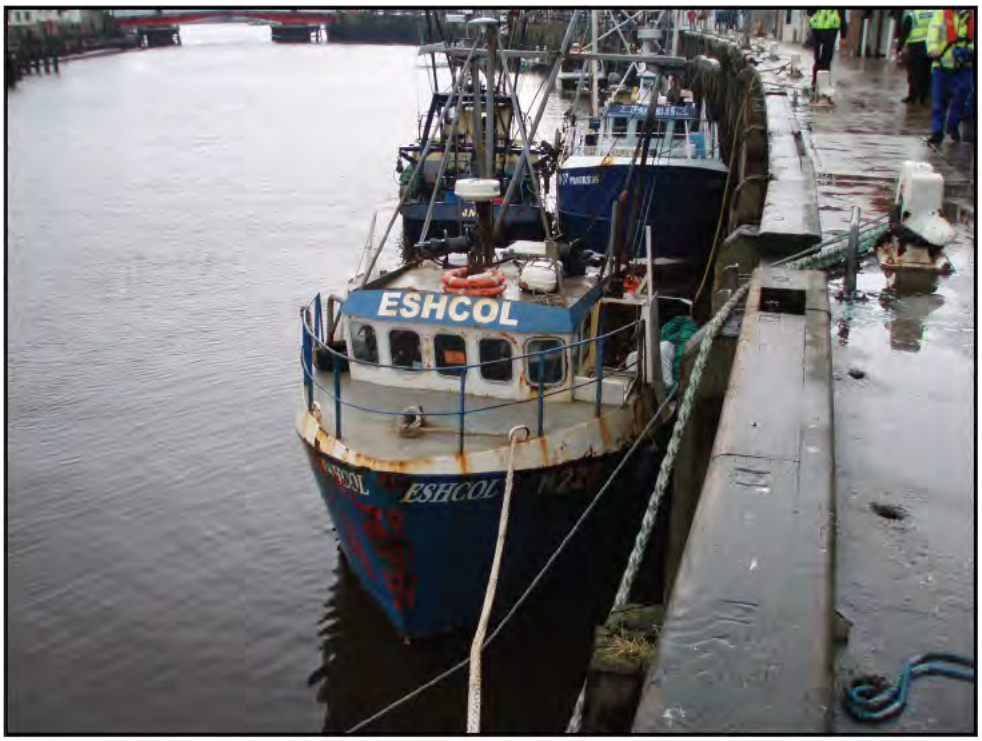
For all enquiries:

Email: maib@dft.gsi.gov.uk
Tel: 023 8039 5500
Fax: 023 8023 2459

Carbon monoxide poisoning on board the scallop-dredger *ESHCOL*

in Whitby, North Yorkshire on 15 January 2014 resulting in two fatalities



MAIB SAFETY BULLETIN 1/2014

This document, containing safety lessons, has been produced for marine safety purposes only, on the basis of 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 the deaths of two persons on board the scallop-dredger *Eshcol* on 15 January 2014.

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

Steve Clinch
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 be inadmissible in any judicial proceedings whose purpose, or one of whose purposes, is to attribute or apportion liability or blame.

This bulletin is also available on our website: www.maib.gov.uk

Press Enquiries: 020 7944 4833/3387; Out of hours: 020 7944 4292

Public Enquiries: 0300 330 3000

Background

An overnight break from fishing ended tragically when the skipper and a crewman sleeping on board the 9.95m scallop-dredger *Eshcol* died in their bunks. Initial findings indicate the men were poisoned by carbon monoxide.

Initial Findings

Before going to bed, the skipper (aged 26) and the crewman (aged 21) had lit the grill of a butane gas cooker fitted in the wheelhouse **(Figure 1)** in order to warm both the wheelhouse and the adjacent sleeping area. When they were not seen as expected the following morning, crewmen from fishing vessels tied up close by forced open the wheelhouse door. The gas grill was still lit **(Figure 2)** and the wheelhouse was full of fumes; the two men were dead in their bunks.

Eshcol was not fitted with a carbon monoxide alarm.

Figure 1

Figure 2

Safety Issues

1. Gas cookers are designed for cooking, not domestic heating. Accommodation areas need to be heated, especially during the winter months and, for this, appropriate, purpose built heaters are required.
2. Fossil fuel burning appliances, such as cookers, need to be checked and maintained to ensure they are in good condition. A yellow flame indicates poor combustion, resulting in an excess of carbon monoxide that, in a poorly ventilated space, can quickly build up to lethal levels.
3. Carbon monoxide is a lethal gas, which has no smell, no taste, is colourless and is extremely difficult for human senses to detect. Crew need to be vigilant and recognise the signs of carbon monoxide poisoning, which can include: headaches, dizziness, nausea, vomiting, tiredness, confusion, stomach pain and shortage of breath.
4. Carbon monoxide alarms are not expensive and should be fitted. When selecting a carbon monoxide alarm, preference should be given to those marked as meeting safety standard EN 50291-2:2010, which are intended for use in a marine environment.

Further guidance for fishermen on the use of liquid petroleum gas (LPG) heaters and cookers can be found in Marine Guidance Notes 312 (F) and 413(F). More detailed advice on how to avoid carbon monoxide poisoning and on carbon monoxide alarms, can be found at:
http://www.boatsafetyscheme.org/stay-safe/carbon-monoxide-(co)

Issued February 2014

Marine Accident Report