BOAT SAFETY SCHEME

SMOKE ALARMS ON RECREATIONAL BOATS

INVESTOR IN PEOPLE

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Registered office: London Road, Moreton in Marsh, Gloucestershire, GL56 0RH
01608 812500

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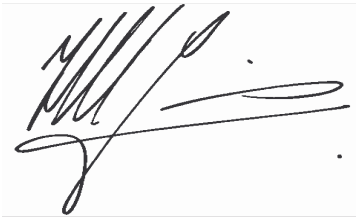
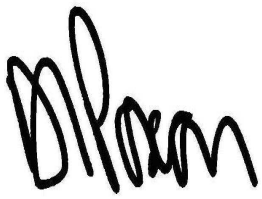


FAS Lewis
BSc CEng FIFireE CChem MRSC CPhys MInstP
Technical Manager

Date 2 July 2007



D Poxon
MIFireE
Network Services Manager

Date 2 July 2007

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BOAT SAFETY SCHEME

SMOKE ALARMS ON RECREATIONAL BOATS

1.0 INTRODUCTION

Every year there are a significant number of fires on boats on inland waterways, some of which result in deaths and injuries (see Annex A). The greatest hazard is at night when the boat is moored with those on board asleep. In these circumstances there may be a delay in a fire being detected with the resulting danger that smoke may render escape routes unnavigable. Clearly, the earlier that a fire is discovered, the more time is available for those on board to escape, raise the alarm with other people in the vicinity and call the fire brigade.

The danger in the event of a fire is not just the immediate threat to life but in a crowded marina a fire could rapidly spread to cause costly damage to many other craft and cause severe disruption to the smooth running of the day to day business of the facility.

A key element in the detection of a fire, especially when those on board may be asleep, is an automatic alarm. There are two types of automatic fire alarm systems, smoke alarms, which have an integral sounder and are designed for use in the home, and smoke detectors, which are the sensing elements of an automatic fire detection and alarm system normally installed to protect commercial and industrial premises.

A smoke alarm is a device that is readily available from many retail outlets, mainly for use in the home. It consists of a smoke detector, alarm sounder and power supply in a single housing. In some instances the device may be designed to be powered from the mains but will normally incorporate a back-up battery power supply in case of mains failure. In this document reference to a smoke *alarm* will indicate the application of such a device.

In contrast, a smoke (or heat) *detector* is a an element of an automatic fire detection and alarm system that only detects the presence of smoke (or heat) and is linked to other components of a system in order for the alarm to be raised. Such installations are normally found in industrial and commercial premises.

Smoke alarms have for many years been routinely fitted in conventional homes but although simple to fit, with no complex or expensive installation process being required, they are not routinely fitted on boats. The environment on board a boat, however, is very different from that in a building, for which smoke alarms and similar devices are principally designed.

The differences arise mainly from:

- Airflows in the cabins and other areas on board,
- Low ceiling height,
- Lack of compartmentation,
- The damp environment,
- Salt in the atmosphere (in tidal waters),
- Wide variations in temperature,
- Vibration from the boat.

There is no legislation requiring the fitting of smoke alarms in either homes or on boats but Approved Document B to the Building Regulations 2000 does require the installation of smoke alarms in new homes. Vigorous campaigns have resulted in smoke alarms being installed in about 80% of homes. There are no requirements for smoke alarms on board boats, even if they happen to be routinely used as homes.

The current position of the Boat Safety Scheme is not to require or recommend the installation of smoke alarms although owners are asked to consider fitting them. The reason for not advocating the use of smoke alarms more strongly has been due to the lack of manufacturing standards and suitable products tested for the marine environment. There has also been a lack of advice from the manufacturers of currently available smoke alarms as to their suitability for installation on recreational boats.

This report examines the types of devices available, the standards to which they are manufactured and their potential application on board boats.

2.0 TYPES OF FIRE DETECTOR

There are many forms of fire detector in use in commerce and industry and most are designed to detect smoke. Devices are available, however, that detect heat, flames and products of combustion such as carbon monoxide. In addition, detectors are now available that incorporate more than one of the following sensory elements that work together to reduce the likelihood of false alarms:

2.1 Smoke detectors

Smoke detectors used in commercial premises tend to be of two types, volumetric and point detectors. In the context of detecting fires on small, or relatively small boats only point detection is relevant due to the small volume of air being monitored and thus the discussions here are restricted to this form of device.

Smoke detectors operate on optical or ionisation principles (or a combination of both of these):

Optical detectors: detect smoke by light scattered from smoke particles in the atmosphere. These detectors are sensitive to optically dense smoke such as that formed in smouldering fires.

Ionisation detectors: operate as a result of smoke causing a reduction in a current flowing between electrodes in an ionisation chamber. These detectors are sensitive to smoke containing small particles such as those produced by rapidly developing, flaming fires.

In some areas of industry other forms of smoke detector are used, utilising video techniques or aspirating systems whereby air is sampled and analysed remotely. Beam detectors are also commonly encountered which are effectively extended forms of optical detector. None of these systems are applicable to small boats.

Because optical detectors react to visible smoke they are well suited for use in escape routes.

Although neither form of smoke detector will detect the products of a ‘clean’ burning fire such as those involving alcohol and some other solvents, this is not likely to be a

problem on board boats. Even this type of fire, however, would soon develop to involve other combustible materials that will produce smoke particles.

Smoke detectors tend to react more quickly than heat detectors but are more likely to give false and unwanted alarms especially in a small area where cooking is undertaken.

2.2 Heat detectors

By their very nature all fires produce heat. Heat detectors operate either when a predetermined fixed temperature is reached or when the temperature increases at a certain rate. Devices operating on the latter principle, however, should not be used unless they incorporate a fixed upper limit as otherwise they may fail to detect a slowly developing fire.

In industry other forms of heat detector include line detectors incorporating low melting insulation in a length of electrical cable running along a duct, for example, but these forms of device are not applicable in small boats.

Devices based on the detection of heat tend to be less sensitive and slower reacting than smoke detectors. They may not react to smouldering fires and as a rough rule of thumb, require flames to reach about a third of the distance to the ceiling before they respond. On board a boat it is possible that smoke from a small fire could become a threat to life before the heat from the fire was detected.

Heat detectors, however, tend to be more resistant to environmental conditions than smoke detectors, produce fewer unwanted and false alarm signals and require less maintenance.

2.3 Detectors of products of combustion

The most common type of combustion gas detector is one that responds to carbon monoxide. Carbon monoxide has a vapour density very similar to air (0.97 compared to 1.0 for air) and will thus mix with the air at all levels rather than stratify and diffuse to areas remote from the location of the fire. Most fire deaths result from the inhalation of carbon monoxide rather than the effects of the flames.

As carbon monoxide results from combustion of materials in circumstances where there is a restricted supply of oxygen, these detectors can be somewhat insensitive to a freely burning fire with a plentiful supply of air. In contrast, the detectors do not give false signals in response to dust, steam and cigarette smoke and react to many types of fire more rapidly than heat detectors.

Carbon monoxide fire detectors for use in a domestic environment are readily available, although significantly more expensive than smoke detectors. These electrochemical detectors do, however, suffer from a restricted life, after which the units must be replaced.

2.4 Flame detectors

Flame detectors: Because of their high cost and inability to detect smouldering fires, flame detectors are not suitable for use on small boats.

Infra red detectors: normally have application to protect large volumes such as cathedrals and are mounted high on the ceiling so are not suitable for use on small boats.

Ultra violet detectors: rely on the presence of a flame and thus will not detect a smouldering fire so again, these are not suitable for use on small boats.

2.5 Multi-sensor detectors

As their name indicates, these are detectors which are designed to react to more than one type of property of a fire. The intention of these designs is to enhance the performance of the device in the event of a fire and to reduce the likelihood of false alarm signals. In some cases the latter is achieved by software incorporated into the base of the unit.

Although comparatively recently introduced in to the market place there are several types of these devices now available. Most feature a smoke detector with a heat or carbon monoxide detector but detector heads featuring all three technologies are available for commercial applications.

3.0 RAISING THE ALARM

When considering automatic fire detection in a specific application the assessment undertaken should address a number of factors, several of which are inter-dependant. These include:

3.1 The objective of the exercise. In the case of a fire on a boat the primary objective will be to protect life. Property protection, while relevant, is of somewhat secondary importance.

Minimising the risk of injury to fire fighters when attending a boat fire, as well as protecting the occupants of the boat, is therefore a key factor, while the need to limit damage by fire spread to other property or boats also supports the case for the wider use of smoke alarms on boats.

3.2 The speed of response of the detectors installed. It is not necessarily the case that ‘the faster the better’ as devices with their sensitivity enhanced in order to enhance the response period may serve to increase the occurrence of false alarms. This is particularly the case where there is a high background level of airborne particles, vapours or similar materials in the normal operating environment.

3.3 The nature of the combustible materials that may be involved in a fire. The properties of the materials will affect their ease of ignition, the form of particles released during the combustion process and the heat release rate.

3.4 The likely rate of growth (and hence spread) of the fire.

3.5 The height and geometry of the protected area. In the case of a boat there will be low ceilings and this will exacerbate the rate of spread of the smoke and other products of combustion.

3.6 The geometry of the area and number of escape routes also defines the escape strategy as well as having a bearing on the spread of smoke and combustion products.

3.7 The attendance time of the local authority fire brigade, although it must be emphasised that the strategy to be adopted must not be dependant on rescue by the fire service. In many cases this will not be practical as boats will be away from the shore or in remote areas and thus reliance cannot be made on third parties detecting a fire or assisting in rescue operations within a timescale that will affect the outcome.

3.8 The management of the alarms is also of importance, especially where units are installed that may incorporate 'hush buttons' to prevent unwanted actuations from occurring while cooking is undertaken. Even though devices revert to normal operation after a predetermined time there should be a procedure for ensuring that all alarms are in working order at all relevant times (especially at night) otherwise they will not achieve their intended function.

An excessive number of false alarms will also inevitably lead to the disabling of the device by the removal of the battery.

4.0 RELEVANT NATIONAL AND OTHER STANDARDS

There are a number of relevant national and other standards that relate to the manufacture and testing of fire detection and fire alarm devices as well as for system design, installation, commissioning and maintenance. There is no standard; however, that considers parameters specifically concerning installations on boats.

Many standards are now recognised throughout Europe (EN standards) or Internationally (ISO standards). Underwriters Laboratories (UL) and National Fire Protection Association (NFPA) Standards originate in the USA.

4.1 Manufacturing standards

BS 5446-1: 2000: Fire detection and fire alarm devices for dwellings. Specification for smoke alarms.
BS 5446-2: 2003: Fire detection and fire alarm devices for dwellings. Specification for heat alarms.
BS 5446-3: 2005: Fire detection and fire alarm devices for dwellings. Specification for smoke alarm kits for deaf and hard of hearing people.

BS EN 54-1:1996: Fire detection and alarm systems. Introduction
BS EN 54-5: 2001: Fire detection and alarm systems. Heat detectors. Point detectors
BS EN 54-7: 2001: Fire detection and fire alarm systems. Smoke detectors. Point detectors using scattered light, transmitted light or ionization.
BS EN 54-10: 2002: Fire detection and alarm systems. Flame detectors. Point detectors.

BS ISO 7240-15: 2004: Fire detection and alarm systems. Point type fire detectors using scattered light, transmitted light or ionization sensors in combination with a heat sensor

BS EN 14604: 2005: Smoke alarm devices.

UL 217: Single and Multiple-Station Smoke Alarms.

There are no specific tests for the use of smoke (or other forms of fire) alarms for use in the marine environment but some research has been carried out in the US.

Paragraph 30 in BS 5446-1 details additional tests which should be applied by manufacturers to devices intended for application in leisure accommodation vehicles. These consist of vibration and temperature testing regimes. This section is also incorporated into BS EN 14604 which has replaced BS 5446-1, although the latter remains current until being withdrawn in 2008.

Over the past few years it is believed that smoke alarm manufacturing capability has greatly improved. Ionisation and photoelectric technology has greatly reduced the incidence of false alarms and corrosion resistance has increased. In the mid '90s, the US Coast Guard contracted Underwriters Laboratories to evaluate the use of smoke alarms aboard recreational vessels. UL authored a report (Report 92NK26482 – Fire Detection in Recreational Vessels) describing their work.

The tests performed by UL consisted of environmental and smoke performance tests and included shock, vibration, salt spray, and corrosion tests. This work also considered installation, maintenance and use of fire detection systems. Actual test fires were set aboard derelict vessels. The UL report summary noted favorably in 1997 that "…some presently available (smoke alarm) models successfully completed the tests. Thus it is possible that at least some manufacturers may not need to produce special marine use models, thus minimizing the costs to the boat builders and ultimately to the consumers."

4.2 Installation standards

The following standards refer to other aspects of fire alarm installations other than those which may be relevant to simple installations, such as those on boats:

BS 5839-1: 2002: Fire detection and fire alarm systems for buildings. Code of practice for system design, installation, commissioning and maintenance.

BS 5839-6: 2004: Fire detection and fire alarm systems for buildings. Code of practice for the design, installation and maintenance of fire detection and fire alarm systems in dwellings.

NFPA 72: National fire alarm code

5.0 CONTRACTORS

Smoke and heat detectors in homes are normally installed by residents but in some instances, such as in newly built homes, they are fitted by contractors. If contractors are employed they should be selected as having demonstrated their competence by gaining third party accreditation from a UKAS recognised approval body (such as the Loss Prevention Certification Board).

Where domestic smoke alarms are installed by the householder there is a reliance on clear and comprehensive instructions being provided by the manufacturer. The application on boats, however, is outside the scope of the instructions and so if detectors on boats are to be installed by the owner clear guidance applicable to the situation should be available.

As no product was identified during a brief survey (see section 7) as being manufactured specifically for use in covered boats the guidance set out in section 8 is designed to address this issue.

6.0 AREAS TO BE PROTECTED

In some small craft a single detector in the cabin may be all that is required. In larger vessels, however, there may be a greater degree of internal compartmentation with a number of areas being formed with differing hazards and uses.

In these cases it is accepted practice to protect the following areas: (see Annex B)

6.1 Sleeping accommodation.

6.2 A space containing an internal combustion engine.

6.3 A space containing a solid fuel heating appliance.

6.4 A space containing appliances or equipment supplied with a fuel having a flash point of 43^{o}C or lower.

6.5 A space containing fuel tanks or containers for petrol or other fuel having a flash point of 43^{o}C or lower. (Fuels with a flash point of 43^{o}C or lower include petrol, propane and butane.)

7.0 SELECTION OF DETECTORS TO BE INSTALLED

Smoke alarms are readily available and may be purchased from do-it-yourself stores, various other retail outlets including catalogue shops and on-line. While there are many brands available, in practice the types of detector for use in the home are limited to ionisation and optical smoke detectors and carbon monoxide detectors.

Combined carbon monoxide and either ionisation or optical detectors are reported by manufacturers to be available but only the carbon monoxide / ionisation type was found during a limited survey of retail outlets.

Examination of the packaging revealed that no products were labelled as being specifically applicable for use on boats or the marine environment although one did say it could be used in ‘home living units’ which could be interpreted as including some boats. Similarly, none was found to be labelled as being suitable for use in leisure accommodation vehicles.

In practice, therefore, the choice of detectors is limited and preference should be given to installing an optical or optical / carbon monoxide detector, with a second option being an ionisation or ionisation / carbon monoxide detector.

To avoid false and unwanted alarms which lead to inconvenience as well as a loss of confidence in the devices, when considering the features of a detector to be purchased and installed:

7.1 Virtually all alarms have a test button and this is a vital feature and should be operated periodically to ensure that the device is working.

7.2 In the confined environment on board a small vessel the alarm may react to fumes from cooking. This may be a real problem and thus there are distinct advantages in installing a type that has a built-in 'hush' button that, when pressed, will turn the device off for a predetermined period of time. The alarm should return to normal operating mode without relying on the occupier to take further action.

7.3 There should not be a reliance on frequent changing of batteries. This can result in the alarm being without power when required in an emergency. To prevent this, devices with lithium batteries with a 10 year life span are commonly available and are strongly recommended.

7.4 Where more than one device is to be installed, a facility should be available for them to be interconnected (see section 8.5.2).

7.5 Alarms are available that have a small escape light built in. This may be of value in some instances but even in a small boat is unlikely to illuminate the whole escape route.

8.0 INSTALLATION OF SMOKE ALARMS

There are two key factors that should be addressed when considering installing fire detection on boats:

- The alarm should be sufficiently loud to wake anyone on board who is asleep.
- The alarm should be sufficiently loud to be clearly audible over all possible background noise such as the sound of the engine(s).
- The alarm(s) should be sited where the products of combustion will be detected without delay.

It is anticipated that in small boats, such as those on inland waterways, these criteria would not be mutually exclusive and in virtually all cases an alarm sited in a location where it would react efficiently to a fire would also be sufficiently audible to waken any sleeping occupants at night but in the case of some large vessels multiple devices may be needed (see section 8.5).

By their very nature, products of combustion are associated with hot, and thus buoyant, gases which in a small enclosed space, such as a cabin on a boat, will rise to ceiling level by the process of convection in a short period of time. The smoke and gases will then travel laterally across the ceiling and begin to form a layer at this level. The smoke layer will build up and has the potential to restrict the visibility and movement of the occupants.

The movement of smoke across the ceiling will be affected by any obstructions which may hold up the smoke until its volume is such that sufficient is present to enable it to travel around, or over the obstruction.

With these factors in mind the following points should be observed when installing a smoke alarm:

8.1 The device should not be sited so close to items such as cooking equipment that an unacceptable number of unwanted alarms occur or there is a need to continually press the 'hush' button.

8.2 Alarms of all types are best located at ceiling (or roof) level, although they should not be installed so as to be flush or higher than the general level of the ceiling lining.

8.3 Where the ceiling (or roof) is sloping, the alarm should be located at or near the highest point.

8.4 Because of the effect that a wall may have on smoke movement, smoke alarms should be located no closer than 300mm to any vertical surface.

8.5 In the case of large vessels, such as some narrow boats, the dimensions of the vessel may result in an unacceptable reaction time for a single alarm and thus multiple devices may be necessary. The sensitivity of alarms varies according to their type, and the sound level may vary with manufacturer but in all cases, unless the supplier advises otherwise:

8.5.1 No point of the protected area of the vessel should be more than 5m from an alarm. This distance may need to be reduced where there are strong air currents that may reduce the sensitivity of the device.

8.5.2 Multiple alarms should be interlinked such that the actuation of one will cause all devices to actuate.

8.6 Where it is not practical to site an alarm on the ceiling (or roof) because of limited headroom, it may be sited on a wall provided that:

8.6.1 The alarm is mounted above the height of any door(s)

8.6.2 The alarm is sited between 150mm and 300mm below the ceiling.

8.7 Smoke alarms should not be mounted on walls or ceilings directly above a vent.

8.8 Where mushroom style vents are present on the ceiling (or roof) an alarm should be installed between each pair of vents.

8.9 To avoid unwanted actuations, alarms should not be located too close to a cooker or heater.

8.10 Because of the restrictions on free movement of the products of combustion resulting from layers of hot air in the vicinity of poorly insulated ceilings (roofs) or walls, smoke alarms should not be mounted on such elements of the structure. The devices are most effective when mounted on well insulated ceilings or walls.

8.11 Alarms should be located where they can be easily reached to actuate the hush button (where fitted) and the test button to test the device periodically.

8.12 Where more than one alarm is to be installed an optical and an ionisation type should both be selected (combined with carbon monoxide detectors where applicable).

9.0 TESTING AND MAINTENANCE

9.1 Alarms should be tested by the user and maintained according to the manufacturer's instructions.

9.2 In all cases they should be tested at the start of each period of use of the vessel and at least weekly thereafter.

9.3 Alarms should be wiped clean regularly and, as far as is practical, be kept dry.

9.4 Alarms should not be painted, stained or subject to other decorative treatment.

9.5 Alarms should not be used for attaching washing lines, decorations or similar artefacts.

10.0 DISPOSAL

The disposal of small numbers of smoke alarms is not a major problem but may be an issue where a number of ionisation detectors have to be scrapped.

In small numbers carbon monoxide and optical smoke alarms do not contain any components that would be harmful to the environment. Alarms incorporating ionisation detectors, however, contain a very small quantity of Americium 241, a radioactive isotope with a relatively long half life of 432 years.

While it is not reported as being unsafe to dispose of domestic smoke alarms in normal domestic waste, when ionisation detectors have to be disposed of it is advisable to take them to the local waste / recycling depot separately and seek advice as to local policy.

11.0 CONCLUSIONS

Owners and users of boats should be strongly encouraged to devise an emergency plan for fire and other emergencies before setting out on a journey. This should include installing a form of automatic warning in case of fire, especially if people are likely to be asleep on board a small vessel.

In the absence of any device designed and manufactured specifically for use on boats, the most cost effective fire protection provision would be a smoke alarm of the type that is readily available for domestic use.

There are several manufacturers these and although detectors designed for the commercial and industrial market now incorporate a variety of new technologies, domestic smoke alarms (that is to say detectors with built-in sounders) only appear to be readily available in two types, an ionisation detector and an optical detector, although combinations of these with carbon monoxide detectors, which are also invaluable on boats, are also available.

Little research appears to have been undertaken as to the design of smoke alarms for boats or the effectiveness of domestic smoke alarms in such vessels. Although the financial implications of researching, designing, testing and manufacturing smoke alarms especially for this purpose are not known, there may be merit in manufacturers undertaking a limited amount of research to enable them to label their products as being suitable (or otherwise) for use on boats.

Until such an exercise is undertaken, it would be difficult to argue against installing domestic smoke alarms such as an optical or combined optical / carbon monoxide detectors on boats. Even a simple ionisation detector is likely to be effective in saving lives if properly installed and incorporating a 'hush' button to minimise false alarms.

When an item has been selected, enquiries could be made with the manufacturer prior to purchase to establish whether the device is recommended for use on a small boat and whether it has passed the additional tests required for use in leisure accommodation vehicles.

With regard to cost, carbon monoxide detectors are much more expensive than smoke alarms. A limited survey found that:

- Combined smoke (ionisation) / carbon monoxide detectors are from £34.99
- Smoke alarms (optical) with hush button are from £7.99
- Smoke alarm (ionisation) with hush buttons are from £3.98

Preference should be given to purchasing products with an LPCB (Loss Prevention Certification Board) logo or a BSI kitemark. In the absence of a standard for smoke alarms for use in boats, detectors should be marked as conforming to BS 5446-1.

For the past 10 years or so there has been a campaign for the installation of smoke alarms in homes. It is difficult to make a logical case for not extending the application to homes and temporary accommodation on boats. Even if the life of smoke alarms is not so long as when installed in a conventional home, given the very reasonable cost of smoke alarms, which are available with additional savings when purchased in multiple packs, provided they are tested routinely when the boat is in use and replaced when necessary, they could make a valuable contribution to both life safety and property protection.

ANNEX A

Examples of typical recent fires involving boats

January 2006
A motor cruiser was connected to the marina shoreline electricity supply and was used to power a dehumidifier. The appliance developed a problem and a fire started. The owner was returning to the boat when there was an explosion. In fighting the fire The FRS filled the marina with foam and other boats had to be moved to safety.

March 2006
A family living aboard a narrowboat in the East Midlands removed the LPG system because they wanted a safe boat. They installed a solid fuel stove as a replacement. A few weeks later the stove set fire to the lining of the boat when the teenage daughter was the only person aboard. She escaped after a hard struggle. Although the fire-fighters attended quickly, the spread of fire was rapid and the heat intense. The family's home was a total loss and the fire killed some of their kittens.

April 2006
A retired seafarer was living aboard a boat in the northwest. When LPG vapour escaped from a poor condition hose and its connections, a tremendous gas explosion lifted the cabin superstructure. On falling back, it trapped the skipper. Large items of debris landed on the opposite riverbank. Nearby roads were sealed off and it caused severe disruption for local residents. With more gas cylinders visible, the fire officer in charge allowed two fire-fighters only to be put at risk in the work to free the victim. He was airlifted to a specialist burns unit in the east midlands, but died the following day.

May 2006
In the home counties, a family due to set off on their first trip aboard on a newly acquired 'entry level' cruiser had its petrol tank filled up at the marina refuelling jetty. Once full, the skipper went to pay for the fuel and spent around 20 minutes in the chandlery. When back aboard, he turned the ignition key, there was an explosion and the boat caught fire. The burning boat drifted close to nearby vessels, but the fire service suppressed the fire with only slight damage to neighbouring jetty. The family escaped without harm and replaced the boat.

November 2006
A cruiser exploded in a large coastal marina. A neighbouring skipper approached the burning craft to rescue the shocked owner. A second blast engulfed the cruiser owner in flames. The fire jumped to an adjacent boat and a third explosion threw the neighbour into the air; he was rescued from the pontoon by a lifeboat. The original cruiser owner was taken to hospital with burns to his face and hands. Many boats were cut free from moorings and were moved away. Eight fire engines, 50 fire-fighters and three lifeboats attended. All boats in the marina, which included some residential craft, and a number holiday homes along the city's seafront were evacuated and the area cordoned off. An emergency pollution control system was put in place.

February 2007
A fire that destroyed a liveaboard boat involved an inexperienced boater who was changing gas cylinders for the first time. Both cylinders, feeding a portable camping gas stove via a flexible hose, were within the cabin. The boater ‘finger tightened’ the screw thread before turning gas on which leaked immediately. The gas then ignited with most likely source being a lit coal stove. Fire-fighters also found a petrol generator within cabin and further petrol, coal and gas cylinders on the stern deck. The boat had a gas locker, but it was empty. Amazingly, the boater escaped with only slight ‘singeing’.

(Information from Warwickshire Fire & Rescue Service)

ANNEX B

Fire and Smoke Detection Systems - *46 CFR 181.40 & 181.450*

General Requirement

The following spaces must be fitted with a **fire detecting system**, except when the space is protected by a fire extinguishing system that is capable of automatic discharge upon heat detection, or if the space is manned:

- A space containing propulsion machinery.
- A space containing an internal combustion engine of more than 50 hp (37.3 kw).
- A space containing an oil fired boiler.
- A space containing machinery powered by gasoline or other fuels having a flash point of 110°F or lower.
- A space containing fuel tanks for gasoline or any other fuel having a flash point of 110°F or lower.

Smoke Detecting System

Each overnight accommodation space on a vessel with overnight accommodations for passengers must be fitted with an **independent modular smoke detecting and alarm unit**. The unit must be:

- UL Standard 217 and be listed as a "Single Station Smoke Detector-Also suitable for use in Recreational Vehicles".
- Contain an independent power source.
- Alarm on low power.

Figure 1: Extract from: *United States Coast Guard, Marine Safety Detachment, Sturgeon Bay, Wisconsin: Small Passenger Vessel Information Package.*

§ 28.325 Fire detection systems.

(a) Each accommodation space must be equipped with an independent modular smoke detector or a smoke actuated fire detecting unit installed in accordance with 46 CFR part 76, subpart 76.33.

(b) An independent modular smoke detector must meet UL 217 and be listed as a ‘‘Single Station Smoke Detector - Also suitable for use in Recreational Vehicles.’’

Figure 2: Extract from: *Title 46—Shipping, Chapter I--Coast Guard, Department Of Transportation, Part 28--Requirements For Commercial Fishing Industry Vessels*

Single and Multiple Station Smoke Alarms

UL 217

1 Scope

1.1 These requirements cover electrically operated single and multiple station smoke alarms intended for open area protection in indoor locations of residential units in accordance with the National Fire Alarm Code, NFPA 72, smoke alarms intended for use in recreational vehicles in accordance with the Standard for Recreational Vehicles, NFPA 501C, and portable smoke alarms used as "travel" alarms.

1.2 A single station smoke alarm, as defined by these requirements, is a self-contained fire alarm device that consists of an assembly of electrical components including a smoke chamber, alarm sounding appliance, and provision for connection to a power supply source, either by splice leads or a cord and plug arrangement or containing integral batteries. Possible accessories include a supplemental heat detector, terminals for connection to a remote audible signaling appliance or accessory, and an integral transmitter to energize a remote audible signaling appliance.

Figure 3: Extract from Underwriters Laboratories Standard *UL 217*.

ANNEX C

Disclaimer

1. FPA warrants that the report has been prepared with all reasonable skill and care. FPA will accept liability for deficiencies in any report caused by its breach of contract or negligence. Negligence shall be as defined as in Section 1(1) of the Unfair Contract Terms Act 1977. Except in the case of death or personal injury arising from the negligence of FPA, liability of FPA for breach of contract or negligence or otherwise in relation to the preparation of the report shall in no case exceed the fee paid by the Client for the report. FPA shall in no circumstances be liable for any other loss, charges, damages, indirect or consequential loss (including loss of profit) or expenses of any kind. The Client acknowledges that all possible circumstances in which the report may have some relevance cannot be foreseen at the time the report is prepared. The Client also acknowledges that FPA would not be able to provide the Report for the agreed fee if FPA were obliged to accept all far reaching responsibilities.

2. The scope of any report produced by FPA shall be limited to matters specifically identified in the Proposal or indicated in the report. Except where FPA has otherwise agreed in writing, FPA shall not be liable for any reliance placed on a report by any person other than the Client or for any reliance placed on a report which is not specified in or envisaged by the Proposal. FPA shall not be liable for any loss caused by a report where such less arises as a result of the provision to FPA of false, misleading or incomplete information by the Client or as a result of the act or omissions of any other person.

3. Any report shall only be valid and may only be relied upon for the period stated in the report. FPA accepts no responsibility for the accuracy of information contained in the report after the stated period of validity. Where so indicated by FPA any report is to be regarded as expressing the opinion only of FPA and is not to be relied upon as being factually correct.

4. Unless otherwise indicated, production of the report for the Client shall not imply that any Product or Service which is the subject of the report is approved under any Loss Prevention Certification Board approval or certification scheme or any other endorsements, approval or certification scheme.