

CHAPTER 23

FIREFIGHTING APPLIANCES AND INSTALLATIONS

CONTENTS

Para

2301.	Portable and Mobile Equipment
2302.	9 ltr Stored Pressure Extinguisher (AFFF)
2303.	SPE(AFFF) Extinguisher Air Charging
2304.	9 ltr SPE (AFFF): - Refilling and Recharging
2305.	Recharging the SPE Portable Air Charging Assembly
2306.	9 kg Stored Pressure Extinguisher (Dry Powder) (SPE (DP))
2307.	Marinised 2 kg Dry Powder Extinguisher
2308.	2 kg CO2 Extinguisher
2309.	6 ltr Wet Chemical Extinguisher (Fry Fighter)
2310.	Misuse of Stored Pressure Extinguishers
2311.	Marking of Portable Fire Extinguishers
2312.	Extinguisher LIFEX
2313.	Mobile Foam Unit SF90
2314.	10 kg CO2 Extinguisher
2315.	Aqueous Film Forming Foam (AFFF)
2316.	AFFF LIFEX
2317.	Freeze Protection of 6% AFFF
2318.	Thermal Imaging Camera (TIC)
2319.	TIC Battery Charging
2320.	TIC Rechargeable Battery Pack
2321.	Foam Inlet Tubes
2322.	Gaseous Firefighting Systems
2323.	Smoke Containment Curtains
2324.	Smoke Boundary Lights
2325.	Smoke Generating Training Devices

CHAPTER 23

FIREFIGHTING, APPLIANCES AND INSTALLATIONS

2301. Portable and Mobile Equipment

- a. This chapter deals with portable and mobile appliances and equipments, and fixed firefighting appliances and installations other than those associated with the HP sea water system. The latter are dealt with in [Chapter 22](#).
- b. There are several types of portable (first aid) appliances for hand use, provided for attacking fire in its early stages. If tackled promptly, such appliances can extinguish most fires, but it is important to realise their limitations and to prepare adequate back up should they fail. It should be noted that whenever a gas or solid (eg CO₂ or dry powder) is expelled under pressure from an extinguisher, electrostatic charges might be generated. The occasions when such charges assume the capability of causing electric shock to the user are rare; they vary according to circumstances and, in any case, are usually only of a minor nature.

EVERYONE MUST KNOW WHERE TO FIND AND HOW TO USE THE RIGHT TYPE OF EXTINGUISHER FOR ANY SORT OF FIRE.

2302. 9 ltr Stored Pressure Extinguisher (AFFF)

**WARNING**

THE 9 LTR STORED PRESSURE (SPE AFFF) EXTINGUISHER IS NOT TO BE USED TO FIGHT ELECTRICAL FIRES.

The 9 ltr SPE (AFFF) can be recognised by a **red painted shell** and a **cream coloured band** to indicate the foam contents. It is used on solid or liquid fires. It has a working charge pressure of 15 bar, so it can only be charged by the portable air charging assembly or from the LP air system, not by a foot pump. When fully charged to 15 bar it has a throw of 6 m and a discharge time of 38 seconds. There are two versions: standard and non-magnetic. The extinguishers are supplied fully charged ie filled with water, Chubb Aerospray Premix Foam and pressurised to 15 bar and are ready for use onboard. There is no requirement for ships staff to discharge and refill. If during the extinguishers life it requires refilling it is to be filled using Chubb Aerospray Premix Foam (see [Para 0507](#)). Should all spare Chubb Aerospray Premix foam charges be used up, AFFF extinguishers can still be charged with 6% AFFF 3M or Solberg AS held onboard. Chubb Aerospray Premix foam is not to be used in any fixed system AFFF tanks. For ships allowances of Chubb Aerospray Premix Foam see BRd 2170(3). To operate the 9 ltr SPE(AFFF):

- a. Hold the extinguisher upright.
- b. Pull out the safety pin (the anti-tamper tally) will break).
- c. Free the discharge hose and aim the nozzle to drop foam onto the fire from a minimum distance of 1 m.
- d. Squeeze the levers.

Fig 23-1. 9 ltr SPE (AFFF)



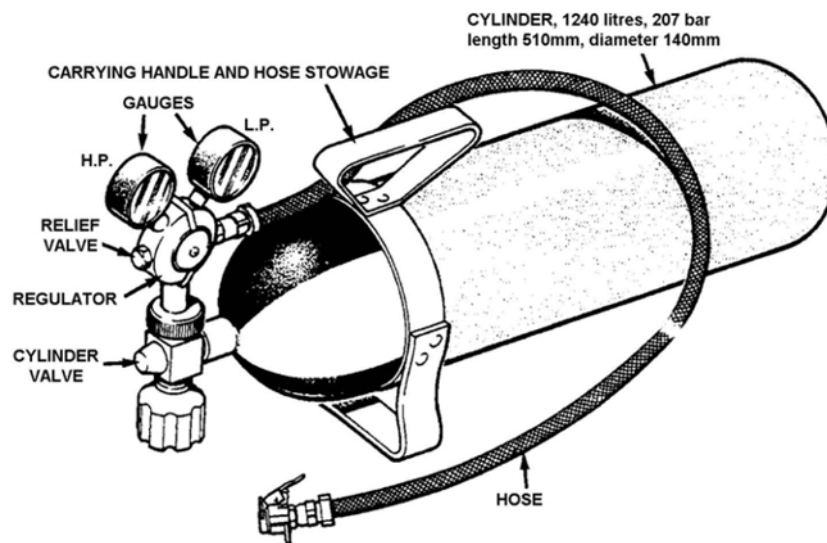
2303. SPE(AFFF) Extinguisher Air Charging



WARNING

GOGGLES AND EAR DEFENDERS ARE TO BE WORN WHEN CHARGING SPE WITH COMPRESSED AIR.

The Portable Air Charging Assembly (see [Fig 23-2](#)) consists of a high pressure air bottle fitted with a regulator valve and pressure gauges. A discharge hose terminates in a connection that will mate with the air charging connection on the SPE. The assembly is also fitted with a carrying handle and wind-around hose stowage. The air bottle is charged to 207 bar with clean, dry air from the ships breathing air charging panel, and will charge the SPE to approximately 15 bar.

Fig 23-2. Portable Air Charging Assembly**2304. 9 ltr SPE (AFFF): - Refilling and Recharging**

- a. Remove the safety pin. Invert the extinguisher and squeeze the operating levers to vent any residual pressure.
- b. Slacken the headcap by rotating it two complete turns and listen for any residual pressure.
- c. Remove the head and siphon tube assembly.
- d. Empty the residual contents and rinse out the extinguisher with fresh water.
- e. Fill the extinguisher with fresh water to the 'F' line level indicator on the siphon tube.
- f. Top up with Chubb Aerospray Premix Foam charge. Do not overfill or mix Chubb Aerospray Premix Foam charge with other foam types.
- g. Check the actuation of all moving parts of the head and the condition of the neck ring. Check that the siphon tube is clear of obstruction.
- h. Lightly grease the 'O' seals, moving parts and neck threads with petroleum jelly.
- i. Screw on the head assembly and tighten it hand tight.
- j. Fit the safety pin and insert a plastic dart through the end.
- k. Pressurise the extinguisher with air to 15 bar (the white line on the gauge), using the portable air charging assembly or the LP air system and a tyre inflator. Replace the dust cap on the Schrader valve.

2305. Recharging the SPE Portable Air Charging Assembly**WARNING**

THE SPE AIR CHARGING ASSEMBLY USES A BASCCA BOTTLE WHICH MUST NOT BE CHARGED TO MORE THAN 207 BAR.

The compressed air bottle is to be recharged from a 207 bar air charging panel, if fitted, or from the ships usual charging facilities ashore. To fill the compressed air bottle from the BA panel the following procedure should be adopted:

- a. Ensure that all valves on the charging panel are shut.
- b. Open the charging panel pressure gauge stop valve on the 207 bar charging line to vent any pressure that might be remaining in the circuit.
- c. Remove the blanking cap from the charging panel 207 bar outlet.
- d. Open the main air supply valve and crack open the 207 bar outlet valve to blow any dirt out of the line.
- e. Remove the regulator and hose assembly from the air charging bottle, first ensuring that the bottle valve is shut.
- f. Connect the compressed air bottle, through the charging hose and adaptor, to the charging panel 207 bar outlet.
- g. Open the bottle valve and then open the charging panel 207 bar outlet valve enough to charge the bottle to 207 bar at a comparatively slow rate. This avoids overheating the air passing into the bottle.
- h. When charging is complete, shut the bottle valve, shut the charging outlet valve and shut the main supply valve.
- i. Disconnect the bottle, charging hose and adaptor from the charging panel.
- j. Replace the blanking cap on the 207 bar outlet connection.
- k. Replace the regulator and hose assembly on the air charging bottle.



Note. *In ships without a 207 bar charging panel, the 205 bar SABA diving BA panel should be used.*

- l. To recharge the 9 ltr SPE (AFFF):
 - (1) Remove the safety pin, if fitted. Invert the extinguisher and squeeze the operating levers to vent any residual pressure.

- (2) Slacken the headcap by rotating it 2 complete turns and listen for any residual pressure. Do not use a hammer on the handle, lever or pressure gauge. Do not unscrew further until all residual pressure has dissipated.
- (3) Remove the head and siphon tube assembly.
- (4) Empty the residual contents and rinse out the extinguisher with fresh water.

2306. 9 kg Stored Pressure Extinguisher (Dry Powder) (SPE (DP))



WARNING

THE 9KG SPE (DP) IS SUPPLIED WITH A 15 BAR NITROGEN CHARGE AND IS NOT TO BE RECHARGED BY SHIPS/UNITS.

The 9 kg SPE (DP) can be recognised by a **red painted shell** and a **blue coloured band** to indicate the powder contents. It is used on solid or liquid fires and is particularly effective for liquid fuel pressure spray fires. It may be used on low voltage electrical fires (up to 440V AC or 800V DC) but **must not be used on live HV systems**. It has a throw of 6 m and a discharge time of 15 seconds. There are two versions: standard and non-magnetic. To operate the 9 kg SPE (DP):

- a. Hold the extinguisher upright.
- b. Pull out the safety pin (the plastic dart will break).
- c. Free the discharge hose and aim at the base of the fire, from a minimum distance of 1 m.
- d. Squeeze the levers.

Fig 23-3. 9 kg SPE (DP)



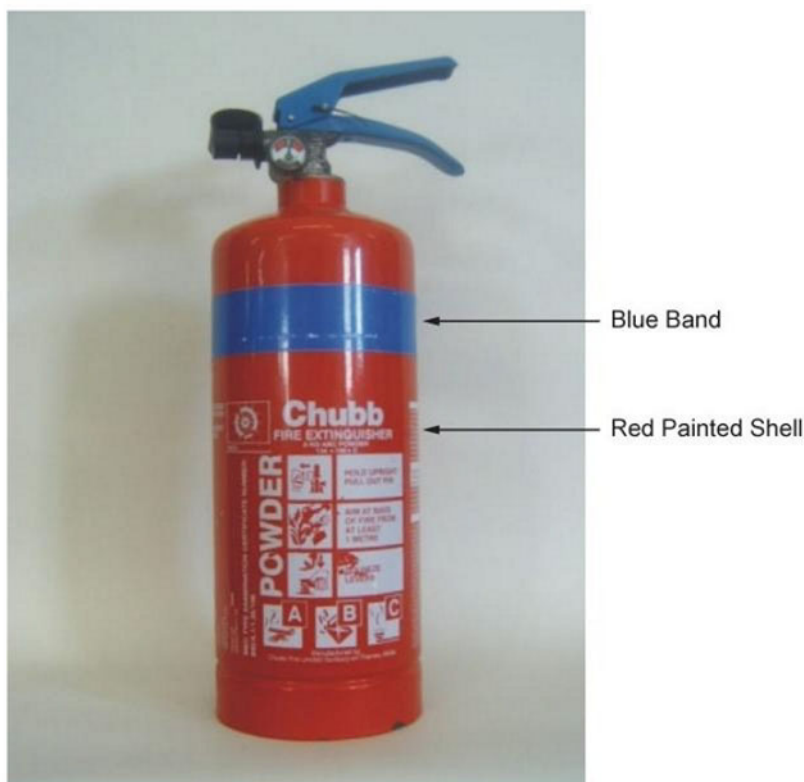
2307. Marinised 2 kg Dry Powder Extinguisher**WARNING**

ALTHOUGH THE DRY POWDER IS NON-TOXIC THIS EXTINGUISHER IS NOT TO BE DIRECTED AT PERSONNEL.

The marinised 2 kg dry powder extinguisher (see [Fig 23-4](#)) is supplied for use in small craft using outboard motors. The extinguisher, which has a dedicated mounting bracket, has a 2 kg charge of dry powder and is pressurised by nitrogen at 15 bar. This marinised version of the extinguisher is manufactured from corrosion resistant materials and should not be confused with the 2 kg dry powder extinguisher supplied for use ashore. It cannot be recharged onboard but must be returned through Naval Stores if partially or fully discharged. To operate the extinguisher:

- a. Hold upright. Pull out the pin.
- b. Aim at the base of the fire, from a distance of at least 1 m.
- c. Squeeze the levers.

Fig 23-4. Marinised 2 kg Dry Powder Extinguisher



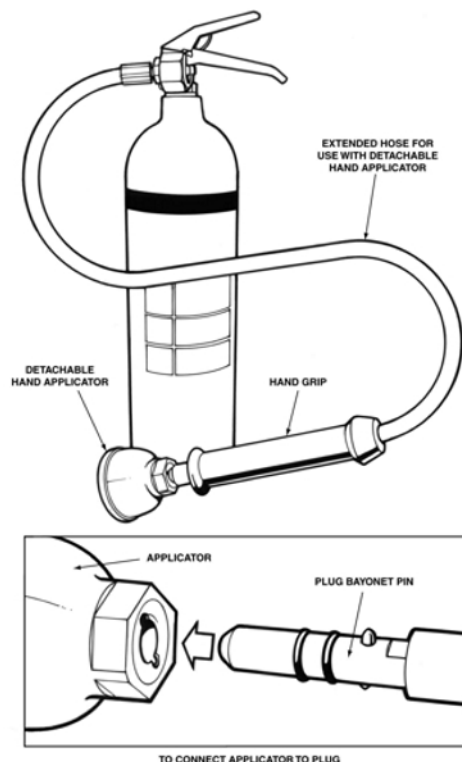
2308. 2 kg CO₂ Extinguisher**WARNINGS**

- 1. DO NOT GRIP THE HORN OR THE BOTTLE DURING USE IT WILL FREEZE THE HAND AND MAY CAUSE BURNS.**
- 2. CO₂ IS HARMFUL IF BREATHED AT RELATIVELY LOW CONCENTRATIONS. ONCE CO₂ HAS BEEN OPERATED PERSONNEL ARE TO RETREAT TO A CLEAN ATMOSPHERE.**

a. The 2 kg CO₂ extinguishers are coloured red with a black identifying band around the bottle. It consists of a bottle containing 2 kg of liquefied CO₂ at a pressure of 58 bar at 20°C and is normally fitted with a rigid discharge horn. There are two versions: normal and non-magnetic. To operate the extinguisher, remove the safety pin, (the plastic dart will break), hold the extinguisher by the squeeze-grip release valve and press the trigger of the grip very firmly to ensure a full discharge and to avoid the risk of freeze up at the orifice. The discharge time is about eight seconds. The horn should be directed at the base of the fire from as near as possible.

b. CO₂ extinguishers provided in compartments containing electrical equipment eg radar cabinets, are fitted with a flexible hose and bayonet plug (see [Fig 23-5b](#)). The plug fits into inlet sockets on electronic cabinets. The socket has a breakable membrane that ruptures when the plug on the extinguisher hose is inserted. For use on open equipment and elsewhere in the compartment the hose is fitted with a detachable hand applicator, which fits over the plug, designed to prevent hand contact with the end of the hose. The extinguisher is normally stowed with the hand applicator fitted. A relatively cool stowage position is required for these extinguishers. No attempt must be made by any individual or ship/unit representative to remove the discharge valve from the extinguisher. If the safety pin is missing, or the plastic dart is missing or broken, the weight must be checked. The 2 kg CO₂ extinguisher must be returned and replaced if any of the following conditions occur:

- (1) Partial or complete discharge.
- (2) Damage to the gauge or any part of the extinguisher that renders it unserviceable.
- (3) Significant signs of corrosion.
- (4) 10 years after Date of Manufacture (DOM) (see [Para 2312](#)).

Fig 23-5a. kg CO₂ Extinguisher With Discharge HornFig 23-5b. 2 kg CO₂ Extinguisher With Flexible Hose

2309. 6 ltr Wet Chemical Extinguisher (Fry Fighter)

**WARNING**

AFTER FRY FIGHTER ACTIVATION RE-ENTRY TEAMS ARE NOT TO TRAIN HOSE NOZZLES DIRECTLY AT THE DEEP FAT FRYER IN ORDER TO PREVENT THE REMOVAL OF THE PROTECTIVE CRUST AND TO AVOID THE RISK OF RE-IGNITION.

The Fry Fighter extinguisher (see [Fig 23-6](#)) is provided in galley compartments specifically to deal with deep fat fryer fires. The extinguisher contains a wet chemical that reacts with the burning fat or oil. When applied it cools and emulsifies the burning liquid forming a crust over the surface. The spray initially knocks down the flames and the crust completes the extinction. The crust formed on the surface also prevents re-ignition by stopping contact with oxygen in the air. The fry fighter can be recognised by a **red painted shell** and a **46 mm wide yellow label** to indicate the contents. It cannot be recharged onboard but must be returned through Naval stores if partially or fully discharged. There are two versions: standard and non-magnetic. To operate the extinguisher:

- Pull out the safety pin and detach the applicator.
- Hold the nozzle directly above the fire at a distance of 1 m.
- Squeeze the levers and apply the entire contents to the total area of the fire.

Fig 23-6. 6 ltr Wet Chemical Extinguisher (Fry Fighter)

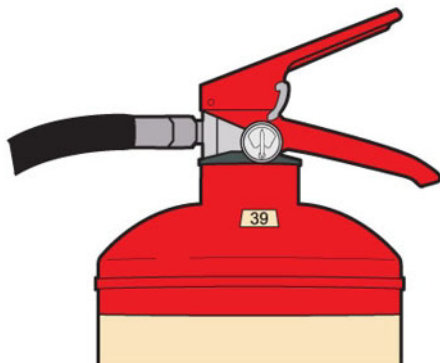
**2310. Misuse of Stored Pressure Extinguishers**

Fire extinguishers are only provided to attack and extinguish fires and in no circumstances are they to be used for any other purpose.

2311. Marking of Portable Fire Extinguishers

- a. **Extinguishers.** All extinguishers are to be marked with 25 mm (1 inch) Black numbers using a permanent marker (see [Fig 23-7a](#) and [Fig 23-7b](#)). These markings can be removed, without causing abrasive damage, using Propanol Ampex, (see BRd 2170(3)) applied with a soft cloth. **ALL THESE POSITIONAL MARKINGS MUST BE REMOVED PRIOR TO THE EXTINGUISHER BEING RETURNED TO STORES.**

Fig 23-7a. Stored Pressure Extinguisher

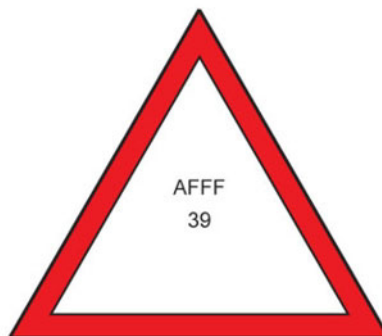
Fig 23-7b. 2 kg CO₂ Extinguisher

b. Stowages

(1) All extinguisher stowages are to be identified by a red triangle on the structure directly above the stowage position. These can be painted or are available from Naval Stores (NSN listed in BRd 2170(3)).

(2) The triangles should have outside dimensions of 115 mm (4.5 inch) per side and a 7 mm ($\frac{1}{4}$ inch) border. Corresponding type and number of the associated extinguisher is to be painted or marked in the triangle with 13 mm ($\frac{1}{2}$ inch) black lettering, as example below.

Fig 23-7c. Fire Extinguisher Stowage

**2312. Extinguisher LIFEX**

a. The LIFEX for AFFF, Dry Powder and Fry Fighter extinguishers is defined as 5 years. This is determined from either the date of manufacture (DOM), or refurbishment date (whichever is most recent). The DOM will be printed on the extinguisher body adjacent to the 'ship's wheel'. If the extinguisher has been refurbished a label will be attached to the lower part of the unit, which should state 'Refurbished by Name + Date'. It should be noted that the original printed DOM will not be amended when an extinguisher is refurbished and will remain visible.

b. The LIFEX of CO₂ extinguishers, including those contained within the operating cabinets of gaseous drench systems, is defined as 10 years. This is determined from the test date stamped on the bottle neck.

c. The discharge of AFFF SPEs and subsequent on-board recharging has no effect on the stated 5 year LIFEX. The AFFF SPE is to be replaced within 5 years regardless of use.

d. On receipt of SPEs from stores, the DOM, refurbishment date or test date is to be checked and recorded by the maintainer. This will enable ships staff to check that SPEs are in date on receipt and enable a calculation to be made on the remaining life. To assist in this process maintainers are to generate electronic history sheets, recording the manufacture, refurbish, test and LIFEX dates against local numbers. An example history sheet for SPEs is detailed at [Table 23-1](#). A copy of the history sheet is to be held within the vessels Master CBRNDC Training and Material Assessment Log to enable the maintainer to plan and record the exchange of extinguishers and facilitate any audit of the equipment.

e. The maintainer is to plan a rolling exchange programme for extinguishers as their LIFEX point approaches. AFFF, Dry Powder, Fry Fighter and CO₂ extinguishers are supplied fully charged from stores and if unused should be returned through the stores system intact and not discharged locally.

Table 23-1. Example of SPE Extinguisher History Sheet

SPE NO	SPE TYPE	LOCATION	DOM/REFURBISH/TEST DATE	LIFEX DATE (see Note)
23	CO ₂	Bridge 02H	Jun 05	Jun 15
24	AFFF	Chart House	Mar 06	Mar 11



Note. AFFF, Dry Powder and Fry Fighter extinguishers have a 5 year life from DOM/ Refurbish Date. CO₂ extinguishers have a 10 year life from bottle test date.

2313. Mobile Foam Unit SF90



WARNINGS

1. DO NOT REMOVE ANY FITTINGS UNTIL ALL INTERNAL PRESSURE HAS BEEN RELEASED FROM THE STORAGE CONTAINER.
2. MAXIMUM WORKING PRESSURE OF THE AIR BOTTLE IS 200 BAR.
3. IF A DEDICATED CHARGING SUPPLY IS NOT AVAILABLE, GREAT CARE MUST BE TAKEN TO AVOID OVER PRESSURISATION OF THE AIR BOTTLE.

a. This is for use against flightdeck or hangar fuel fires in some ships. It is designed for rapid action to gain time while the main firefighting system is being brought into operation. The unit carries 90 ltrs of foam premix (fresh water/6% firefighting foam solution), mounted on a trolley. It has a hose and a branchpipe with an on/off control valve. An air bottle mounted on the foam tank provides discharge pressure. Older designs of the unit will have the discharge hoses 'Dutch rolled' in a stowage basket. Newer designs have a small bore hose coiled on hooks. The unit discharges in 1 min and has a throw of 15 to 18 m. To operate the unit:

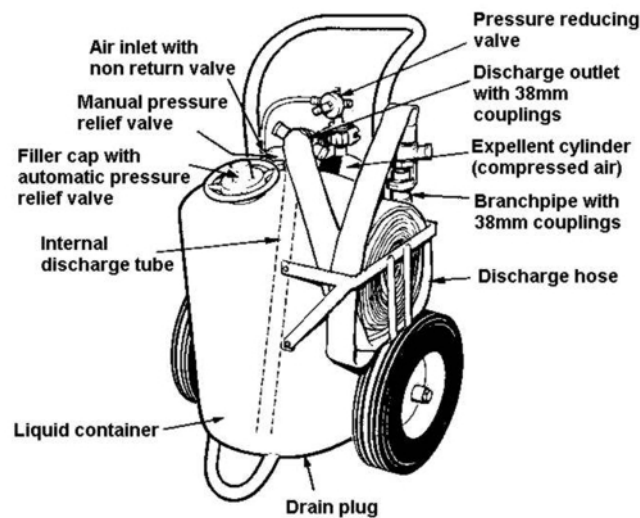
- (1) Roll out the hose towards the fire
- (2) Open the valve on the air bottle to pressurise the foam tank.
- (3) Open the nozzle control valve and direct the jet to fall lightly on to the burning material.



Note. The SF90-AS (a static version of the SF90 unit) is fitted in the machinery spaces of some RFAs and submarines (see BRd 2170(4)).

- b. The SF90-AW and SFU 90-AS extinguishers are re-charged after use as follows:
- (1) Ensure the air bottle valve is shut.
 - (2) De-pressurise the premix foam container tank via the pressure release valve.
 - (3) Disconnect the foam discharge hose from the premix foam container and flush with fresh water.

Fig 23-8. Mobile Foam Unit SF90-AW



- (4) Re-connect the foam discharge hose to the premix foam container.
- (5) Stow the foam discharge hose.
- (6) Unscrew the filler cap assembly and remove.
- (7) If completely discharged, fill the container with clean fresh water to within 150 mm of the filling hole sealing face. Slowly add 5 ltrs of AFFF liquid concentrate and stir to ensure a constant mix. Top up with fresh water to 100 mm from the sealing face.
- (8) If the unit has been partially discharged, top up with a prepared premix of 85 ltrs of clean fresh water and 5 ltrs of 6% AFFF liquid concentrate, to within 100 mm of the filling hole sealing face.
- (9) Check the filler cap gasket is not damaged and in place and replace the filler cap hand tight.
- (10) Disconnect the air bottle from the pressure regulator, release the bottle retaining strap and remove the air bottle.
- (11) Charge the air bottle to 124 bar (minimum) to 200 bar (maximum) pressure.

(12) Replace the air bottle, secure the retaining strap and re-connect the pressure regulator to the air bottle.

**Notes:**

1. *In an emergency, when fresh water is not available the unit can be recharged using seawater to enable it to be prepared for immediate use. At the earliest opportunity after being charged with seawater the unit is to be emptied and the storage container and hoses flushed with clean fresh water to prevent corrosion and salt deposit build up.*
2. *The unit is not to be left charged with seawater for long periods.*

(13) Check all connections are tight.

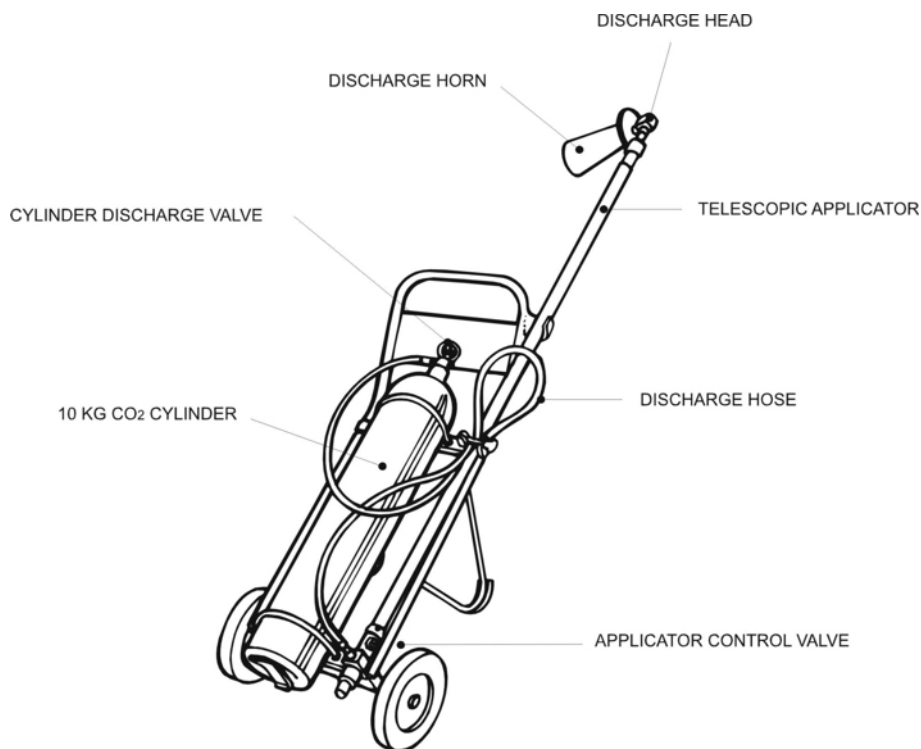
2314. 10 kg CO₂ Extinguisher**WARNING**

AFTER DISCHARGE, THE APPLICATOR EXTENSION TUBE WILL BE EXTREMELY COLD AND SHOULD NOT BE DIRECTLY HANDLED.

a. The trolley-mounted 10 kg CO₂ extinguisher (see [Fig 23-11](#)) is provided for dealing with fire during the starting of aircraft engines. The apparatus comprises a trolley-mounted bottle, containing 10 kg of liquefied CO₂, connected by flexible hose to a telescopic applicator. The applicator may be extended up to 3.6 m and the length set by turning the knurled locking collar. A horn is normally fitted over the discharge nozzle for use in the open, but this is unscrewed and removed if the nozzle is to be inserted into an engine access panel. Discharge of a fully charged bottle lasts between 30 and 40 seconds. Detailed instructions are contained in Air Publication 957.

b. To operate the extinguisher:

- (1) Place the trolley in the upright position.
- (2) Open the bottle discharge valve.
- (3) Remove the applicator from the trolley and extend to the required length. Lock the applicator adjustment to prevent it extending under gas pressure.
- (4) Position the discharge nozzle through an engine bay fire access panel, etc.
- (5) Squeeze the applicator control valve to release the gas. The operator should be prepared for jet reaction on discharge, especially if the applicator is fully extended.

Fig 23-9. 10 kg CO₂ Extinguisher**2315. Aqueous Film Forming Foam (AFFF)**

a. AFFF is a synthetic, non-toxic, foam-forming liquid based on fluoro-chemical wetting agents designed for use with fresh or seawater. It produces an aqueous film to float out over the surface of a burning fuel, forming a vapour seal that extinguishes fire and prevents re-flash. This sealing action will also take place on fuel spillages, thus securing them from ignition. AFFF can be used in conjunction with other firefighting agents used in HM ships, without impairment of its efficiency. It is as effective against solid fuel fires as it is against liquid fuel fires and, in each case, should be sprayed directly over the fire to achieve complete coverage as quickly as possible. Firefighting systems using AFFF should only be supplied with undiluted (neat) AFFF (except when freeze protection is added; see [Para 2317](#)).

b. There are two types of AFFF used in HM ships, 6% and 1%. These figures indicate the percentage of AFFF concentrate that is mixed with water at the inductor. The 1% AFFF is therefore a stronger concentrate than the 6% AFFF. The two types are used as follows:

(1) 6% AFFF is used in 9 ltr stored pressure extinguishers, SF90 and SFU90 extinguishers, FBU5X and FB10/10 branchpipes. This is supplied in 20 ltr drums.

(2) 1% AFFF is used in flight deck monitors and in some hangar and vehicle deck spray systems (see specification for individual ships). This is also supplied in 20 ltr drums.

- c. On receipt of the AFFF drums, the caps should be eased so that when required for use they may be opened by hand. Extreme care should be taken to prevent breaking of the anti-tamper tag, so ensuring that the quality and nature of the contents is preserved. If necessary, the red plastic security seals, listed in BRd 2170(3), may be used.
- d. Do not mix AFFF 6% 3M or Solberg AS with Chubb Aerospray Premix Foam. Chubb Aerospray Premix Foam is not to be used in any fixed system AFFF tanks.

2316. AFFF LIFEX

- a. Sealed 20 ltr drums of AFFF have 20 year life from Date of Manufacture (DOM). This date can be found on the drums label. An anti-tamper tag is to be fitted to all drums. LIFEX date is also to be written on the drum in permanent marker to guard against illegibility or loss of the drums label over its 20 year life.
- b. AFFF used in spray system tanks has a 10 year life from DOM. The quality and strength is to be checked annually in accordance with relevant maintenance schedules. The unit must permanently record the DOM of decanted AFFF and the LIFEX date annotated on the tank. Units who suspect the quality of AFFF contained in storage tanks are to contact Abbeywood 9375 39602 for guidance on testing.
- c. AFFF once mixed with fresh or salt water has a 5 year life (pre-mix).
- d. The storage life of Chubb Aerospray Premix Foam is 10 years in an unopened bottle and 5 years premixed.

2317. Freeze Protection of 6% AFFF

- a. 6% AFFF concentrate is liable to temporary thickening when exposed to temperatures below 2°C. This could affect the pick-up of the concentrate by an inductor. AFFF stowed in exposed positions in cold climates, eg unheated stowage on jetties, on upper decks of ships or on submarine casings, may be freeze protected by the addition of 24% ethylene glycol, which will give protection down to -10°C. Drums of AFFF which have been thus treated must be clearly marked: **'Freeze protected by 24% ethylene glycol'** to avoid confusion with untreated AFFF, and are not to be put in between-deck stowages. Freeze protected 6% AFFF down to -16°C is available under the following: NSN F216 99 961 3301.
- b. Dilution by ethylene glycol will affect the performance of AFFF, so it is only to be added in exceptional climatic conditions, eg Upkeep Periods, when no heated stowages are available.

2318. Thermal Imaging Camera (TIC)

These are issued to HM Ships, Submarines and RFAs to the scale of allowances given in BRd 2170(3) for Surface ships, Submarines and RFA.

- a. **Purpose.** For use as an aid to firefighting and search and rescue operations by providing thermal pictures through dense smoke where normal vision is impossible. The TIC will provide:

- (1) The operator with a clear vision through dense smoke and darkness.
 - (2) Locate the source and spread of the fire.
 - (3) Improve the safety and mobility of the firefighters by making obstacles and other hazards visible.
 - (4) Reduce the time taken in search and rescue operations.
 - (5) Detect and display the relative temperatures within the fire scene.
- b. Other features include:
- (1) Capture of up to 100 images.
 - (2) Direct and Ambient Temperature Measurement.
 - (3) 2 x Zoom.
 - (4) Removable Handle.
 - (5) Date and Time.
- c. **Description.** The TIC is a battery operated, hand-held, self contained camera which has a fully automatic operation with no control or adjustment required in use. No routine maintenance is required for the camera. If it is not in regular use, it should be switched on for a period of 10 mins every month to check correct operation. After use and prior to stowing, the camera should be cleaned using a cloth soaked with warm soapy water. The TIC is fully illustrated in [Fig 23-10a](#), [Fig 23-10b](#) and [Fig 23-10c](#).
- d. **Initial Operation**
- (1) The rechargeable batteries should be fully charged before use.
 - (2) Fit the battery into the compartment on the top of the camera and push down until a click is heard. To remove the battery, press the battery release button and the battery will eject and can be removed.
 - (3) Turn on the camera using the middle red button on the rear. A **RED** light will be illuminated to show the camera is powered. A long (3 sec) press is required to switch the camera off.
 - (4) After the camera is switched on and for approximately 5 secs afterwards, a start-up screen will be displayed on the camera screen while the system performs a self-test routine. This start-up screen is configurable by the operator.
 - (5) The thermal image, with battery status display, training bar, time and date and ambient and spot temperature and spot target markings, will appear.

(6) When the TIC is in operation, the camera has to recalibrate to maintain its performance and image quality. This is achieved by an internal shutter that 'freezes' the image; this in turn allows the electronics to recalibrate and redisplay the image. This recalibration will only occur when necessary due to a change in scene or internal temperatures. The freezing of the image will last for less than 0.2 seconds.

(7) The camera can be used with or without the handle. To remove the handle, spin the large thumbwheel anti-clockwise until the handle detaches from the camera body. Refitting is the reverse of this, initially making sure that the locating pip is positioned correctly.

Fig 23-10a. Thermal Imaging Camera



Fig 23-10b. Thermal Imaging Camera (Rear View)

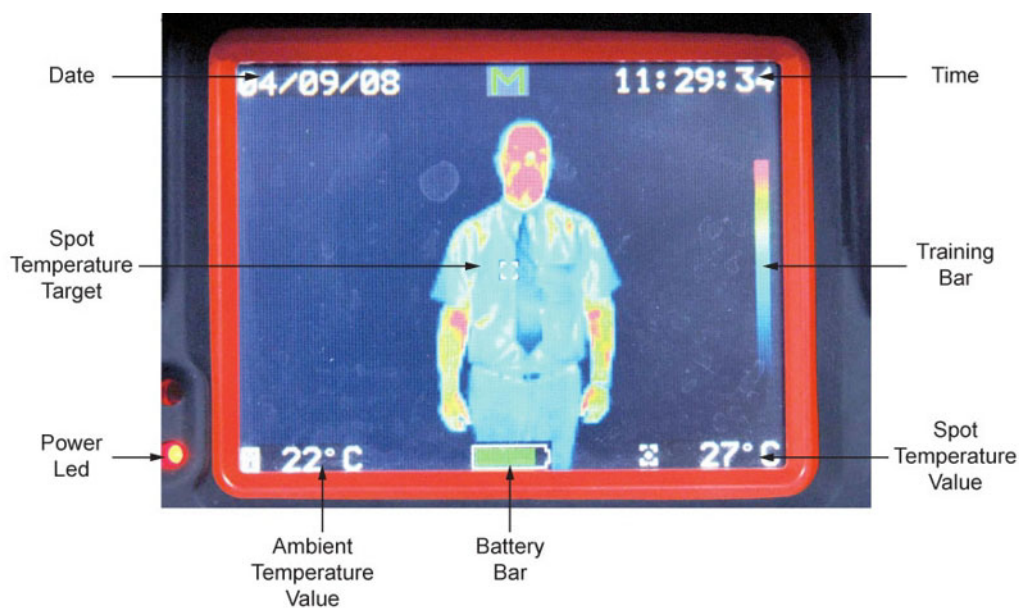


Fig 23-10c. Thermal Imaging Camera (Front View)

e. **Operating Modes.** The two modes to be utilised for firefighting and Search and Rescue (SAR) operations are as follows:

- (1) **Firefighting.** 'Heat finder soft red' (to remain in this mode unless SAR operations have been authorised).
- (2) **Search and Rescue.** 'Grey Scale (WH)'.



Note. The operating modes can be changed using the remote unit (supplied with each TIC).

f. **Camera Features**

- (1) **Dynamic Scene Colourisation (DSC).** The TIC provides the end-user with a selection of colour palettes, which colourises the thermal image to allow the user to pinpoint the hottest areas within the fire scene.
- (2) **Direct Temperature Measurement**
 - (a) The TIC allows the operator to view the average temperature of the centre spot of the scene (defined by the target markings). The temperature reading is displayed in the bottom right-hand corner of the display. This system is intended to give the operator the ability to detect possible hazards such as hot gas bottles or tanks.

(b) The camera can be configured to give a reading in degrees Celsius or degrees Fahrenheit by using the user software or the remote control. Scene temperatures between -40°C (-30°F) and 800°C (1480°F) can be displayed. This feature can be turned off if not required by using the software provided.

**Notes:**

1. *If the object in the scene does not fully fill the target marks then a false reading may be obtained.*
2. *Different materials have differing surface emissivities, which will produce variations in the temperature readings. Variations can also be caused by the distance from the object. This temperature measurement must be regarded as an indication and not a guaranteed reading.*
3. *If the temperature falls outside the maximum value, the display will show '+++'.*

(3) Image Capture

(a) Up to 100 images can be captured and stored in the TIC. These images can then be viewed or deleted using the remote control or software provided. Using the software provided, captured images can be downloaded to a suitable laptop/PC in several formats.

(b) To capture an image, press the left-hand button. The image capture symbol appears for a short time above the ambient temperature reading and the number of the image out of 100 will also be indicated on the display.

(c) If the image capture button is pressed and the camera already has 100 images stored, a '**CAMERA FULL**' warning will appear. Before further images can be captured, unwanted images will need to be deleted using the remote control or software.

(4) **Tri-Mode Sensitivity.** The TIC has three levels of sensitivity: High, Low and Extended Low. These levels provide the user with a thermal image over the widest possible temperature range. The TIC will switch to the optimum level of sensitivity automatically and will indicate which mode the camera is using by a coloured 'M' symbol at the top of the display as follows:

(a) **High Sensitivity Mode.** The TIC will operate in High Sensitivity mode under normal operating conditions and is indicated by a green '**M**' symbol. The image that is produced is clearer and will show more detail. The temperature range for this mode is between -40°C and 150°C (-40°F and 300°F).

(b) **Low Sensitivity Mode.** The TIC will automatically switch to Low Sensitivity mode when higher temperatures have been detected. It is indicated by an orange 'M' symbol. The image that is produced loses some clarity, but will still show a significant amount of detail. The temperature range for this mode is up to 400°C (750°F).

(c) **Extended Low Sensitivity Mode.** If the scene has extreme temperatures, the TIC will automatically switch to Extended Low Sensitivity mode, indicated by a red 'M' symbol, and allows an image to be produced that is clear and will show some detail. The temperature range for this mode is up to around 800°C (1480 °F).

(5) **Zoom.** A short press on the right-hand button operates the zoom function. The zoom symbol will appear to the right of the display above the spot temperature reading and is indicated by the magnifying glass icon on the screen. The temperature measurement sample window is also expanded to suit. The zoom feature can be turned off if not required by using the software provided.

(6) **Ambient Temperature.** The ambient temperature sensor is fitted to the front of the camera and the ambient temperature is displayed on the bottom left-hand side of the display. The range for ambient temperature measurement is – 15°C (5°F) to 150°C (302°F). If ambient temperature measurement is not required, it can be turned off using the software and the reading will be removed from the display. The ambient temperature will be shown with any image captured.



Note. The ambient temperature is an indication only. If the temperature falls outside the minimum value, the display will show '---'. If the temperature falls outside the maximum value, the display will show '+++'.

(7) **Time and Date.** Time and date are displayed at the top of the screen in the format: dd/mm/yy and hh:mm:ss. The date and time can be adjusted using the remote control or software provided and will be shown on any image captured.

g. **Display Warning Graphics.** The TIC is equipped with an advanced microprocessor based control and user warning system. In addition to controlling the automatic operation of the camera to ensure the best possible picture at all times, the control system provides graphics on the display to alert the user to certain conditions as follows:

(1) **Over Temperature Warning.** As the circuitry within the camera approaches its maximum internal operating temperature, a warning symbol in the shape of a thermometer will appear to the left of the battery display. The camera will continue to operate at this temperature, but the user may see some degradation of the image quality. If the user ignores this warning and continues to operate the camera in very high temperatures, the warning symbol will flash.



Note. When the flashing temperature warning is present, the camera is very close to its absolute operating limit and the image will start to degrade considerably. The user must remove the unit from the high ambient temperature at this time; failure to comply may result in permanent damage to the unit. Failure to act upon this level of warning may result in serious damage to the system and may invalidate the warranty.

(2) **General System Failure Warning.** As part of the operation of the system, the microprocessor monitors certain functions and displays an internationally recognised warning symbol if it detects a fault. The warning, which takes the form of an exclamation mark within a triangle, will appear to the left of the battery status indicator. If the warning appears and if appropriate, turn the camera off and leave for 5 mins. Turn the camera on and check if the warning symbol has disappeared. If the warning symbol is still present, or the symptoms return the camera is not to be used.

h. **Operating Notes.** The following information relates to a 'white-hot' image.

(1) **Interpreting The Image - Relative Temperatures.** The image displayed is simply a black and white picture of the infrared energy entering the lens. The camera displays relative temperature differences between individual objects and their surroundings irrespective of overall ambient temperature. The camera is set up to display objects at various shades between black for cooler items and white for hotter bodies, eg in a room at 20°C a cold drink would appear black whilst a hot radiator would appear white. However, in a room at 250°C, it is possible that the same hot radiator may appear darker than, for example, burning materials.

(2) **Identification of Fire and Hotspots.** The camera will represent zones of very high temperature as white zones within the picture. When sufficient heat has been detected, eg a large area of fire, the camera will automatically enter low sensitivity mode. This will extend the dynamic range of the camera and allow the image of surrounding objects to remain clearly visible.

(3) **Hidden Fires.** It is possible that fires may be burning or smouldering behind doors, in trunking or in bulkhead or deck cavities. In such circumstances, the operator should look for areas that appear whiter when compared with the surroundings. For example, a fire behind a door will cause the door to appear whiter against the background. Similarly, a white area on an otherwise dark wall could indicate an area of fire behind the structure.

(4) **Search and Rescue.** The camera can be used by search and rescue teams to search for casualties and to seek out dangerous items such as fuel tanks or gas bottles.

(5) **Image Clarity.** The sharpness and clarity of the image provided is related to the temperature of the scene and objects in view. A cold room provides little infrared energy and less detail is detected than in a warm environment where objects give off significant energy. In general, the warmer the scene, the more thermal contrast and hence the greater detail in the picture.

(6) **Heat Layers in Closed Spaces.** In a major fire, a layer of hot gases may build up in the upper region of the closed space. Attempting to use the camera in this hot layer will cause the image to become featureless. By bringing the camera down beneath this layer, the unit is able to provide the firefighter with a clearer picture of the scene ahead.

(7) **Windows and Polished Surfaces.** Glass is not transparent to long wavelength infrared energy and it is not possible for the operator to use the camera to look through a window. A white window would indicate that the window itself is relatively warm and may be being heated by a fire behind it. Just as we see reflections in glass under normal circumstances, it is possible that the camera can detect infrared reflections in glass, mirrors and polished or painted surfaces. Care must be taken to ensure that the image seen is not simply a reflection. Training and experience will give the operator the required added confidence.

(8) **Control of Water Streams/Jets.** When viewed through the camera, water streams from hoses will appear black against the background scene. The control and direction of a water flow can be monitored by viewing its flow and effect on the fire through the camera. It may be necessary, if employing a waterwall, to drop the wall momentarily to view the effects of the extinguishing stream.

(9) **Lens Cleaning During Operation.** The camera lens, like the BA visor, may become obscured during use. The lens may be cleaned with a glove or cloth if necessary.

2319. TIC Battery Charging

a. The rechargeable battery system supplied with the TIC has been specifically designed to fast-charge the Ni-MH rechargeable batteries. The charger is to be used with the charging shoe and is mains powered. The charger is a fully automatic 'smart charger', monitoring voltage, time and temperature and ensures optimum charge for the battery. In addition:

(1) The charger has a built-in start timer that eliminates early termination of charging when a battery is first connected to it. This prevents batteries that have not been used for some time, or are completely discharged, from showing a fully charged status incorrectly.

(2) If the battery temperature is too low, the charger will start with a trickle charge until the correct operating temperature has been reached.

(3) If the battery temperature is too high, the charger will reduce the charge rate until the normal operating temperature has been reached.

b. Once the battery has reached full charge, the charger will go into top-up charge mode and the LED will turn green and flash intermittently yellow. Once the top-up has been completed, the charger will go into maintenance mode and the LED will show green.

The battery is to be removed from the charging shoe once charged. Before fitting another battery into the charger, allow at least 30 seconds so the battery charger can reset; the LED turning to yellow indicates that the charger has reset.

LED COLOURS DURING NORMAL OPERATION	
LED	MODE
Orange	No battery fitted, initial power applied
Yellow	No battery fitted, charger ready for use
Yellow	Battery fitted, start up trickle charging
Orange	Battery fitted, fast charging
Green with intermittent yellow flash	Top up charge
Green	Charge complete, maintenance mode
LED COLOURS DURING FAULT CONDITIONS	
LED	MODE
Green while flashing yellow	Battery or charger out of operating range
Flashing between orange and green	Battery or charger has a fault. Remove battery and disconnect the power.



Note. On some models the 'orange' LED may appear to have a red tint. This is normal.

2320. TIC Rechargeable Battery Pack

The TIC is supplied with two rechargeable battery packs which are designed to power the unit for 4 hours from a full charge and use Nickel Metal Hydride (Ni-MH) cells. The battery pack contains circuitry that monitors the cell's temperature to ensure that maximum performance is provided and that correct charging is performed. The pack also has a recoverable short-circuit protection. The battery pack provides an output to the 'battery status bar' on the camera display (see [Fig 23-10b](#)). This battery status bar provides a continuous colour indication of the remaining charge, allowing the firefighter to avoid unpredicted power loss. With a fully charged battery, the battery bar will show full and be coloured green. The battery bar will then progressively decrease as the battery capacity is consumed. When the battery status bar has reached a quarter full, the battery bar will turn orange and there is approximately one (1) hour of battery life remaining. As the battery capacity is consumed further, the battery bar will turn red and there is approximately 30 min of battery life remaining. When the battery is low, the battery status bar border will turn red and flash to alert the operator. The time remaining will typically be 10 mins.



Note. To maintain the accuracy of the battery charge indicator, it is recommended that batteries are occasionally fully discharged in a camera before charging.

Fig 23-11. TIC Battery Charger**2321. Foam Inlet Tubes**

These are fitted in machinery spaces to enable AFFF foam to be delivered direct into the bilges, by means of an FB5X branchpipe, from positions outside the spaces. The tops of the tubes are to be fitted with blanking caps (identified) and these caps must be screwed down tightly when not in use to preserve watertight and gastight integrity. The upper portion of the tube protruding through the deck/bulkhead is to be painted signal red, the remainder being painted to suit the compartment decor and identified with red tape marked FOAM. Adjacent to the top of the inlet tube a notice is to be provided (white lettering on a red background) stating FOAM TUBE, compartment served and the maximum amount of AFFF solution necessary when fighting a fire via the foam tube. This may be calculated as follows: The water consumption of the FB5X, as indicated on the branch pipe, is 225 ltr/min at 5.5 bar, consumption of AFFF is therefore 13.5 ltr/min ($225 \times 6\%$) and allowing an expansion factor of 10 the foam produces is 2250 ltrs/min. From this it can be shown that to produce a layer of foam 100 mm deep (experience has shown that an average depth of 100 mm is required to produce a minimum depth of 50 mm) in a compartment L metres long, W metres wide and having N foam inlets will require 0.03 LW/N 20 ltr containers at each foam inlet. On current major warships this approximates to 2 x 20 ltr containers at each foam inlet.

2322. Gaseous Firefighting Systems

See [Chapter 21](#) for details.

2323. Smoke Containment Curtains

- a. Smoke curtains are fitted at main watertight doors to sub-divide passageways to enable smoke boundaries to be maintained in the event of distortion of doors/structure or for the passage of personnel. They are manufactured from Temprotech TPT3200-2-SS flame retardant fabric. Canopy arrangements are provided at doors to form a mini airlock about 1 x 1 m on the non-door side of the bulkhead. A pelmet curtain rail, with well rounded corners to allow easy curtain movement, follows the form of the airlock. Curtains are fitted in two parts with an overlap. Reflective tape is fitted to the edges of the smoke curtains to allow the access to be rapidly identified, thus reducing the time taken to pass through. Curtains must be checked to ensure that:

- (1) Temprotech curtains have an overlap of between 600 and 700 mm and Columbus 300 curtains have a minimum overlap of 505 mm.



Note. *Type 45 curtains have been designed with a nominal 550 mm overlap ($\pm 5\%$) closed by full length Velcro tapes to provide a continuous seal along the length of the curtain (minimum acceptable overlap of 522.5 mm).*

- (2) Pelmetts fitted for the sub division of passageways hang both sides of the curtain to a depth of 225 mm.
- (3) Curtains have lead weight strips sewn in 50 mm from the deck.
- (4) Curtains touch the deck to form a smoke tight seal that will be maintained while the ship is pitching and rolling within its design parameters.
- (5) Internal and external edges of curtains have reflective tape fitted.

b. Smoke containment curtains are susceptible to considerable wear, chaffing and snagging from the passage of personnel and equipments when left in the rigged position. In order to retain the effectiveness and integrity of the curtains the following procedures are to be adopted:

- (1) **State 1** - Curtains are to be fully rigged and checked for defects; they are then to be re-stowed using only one tieback. Defects are to be rectified as soon as possible.
- (2) **States 2 and 3** - Curtains are to remain stowed.
- (3) In the event of a real fire or smoke generated for exercise purposes the curtains are to be rigged as soon as possible to hinder the spread of smoke.



Notes:

1. *Temprotech TPT3200-2-SS flame retardant fabric is available from Naval stores (see BRd 2170(3) Chapter 3) to allow for curtain repair or the manufacture of ad-hoc smoke curtains.*
2. *It is entirely acceptable for units to be fitted with a mixture of Temprotech TPT3200-2-SS and Columbus 300 smoke curtains and any remaining stock of Columbus 300 may be used for the repair of existing Columbus 300 curtains.*

2324. Smoke Boundary Lights

The Smoke Boundary Light has been introduced to indicate the smoke boundary limits during a fire incident freeing valuable manpower for other tasking. The light is lightweight, robust, magnetic and fully portable. It is powered by 4 AA alkaline batteries with 26 super-bright red LED lights providing 22 hours of light in the static mode and between 24-40 hours in the flashing mode before the brightness starts to decline. When using the light to indicate a smoke boundary opening, be it doors, hatches or other openings, it should be switched to the 'Flash' mode.

The light will provide an intense visual indication of the extent of the smoke boundary and a prompt to personnel of the smoke danger behind the opening.



Note. At present an alternative means of attachment is being investigated for the use of these lights on non-magnetic vessels.

Fig 23-12. Smoke Boundary Light



2325. Smoke Generating Training Devices

There are 2 smoke generating machines in use in the RN, the RN Colt 4 Turbo Basic and the Spirit 900A Smoke System available for firefighting/search and rescue team training aids. Both these units operate on a 115V 60 Hz electrical supply via transformers, producing smoke from a pressurised canister containing smoke fluid and a pressurising agent. They allow realistic exercise of breathing apparatus, TICs and DC communications techniques and enhances training in smoke control and clearance. Although simple to use, these devices require operator training and is delivered to all CBRNDCQs on the CBRNDC 35 Course, as well as LET(ME)'s during CBRNDC 29 Course.



Note. In Archer Class vessels, as an interim measure, 1PBS SMEO will conduct local training of the smoke generating device for all Archer Class MEOs as the vessel is not complemented for a CBRNDCQ. This training must be recorded in the P2000 CBRNDC Training and Material Assessment Log.

A quick reference guide for the use of these units is as follows:

a. **RN Colt 4 Turbo Basic**

(1) **Preparation and Operation**

- (a) Connect unit to a suitable 115V supply and put the Red Power switch to **ON**.

(b) After approx 5 mins the Green Ready Indicator will light. **For the best performance wait a further 5-10 mins before operating** (the unit is thermostatically controlled and can be left heating indefinitely if required).

(c) Screw a full Colt 4 canister into the machine.

(d) Ensure Flow Regulator valve is fully anticlockwise (fully open).

(e) To produce smoke depress the black smoke button.

(f) To stop producing smoke release the black smoke button.

(2) **Off Power Use**

(a) This unit incorporates a high mass steel heater block. Once pre-heated this will hold sufficient energy to produce a considerable quantity of smoke 'off power' allowing the operator to carry the unit, making smoke as required, without a trailing lead.

(b) If using the smoke 'off power', the operator should monitor the smoke quality being produced. When the smoke thins and becomes 'bluish' in appearance stop producing smoke and re-heat the machine until the Green Ready light comes on again.

(3) **Shut Down**

(a) When finished with smoke production the Colt 4 aerosol can be removed. The can re-seals for later use.

(b) If the Colt 4 was last used in the 'off power' mode, it is recommended that the unit is connected to the power supply for 2-3 mins before the unit is switched off and stored. This helps vaporise any residual chemical left in the heat exchanger chamber.

(4) **General Information**

(a) Colt smoke machines are designed for use only with the appropriate Colt aerosols. Damage will occur if any other aerosol is used.

(b) Do not cover or obstruct louvres in any way. Only use the unit in well ventilated areas.

(c) When smoke is required to be hosed away from the machine, a ducting adaptor must be used. This acts as an adaptor for the flexible hose and also serves to remove any large droplets of fluid from the smoke that would otherwise collect in the hose.

(d) Normal precautions should be observed regarding the storage and use of aerosols ie protect from sunlight and do not expose to temperatures exceeding 50°C.

Do not pierce or burn after use. Do not spray on a naked flame or any incandescent material. Store aerosols with valve downwards.



Note. *At present an alternative means of attachment is being investigated for the use of these lights on non-magnetic vessels.*

b. **Spirit 900A Smoke System**

- (1) Fill the unit with Smoke Fluid A. Do not overfill. Ensure that the transit cap (underneath the red reservoir cover) is removed when making smoke.
- (2) Connect unit to a suitable 110V AC supply and put the red power switch to ON. The digital display will light and the temperature of the unit (red display) will begin to increase. The green 335 figure is the target temperature.
- (3) After approx 5 mins the green ready indicator will light. **For best performance wait a further 5 mins before operating** (the unit is electronically temperature controlled and can be left heating indefinitely if required).
- (4) Ensure Flow Regulator Valve (FRV) is fully anti-clockwise (fully open). If continuous smoke is required this can be achieved by closing the FRV until that is achieved.
- (5) To produce smoke put the black smoke switch to On (1). Alternatively, with the remote switch fitted, put the remote switch to On (1).
- (6) To stop producing put the black smoke switch to Off (0). Alternatively, if the remote switch is being used, put the remote switch to Off (0).

Notes:

1. *To ensure optimum performance clean out the nozzle of the heat exchanger block with the 2 mm twist drill provided after every 2 hours of use. This operation takes 10 secs.*
2. *When finished with smoke production, disconnect the machine from the power supply, re-fit the transit cap under the red reservoir cover to prevent liquid spill.*
3. *For detailed information on the units maintenance, health and safety and fault finding refer to the manufacturers full instructions supplied with the unit.*

