

BAB V
PENUTUP

V.1 KESIMPULAN

Berdasarkan hasil perencanaan Sistem Pemadam Kebakaran Pada Kapal Curah Pengangkut Batu Bara 17500 DWT maka dapat disimpulkan alat – alat pemadam kebakaran yang terdapat pada kapal rancangan adalah :

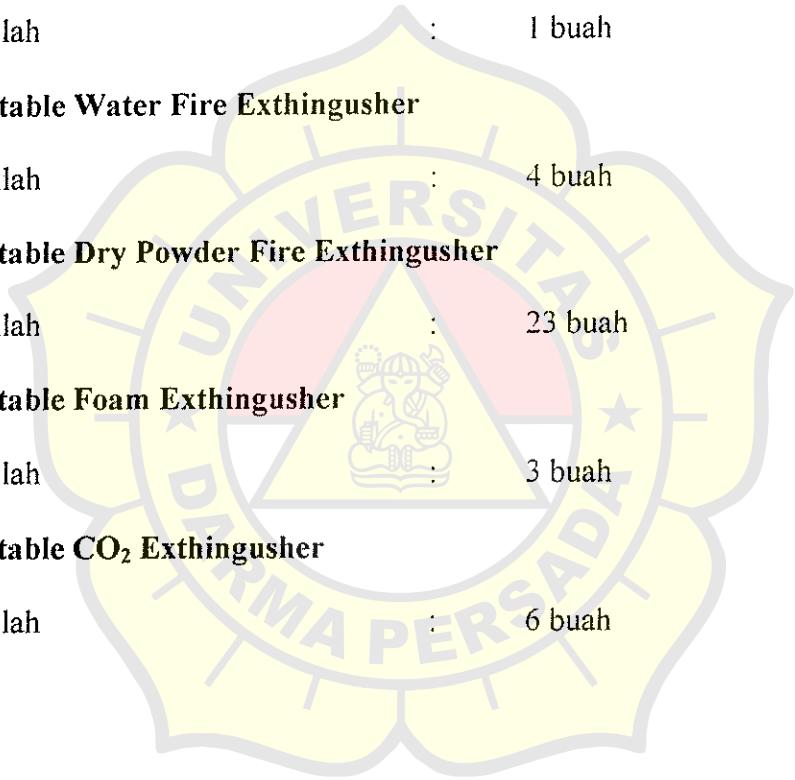
A. Alat – alat pemadam kebakaran yang dipasang tetap (*Fixed Fire Instalation*)

- **Fire Hydrant**
Jumlah : 13 buah
- **CO₂ System**
Jumlah botol CO₂ : 34 buah
Jumlah CO₂ realase : 4 buah
Jumlah CO₂ station : 4 buah
- **Sprinkler System**
Jumlah sprinkler head : 169 buah
- **International Shore Connection**
Jumlah : 2 buah
- **Fire Detector**
Jumlah heat detector : 56 buah
Jumlah smoke detector : 36 buah
Jumlah flame detector : 5 buah
- **Audible Alarm**
Jumlah : 11 buah

- **Visual Alarm**
 Jumlah : 20 buah
- **Fire Alarm Bell**
 Jumlah : 6 buah
- **Fire Switch Alarm**
 Jumlah : 11 buah

B. Alat – alat pemadam yang dapat dipindah atau dibawa (*Fire Exthingusher*).

- **Portable Foam Applicator**
 Jumlah : 1 buah
- **Portable Water Fire Exthingusher**
 Jumlah : 4 buah
- **Portable Dry Powder Fire Exthingusher**
 Jumlah : 23 buah
- **Portable Foam Exthingusher**
 Jumlah : 3 buah
- **Portable CO₂ Exthingusher**
 Jumlah : 6 buah



DAFTAR PUSTAKA

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2. BIRO KLASIFIKASI INDONESIA, Biro Klasifikasi Indonesia (*Volume II*) 1996.
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4. KESELAMATAN PELAYARAN DAN PENCEGAHAN PENCEMARAN DARI KAPAL, Pieter Batti, Jasa Usaha Mulia CV Febuari 2000.
5. MARINE AUXILARY MACHINERY AND SYSTEMS, M. Khetagurov, Peace Publisher Moscow.
6. PEMADAM KEBAKARAN DI-KAPAL, Durijat, Harahap. S.S, Yayasan Bakti Samudera.
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either:

- 1 chapter 19 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk adopted by the Maritime Safety Committee by resolution MSC.5(48), hereinafter referred to as "the International Gas Carrier Code", as may be amended by the Organization; or
- 2 chapter XIX of the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk adopted by the Assembly of the Organization by resolution A.328(IX), hereinafter referred to as "the Gas Carrier Code", as has been or may be amended by the Organization;

whichever is applicable.

- 32 *Cargo area* is that part of the ship that contains cargo tanks, slop tanks and cargo pump-rooms including pump-rooms, cofferdams, ballast and void spaces adjacent to cargo tanks and also deck areas throughout the entire length and breadth of the part of the ship over the above-mentioned spaces.
- 33 For ships constructed on or after 1 October 1994, in lieu of the definition of main vertical zones provided in paragraph 9, the following definition shall be applied:

Main vertical zones are those sections into which the hull, superstructure and deckhouses are divided by "A" class divisions, the mean length and width of which on any deck does not in general exceed 40 m.

- 34 *Ro-ro passenger ship* means a passenger ship with ro-ro cargo spaces or special category spaces as defined in this regulation.

Regulation 4

Fire pumps, fire mains, hydrants and hoses

(Paragraph 3.3.2.5 of this regulation: applies to ships constructed on or after 1 February 1992)

- 1 Every ship shall be provided with fire pumps, fire mains, hydrants and hoses complying as applicable with the requirements of this regulation.
- 2 Capacity of fire pumps
- 2.1 The required fire pumps shall be capable of delivering for fire-fighting purposes a quantity of water, at the pressure specified in paragraph 4, as follows:

*The paragraph applies from 1 July 1997.

... of a flammable nature listed in

- 24 *Bulkhead deck* is the uppermost deck up to which the transverse watertight bulkheads are carried.

25 *Deadweight* is the difference in tonnes between the displacement of a ship in water of a specific gravity of 1.025 at the load watertline corresponding to the assigned summer freeboard and the lightweight of the ship.

26 *Lightweight* is the displacement of a ship in tonnes without cargo, fuel, lubricating oil, ballast water, fresh water and feedwater in tanks, consumable stores, and passengers and crew and their effects.

27 *Combination carrier* is a tanker designed to carry oil or alternatively solid cargoes in bulk.

28 *Crude oil* is any oil occurring naturally in the earth whether or not treated to render it suitable for transportation and includes:

- 1 crude oil from which certain distillate fractions may have been removed; and
- 2 crude oil to which certain distillate fractions may have been added.

29 *Dangerous goods* are those goods referred to in regulation VII/2.

30 *Chemical tanker* is a tanker constructed or adapted and used for the carriage in bulk of any liquid product of a flammable nature listed in either:

- 1 chapter 17 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by the Maritime Safety Committee by resolution MSC.4(48), hereinafter referred to as "the International Bulk Chemical Code", as may be amended by the Organization; or
- 2 chapter VI of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by the Assembly of the Organization by resolution A.212(VII), hereinafter referred to as "the Bulk Chemical Code", as has been or may be amended by the Organization;

whichever is applicable.

* Refer to the Recommendation on fire test procedures for upholstered furniture adopted by the Organization by resolution A.652(16).

quantity required to be capable employed for bilge pumping; and

- 2 pumps in cargo ships, other than any emergency pump, not less than four thirds of the quantity required under regulation 11-1/21 to be dealt with by each of the independent bilge pumps in a passenger ship of the same dimension when employed in bilge pumping, provided that in no cargo ship need the total required capacity of the fire pumps exceed 180 m³/h.
- 2.2 Each of the required fire pumps (other than any emergency pump required in paragraph 3.3.2 for cargo ships) shall have a capacity not less than 80% of the total required capacity divided by the minimum number of required fire pumps but in any case not less than 25 m³/h and each such pump shall in any event be capable of delivering at least the two required jets of water. These fire pumps shall be capable of supplying the fire main system under the required conditions. Where more pumps than the minimum of required pumps are installed the capacity of such additional pumps shall be to the satisfaction of the Administration.
- 3 Arrangements of fire pumps and of fire mains
 - 3.1 Ships shall be provided with independently driven fire pumps as follows:
 - 1 Passenger ships of 4,000 tons gross tonnage and upwards at least three
 - 2 Passenger ships of less than 4,000 gross tonnage and cargo ships of 1,000 tons gross tonnage and upwards at least two
 - 3 Cargo ships of less than 1,000 tons gross tonnage to the satisfaction of the Administration
 - 3.2 Sanitary, ballast, bilge or general service pumps may be accepted as fire pumps, provided that they are not normally used for pumping oil and that if they are subject to occasional duty for the transfer or pumping of oil fuel, suitable change-over arrangements are fitted.
 - 3.3 The arrangement of sea connections, fire pumps and their sources of power shall be such as to ensure that:
 - 1 In passenger ships of 1,000 gross tonnage and upwards, in the event of a fire in any one compartment all the fire pumps will not be put out of action.
 - 2 In cargo ships of 2,000 gross tonnage and upwards, if a fire in any one compartment could put all the pumps out of action

of supplying two jets of water to the satisfaction of the Administration. The pump and its location shall comply with the following requirements:

- 2.1 The capacity of the pump shall not be less than 40% of the total capacity of the fire pumps required by this regulation and in any case not less than 25 m³/h.
- 2.2 When the pump is delivering the quantity of water required by paragraph 3.3.2.1, the pressure at any hydrant shall be not less than the minimum pressures given in paragraph 4.2.
- 2.3 Any diesel driven power source for the pump shall be capable of being readily started in its cold condition down to a temperature of 0°C by hand (manual) cranking. If this is impracticable, or if lower temperatures are likely to be encountered, consideration is to be given to the provision and maintenance of heating arrangements, acceptable to the Administration, so that ready starting will be assured. If hand (manual) starting is impracticable, the Administration may permit other means of starting. These means shall be such as to enable the diesel driven power source to be started at least six times within a period of 30 min, and at least twice within the first 10 min.
- 2.4 Any service fuel tank shall contain sufficient fuel to enable the pump to run on full load for at least 3 h and sufficient reserves of fuel shall be available outside the main machinery space to enable the pump to be run on full load for an additional 15 h.
- 2.5 The total suction head and the net positive suction head of the pump shall be such that the requirements of paragraphs 3.3.2, 3.3.2.1, 3.3.2.2 and 4.2 of this regulation shall be obtained under all conditions of list, trim, roll and pitch likely to be encountered in service.
- 2.6 The boundaries of the space containing the fire pump shall be insulated to a standard of structural fire protection equivalent to that required for a control station in regulation 44.
- 2.7 No direct access shall be permitted between the machinery space and the space containing the emergency fire pump and its source of power. When this is impracticable an Administration may accept an arrangement where the access is by means of an airlock, each of the two doors being self-closing, or through a watertight door capable of being operated from a space remote from the machinery space and the space containing the emergency fire pump and unlikely to be cut off in the event of fire in those spaces. In such cases a second

2.8 Ventilation arrangements to the space containing the independent source of power for the emergency fire pump shall be such as to preclude, as far as practicable, the possibility of smoke from a machinery space fire entering or being drawn into that space.

2.9 Ships constructed on or after 1 October 1994, in lieu of the provisions of paragraph 3.3.2.6, shall comply with the following requirements:

The space containing the fire pump shall not be contiguous to the boundaries of machinery spaces of category A or those spaces containing main fire pumps. Where this is not practicable, the common bulkhead between the two spaces shall be insulated to a standard of structural fire protection equivalent to that required for a control station in regulation 44.

3 In passenger ships of less than 1,000 gross tonnage and cargo ships of less than 2,000 gross tonnage, if a fire in any one compartment could put all the pumps out of action the alternative means of providing water for fire-fighting purposes are to the satisfaction of the Administration.

3.1 For ships constructed on or after 1 October 1994, the alternative means to be provided in accordance with the provisions of paragraph 3.3.3 shall be an independently driven, power-operated emergency fire pump with its source of power and sea connection located outside the machinery space.

4 In addition, in cargo ships where other pumps, such as general service, bilge and ballast, etc., are fitted in a machinery space, arrangements shall be made to ensure that at least one of these pumps, having the capacity and pressure required by paragraphs 2.2 and 4.2, is capable of providing water to the fire main.

3.4 The arrangements for the ready availability of water supply shall be:

1 in passenger ships of 1,000 gross tonnage and upwards such that at least one effective jet of water is immediately available from any hydrant in an interior location and so as to ensure the continuation of the output of water by the automatic starting of a required fire pump;

2 in passenger ships of less than 1,000 gross tonnage and in cargo ships to the satisfaction of the Administration;

3 in cargo ships with a periodically unattended machinery space or when only one person is required on watch, there shall be

with remote starting from the navigation bridge and fire control station, if any, or permanent pressurization of the fire main system by one of the main fire pumps, except that the Administration may waive this requirement for cargo ships of less than 1,000 gross tonnage if the arrangement of the machinery space access makes it unnecessary;

4 in passenger ships, if fitted with periodically unattended machinery spaces in accordance with regulation 11-1/54, the Administration shall determine provisions for fixed water fire-extinguishing arrangement for such spaces equivalent to those required for normally attended machinery spaces.

3.5 Relief valves shall be provided in conjunction with all fire pumps if the pumps are capable of developing a pressure exceeding the design pressure of the water service pipes, hydrants and hoses. These valves shall be so placed and adjusted as to prevent excessive pressure in any part of the fire main system.

3.6 In tankers isolation valves shall be fitted in the fire main at poop front in a protected position and on the tank deck at intervals of not more than 40 m to preserve the integrity of the fire main system in case of fire or explosion.

4 Diameter of, and pressure in, the fire mains

4.1 The diameter of the fire main and water service pipes shall be sufficient for the effective distribution of the maximum required discharge from two fire pumps operating simultaneously, except that in the case of cargo ships the diameter need only be sufficient for the discharge of 140 m³/h.

4.2 With the two pumps simultaneously delivering through nozzles specified in paragraph 8 the quantity of water specified in paragraph 4.1, through any adjacent hydrants, the following minimum pressures shall be maintained at all hydrants:

Passenger ships:

4,000 gross tonnage and upwards 0.31 N/mm²

1,000 gross tonnage and upwards
but under 4,000 gross tonnage 0.27 N/mm²

Under 1,000 gross tonnage
To the satisfaction of the
Administration

6,000 gross tonnage and upwards
1,000 gross tonnage and upwards
but under 6,000 gross tonnage
Under 1,000 gross tonnage

0.25 N/mm²

To the satisfaction of the
Administration

1 Passenger ships constructed on or after 1 October 1994, in lieu of the provisions of paragraph 4.2, shall comply with the following requirements:

With the two pumps simultaneously delivering through the nozzles specified in paragraph 8 and with sufficient hydrants to provide for the quantity of water specified in paragraph 4.1, a minimum pressure of 0.4 N/mm² for ships of 4,000 gross tonnage and above and 0.3 N/mm² for ships of less than 4,000 gross tonnage shall be maintained at all hydrants.

4.3 The maximum pressure at any hydrant shall not exceed that at which the effective control of a fire hose can be demonstrated.

5 Number and position of hydrants

5.1 The number and position of hydrants shall be such that at least two jets of water not emanating from the same hydrant, one of which shall be from a single length of hose, may reach any part of the ship normally accessible to the passengers or crew while the ship is being navigated and any part of any cargo space when empty, any to-to cargo space or any special category space in which latter case the two jets shall reach any part of such space, each from a single length of hose. Furthermore, such hydrants shall be positioned near the accesses to the protected spaces.

5.2 In the accommodation, service and machinery spaces of passenger ships the number and position of hydrants shall be such that the requirements of paragraph 5.1 may be complied with when all watertight doors and all doors in main vertical zone bulkheads are closed.

5.3 Where, in a passenger ship, access is provided to a machinery space of category A at a low level from an adjacent shaft tunnel, two hydrants shall be provided external to, but near the entrance to that machinery space. Where such access is provided from other spaces, in one of those spaces two hydrants shall be provided near the entrance to the machinery space of category A. Such provision need not be made where the tunnel or adjacent spaces are not part of the escape route.

6 Pipes and hydrants

6.1 Materials readily rendered ineffective by heat shall not be used for fire mains and hydrants unless adequately protected. The pipes and hydrants

arrangements shall be such as to avoid the possibility of freezing. In ships where deck cargo may be carried, the positions of the hydrants shall be such that they are always readily accessible and the pipes shall be arranged as far as practicable to avoid risk of damage by such cargo. Unless one hose and nozzle is provided for each hydrant in the ship, there shall be complete interchangeability of hose couplings and nozzles.

6.2 A valve shall be fitted to serve each fire hose so that any fire hose may be removed while the fire pumps are at work.

6.3 Isolating valves to separate the section of the fire main within the machinery space containing the main fire pump or pumps from the rest of the fire main shall be fitted in an easily accessible and tenable position outside the machinery spaces. The fire main shall be so arranged that when the isolating valves are shut all the hydrants on the ship, except those in the machinery space referred to above, can be supplied with water by a fire pump not located in this machinery space through pipes which do not enter this space. Exceptionally, the Administration may permit short lengths of the emergency fire pump suction and discharge piping to penetrate the machinery space if it is impracticable to route it externally provided that the integrity of the fire main is maintained by the enclosure of the piping in a substantial steel casing.

7 Fire hoses

7.1 Fire hoses shall be of non-perishable material approved by the Administration and shall be sufficient in length to project a jet of water to any of the spaces in which they may be required to be used. Fire hoses of non-perishable material shall be provided in ships constructed on or after 1 February 1992, and on ships constructed before 1 February 1992 when the existing fire hoses are replaced. Their maximum length shall be to the satisfaction of the Administration. Each hose shall be provided with a nozzle and the necessary couplings. Hoses specified in this chapter as "fire hoses" shall, together with any necessary fittings and tools, be kept ready for use in conspicuous positions near the water service hydrants or connections. Additionally, in interior locations in passenger ships carrying more than 36 passengers fire hoses shall be connected to the hydrants at all times.

7.2 Ships shall be provided with fire hoses the number and diameter of which shall be to the satisfaction of the Administration.

7.3 In passenger ships there shall be at least one fire hose for each of the hydrants required by paragraph 5 and these hoses shall be used only for the purposes of extinguishing fires or testing the fire-extinguishing apparatus at fire drills and surveys.

noses to be provided shall be five in all. This number does not include any spare but in no case less than five in all. This number does not include any hoses required in any engine or boiler room. The Administration may increase the number of hoses required so as to ensure that hoses in sufficient number are available and accessible at all times, having regard to the type of ship and the nature of trade in which the ship is employed.

7.4.2 In cargo ships of less than 1,000 gross tonnage the number of fire hoses to be provided shall be to the satisfaction of the Administration.

8 Nozzles

8.1 For the purposes of this chapter, standard nozzle sizes shall be 12 mm, 16 mm and 19 mm or as near thereto as possible. Larger diameter nozzles may be permitted at the discretion of the Administration.

8.2 For accommodation and service spaces, a nozzle size greater than 12 mm need not be used.

8.3 For machinery spaces and exterior locations, the nozzle size shall be such as to obtain the maximum discharge possible from two jets at the pressure mentioned in paragraph 4 from the smallest pump, provided that a nozzle size greater than 19 mm need not be used.

8.4 All nozzles shall be of an approved dual-purpose type (i.e., spray/jet type) incorporating a shutoff.

9 Location and arrangement of water pumps, etc., for other fire-extinguishing systems

Pumps required for the provision of water for other fire-extinguishing systems required by this chapter, their sources of power and their controls shall be installed outside the space or spaces protected by such systems and shall be so arranged that a fire in the space or spaces protected will not put any such system out of action.

Regulation 5

Fixed gas fire-extinguishing systems

1 General

1.1 The use of a fire-extinguishing medium which, in the opinion of the Administration, either by itself or under expected conditions of use gives off toxic gases in such quantities as to endanger persons shall not be permitted.

1.2 The necessary pipes for conveying fire-extinguishing medium into protected spaces shall be provided with control valves so marked as to indicate clearly the spaces to which the pipes are led. Suitable provision shall

passenger space, the gas connection shall be blanked during such use.

1.3 The piping for the distribution of fire-extinguishing medium shall be arranged and discharge nozzles so positioned that a uniform distribution of medium is obtained.

1.4 Means shall be provided to close all openings which may admit air to or allow gas to escape from a protected space.

1.5 Where the volume of free air contained in air receivers in any space is such that, if released in such space in the event of fire, such release of air within that space would seriously affect the efficiency of the fixed fire-extinguishing system, the Administration shall require the provision of an additional quantity of fire-extinguishing medium.

1.6 Means shall be provided for automatically giving audible warning of the release of fire-extinguishing medium into any space in which personnel normally work or to which they have access. The alarm shall operate for a suitable period before the medium is released.

1.7 The means of control of any fixed gas fire-extinguishing system shall be readily accessible and simple to operate and shall be grouped together in as few locations as possible at positions not likely to be cut off by a fire in a protected space. At each location there shall be clear instructions relating to the operation of the system having regard to the safety of personnel.

1.8 Automatic release of fire-extinguishing medium shall not be permitted, except as permitted by paragraph 3.3.5 and in respect of local automatically operated units referred to in paragraphs 3.4 and 3.5.

1.9 Where the quantity of extinguishing medium is required to protect more than one space, the quantity of medium available need not be more than the largest quantity required for any one space so protected.

1.10 Except as otherwise permitted by paragraphs 3.3, 3.4 or 3.5, pressure containers required for the storage of fire-extinguishing medium, other than steam, shall be located outside protected spaces in accordance with paragraph 1.13.

1.11 Means shall be provided for the crew to safely check the quantity of medium in the containers.

1.12 Containers for the storage of fire-extinguishing medium and associated pressure components shall be designed to pressure codes of practice to the satisfaction of the Administration having regard to their locations and maximum ambient temperatures expected in service.

1.13 When the fire-extinguishing medium is stored outside a protected space, it shall be stored in a room which shall be situated in a safe and readily

controls is to be locked, a key to the box shall be in a break-glass-type enclosure conspicuously located adjacent to the box.

3 Halogenated hydrocarbon systems*

3.1 The use of halogenated hydrocarbons as fire-extinguishing media is only permitted in machinery spaces, pump-rooms and in cargo spaces intended solely for the carriage of vehicles which are not carrying any cargo. New installations of halogenated carbon systems shall be prohibited on all ships.

3.2 When halogenated hydrocarbons are used as the fire-extinguishing media in total flooding systems:

- 1 The system shall be arranged for manual initiation of power release only.
- 2 If the charge of halogenated hydrocarbon is required to supply more than one space, the arrangements for its storage and release shall be such that compliance with paragraphs 3.2.9 or 3.2.10 respectively, is obtained.
- 3 Means shall be provided for automatically stopping all ventilation fans serving the protected space before the medium is released.
- 4 Means shall be provided to manually close all dampers in the ventilation system serving a protected space.
- 5 The discharge arrangements shall be so designed that the minimum quantity of medium required for cargo spaces or machinery spaces in paragraphs 3.2.9 or 3.2.10 respectively can be substantially discharged in a nominal 20 s or less based on the discharge of the liquid phase.
- 6 The system shall be designed to operate within a temperature range to the satisfaction of the Administration.
- 7 The discharge shall not endanger personnel engaged on maintenance of equipment or using the normal access ladders and escapes serving the space.
- 8 Means shall be provided for the crew to safely check the pressure within containers.

* Refer to resolution A.719(17) concerning prevention of air pollution from ships and to MSC/Circ.668 on alternative arrangements for halon fire-extinguishing systems in machinery spaces and pump-rooms.

from the open deck and in any case shall be independent of the protected space. Access doors shall open outwards, and bulkheads and decks including doors and other means of closing any opening therein, which form the boundaries between such rooms and adjoining enclosed spaces shall be gas-tight. For the purpose of the application of the integrity tables in regulations 26, 27, 44 and 58, such storage rooms shall be treated as control stations.

1.14 Spare parts for the system shall be stored on board and be to the satisfaction of the Administration.

2 Carbon dioxide systems

2.1 For cargo spaces the quantity of carbon dioxide available shall, unless otherwise provided, be sufficient to give a minimum volume of free gas equal to 30% of the gross volume of the largest cargo space so protected in the ship.

2.2 For machinery spaces the quantity of carbon dioxide carried shall be sufficient to give a minimum volume of free gas equal to the larger of the following volumes, either:

- 1 40% of the gross volume of the largest machinery space so protected, the volume to exclude that part of the casing above the level at which the horizontal area of the casing is 40% or less of the horizontal area of the space concerned taken midway between the tank top and the lowest part of the casing; or
- 2 35% of the gross volume of the largest machinery space protected, including the casing;

provided that the above-mentioned percentages may be reduced to 35% and 30% respectively for cargo ships of less than 2,000 gross tonnage, provided also that if two or more machinery spaces are not entirely separate they shall be considered as forming one space.

2.3 For the purpose of this paragraph the volume of free carbon dioxide shall be calculated at 0.56 m³/kg.

2.4 For machinery spaces the fixed piping system shall be such that 85% of the gas can be discharged into the space within 2 min.

2.5 Carbon dioxide systems installed on or after 1 October 1994 shall comply with the following requirements:

- 1 Two separate controls shall be provided for releasing carbon dioxide into a protected space and to ensure the activities of the alarm. One control shall be used to discharge the gas from its storage containers. A second control shall be used for opening the valve of the piping which conveys the gas into the protected space.

tunnel, near the watertight door, a light steel fire-screen door operable from each side.

7 For periodically unattended machinery spaces in cargo ships, the Administration shall give special consideration to maintaining fire integrity of the machinery spaces, the location and centralization of the fire-extinguishing system controls, the required shutdown arrangements (e.g. ventilation, fuel pumps, etc.) and may require additional fire-extinguishing appliances and other fire-fighting equipment and breathing apparatus. In passenger ships these requirements shall be at least equivalent to those of machinery spaces normally attended.

8 A fixed fire detection and alarm system complying with the provisions of regulation 14 shall be fitted in any machinery space:

- 1 where the installation of automatic and remote control systems and equipment has been approved in lieu of continuous manning of the space; and
- 2 where the main propulsion and associated machinery including sources of main electrical supply are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room.

Regulation 12

*Automatic sprinkler, fire detection and fire alarm systems**

1.1 Any required automatic sprinkler, fire detection and fire alarm system shall be capable of immediate operation at all times and no action by the crew shall be necessary to set it in operation. It shall be of the wet pipe type but small exposed sections may be of the dry pipe type where in the opinion of the Administration this is a necessary precaution. Any parts of the system which may be subjected to freezing temperatures in service shall be suitably protected against freezing. It shall be kept charged at the necessary pressure and shall have provision for a continuous supply of water as required in this regulation.

1.2 Each section of sprinklers shall include means for giving a visual and audible alarm signal automatically at one or more indicating units whenever any sprinkler comes into operation. Such alarm systems shall be such as to indicate if any fault occurs in the system.

* Refer to the Revised guidelines for approval of sprinkler systems equivalent to that referred to in SOLAS regulation II-2/12 adopted by the Organization by resolution A.800(18).

location. Any space served by the system and shall be centralized on the navigation bridge or in the main fire control station, which shall be so manned or equipped as to ensure that any alarm from the system is immediately received by a responsible member of the crew.

1.2.2 In cargo ships such units shall indicate in which section served by the system fire has occurred and shall be centralized on the navigation bridge and in addition, visible and audible alarms from the unit shall be placed in a position other than on the navigation bridge, so as to ensure that the indication of fire is immediately received by the crew.

2.1 Sprinklers shall be grouped into separate sections, each of which shall contain not more than 200 sprinklers. In passenger ships any section of sprinklers shall not serve more than two decks and shall not be situated in more than one main vertical zone. However, the Administration may permit such a section of sprinklers to serve more than two decks or be situated in more than one main vertical zone, if it is satisfied that the protection of the ship against fire will not thereby be reduced.

2.2 Each section of sprinklers shall be capable of being isolated by one stop valve only. The stop valve in each section shall be readily accessible and its location shall be clearly and permanently indicated. Means shall be provided to prevent the operation of the stop valves by any unauthorized person.

2.3 A gauge indicating the pressure in the system shall be provided at each section stop valve and at a central station.

2.4 The sprinklers shall be resistant to corrosion by marine atmosphere. In accommodation and service spaces the sprinklers shall come into operation within the temperature range from 68°C to 79°C, except that in locations such as drying rooms, where high ambient temperatures might be expected, the operating temperature may be increased by not more than 30°C above the maximum deckhead temperature.

2.5 A list or plan shall be displayed at each indicating unit showing the spaces covered and the location of the zone in respect of each section. Suitable instructions for testing and maintenance shall be available.

3 Sprinklers shall be placed in an overhead position and spaced in a suitable pattern to maintain an average application rate of not less than 5 l/m²/min over the nominal area covered by the sprinklers. However, the Administration may permit the use of sprinklers providing such an alternative amount of water suitably distributed as has been shown to the satisfaction of the Administration, to be not less effective.

4.1 A pressure tank having a volume equal to at least twice that of the charge of water specified in this subparagraph shall be provided. The tank shall contain a standing charge of fresh water, equivalent to the amount of water which would be discharged in one minute by the pump referred to in

pressure in the tank shall be used. The pressure will be not less than the pressure in the tank has been used the pressure exerted by a head of working pressure of the sprinkler, plus the pressure exerted by the highest sprinkler in the water measured from the bottom of the tank to the highest sprinkler in the system. Suitable means of replenishing the air under pressure and of replenishing the fresh water charge in the tank shall be provided. A glass gauge shall be provided to indicate the correct level of the water in the tank.

4.2 Means shall be provided to prevent the passage of seawater into the tank.

5.1 An independent power pump shall be provided solely for the purpose of continuing automatically the discharge of water from the sprinklers. The pump shall be brought into action automatically by the pressure drop in the system before the standing fresh water charge in the pressure tank is completely exhausted.

5.2 The pump and the piping system shall be capable of maintaining the necessary pressure at the level of the highest sprinkler to ensure a continuous output of water sufficient for the simultaneous coverage of a minimum area of 280 m² at the application rate specified in paragraph 3.

5.3 The pump shall have fitted on the delivery side a test valve with a short open-ended discharge pipe. The effective area through the valve and pipe shall be adequate to permit the release of the required pump output while maintaining the pressure in the system specified in paragraph 4.1.

5.4 The sea inlet to the pump shall wherever possible be in the space containing the pump and shall be so arranged that when the ship is afloat it will not be necessary to shut off the supply of seawater to the pump for any purpose other than the inspection or repair of the pump.

6 The sprinkler pump and tank shall be situated in a position reasonably remote from any machinery space of category A and shall not be situated in any space required to be protected by the sprinkler system.

7.1 In passenger ships there shall be not less than two sources of power supply for the seawater pump and automatic alarm and detection system. Where the sources of power for the pump are electrical, these shall be a main generator and an emergency source of power. One supply for the pump shall be taken from the main switchboard, and one from the emergency switchboard by separate feeders reserved solely for that purpose. The feeders shall be so arranged as to avoid galleys, machinery spaces and other enclosed spaces of high fire risk except in so far as it is necessary to reach the appropriate switchboards, and shall be run to an automatic change-over switch situated near the sprinkler pump. This switch shall permit the supply of power from the main switchboard so long as a supply is available therefrom, and be so designed that upon failure of that supply it

switchboard. The switches on the main switchboard and the emergency switchboard shall be clearly labelled and normally kept closed. No other switch shall be permitted in the feeders concerned. One of the sources of power supply for the alarm and detection system shall be an emergency source. Where one of the sources of power for the pump is an internal combustion engine it shall, in addition to complying with the provisions of paragraph 6, be so situated that a fire in any protected space will not affect the air supply to the machinery.

7.2 In cargo ships there shall not be less than two sources of power supply for the seawater pump and automatic alarm and detection system. If the pump is electrically driven it shall be connected to the main source of electrical power, which shall be capable of being supplied by at least two generators. The feeders shall be so arranged as to avoid galleys, machinery spaces and other enclosed spaces of high fire risk except in so far as it is necessary to reach the appropriate switchboards. One of the sources of power supply for the alarm and detection system shall be an emergency source. Where one of the sources of power for the pump is an internal combustion engine it shall, in addition to complying with the provisions of paragraph 6, be so situated that a fire in any protected space will not affect the air supply to the machinery.

8 The sprinkler system shall have a connection from the ship's fire main by way of a lockable screw-down non-return valve at the connection which will prevent a backflow from the sprinkler system to the fire main.

9.1 A test valve shall be provided for testing the automatic alarm for each section of sprinklers by a discharge of water equivalent to the operation of one sprinkler. The test valve for each section shall be situated near the stop valve for that section.

9.2 Means shall be provided for testing the automatic operation of the pump on reduction of pressure in the system.

9.3 Switches shall be provided at one of the indicating positions referred to in paragraph 1.2 which will enable the alarm and the indicators for each section of sprinklers to be tested.

10 Spare sprinkler heads shall be provided for each section of sprinkler: to the satisfaction of the Administration.

Regulation 13

Fixed fire detector and fire alarm systems

1 General requirements

1.1 Any required fixed fire detection and fire alarm system with manually operated call points shall be capable of immediate operation at all times.

system shall be monitored for loss of power. The fire detection system shall initiate a visual and audible fault signal at the control panel which shall be distinct from a fire signal.

1.3 There shall be not less than two sources of power supply for the electrical equipment used in the operation of the fire detection and fire alarm system, one of which shall be an emergency source. The supply shall be provided by separate feeders reserved solely for that purpose. Such feeders shall run to an automatic change-over switch situated in or adjacent to the control panel for the fire detection system.

1.4 Detectors and manually operated call points shall be grouped into sections. The activation of any detector or manually operated call point shall initiate a visual and audible fire signal at the control panel and indicating units. If the signals have not received attention within 2 min an audible alarm shall be automatically sounded throughout the crew accommodation and service spaces, control stations and machinery spaces of category A. This alarm sounder system need not be an integral part of the detection system.

1.5 The control panel shall be located on the navigation bridge or in the main fire control station.

1.6 Indicating units shall, as a minimum, denote the section in which a detector or manually operated call point has operated. At least one unit shall be so located that it is easily accessible to responsible members of the crew at all times, when at sea or in port, except when the ship is out of service. One indicating unit shall be located on the navigation bridge if the control panel is located in the main fire control station.

1.7 Clear information shall be displayed on or adjacent to each indicating unit about the spaces covered and the location of the sections.

1.8 Where the fire detection system does not include means of remotely identifying each detector individually, no section covering more than one deck within accommodation, service and control stations shall normally be permitted except a section which covers an enclosed stairway. In order to avoid delay in identifying the source of fire, the number of enclosed spaces included in each section shall be limited as determined by the Administration. In no case shall more than 50 enclosed spaces be permitted in any section. If the detection system is fitted with remotely and individually identifiable fire detectors, the sections may cover several decks and serve any number of enclosed spaces.

1.9 In passenger ships, if there is no fire detection system capable of remotely and individually identifying each detector, a section of detectors shall not serve spaces on both sides of the ship nor on more than one deck

zone except that the Administration, if it is satisfied that the protection of the ship against fire will not thereby be reduced, may permit such a section of detectors to serve both sides of the ship and more than one deck. In passenger ships fitted with individually identifiable fire detectors, a section may serve spaces on both sides of the ship and on several decks but may not be situated in more than one main vertical zone.

1.10 A section of fire detectors which covers a control station, a service space or an accommodation space shall not include a machinery space of category A.

1.11 Detectors shall be operated by heat, smoke or other products of combustion, flame, or any combination of these factors. Detectors operated by other factors indicative of incipient fires may be considered by the Administration provided that they are no less sensitive than such detectors. Flame detectors shall only be used in addition to smoke or heat detectors.

1.12 Suitable instructions and component spares for testing and maintenance shall be provided.

1.13 The function of the detection system shall be periodically tested to the satisfaction of the Administration by means of equipment producing hot air at the appropriate temperature, or smoke or aerosol particles having the appropriate range of density or particle size, or other phenomena associated with incipient fires to which the detector is designed to respond. All detectors shall be of a type such that they can be tested for correct operation and restored to normal surveillance without the renewal of any component.

1.14 The fire detection system shall not be used for any other purpose, except that closing of fire doors and similar functions may be permitted at the control panel.

1.15 Fire detection systems with a zone address identification capability fitted on or after 1 October 1994 shall be so arranged that:

- a loop cannot be damaged at more than one point by a fire;
- means are provided to ensure that any fault (e.g. power break, short circuit, earth) occurring in the loop will not render the whole loop ineffective;
- all arrangements are made to enable the initial configuration of the system to be restored in the event of failure (electrical, electronic, informatic);
- the first initiated fire alarm will not prevent any other detector from initiating further fire alarms.

2.1 Manually operated call points shall be installed in accommodation spaces, service spaces and control stations. One manually operated call point shall be located at each exit. Manually operated call points shall be readily accessible in the corridors of each deck such that no part of the corridor is more than 20 m from a manually operated call point.

2.2 Smoke detectors shall be installed in all stairways, corridors and escape routes within accommodation spaces. Consideration shall be given to the installation of special purpose smoke detectors within ventilation ducting.

2.3 Where a fixed fire detection and fire alarm system is required for the protection of spaces other than those specified in paragraph 2.2, at least one detector complying with paragraph 1.11 shall be installed in each such space.

2.4 Detectors shall be located for optimum performance. Positions near beams and ventilation ducts or other positions where patterns of air flow could adversely affect performance and positions where impact or physical damage is likely shall be avoided. In general, detectors which are located on the overhead shall be a minimum distance of 0.5 m away from bulkheads.

2.5 The maximum spacing of detectors shall be in accordance with the table below:

Type of detector	Maximum floor area per detector	Maximum distance apart between centres	Maximum distance away from bulkheads
Heat	37 m ²	9 m	4.5 m
Smoke	74 m ²	11 m	5.5 m

The Administration may require or permit other spacings based upon test data which demonstrate the characteristics of the detectors.

2.6 Electrical wiring which forms part of the system shall be so arranged as to avoid galleys, machinery spaces of category A, and other enclosed spaces of high fire risk except where it is necessary to provide for fire detection or fire alarm in such spaces or to connect to the appropriate power supply.

3 Design requirements

3.1 The system and equipment shall be suitably designed to withstand supply voltage variation and transients, ambient temperature changes, vibration, humidity, shock, impact and corrosion normally encountered in ships.

until the smoke density exceeds 2% obscuration per metre, but not detectors to be installed in other spaces shall operate within sensitivity limits to the satisfaction of the Administration having regard to the avoidance of detector insensitivity or oversensitivity.

3.3 Heat detectors shall be certified to operate before the temperature exceeds 78°C but not until the temperature exceeds 54°C, when the temperature is raised to those limits at a rate less than 1°C per minute. At higher rates of temperature rise, the heat detector shall operate within temperature limits to the satisfaction of the Administration having regard to the avoidance of detector insensitivity or oversensitivity.

3.4 At the discretion of the Administration, the permissible temperature of operation of heat detectors may be increased to 30°C above the maximum deckhead temperature in drying rooms and similar spaces of a normal high ambient temperature.

Regulation 13-1

Simple extraction smoke detection systems

(This regulation applies to ships constructed on or after 1 February 1992)

1 General requirements

1.1 Wherever in the text of this regulation the word *system* appears, it shall mean *simple extraction smoke detection system*.

1.2 Any required system shall be capable of continuous operation at all times except that systems operating on a sequential scanning principle may be accepted, provided that the interval between scanning the same position twice gives an overall response time to the satisfaction of the Administration.

1.3 Power supplies necessary for the operation of the system shall be monitored for loss of power. Any loss of power shall initiate a visual and audible signal at the control panel and the navigation bridge which shall be distinct from a signal indicating smoke detection.

1.4 An alternative power supply for the electrical equipment used in the operation of the system shall be provided.

1.5 The control panel shall be located on the navigation bridge or in the main fire control station.

1.6 The detection of smoke or other products of combustion shall initiate a visual and audible signal at the control panel and the navigation bridge.

1.8 The sampling pipe arrangements shall be such that the location of the fire can be readily identified.

1.9 Suitable instructions and component spares shall be provided for the testing and maintenance of the system.

1.10 The functioning of the system shall be periodically tested to the satisfaction of the Administration. The system shall be of a type that can be tested for correct operation and restored to normal surveillance without the renewal of any component.

1.11 The system shall be designed, constructed and installed so as to prevent the leakage of any toxic or flammable substances or fire-extinguishing media into any accommodation and service space, control station or machinery space.

2 Installation requirements

2.1 At least one smoke accumulator shall be located in every enclosed space for which smoke detection is required. However, where a space is designed to carry oil or refrigerated cargo alternatively with cargoes for which a smoke sampling system is required, means may be provided to isolate the smoke accumulators in such compartments for the system. Such means shall be to the satisfaction of the Administration.

2.2 Smoke accumulators shall be located for optimum performance and shall be spaced so that no part of the overhead deck area is more than 12 m measured horizontally from an accumulator. Where systems are used in spaces which may be mechanically ventilated, the position of the smoke accumulators shall be considered having regard to the effects of ventilation.

2.3 Smoke accumulators shall be positioned where impact or physical damage is unlikely to occur.

2.4 Not more than four accumulators shall be connected to each sampling point.

2.5 Smoke accumulators from more than one enclosed space shall not be connected to the same sampling point.

2.6 Sampling pipes shall be self-draining and suitably protected from impact or damage from cargo working.

3 Design requirements

3.1 The system and equipment shall be suitably designed to withstand supply voltage variations and transients, ambient temperature changes,

ships and to avoid the possibility of ignition of flammable gas air mixture.

3.2 The sensing unit shall be certified to operate before the smoke density within the sensing chamber exceeds 6.65% obscuration per metre.

3.3 Duplicate sample extraction fans shall be provided. The fans shall be of sufficient capacity to operate with the normal conditions or ventilation in the protected area and shall give an overall response time to the satisfaction of the Administration.

3.4 The control panel shall permit observation of smoke in the individual sampling pipe.

3.5 Means shall be provided to monitor the airflow through the sampling pipes so designed as to ensure that as far as practicable equal quantities are extracted from each interconnected accumulator.

3.6 Sampling pipes shall be a minimum of 12 mm internal diameter except when used in conjunction with fixed gas fire-extinguishing systems when the minimum size of pipe should be sufficient to permit the fire-extinguishing gas to be discharged within the appropriate time.

3.7 Sampling pipes shall be provided with an arrangement for periodically purging with compressed air.

Regulation 14

Fixed fire detection and fire alarm systems for periodically unattended machinery spaces

1 A fixed fire detection and fire alarm system of an approved type in accordance with the relevant provisions of regulation 13 shall be installed in periodically unattended machinery spaces.

2 This fire detection system shall be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in spaces of restricted height and where their use is specially appropriate, detection systems using only thermal detectors shall not be permitted. The detection system shall initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places to ensure that the alarms are heard and observed on the navigation bridge and by a responsible engineer officer. When the navigation bridge is unmanned the alarm shall sound in a place where a responsible member of the crew is on duty.

3 After installation the system shall be tested under varying conditions of engine operation and ventilation.

category A, galley, car deck space, ro-ro cargo space or special category space are constructed of steel in accordance with paragraphs 3.1.1 and 3.1.2; and

2.2 the ducts are insulated to "A-60" standard within the machinery space, galley, car deck space, ro-ro cargo space or special category space;

except that penetrations of main zone divisions shall also comply with the requirements of paragraph 8.

5 Ventilation ducts with a free cross-sectional area exceeding 0.02 m² passing through "B" class bulkheads shall be lined with steel sheet sleeves of 900 mm in length divided preferably into 450 mm on each side of the bulkheads unless the duct is of steel for this length.

6 Such measures as are practicable shall be taken in respect of control stations outside machinery spaces in order to ensure that ventilation, visibility and freedom from smoke are maintained, so that in the event of fire the machinery and equipment contained therein may be supervised and continue to function effectively. Alternative and separate means of air supply shall be provided; air inlets of the two sources of supply shall be so disposed that the risk of both inlets drawing in smoke simultaneously is minimized. At the discretion of the Administration, such requirements need not apply to control stations situated on, and opening on to, an open deck, or where local closing arrangements would be equally effective.

7 Where they pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges shall be constructed of "A" class divisions. Each exhaust duct shall be fitted with:

- 1 a grease trap readily removable for cleaning;
- 2 a fire damper located in the lower end of the duct;
- 3 arrangements, operable from within the galley, for shutting off the exhaust fans; and
- 4 fixed means for extinguishing a fire within the duct.

8 Where in a passenger ship it is necessary that a ventilation duct passes through a main vertical zone division, a fail-safe automatic closing fire damper shall be fitted adjacent to the division. The damper shall also be capable of being manually closed from each side of the division. The operating position shall be readily accessible and be marked in red light-reflecting colour. The duct between the division and the damper shall be of steel or other equivalent material and, if necessary, insulated to comply with the requirements of regulation 18.1.1. The damper shall be fitted on at least

9 The main inlets and outlets of all ventilation systems shall be capable of being closed from outside the spaces being ventilated.

10 Power ventilation of accommodation spaces, service spaces, cargo spaces, control stations and machinery spaces shall be capable of being stopped from an easily accessible position outside the space being served. This position should not be readily cut off in the event of a fire in the space. The means provided for stopping the power ventilation of the machinery spaces shall be entirely separate from the means provided for stopping ventilation of other spaces.

Regulation 17 Fireman's outfit

1 A fireman's outfit shall consist of:

1.1 Personal equipment comprising:

- 1 Protective clothing of material to protect the skin from the heat radiating from the fire and from burns and scalding by steam. The outer surface shall be water-resistant.
- 2 Boots and gloves of rubber or other electrically nonconducting material.
- 3 A rigid helmet providing effective protection against impact.
- 4 An electric safety lamp (hand lantern) of an approved type with a minimum burning period of 3 h.
- 5 An axe to the satisfaction of the Administration

1.2 A breathing apparatus of an approved type which may be either:

- 1 a smoke helmet or smoke mask which shall be provided with a suitable air pump and a length of air hose sufficient to reach from the open deck, well clear of hatch or doorway, to any part of the holds or machinery spaces. If, in order to comply with this subparagraph, an air hose exceeding 36 m in length would be necessary, a self-contained breathing apparatus shall be substituted or provided in addition as determined by the Administration; or
- 2 a self-contained compressed-air-operated breathing apparatus, the volume of air contained in the cylinders of which shall be at least 1,200 l, or other self-contained breathing apparatus which shall be capable of functioning for at least 30 min. A number of spare charges, suitable for use with the apparatus provided, shall be available on board to the satisfaction of the Administration. In

designed for 1.0 N/mm² services. The flange shall have a flat face on one side and on the other shall be permanently attached to a coupling that will fit the ship's hydrant and hose. The connection shall be kept aboard the ship together with a gasket of any material suitable for 1.0 N/mm² services, together with four 16 mm bolts, 50 mm in length, and eight washers.

Regulation 20 Fire control plans* and fire drills

(This regulation applies to all ships)

- 1 In all ships general arrangement plans shall be permanently exhibited for the guidance of the ship's officers, showing clearly for each deck the control stations, the various fire sections enclosed by "A" class divisions, the sections enclosed by "B" class divisions together with particulars of the fire detection and fire alarm systems, the sprinkler installation, the fire-extinguishing appliances, means of access to different compartments, decks, etc. and the ventilating system including particulars of the fan control positions, the position of dampers and identification numbers of the ventilating fans serving each section. Alternatively, at the discretion of the Administration, the aforementioned details may be set out in a booklet, a copy of which shall be supplied to each officer, and one copy shall at all times be available on board in an accessible position. Plans and booklets shall be kept up to date, any alterations being recorded thereon as soon as practicable. Description in such plans and booklets shall be in the official language of the flag State. If the language is neither English nor French, a translation into one of those languages shall be included. In addition, instructions concerning the maintenance and operation of all the equipment and installations on board for the fighting and containment of fire shall be kept under one cover, readily available in an accessible position.
- 2 In all ships a duplicate set of fire control plans or a booklet containing such plans shall be permanently stored in a prominently marked weather-tight enclosure outside the deckhouse for the assistance of shoreside fire-fighting personnel.[†]
- 3 Fire drills shall be conducted in accordance with the provisions of regulation III/18.
- 4 In ships carrying more than 36 passengers, plans and booklets required by this regulation shall provide information regarding fire protection, fire

* Refer to resolution A.654(16) concerning graphical symbols for fire control plans.

† Refer also to MSC/Circ.451. Guidance concerning the location of fire control plans for assistance of shoreside fire-fighting personnel.

- 2 If the platform is located above the ship's deckhouse or similar structure, the following conditions shall be satisfied:
 - 2.1 the deckhouse top and bulkheads under the platform shall have no openings;
 - 2.2 all windows under the platform shall be provided with steel shutters;
 - 2.3 the required fire-fighting equipment shall be to the satisfaction of the Administration;
 - 2.4 after each fire on the platform or in close proximity, the platform shall undergo a structural analysis to determine its suitability for further use.

Regulation 19 International shore connection*

- 1 Ships of 500 gross tonnage and upwards shall be provided with at least one international shore connection, complying with provisions of paragraph 3.
- 2 Facilities shall be available enabling such a connection to be used on either side of the ship.
- 3 Standard dimensions of flanges for the international shore connection shall be in accordance with the following table:

Description	Dimension
Outside diameter	178 mm
Inside diameter	64 mm
Bolt circle diameter	132 mm
Slots in flange	Four holes 19 mm in diameter spaced equidistantly on a bolt circle of the above diameter, slotted to the flange periphery
Flange thickness	14.5 mm minimum
Bolts and nuts	Four, each of 16 mm diameter, 50 mm in length

* Refer to resolution A.470(XII) concerning international shore connection (shore side).

(Paragraphs 2.2(5) and 2.2(9) of this regulation apply to ships constructed on or after 1 February 1992)

1 In addition to complying with the specific provisions for fire integrity of bulkheads and decks mentioned elsewhere in this part, the minimum fire integrity of bulkheads and decks shall be as prescribed in tables 44.1 and 44.2.

2 The following requirements shall govern application of the tables:

1 Tables 44.1 and 44.2 shall apply respectively to the bulkheads and decks separating adjacent spaces.

2 For determining the appropriate fire integrity standards to be applied to divisions between adjacent spaces, such spaces are classified according to their fire risk as shown in categories (1) to (11) below. The title of each category is intended to be typical rather than restrictive. The number in parentheses preceding each category refers to the applicable column or row in the tables.

(1) *Control stations*

Spaces containing emergency sources of power and lighting.

Wheelhouse and chartroom.

Spaces containing the ship's radio equipment.

Fire-extinguishing rooms, fire control rooms and fire-recording stations.

Control room for propulsion machinery when located outside the machinery space.

Spaces containing centralized fire alarm equipment.

(2) *Corridors*

Corridors and lobbies.

(3) *Accommodation spaces*

Spaces as defined in regulation 3.10, excluding corridors.

(4) *Stairways*

Interior stairway, lifts and escalators (other than those wholly contained within the machinery spaces) and enclosures thereto.

In this connection, a stairway which is enclosed only at one level shall be regarded as part of the space from which it is not separated by a fire door.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Control stations (1)	A-0 ^a	A-0	A-60	A-0	A-15	A-60	A-15	A-60	A-60	*	A-60
Corridors (2)		C	B-0	B-0	B-0	A-60	A-0	A-0	A-0	*	A-30
Accommodation (3) spaces											
Stairways (4)			C ^{a, b}	B-0	B-0	A-60	A-0	A-0	A-0	*	A-30
Service spaces (5) (low risk)					B-0	A-60	A-0	A-0	A-0	*	A-30
					A-0 ^c					*	A-30
Machinery spaces (6) of category A					C	A-60	A-0	A-0	A-0	*	A-0
Other machinery (7) spaces								*	A-0 ^d	*	A-60 ^f
Cargo spaces (8)								A-0 ^d	A-0	*	A-0
Service spaces (9) (high risk)											
Open decks (10)											
Ro-ro cargo (11) spaces											

Note: To be applied to tables 44.1 and 44.2, as appropriate.

^a No special requirements are imposed upon bulkheads in methods IIC and IIIC fire protection.

^b In case of method IIC: "1" class bulkheads of "B-0" rating shall be provided between spaces or groups of spaces of 50 m² and over in area.

^c For clarification as to which applies, see regulations 43 and 46.

^d Where spaces are of the same numerical category and superscript d appears, a bulkhead or deck of the rating shown in the tables is only required when the adjacent spaces are for a different purpose, e.g. in category (9). A galley next to a galley does not require a bulkhead but a galley next to a paint room requires an "A-0" bulkhead.

^e Bulkheads separating the wheelhouse, chartroom and radio room from each other may be "B-0" rating. "A-0" rating may be used if no dangerous goods are intended to be carried or if such goods are stowed not less than 3 m horizontally from such bulkhead.

^f For cargo spaces in which dangerous goods are intended to be carried, regulation 54.2.8 applies.

^g Bulkheads and decks separating ro-ro cargo spaces shall be capable of being closed reasonably gastight and such divisions shall have "A" class integrity in so far as is reasonable and practicable in the opinion of the Administration.

^h Fire insulation need not be fitted if the machinery space in category (7), in the opinion of the Administration, has little or no fire risk.

ⁱ Where an asterisk appears in the tables, the division is required to be of steel or other equivalent material but is not required to be of "A" class standard.

(5) *Service spaces (low risk)*

Lockers and store-rooms not having provisions for the storage of flammable liquids and having areas less than 4 m² and drying rooms and laundries.

(6) *Machinery spaces of category A*

Spaces as defined in regulation 3.19.

(7) *Other machinery spaces*

Spaces as defined in regulation 3.20 excluding machinery spaces of category A.

boundaries which are not required to have "A" class integrity, doors may be of materials to the satisfaction of the Administration.

Regulation 45 Means of escape

1 Stairways and ladders shall be so arranged as to provide, from all accommodation spaces and from spaces in which the crew is normally employed, other than machinery spaces, ready means of escape to the open deck and thence to the lifeboats and liferafts. In particular the following general provisions shall be complied with:

1. At all levels of accommodation there shall be provided at least two widely separated means of escape from each restricted space or group of spaces.
- 2.1 Below the lowest open deck the main means of escape shall be a stairway and the second escape may be a trunk or a stairway.
- 2.2 Above the lowest open deck the means of escape shall be stairways or doors to an open deck or a combination thereof.
3. Exceptionally the Administration may dispense with one of the means of escape, due regard being paid to the nature and location of spaces and to the numbers of persons who normally might be quartered or employed there.
4. No dead-end corridors having a length of more than 7 m shall be accepted. A dead-end corridor is a corridor or part of a corridor from which there is only one escape route.
5. The width and continuity of the means of escape shall be to the satisfaction of the Administration.
6. If a radiotelegraph station has no direct access to the open deck, two means of access to or egress from such station shall be provided, one of which may be a porthole or window of sufficient size or other means to the satisfaction of the Administration, to provide an emergency escape.

2. In all ro-ro cargo spaces where the crew is normally employed the number and locations of escape routes to the open deck shall be to the satisfaction of the Administration, but shall in no case be less than two and shall be widely separated.
3. Except as provided in paragraph 4, two means of escape shall be provided from each machinery space of category A. In particular, one of the following provisions shall be complied with:

Control stations (1)	A-0	A-0	A-0	A-0	A-0	A-60	A-0	A-0	A-0	A-60	A-0	A-0	A-0	A-60	*	A-60
Corridors (2)	A-0	*													*	A-30
Accommodation spaces (3)	A-60	A-0	*												*	A-30
Stairways (4)	A-0	A-0	A-0	*											*	A-30
Service spaces (low risk) (5)	A-15	A-0	A-0	A-0	*										*	A-0
Machinery spaces of category A (6)	A-60	A-60	A-60	A-60	A-60	*									*	A-60
Other machinery spaces (7)	A-15	A-0	A-0	A-0	A-0	*									*	A-0
Cargo spaces (8)	A-60	A-0	A-0	A-0	A-0	A-0	*								*	A-0
Service spaces (high risk) (9)	A-60	A-0	A-0	A-0	A-0	A-60	A-0	*							*	A-30
Open decks (10)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Ro-ro cargo spaces (11)	A-60	A-30	A-30	A-30	A-0	A-60	A-0	A-0	A-0	A-60	A-0	A-30	A-0	A-30	*	A ^b

See notes under table 44.1.

(8) Cargo spaces

All spaces used for cargo (including cargo oil tanks) and trunkways and hatchways to such spaces.

(9) Service spaces (high risk)

Galleys, pantries containing cooking appliances, paint and lamp rooms, lockers and store-rooms having areas of 4 m² or more, spaces for the storage of flammable liquids, and workshops other than those forming part of the machinery spaces.

(10) Open decks

Open deck spaces and enclosed promenades having no fire risk. Air spaces (the space outside superstructures and deckhouses).

(11) Ro-ro cargo spaces

Spaces as defined in regulation 3.14. Cargo spaces intended for the carriage of motor vehicles with fuel in their tanks for their own propulsion.

3. Continuous "B" class ceilings or linings, in association with the relevant decks or bulkheads, may be accepted as contributing, wholly or in part, to the required insulation and integrity of a division.
4. External boundaries which are required in regulation 42.1 to be of steel or other equivalent material may be pierced for the fitting of windows

these ladders shall provide continuous fire shelter from the lower part of the space to a safe position outside the space. However, the Administration may not require the shelter if, due to the special arrangement or dimensions of the machinery space, a safe escape route from the lower part of this space is provided. This shelter shall be of steel, insulated, where necessary, to the satisfaction of the Administration and be provided with a self-closing steel door at the lower end; or

2. one steel ladder leading to a door in the upper part of the space from which access is provided to the open deck and additionally, in the lower part of the space and in a position well separated from the ladder referred to, a steel door capable of being operated from each side and which provides access to a safe escape route from the lower part of the space to the open deck.
4. In a ship of less than 1,000 gross tonnage, the Administration may dispense with one of the means of escape required under paragraph 3, due regard being paid to the dimension and disposition of the upper part of the space.
5. From machinery spaces other than those of category A, escape routes shall be provided to the satisfaction of the Administration having regard to the nature and location of the space and whether persons are normally employed in that space.
6. Lifts shall not be considered as forming one of the required means of escape as required by this regulation.

Regulation 46

Protection of stairways and lift trunks in accommodation spaces, service spaces and control stations

1. Stairways which penetrate only a single deck shall be protected at least at one level by at least "B-0" class divisions and self-closing doors. Lifts which penetrate only a single deck shall be surrounded by "A-0" class divisions with steel doors at both levels. Stairways and lift trunks which penetrate more than a single deck shall be surrounded by at least "A-0" class divisions and be protected by self-closing doors at all levels.
2. On ships having accommodation for 12 persons or less, where stairways penetrate more than a single deck and where there are at least two escape routes direct to the open deck at every accommodation level,

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3. All stairways shall be of steel frame construction except where the Administration sanctions the use of other equivalent material.

Regulation 47

Doors in fire-resisting divisions

1. The fire resistance of doors shall, as far as practicable, be equivalent to that of the division in which they are fitted. Doors and door frames in "A" class divisions shall be constructed of steel. Doors in "B" class divisions shall be non-combustible. Doors fitted in boundary bulkheads of machinery spaces of category A shall be reasonably gastight and self-closing. In ships constructed according to method IC, an Administration may permit the use of combustible materials in doors separating cabins from individual interior sanitary accommodation such as showers.
2. Doors required to be self-closing shall not be fitted with hold-back hooks. However, hold-back arrangements fitted with remote release devices of the fail-safe type may be utilized.
3. In corridor bulkheads ventilation openings may be permitted only in and under the doors of cabins and public spaces. The openings shall be provided only in the lower half of a door. Where such opening is in or under a door the total net area of any such opening or openings shall not exceed $0,05 \text{ m}^2$. When such opening is cut in a door it shall be fitted with a grille made of non-combustible material.
4. Watertight doors need not be insulated.

Regulation 48

Ventilation systems

The ventilation systems of cargo ships shall be in compliance with the provisions of regulation 16, except paragraph 8.

Regulation 49

Restricted use of combustible materials

1. All exposed surfaces in corridors and stairway enclosures and surfaces including grounds in concealed or inaccessible spaces in accommodation and service spaces and control stations shall have low flame-spread

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FIRE PREVENTION AND FIRE FIGHTING

PENDAHULUAN DAN PRINSIP-PRINSIP KESELAMATAN

Ancaman bahaya kebakaran tergantung dari terkendali atau tidaknya api yang menyala. Oleh sebab itu dikatakan, bahwa bahaya kebakaran adalah bahaya yang ditimbulkan oleh adanya nyala api yang tidak terkendali dan dapat mengancam keselamatan jiwa maupun harta benda.

PENCEGAHAN BAHAYA KEBAKARAN

Berdasarkan definisi tentang bahaya kebakaran diatas, maka Pencegahan Bahaya berarti segala usaha yang dilakukan agar tidak terjadi penyalaan api yang tidak terkendali.

Kalimat tersebut mengandung dua pengertian. Pertama, penyalaan api belum ada dan diusahakan agar tidak terjadi penyalaan api. Hal ini khususnya dilakukan pada tempat-tempat tertentu yang dianggap penting. Misalnya ditempat-tempat pembelian bensin, di gudang-gudang bahan yang mudah terbakar dan sebagainya.

Kedua, penyalaan api sudah ada karena memang digunakan untuk suatu keperluan, dan diusahakan jangan sampai api tersebut berkembang menjadi tidak terkendali. Tindakan pencegahan yang dilakukan misalnya saja dengan menjauhkan bahan yang mudah terbakar dari tempat tersebut, menyilapkan alat-alat pemadam api dan sebagainya.

TEORI TENTANG API

1. SYARAT-SYARAT TERJADINYA API.

Penyalaaan api yang sederhana dapat dilihat pada korek api. Bila korek api tidak ada bensinnya, maka korek tidak akan menyala. Dari sini diketahui unsur pertama yang diperlukan untuk membuat api, yaitu bensin atau bahan bakar. Walaupun sudah ada bensinnya tetapi tidak ada loncatan bunga api yang berasal dari gesekan roda dan batu api, maka korek tidak akan menyala. Dengan demikian setelah ada unsur bahan bakar, maka unsur kedua loncatan diperlukan adalah panas.

Dua unsur bahan bakar dan panas tersebut sebenarnya belum dapat menimbulkan nyala api tanpa bantuan unsur yang ketiga yaitu : Oksigen. Hal ini dapat dibuktikan dengan menaruh lilin menyala kemudian ditutup dengan gelas. Maka api lilin segera padam karena kekurangan oksigen.

Dengan demikian diketahui api terjadi dari tiga unsur yaitu : bahan bakar, Panas dan Oksigen. Dan nyala api adalah suatu reaksi berantai antara ketiga unsur tersebut secara cepat dan seimbang. Bila salah satu unsur tidak ada atau kadanya kurang, maka tidak akan terjadi nyala api.

2.) BAHAN YANG MUDAH TERBAKAR

Umumnya semua benda di alam ini dapat dibakar. Diantara bahan-bahan tersebut ada yang mudah terbakar. Hal tersebut dibedakan dengan menggunakan istilah yang disebut Titik Nyala : yaitu suatu temperatur terendah dari suatu bahan untuk dapat diubah bentuk menjadi uap, dan akan menyala bila tersentuh api (menyala sekejap).

Makin rendah titik nyala suatu bahan, maka bahan tersebut akan makin mudah terbakar. Sebaliknya makin tinggi titik nyalanya, maka makin sulit terbakar.

Bahan yang titik nyalanya rendah digolongkan sebagai bahan yang mudah terbakar, contohnya :

1. Benda Padat : Kayu, kertas, karet, plastik, tekstil dsb.
2. Benda Cair : Bensin, spiritus, solar, oli dsb.
3. Benda Gas : Asetilin, Butan, L.N.G. dsb.

3.) BAHAYA KEBAKARAN DAN MELUASNYA API

SUMBER PANAS YANG DAPAT MENIMBULKAN KEBAKARAN

Panas adalah salah satu penyebab timbulnya kebakaran. Dengan adanya panas, maka suatu bahan akan mengalami perubahan temperatur, sehingga akhirnya mencapai titik nyala. Bahan yang telah mencapai titik nyala menjadi mudah sekali terbakar. Dan disebut titik bakar, yaitu suatu temperatur terendah dimana suatu zat atau bahan bakar cukup mengeluarkan uap dan terbakar (menyala terus menerus) bila diberi sumber panas.

Sumber-sumber panas antara lain :

- (a). Sinar Matahari
- (b). Listrik
- (c). Panas yang berasal dari energi mekanik
- (d). Panas yang berasal dari reaksi kimia
- (e). Kompresi udara.

Pemanasan langsung oleh sinar matahari biasanya dapat menyebabkan bahaya kebakaran, dan sering juga menyebabkan peristiwa ledakan dari bahan-bahan yang mudah meledak.

Panas yang berasal dari sumber-sumber yang disebut di atas dapat berpindah melalui empat cara. Keempat cara perpindahan panas adalah :

- Radiasi : adalah perpindahan panas yang memancar ke segala arah.
- Konduksi : adalah perpindahan panas yang melalui benda (perambatan panas).
- Konveksi : adalah perpindahan panas yang menyebabkan perbedaan tekanan udara.
- Loncatan bunga api : adalah suatu reaksi antara energi panas dengan udara (oksigen).

OKSIGEN (O_2)

Selain bahan bakar dan panas, oksigen adalah unsur ketiga yang dapat menyebabkan nyala api. Oksigen atau gas O_2 terdapat di udara bebas. Dalam keadaan normal, prosentase oksigen di udara bebas adalah 21%. Karena oksigen sebenarnya adalah suatu gas pembakar, maka sangat menentukan kadar atau Keaktifan dan Pembakaran.

Suatu tempat dinyatakan masih mempunyai keaktifan pembakaran, bila kadar oksigennya lebih dari 15%. Sedangkan pembakaran tidak akan terjadi bila kadar oksigen di udara kurang 12%. Oleh sebab itu salah satu teknik pemadaman api menggunakan cara penurunan kadar keaktifan pembakaran. Dalam hal ini adalah dengan cara menurunkan kadar oksigen di udara bebas menjadi kurang dari 12%.

a). Dasar Perkembangan Klasifikasi

Klasifikasi pernah mengalami perkembangan dan perubahan sehingga timbul berbagai klasifikasi, hal tersebut disebabkan :

- (1). Ditemukan makin intensifnya pemakaian jenis bahan bakar yang sifatnya berbeda dengan bahan bakar lain.
- (2). Dikembangkan jenis-jenis media pemadam baru yang lebih efektif bagi suatu jenis bahan bakar tertentu.

Sampai saat ini terdapat 4 (empat) macam klasifikasi yang berlaku dalam teknologi penanganan kebakaran. Klasifikasi tersebut antara lain

- (1). Klasifikasi sebelum tahun 1970
- (2). Klasifikasi sesudah tahun 1970
- (3). Klasifikasi menurut NFPA (USA)
- (4). Klasifikasi menurut Coast Guard (USA).

b). Klasifikasi sebelum Tahun 1970

Sebelum tahun 1970 negara-negara Eropa mengakui klasifikasi kebakaran ini yang antara lain sebagai berikut :

- (1). Klas A : Bahan bakar padat (kain, kertas, kayu, dll.)
- (2). Klas b : Bahan bakar cair dan padat lunak (misalnya Grease atau lemak).
- (3). Klas C : Kebakaran listrik "hidup"

c). Klasifikasi Sesudah Tahun 1970

Pada bulan Juni tahun 1970 diadakan Konvensi Internasional, dimana dalam konvensi ini melahirkan klasifikasi kebakaran sebagai berikut :

- (1). Klas A : Bahan bakar apabila terbakar akan meninggalkan arang dan abu.

- (2). Klas B : Bahan bakarnya lunak dan cair (minyak tanah, bensin, solar, dll.)
- (3). Klas C : Bahan bakarnya gas.
- (4). Klas D : Bahan bakarnya logam.

Dengan adanya konvensi ini maka saat ini negara-negara Eropa mengakui klasifikasi sesudah tahun 1970, sedang negara-negara yang mengikuti klasifikasi sebelum tahun 1970 adalah Amerika Utara, Australia dan Afrika Selatan.

KLASIFIKASI MENURUT NFPA (National Fire protection Association)

Klasifikasi NFPA ini dikenal sebagai Klasifikasi Amerika di darat (sama dengan DPK = Dinas Pemadam, Kebakaran di Indonesia). Adapun pembagian dari Klasifikasi menurut NFPA ini sebagai berikut :

1. Klas A : Bahan bakarnya bila terbakar akan meninggalkan arang dan abu.
2. Klas B : Bahan bakar cair.
3. Klas C : Kebakaran listrik.
4. Klas D : Kebakaran logam.

Indonesia mengikuti Klasifikasi menurut NFPA yang tertuang dalam : Peraturan Menteri Tenaga Kerja dan Transmigrasi tanggal 14 April 1980 No. PE-04/MEN/1980. Tentang syarat-syarat pemasangan dan pemeliharaan alat pemadam api ringan.

KLASIFIKASI MENURUT COAST GUARD (Satuan Penjaga Pantai dan Laut USA)

Klasifikasi menurut Coast Guard terdapat 7 (tujuh) klasifikasi kebakaran sebagai berikut :

1. Klas A : Sisa pembakaran berupa arang dan abu (kain, kayu, kertas, plastik, dll).
2. Klas B : Cairan dengan titik nyala lebih kecil dari 170°F dan tidak larut dalam air (misalnya bensin, benzene dll).
3. Klas C : Cairan dengan titik nyala lebih kecil dari 170°F dan larut dalam air (misalnya acetone, ethanol dll).
4. Klas D : Cairan dengan titik nyala sama dengan 170°F dan lebih tinggi, dan tidak larut dalam air (misalnya minyak kelapa, minyak ikan paus, minyak trafo, bahan bakar/minyak berat).
5. Klas E : Cairan dengan titik nyala sama dengan 170°F dan lebih tinggi, akan larut dalam air (misalnya glicerine, etilen, glikol dll).
6. Klas F : Kebakaran logam (misalnya aluminium dll).
7. Klas G : Kebakaran listrik.

MEDIA PEMADAM

Dasar-dasar pemadaman terbagi menjadi 2 (dua) yaitu :

- a). Prinsip pemadaman
- b). Teknik pemadaman

Prinsip Pemadaman

Prinsip-prinsip pemadaman kebakaran adalah sebagai berikut :

- (1). Menghilangkan bahan bakar
- (2). Memisahkan uap bahan bakar dengan udara
- (3). Mendinginkan
- (4). Memutus rantai reaksi pembakaran.

Sedapat mungkin didalam memadamkan kebakaran, salah satu unsur dari segi api (bahan bakar - panas - udara) dihilangkan.

b). Tehnik Pemadaman

Di dalam tehnik pemadaman kebakaran dikenal dengan apa yang disebut sebagai berikut :

- (1). **Starvation** (menghilangkan atau mengurangi bahan bakar sampai dibawah batas bisa terbakar = low flammable limit).
- (2). **Smothering** (Menyelimuti atau menghilangkan atau memisahkan udara dengan bahan bakar), sedangkan **Dilution** (mengurangi atau memisahkan kadar zat asam).
- (3). **Cooling** (mengurangi panas sampai bahan bakar mencapai suhu dibawah titik nyala atau mendinginkan).
- (4). **Cut Chain Reaction** (memutuskan rantai reaksi pembakaran baik secara kimiawi maupun mekanis).

c). Jenis-jenis Media Pemadam

Media pemadam menurut fasanya dibagi menjadi 3 (tiga) bagian :

- (1). **Jenis Padat** : pasir, tanah, selimut api (fire blanket), tepung kimia (dry chemical).

- (2). Jenis Cair : Air, busa (Foam), cairan mudah menguap
- (3). Jenis Gas : Gas asam arang (CO_2), gas zat lemas (N_2), gas argon serta gas-gas inert yang lain.

d). Media Pemadam Jenis Padat

(1). Pasir dan Tanah

Fungsi utama ialah membatasi menjalarnya kebakaran, namun untuk kebakaran kecil dapat dipergunakan untuk menutupi permukaan bahan bakar yang terbakar sehingga memisahkan udara dari proses nyala yang terjadi. Dengan demikian nyalanya akan padam.

(2). Tepung Kimia

Menurut klas kebakaran yang dipadamkan, maka tepung kimia dibagi sebagai berikut :

(a) Tepung Kimia biasa (Regular)

Kebakaran yang dipadamkan adalah kebakaran cairan, gas dan listrik. Bahan baku tepung kimia regular :

1. Natrium bicarbonat/baking soda (Na HCO_3)
2. Potasium bicarbonat (KHCO_3) Ini dikenal sebagai purple "K" yaitu untuk mencegah sifat higroskopis (mengisap air), dan penggumpalan serta untuk memberikan daya pengaktifan yang lebih baik, maka ditambah logam stearate dan lain additive (rahasia perusahaan/pembuatnya)
3. Potasium carbonat yang dikenal sebagai "Monnex"
4. Potasium Chloride (KCl) yang dikenal sebagai Super "K"

(b). Tepung Kimia serba guna (Multipurpose)

Tepung ini dikenal sebagai tepung kimia ABC, tepung ini sangat efektif untuk memadamkan kebakaran klas A, B, C. misalnya minyak, kayu, gas dan listrik.

Bahan baku tepung kimia multi-purpose :

1. Mono Amonium phosphate (MAP) atau $(\text{NH}_4) \text{H}_2\text{PO}_4$
2. Kalium Sulfate (K_2SO_4)

(c) Tepung Kimia kering (Khusus)

Tepung kimia khusus atau tepung kering atau dry powder untuk memadamkan kebakaran logam.

Bahan baku kimia kering :

1. Campuran Kalium Chloride, Barium Chloride, Magnesium Chloride, Natrium Chloride dan Kalsium Chloride.
2. Bubuk grafik dengan berbagai campuran lain seperti organic phosphate. Dalam perdagangan jenis ini dikenal dengan nama antara lain : Lith - X powder, Metal - X Guard powder, pyrene G - L powder.
3. Campuran sodium chloride tri Kalsium Phosphate, Metal Stearate dan termo plastic. Dalam perdagangan dijual dengan nama Mat - L - X powder.
4. Campuran Sodium Chloride, Amonium Phosphate. Dalam perdagangan dikenal dengan nama Pyromet Powder.

- Cara Kerja Tepung Kimia Dalam Memadamkan Api

1. Secara fisik yaitu dengan mengadakan pemisahan atau penyalutan bahan bakar, sehingga tidak terjadi pencampuran oksigen dengan uap bahan bakar. Semua tepung mempunyai cara kerja fisik seperti ini.
2. Secara kimiawi yaitu memutus rantai reaksi pembakaran dimana partikel-partikel tepung kimia tersebut akan menyerap radikal hidroksil dari api.

Tepung kimia yang bekerja secara kimiawi adalah berbeban baku KHCO_3 (Potasium Bicarbonat) dan $(\text{NH}_4) \text{H}_2\text{PO}_4$ (Mono Amonium Phosphate).

e). Media Pemadam Jenis Cair.

Media pemadam jenis cair terbagi dalam beberapa jenis :

(1). A i r

Dalam pemadaman kebakaran air adalah media pemadam yang paling banyak dipergunakan, hal ini dikarenakan air mempunyai beberapa keuntungan antara lain :

- (a). Mudah didapat dalam jumlah yang banyak
- (b). Harganya murah
- (c). Mudah disimpan, diangkut dan dialirkan
- (d). Dapat dipancarkan dalam bentuk pancaran :
 - Jet (Jet Stream)
 - Setengah tirai (Coarse Spray Stream)
 - Tirai (Spray Steam)
 - Mempunyai daya mengembang yang besar dan daya untuk penguapan yang tinggi.

Air dalam pemadaman bekerja secara fisis yaitu :

(a). Mendinginkan

Air (Water) mempunyai daya penyerap panas yang cukup tinggi dalam hal ini berfungsi sebagai pendingin. Panas yang diserap dari 15°C sampai 100°C : $84,4 \text{ KCal/kg}$ (152 BTU/lb).

Panas laten penguapan : 538 KCal/kg (970 BTU/lb). Panas yang diserap air dari 15°C sampai menjadi uap (100°C) adalah 622 KCal/kg atau 1122 BTU/lb (9362 BTU/galon).

(b). Menyelimuti

Air yang terkena panas berubah menjadi uap dan uap tersebutlah yang menyelimuti bahan yang terbakar. Dalam penyelimutan ini air cukup efektif karena dari 1 liter air akan berubah menjadi uap sebanyak 1670 liter uap air.

(2). B u s a

Busa dibagi dalam beberapa bagian yang sesuai dengan klas kebakaran :

(a). Busa regular

Yaitu busa yang hanya mampu memadamkan bahan-bahan yang berasal dari Hydrocarbon atau bahan-bahan cair bukan pelarut (solvent).

(b). Busa serbaguna (All purpose foam)

Busa ini juga sebagai busa anti alkohol yang dapat memadamkan kebakaran yang berasal dari cairan pelarut seperti : alkohol, ether dll. atau zat cair yang melarut.

- Busa dapat dibagi lagi menurut terjadinya :

(a). Busa Kimia

Busa ini terjadi karena adanya proses kimia (chemical foam), yaitu percampuran bahan-bahan kimia.

Bahan bakunya :

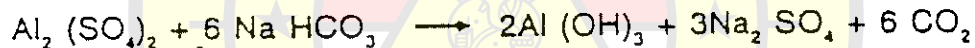
- Tepung tunggal (single powder)

Tepung ini bila bercampur dengan air akan menjadi busa.

- Tepung ganda (dual powder)

Tepung ini terdiri dari tepung aluminium sulfat dan tepung natrium karbonat.

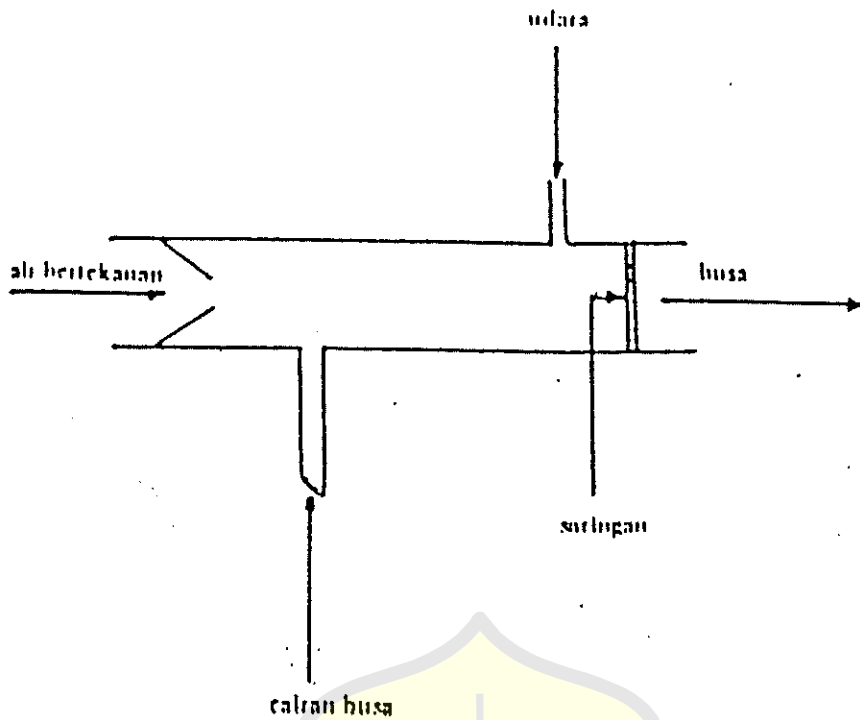
Kedua tepung tersebut masing-masing dilarutkan dengan air dengan perbandingan volume tertentu. Apabila keduanya dicampurkan akan terjadi bentuk busa. Proses reaksi kimianya sebagai berikut :



(b). Busa Mekanik.

Busa ini terjadi karena proses mekanis yaitu berupa adukan dari bahan-bahan pembuat busa yang terjadi dari cairan busa dan udara.

Untuk melaksanakan proses pembuatan busa dipergunakan alat-alat



Gambar 5 :

Pada air dicampurkan cairan busa sehingga membentuk larutan busa. Karena proses adukan atau penguapan udara ke dalam larutan busa maka terbentuklah busa mekanik.

pembuat busa, secara singkat sebagai berikut :

Bahan-bahan cairan busa adalah sebagai berikut :

1. Protein (hewani dan nabati)
2. Fluoro protein (FP 70)
3. Fluorocarbon surfactant (AF_3 , light water)
4. Detergent atau hydrocarbon surfactant atau lourylalcohol, ini disebut sebagai cairan busa expansi tinggi. Fluorocarbon surfactant dan hydrocarbon surfactant disebut juga sebagai cairan busa sintetis.

f). Media Pemadam Jenis Gas

Media pemadam jenis gas akan memadamkan api secara fisis yaitu :
Pendinginan dan Penyelebaran (Dilusi)

Berbagai gas dapat dipergunakan dalam pemadam api, namun gas asam arang (CO_2) dan gas zat lemas (N_2) yang paling banyak dipergunakan. Gas zat lemas banyak digunakan untuk mendorong tepung kimia pada instalasi pemadam tetap atau dilarutkan dalam BCF, sedangkan yang langsung digunakan untuk memadamkan api adalah gas asam (CO_2). Dalam pemakalannya gas CO_2 disimpan dalam botol yang mempunyai tekanan 1000 - 1200 psi (+80 atm).

Keuntungan gas CO_2 ialah : Bersih, murah, mudah didapat di pasaran, dapat untuk memadamkan listrik hidup, juga gas ini menyemprot dengan tekanan penguapannya sendiri.

Kerugiannya : Wadah berat dan sulit bergerak bagi si pemakai.

g). Media Pemadam Jenis Cairan Mudah Terbakar

Media pemadam ini bekerja dengan cara memutuskan rantai reaksi pembakaran dan mendesak udara atau memisahkan zat asam. Nama umum media ini adalah HALON atau HALOGENATED HYDROCARBON, yaitu suatu ikatan methan dan halogen (Jodium, Flour, Chlor dan Brom). Bila dibandingkan dengan udara maka Halon adalah lebih berat (contoh Halon 1301 adalah 5 kali lebih berat dari udara).

RUANGAN MASAK / DAPUR

- a). Alat-alat pemadam api portable harus selalu disiapkan di dapur, dan dijaga baik kondisinya.

Pekerja di dapur juga harus mampu menggunakan alat tersebut pada saat diperlukan.

- b). Semua peralatan masak harus selalu dijaga kondisinya. Khusus peralatan masak yang modern, pekerja harus sudah menguasai prosedur penggunaannya dan tindakan-tindakan keamanan yang diperlukan harus dilaksanakan.

- c). Penggunaan minyak harus hati-hati. Perhatikan temperatur minyak dan hindari hal-hal yang berbahaya.

- d). Larangan jangan merokok harus ditaati, jangan bekerja di dapur sambil merokok.

- e). Setelah selesai memasak dan ketika meninggalkan ruangan (galley/pantry), yakinkan bahwa semua peralatan sudah aman.

PENGAMANAN DINI SEBELUM DAN AWAL TERJADINYA KEBAKARAN

1. SISTEM DETEKSI ASAP DAN KEBAKARAN

Sesuai kemajuan teknologi yang demikian pesatnya, pada saat ini bahaya kebakaran dapat dideteksi sedini mungkin dengan cermat sekali. Dan berbagai macam alat deteksi bahaya kebakaran teknologi elektronika mulai dihasilkan dalam berbagai type dan kemampuan yang menakjubkan dibedakan menjadi tiga macam :

Alat Deteksi Asap (Smoke Detector)

Alat ini mempunyai kepekaan yang tinggi, dan akan memberikan alarm bila terjadi asap di ruangan tempat alat ini dipasang. Karena kepekaannya, kadang-kadang disebabkan oleh asap rokok saja alat deteksi ini langsung aktif.

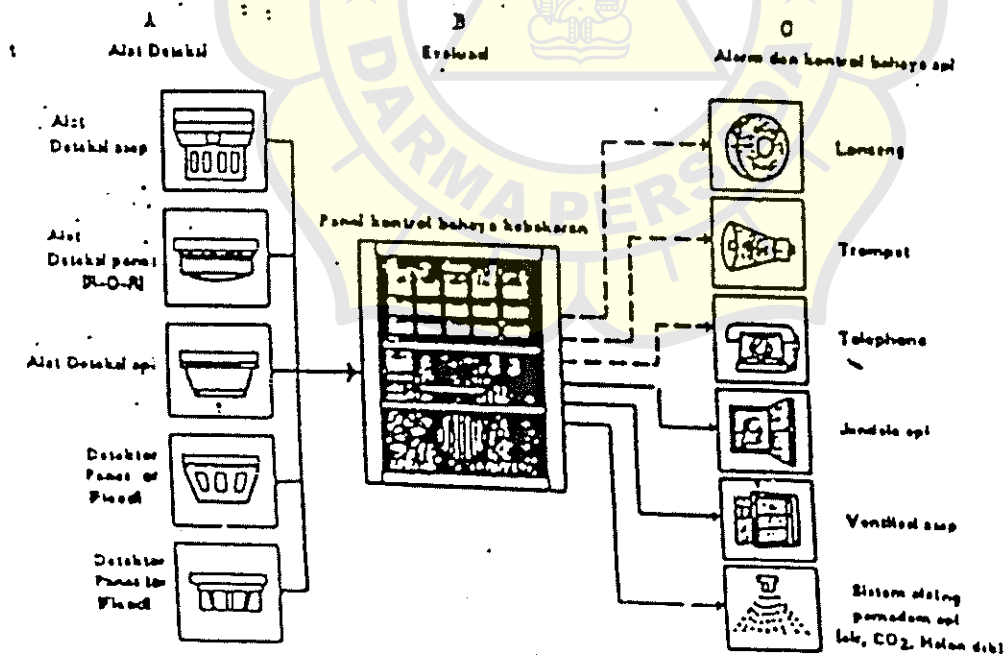
Alat Deteksi Nyala Api (Flame Detector)

Alat ini dapat mendeteksi adanya nyala api yang tidak terkendali dengan cara menangkap sinar Ultra Violet yang dipancarkan oleh nyala api tersebut.

Alat Deteksi Panas (Heat Detector)

Alat ini dapat mendeteksi adanya bahaya kebakaran dengan cara membedakan kenaikan temperatur (panas) yang terjadi di ruangan, misalnya bila temperatur ruangan naik sampai 50° - 60° C.

Selanjutnya bagaimana alat-alat deteksi di atas dapat memberikan peringatan awal tentang adanya bahaya kebakaran dapat dilihat pada gambar 12.



Gambar 12 : Sistem Deteksi Awal Bahaya Kebakaran

POMPA KEBAKARAN DARURAT UNTUK KAPAL BARANG

Pada kapal barang dengan Isi kotor 1000 ton atau lebih jika ada kebakaran disalah satu bagian ruangan manapun yang dapat mengakibatkan berhentinya pompa, harus ada sarana pengganti yang dapat menyediakan air untuk memadamkan kebakaran tersebut.

Pada kapal barang dengan Isi kotor 2000 ton atau lebih, sarana pengganti di atas harus berupa pompa darurat yang dipasang secara tetap dan berdiri sendiri. Pompa darurat ini harus dapat mengeluarkan 2 semprotan jet yang memadai untuk suatu pemadaman kebakaran:

Pompa kebakaran darurat ditempatkan di ceruk depan yang jaraknya bisa sampai dengan 300 m dari ruang akomodasi, atau diburitan pada ruangan yang terlindung penuh dan mempunyai jalan masuk dari geladak terbuka diburitan.

Pompa kebakaran darurat ini harus dicoba setiap minggu dan catat pada buku harian dek. Kemampuan penghisapan dan tekanan pompa kebakaran darurat harus dicatat.

Kepala kamar mesin harus memastikan bahwa pompa kebakaran darurat diperiksa oleh Masinis yang cakap tiap kali sebelum dihidupkan. Pemeriksaan ini termasuk pemeriksaan adanya air di tangki bahan bakar dan sistimnya.

Petunjuk lengkap yang mudah dimengerti harus dileakkan ditempat yang mudah terlihat pada pompa kebakaran darurat, berisi cara memeriksa yang benar, cara menghidupkan pompa kebakaran darurat.

Kepala kamar mesin harus memastikan bahwa semua Muallim dan Masinis betul-betul menguasai dengan baik cara menghidupkan pompa kebakaran darurat.

MACAM-MACAM PERLENGKAPAN PEMADAMAN KEBAKARAN LAINNYA.

6.1. SELANG AIR PEMADAM KEBAKARAN DAN PENYEMPROT (FIRE HOSES AND NOZZLES)

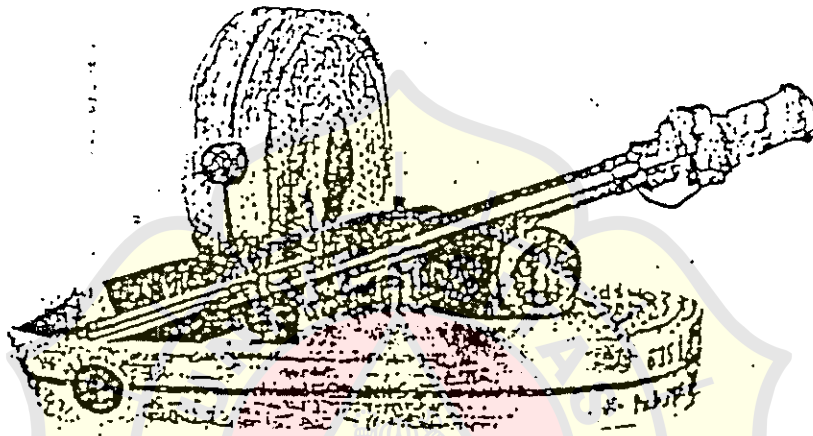
Selang air pemadam biasanya dibuat secara khusus sesuai dengan fungsi yang diperlukan dalam tugas-tugas pemadam kebakaran. Syarat-syarat selang air pemadam kebakaran yang baik, adalah sebagai berikut :

- 1). Harus kuat menahan tekanan yang tinggi
- 2). Harus dilapisi bahan yang tahan api
- 3). Tahan gesekan.
- 4). Tahan pengaruh zat-zat kimia.
- 5). Mempunyai sifat-sifat yang kuat, ringan dan elastis.

Karena syarat yang diperlukan diatas maka semua selang air yang digunakan untuk pemadaman dibuat secara berlapis-lapis. Lapisan pertama sebelah dalam, biasanya dibuat dari bahan latex murni yang diolah dengan kuat, licin dan rata. Dengan demikian lapisan sebelah dalam merupakan lapisan yang kuat menahan tekanan air yang tinggi, serta memungkinkan air mengalir dengan sempurna.

Lapisan tengah dapat dibuat dari benang-benang sintetis yang dianyam sedemikian rupa sehingga menjadi satu lapisan yang kuat dan tahan gesekan. Sedangkan lapisan luar dibuat dari benang sintetis dan tetoron, diolah secara khusus dengan bahan karet. Selanjutnya seluruh lapisan diperkuat dengan bahan sintetis Fiber sehingga komposisi lapisan menjadi elastis dan kuat, serta tetap ringan dan tahan terhadap panas.

Selang-selang air tersebut dibuat dalam berbagai ukuran, baik panjang maupun diameternya. Yang dipergunakan dikapal-kapal, pada umumnya dengan ukuran panjang 15 meter, 20 meter dan 30 meter, dengan diameter dari 1,5" - 3". Jumlah maupun macamnya telah ditentukan sesuai dengan besar kecilnya, demikian juga dengan perlengkapan Coupling dan Nozzie-Nozzlenya.



Gambar 34 : Selang air pemadam kebakaran

Untuk memudahkan penggunaannya selang air harus disimpan dalam keadaan tergantung sedemikian rupa, agar sewaktu-waktu jika diperlukan dapat cepat dipasang, serta aman bagi petugasnya. Cara-cara menggulung selang air ditunjukkan pada Gbr. 35.

Sebelum disimpan ditempat penyimpanannya, selang yang selesai digunakan perlu dibersihkan dari kotoran-kotoran yang melekat. Sisa olie dan sebagainya.

1.2. PERALATAN PEMADAM KEBAKARAN YANG DAPAT BERGERAK

Seperti telah diketahui, bahan-bahan pemadam api dapat ditempatkan dalam tabung-tabung berbagai ukuran, sehingga sewaktu-waktu diperlukan mudah dipergunakan. Tabung pemadam disebut portable bila berat tabung dan isinya tidak lebih dari 16 kg. Tabung yang lebih besar, berat seluruhnya tidak lebih dari 30 kg. Bila beratnya lebih dari 30 kg, biasanya tabung dipasang pada tempat yang mempunyai roda.

Pabrik pembuatan alat-alat pemadam kebakaran diharuskan memasang label dan informasi-informasi yang diperlukan pada bagian luar tabung-tabung hasil produksinya. Hal ini diwajibkan agar tidak terjadi kekeliruan pada waktu mempergunakannya. Sebab, kekeliruan pemakaian alat dapat menimbulkan akibat fatal. Sebaliknya, konsumen pemakai alat-alat pemadam api, baik instansi pemerintah, swasta, pabrik-pabrik, kapal-kapal dan sebagainya, seyogyanya mewajibkan setiap karyawannya untuk mengetahui dengan tepat fungsi dari tabung-tabung pemadam dan bagaimana cara memakainya. Dengan cara demikian diharapkan dapat diambil tindakan yang tepat pada awal kejadian kebakaran.

Keterangan-keterangan yang harus dicantumkan pada label portable adalah :

- 1). Jenis-bahan-bahan pemadam yang diisikan di dalamnya
- 2). Kelas-kelas yang dapat dipadamkan.

ALAT PEMADAM KEBAKARAN YANG DAPAT DIJINJING (APAR)

TUJUAN : Memadamkan kebakaran kecil

DEFINISI : Alat pemadam kebakaran yang dapat dibawa dan digunakan oleh satu orang dan berdiri sendiri.

BERAT : Antara 1 lbs - 35 lbs (1/2 kg - 16 kg).

JENIS UTAMA

- a. Bahan padat : Dry Powder atau Dry Chemical atau Tepung Kering.
- b. Bahan Cair : (1). Air bertekanan.
(2). Cairan yang mudah menguap :
- BCF (Bromo Chloro Difluoro Methane).
- CBM (Chloro Bromo Methane)
- BTM (Bromo Trifluoro Methane).
(3). Soda Acid
- c. Busa (Foam) : (1). Busa kimia (Chemical Foam)
(2). Busa Mekanik (Mechanical Foam)
- d. Gas : CO₂ (Carbon Dioxide/Gas Asam Arang)

KONSTRUKSI UMUM :

- Dry Powder : (1). Gas Cartridge type (cartridge berisi CO₂)
(2). Stored Pressure type (botolnya bertekanan CO₂ atau Nitrogen).
- Air Bertekanan : (1) Stored Pressure type
(2). Gas Cartridge type
- Busa kimia : (1). Jenis balik tanpa seal (sekat)
(2). Jenis balik dengan seal
(3). Jenis karangan (valve).
- Busa Mekanik : (1). Stored pressure type (Mechanical Foam)

1.4. PERLENGKAPAN PETUGAS PEMADAM KEBAKARAN

MACAM-MACAM ALAT BANTU

Dalam melaksanakan pemadaman kebakaran, selain alat-alat pemadam yang diperlukan juga alat-alat bantu. Dan sesuai dengan kemajuan teknologi pemadam kebakaran pada saat ini dihasilkan banyak sekali alat bantu, dimana masing-masing mempunyai kegunaan yang tertentu. Demikian juga karena banyak negara dan banyak pabrik yang memproduksi alat-alat tersebut, maka bermacam-macam keperluan dalam usaha menanggulangi kebakaran dapat terpenuhi, dan dalam berbagai type yang masing-masing mempunyai keunggulan tertentu.

Namun pada pokoknya, macam-macam alat bantu pemadam kebakaran terdiri dari peralatan tersebut dibawah ini :

- 1). Alat bantu pernapasan (Breathing Apparatus).
- 2). Pakalan tahan api dan pelengkapannya, misalnya sepatu, helm, kaca mata, sarung tangan pengaman, dan sebagainya.
- 3). Tali dan sabuk pengaman
- 4). Jala-jala pengaman
- 5). Lampu pengaman.
- 6). Kampak, ganco, gunting besar berisolasi dan sebagainya.

Khusus untuk kapal-kapal laut jumlah maupun macam alat bantu yang harus ada di kapal telah ditentukan berdasarkan persyaratan peraturan Internasional (tercantum dalam SOLAS : Safety Of Life At Sea), maupun peraturan-peraturan nasional bidang perhubungan / pelayaran.

Jumlah maupun macamnya ditentukan sesuai besar kecilnya kapal, maupun jenis kapalnya. Misalnya, peralatan bantu pemadam kebakaran dikapal-kapal tanker berbeda dengan kapal-kapal barang atau penumpang. Oleh sebab itu adalah sangat baik bila masing-masing pekerja/awak kapal mengetahui dengan benar alat-alat apa saja yang seharusnya disiapkan dikapalnya. Dengan demikian mereka ikut bertanggung jawab terhadap keselamatan dirinya, kapalnya, barang maupun penumpangnya. Dan tentu saja, perusahaan yang memiliki dan mempekerjakan mereka harus mematuhi ketentuan-ketentuan yang seharusnya, sehingga dengan demikian faktor-faktor keselamatan kerja benar-benar terjamin.

PAKAIAN TAHAN API DAN PERLENGKAPANNYA

Untuk menahan sengatan panas, petugas pemadam harus mengenakan pakaian tahan api dan perlengkapannya : Helm, pelindung muka (masker), sarung tangan, dan sepatu boot untuk pemadam api.

Tutup kepala (helm) dibuat dari bahan "Reinforced Plastic" yang mempunyai sifat-sifat tahan panas kuat dan ringan. Di bagian depan terdapat kaca untuk pelindung muka, sehingga dapat melindungi mata dari sengatan panas atau percikan-percikan api.

Sedangkan pakaian tahan api dibuat dari bahan "Alumix" yang mempunyai kemampuan-kemampuan :

- 1). Mempunyai daya pencegah panas/tahan api yang baik sekali.
- 2). Dapat memantulkan panas, sehingga si pemakai terlindung dari pancaran panas api.
- 3). Sangat ringan, sehingga mempunyai sifat yang ulet/kuat.

Bagi petugas pemadam yang akan melakukan pemadaman api dalam mengenakan perlengkapan pakaian tersebut perlu memperhatikan agar jangan membawa/mengantongi bahan-bahan yang mudah terbakar, misalnya korek api gas, sebab dapat berbahaya bagi dirinya. Dan walaupun sudah memakai perlengkapan tahan api, sengatan panas kadang-kadang masih terjadi pula. Apabila dalam suatu kebakaran besar dimana daya sengat panasnya sangat tinggi. Oleh sebab itu dalam melakukan pemadaman kebakaran harus tetap memperhatikan faktor keselamatan diri.



Gbr. 52 : Pakaian tahan api dan perlengkapannya.

ALAT PELINDUNG PERNAFASAN

Seperti kita ketahui peracunan dapat masuk kedalam tubuh manusia umumnya masuk lewat tiga jalur, pertama lewat sistem pernafasan, kedua lewat sistem pencernaan dan ketiga lewat kulit/pori-pori tubuh manusia. Dimana akibat peracunan yang paling akut adalah peracunan lewat sistem pernafasan. Hal ini dapat dilihat dengan jatuhnya korban, misalnya akibat kebocoran gas beracun, dimana umumnya waktu yang diperlukan untuk menyelamatkan diri sangat pendek, dan akibat peracunan lewat sistem pernafasan ini langsung berakibat fatal/meninggal. Untuk itulah diciptakan suatu alat pelindung pernafasan (APP), yang tujuannya adalah semata-mata melindungi sistem pernafasan saja.

APP ini cara kerjanya bermacam-macam, ada dengan cara menyaring atau mengikat bahan pengotor, misalnya respirator, dan ada juga yang prinsip kerjanya dengan cara mencatu/menyediakan udara pernafasan dari tempat yang bersih/sehat, misalnya APP udara bersih atau APP dengan oksigen. Untuk APP udara bersih, berarti udara yang dikonsumsi oleh pemakai mengandung O₂ 20,93%, Nitrogen 79,04% CO₂ dan lain-lain 0,03%, jadi memang seperti udara yang kita hirup ditempat normal.

Ada 3 jenis APP udara bersih

Pertama, APP udara bersih jenis catu udara segar, jenis ini dilengkapi dengan topeng/face mask & selang udara yang panjang maximum adalah 8 m. Jadi pemakaian APP jenis catu udara segar ini menggunakan topeng, sedangkan udara pernafasannya dihirup melalui selang udara yang ujung luarnya ditempatkan pada tempat yang udaranya memenuhi syarat/sehat.

Kedua, APP udara bersih jenis catu udara bertekanan, jenis ini dilengkapi dengan topeng/face mask, selang udara yang panjang maximum 50 m dan ujung luar dari selang udara disambungkan ke bejana tekan/kaskade (berisi udara) atau ke kompresor udara. Jadi pemakaian APP ini bisa bernafas berdasarkan catu udara yang diberikan oleh kaskade atau kompresor.

Ketiga, APP udara bersih jenis berdiri sendiri, jenis ini dilengkapi dengan topeng, botol dan penggandong. Jadi pemakai APPBS ini dapat bernafas berdasarkan catu udara yang diberikan oleh botol yang digandong sendiri. Pada jenis APP dengan oksigen, digunakan botol/bejana tekan berisi O₂ murni yang biasa digunakan di rumah sakit.

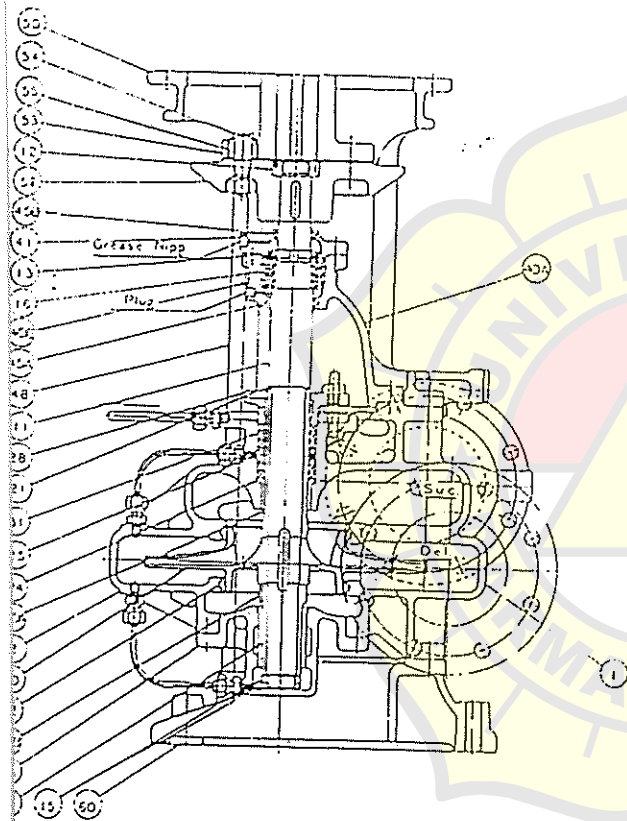
Khusus untuk menggunakan APP jenis respirator katrid maupun yang berkanister harus memperhatikan syarat-syarat pemakalannya, yaitu :

- 1). Kadar oksigen tidak kurang dari 19,5%
- 2). Gunakan katrid atau kanister sesuai dengan zat pengotor yang akan disaring.
- 3). Kadar zat pengotor yang dapat disaring oleh katrid max. 0,1% kecuali untuk Amoniak max 1,5% sedangkan kadar zat pengotor yang dapat disaring oleh kanister max 2% kecuali untuk Amoniak max 3%.
- 4). Perhitungkan lamanya katrid atau kanister dapat digunakan untuk bekerja.
- 5). Lihat Exp. datanya, apakah masih berlaku.

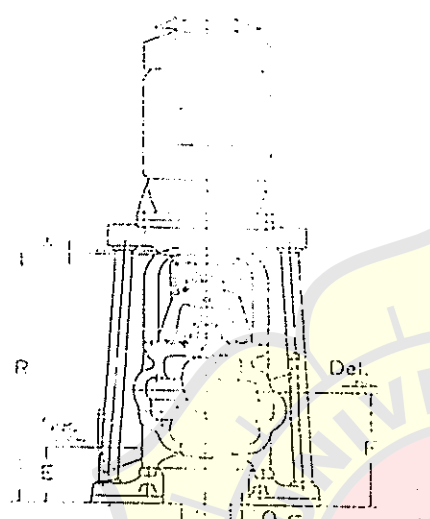
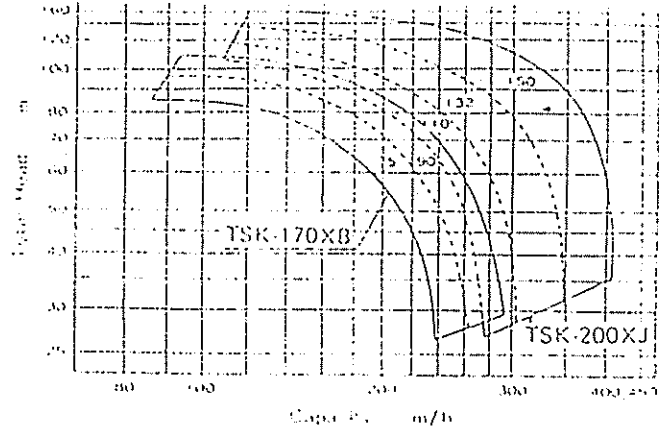
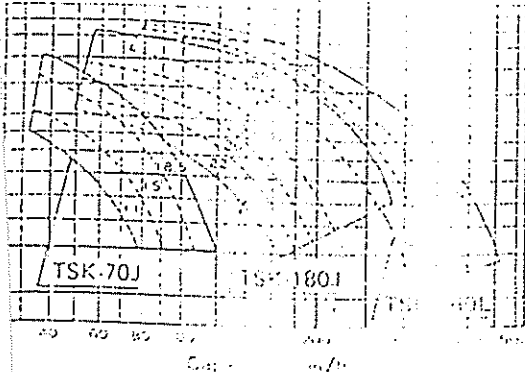
Dari uraian di atas, bisa kita simpulkan bahwa respirator berkatrid maupun berkanister tidak dapat digunakan pada saat-saat darurat. Hanya pada operasi-operasi normal saja kita dapat memakai respirator.

TK-TSK Type FIRE & G.S PUMP 2/5

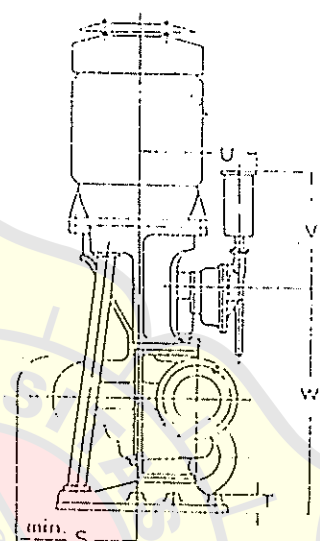
Refer to page 1 for materials of the main parts.



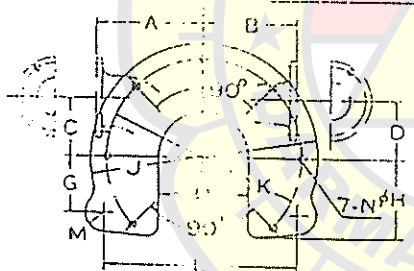
PART NO.	NAME OF PART	MATERIAL NOMINATION	QUANTITY
1	CASING	BRONZE	1
2	CASING COVER	BRONZE	1
3	FOOT COVER	BRONZE	1
10	IMPELLER	PHOS. BRONZE	1
11	SHAFT WITH KEY	STAINLESS STEEL	1 SET
12	COUPLING NUT	CARBON STEEL	1
13	BEARING NUT	CARBON STEEL	1
15	SLEEVE NUT	HIGH-TEN, BRASS	2
16	BALL BEARING		1
17	BEARING BUSH	LEADED BRONZE	1
20A	UPPER SLEEVE	STAINLESS STEEL	1
20B	FOOT SLEEVE	STAINLESS STEEL	1
21	"O"RING	SYNTH. RUBBER	1
22	MOUTH RING	LEADED BRONZE	2
24	NECK BUSH	LEADED BRONZE	1
25	SEAL CAGE	LEADED BRONZE	1
28	PACKING GLAND	BRONZE	1
31	GLAND PACKING	PILLAR NO. 6501L	1 SET
40A	BEARING CASE	BRONZE	1
40B	BEARING CASE COVER	BRONZE	1
41	BEARING COVER	BRONZE	1
45A	FELT RING	FELT	1
45B	FELT RING	FELT	1
48	STAY PIPE	CARBON STEEL	1
50	MOTOR FRAME	BRONZE/CAST IRON	1
52	FLEXIBLE COUPLING	BRONZE/CAST IRON	1
53	FLEXIBLE COUPLING	BRONZE/CAST IRON	1
54	COUPLING BOLT	MILD STEEL	8
55	BUFFER RING	SYNTH. RUBBER	8
60	PUMP BED	CAST IRON	1



Q For removal of foot cover.



For removal of casing cover.



Type	Bore		A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Vacuum Pump	Pump Weight (kg)
	Suc.	Del.																									
50H	100	100	250	250	155	155	155	205	140	230	600	530	540	63	23	270	158	40	767	340	50	408	465	677	3	V-18	300
40H	100	100	260	260	190	190	165	205	140	230	600	530	540	63	23	270	158	5	767	310	50	408	465	677	3	V-18	370
70J	125	125	275	275	175	175	180	344	190	260	700	630	630	65	27	280	220	25	800	390	65	420	465	703	3	V-50	400
95J	125	125	350	300	185	185	203	381	190	260	700	630	630	65	27	280	188	5	840	425	65	420	465	743	3	V-50	430
	150	150					190																				
100P	125	125	300	300	210	210	225	410	210	300	800	730	680	65	27	300	220	25	923	450	80	416	465	826	3	V-50	370
180J	200	200	350	350	200	200	250	495	210	300	800	730	680	65	27	300	188	30	997	456	80	416	465	900	3	V-50	470
250L	250	250	370	400	240	240	350	650	230	340	900	810	800	75	33	380	230	-	1312	520	110	430	465	1200	4	V-60	1010
200XJ	250	250	450	450	250	280	380	680	320	450	1200	1070	1100	87	39	500	250	-	1360	600	120	490	465	1220	4	V-50	1120
170XB	200	200	390	390	230	230	340	585	270	380	1000	900	960	87	33	470	188	30	1230	510	110	490	465	1090	4	V-50	920

Y-DK Type EMERGENCY FIRE PUMP

these pumps are of a single stage centrifugal type, and connected to diesel engines.

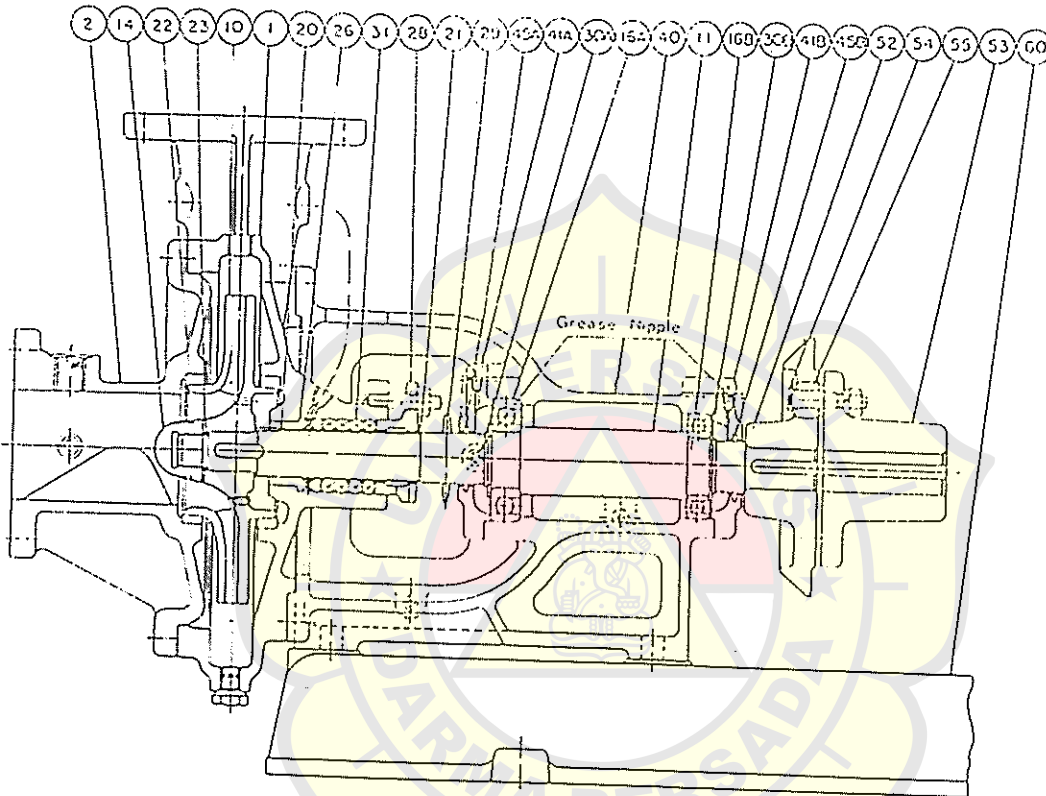
They are equipped with a vacuum pump.

Working water is circulated to the engine by the pump through a pipe.

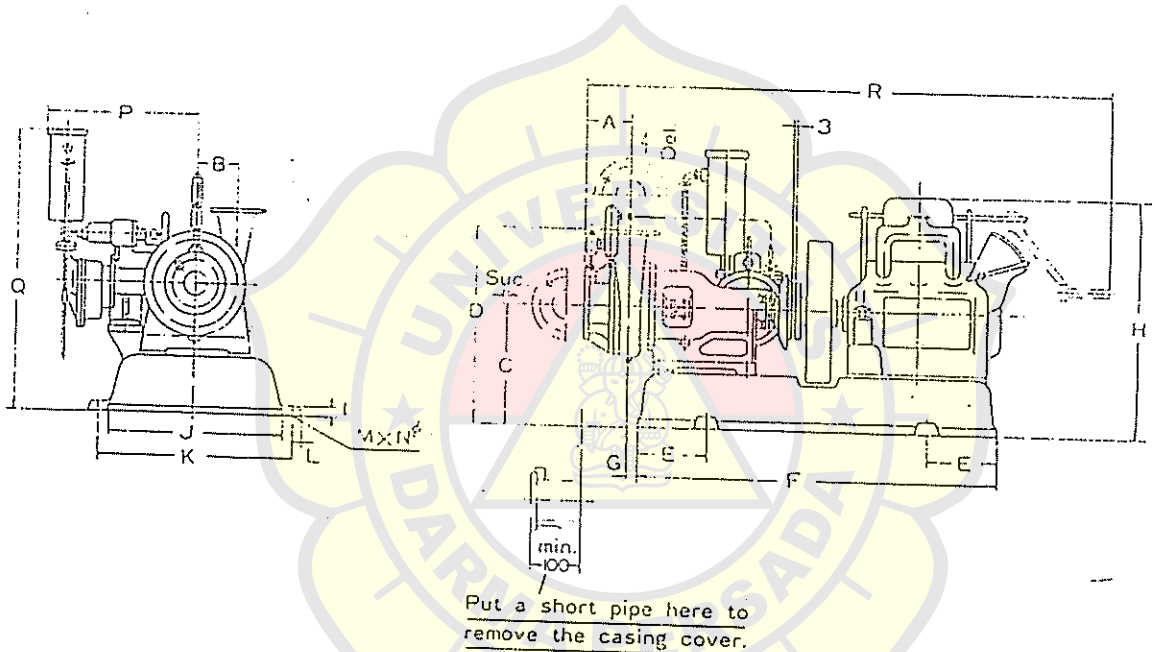
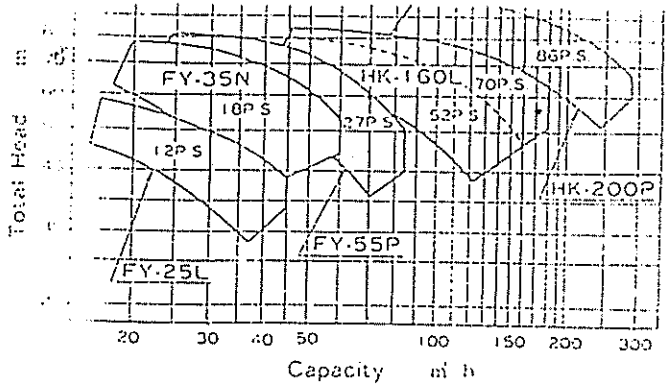
Refer to page 1 for materials of the main parts.

Buffer will be provided separately upon request.

Type of Pump	Diesel Engine		No. of Revolution r. p. m.	Starting Method
	Type	Output PS		
FY-25L	SKL	12	2800	Hand Worked
FY-35N	2LKL	18	3000	
FY-55P	3LKL	27	3000	
DK-160L	3ESDL	52	1800	Compressed Air
DK-200P	4EKDL	86	1800	



NAME OF PART	MATERIAL NOMINATION	QUANTITY	PART NO.	NAME OF PART	MATERIAL NOMINATION	QUANTITY
HOUSING	BRONZE	1	30A	RETAINING RING	CARBON T. STEEL	1
HOUSING COVER	BRONZE	1	30B	RETAINING RING	CARBON T. STEEL	1
IMPELLER	PHCS. BRONZE	1	31	GLAND PACKING	PILLAR NO. 6501L	1 SET
IMPELLER SHAFT WITH KEY	STAINLESS STEEL	1 SET	40	BEARING CASE	BRONZE/CAST IRON	1
IMPELLER NUT	HIGH-TEN. BRASS	1	41A	BEARING COVER	BRONZE/CAST IRON	1
IMPELLER BEARING		1	41B	BEARING COVER	BRONZE/CAST IRON	1
IMPELLER BEARING		1	45A	FELT RING	FELT	1
IMPELLER KEY	STAINLESS STEEL	1	45B	FELT RING	FELT	1
O-RING	SYNTH. RUBBER	1	52	FLEXIBLE COUPLING	CAST IRON	1
IMPELLER MOUTH RING	LEADED BRONZE	1-2	53	FLEXIBLE COUPLING	CAST IRON	1
IMPELLER WASHER	BRASS	1	54	COUPLING BOLT	MILD STEEL	6-8
IMPELLER SEAL BUSH	LEADED BRONZE	1	55	BUFFER RING	SYNTH. RUBBER	6-8
IMPELLER PACKING GLAND	BRONZE	1	60	COMMON BED	CAST IRON	1
IMPELLER WATER SHELTER	SYNTH. RUBBER	1				



Die. Engine (P.S)	Bore		Dimensions—mm																	Vacuum Pump	Pump Weight (kg)
	Suc.	Del.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	R		
12	65	65	130	140	319	530	125	750	38	791	30	460	510	25	4	19	398	760	1264	V-18	290
18	80	80	140	140	330	520	125	950	38	813	30	480	530	25	4	19	398	795	1397	V-18	340
27	100	100	150	150	348	558	150	1140	48	831	30	500	550	25	4	19	398	813	1589	V-18	390
52	125	125	152	235	403	710	120	1500	75	1040	35	550	610	28	6	23	420	855	1913	V-50	430
70	125	125	152	235	433	740	200	1700	75	1170	35	550	610	28	6	23	420	885	2088	V-50	450
86	200	200	200	270	488	945	200	1800	75	1457	50	570	490	40	6	27	442	960	2185	V-50	490