2024 January

List the important operations that should be included when organising fire drills. (10)

sept 2020

Sept 2020

9. List the important operations that should be included when organising fire drills. (10)

Fire drills are essential for ensuring the safety of crew and passengers on marine vessels. Here's a list of important operations that should be included when organizing fire drills for marine applications:

1. Alarm Activation and Response:

- Simulate a fire alarm by activating the fire alarm system in the designated drill area.
- Crew members should practice their immediate response to the alarm, including:
    - Reporting to their assigned muster stations.
    - Donning personal protective equipment (PPE), including breathing apparatus if applicable.
    - Taking headcount to ensure everyone is accounted for.

2. Fire Reporting and Communication:

- Simulate the discovery of a fire by a crew member.
- Practice proper procedures for reporting the fire location and size to the designated personnel (bridge, control room).
- Test communication protocols between different teams (e.g., bridge team informing firefighting teams).

3. Firefighting Operations:

- Depending on the scenario, practice various firefighting techniques:
    - Using fire hoses to extinguish flames with simulated fire sources (following safety precautions).
    - Operating portable fire extinguishers on designated training fires.
    - Utilizing fire blankets to smother small fires.
    - Sealing watertight doors to isolate the fire zone.

4. Evacuation Procedures:

- Practice emergency evacuation procedures for the designated area:
    - Following designated escape routes according to muster station assignments.
    - Using emergency exits and life-saving equipment (lifeboats, liferafts) if applicable to the drill scenario.
    - Conducting headcount at the designated assembly stations after evacuation.

5. Search and Rescue:

- In some drills, simulate search and rescue operations for missing crew members within the designated area.
- Practice utilizing search equipment (thermal imaging cameras) and proper rescue techniques.

6. Abandon Ship Procedures:

- In specific scenarios, practice complete abandonment ship procedures:
  - Boarding lifeboats and liferafts following assigned stations.
  - Launching lifeboats and deploying liferafts.
  - Signaling for help using distress flares or radios.
  - Performing emergency first aid and survival techniques while awaiting rescue.

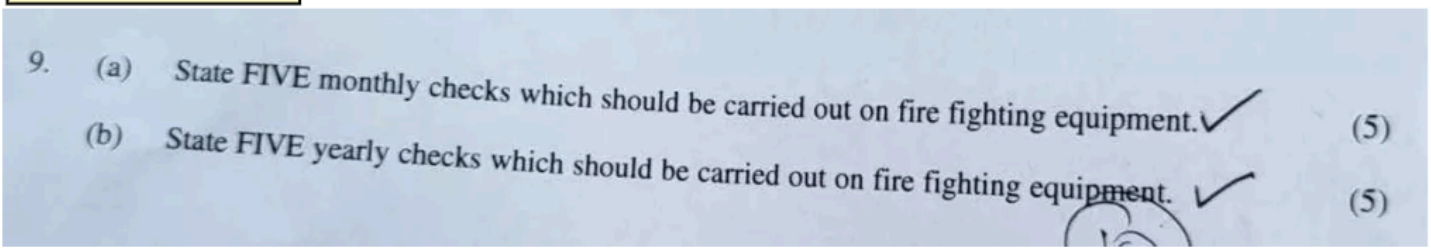
Additional Considerations:

- **Different Scenarios:** Conduct drills for various fire scenarios, including engine room fires, galley fires, and cabin fires.
- **Realistic Environment:** As far as practical, create a realistic environment during the drill to simulate the stress and confusion of a real fire.
- **Debriefing:** After each drill, conduct a debriefing session to discuss performance, identify areas for improvement, and answer any questions from crew members.
- **Record Keeping:** Maintain accurate records of fire drills, including date, time, scenario, participants, and any observations or lessons learned.

By incorporating these essential operations and considering these additional factors, you can ensure that your marine fire drills are effective in preparing crew members for real-world emergencies. Remember, the goal is to instill a sense of urgency, practice teamwork, and ensure everyone onboard knows their roles and responsibilities in case of fire.

aug 2023

AUG 2023



9. (a) State FIVE monthly checks which should be carried out on fire fighting equipment. (5)

(b) State FIVE yearly checks which should be carried out on fire fighting equipment. (5)

march 2021

March 21

9. (a) State FIVE monthly checks which should be carried out on fire fighting equipment. (5)

(b) State FIVE yearly checks which should be carried out on fire fighting equipment. (5)

Firefighting Equipment Checks on Marine Vessels

Here's a breakdown of important monthly and yearly checks for firefighting equipment on marine applications:

(a) Monthly Checks (Five Examples):

1. **Visual Inspection:** Perform a thorough visual inspection of all firefighting equipment for any signs of damage, corrosion, leaks, or missing parts. This includes:
   - Fire hoses: Check for cracks, cuts, bulges, or loose couplings.

- Portable fire extinguishers: Verify tamper seals are intact, pressure gauges are in the green zone, and safety pins are secure.
- Fire hydrants and valves: Ensure they are accessible, not blocked by debris, and operate smoothly.
- Breathing apparatus: Inspect masks, hoses, and cylinders for damage or leaks.
- Firefighting clothing: Check for tears, burns, or any deterioration that might affect protection.

2. **Operational Checks:** Where possible, conduct basic operational checks on some equipment:
   - **Fire hoses:** Unroll and connect hoses to hydrants to ensure proper water flow and pressure.
   - **Portable fire extinguishers: Visually** confirm the lifting handle and discharge lever are functional (**Do not** discharge extinguishers during monthly checks).
3. **Crew Familiarization:** Organize short training sessions or reminders for crew members to ensure familiarity with the location and operation of firefighting equipment in their assigned areas.
4. **Record Keeping:** Document the monthly checks in a designated logbook, recording the date, equipment inspected, any findings, and corrective actions taken (if necessary).
5. **Pressure Gauges:** While a detailed pressure gauge check might be done yearly, a monthly glance at the pressure gauges on fire hydrants and portable extinguishers can provide a quick indication of potential issues.

(b) Yearly Checks (Five Examples):

1. **Detailed Functional Testing:** Perform a more comprehensive functional test on firefighting equipment:
   - **Fire hoses:** Conduct a pressure test to ensure they meet the required pressure rating.
   - **Portable fire extinguishers:** These require a thorough internal and external inspection by a certified technician. This includes a hydrostatic pressure test to ensure the extinguisher can safely handle the pressure of the extinguishing agent. Discharging a small amount of the agent might also be required to verify proper functionality.
   - **Fire hydrants and valves:** Conduct a flow test to verify adequate water pressure and flow rate. Operate the valves to ensure smooth opening and closing.
2. **Breathing Apparatus (BA) Inspection:** A qualified technician should perform a detailed inspection of breathing apparatus sets, including:
   - Checking the integrity of the masks, hoses, and cylinders.
   - Testing alarms and low-air pressure warnings.
   - Verifying the serviceability of breathing gas and refilling cylinders if necessary.
3. **Firefighting Clothing Inspection:** A qualified person should inspect firefighting clothing for any damage, tears, or signs of wear and tear that might compromise their protective capabilities. Replace any unsuitable clothing.
4. **Spare Parts Inventory:** Review the stock of spare parts for firefighting equipment and ensure critical replacement parts are readily available in case of repairs.
5. **Record Keeping:** Document the yearly checks in a designated logbook, recording the date, equipment serviced, any findings or repairs done, and the name of the certified technician (if applicable).

These are just some examples, and the specific requirements for checks and maintenance might vary depending on the type of vessel, national regulations, and classification society guidelines. Always refer to the manufacturer's instructions and relevant regulations for detailed procedures and service intervals.

March 21

8. With reference to portable fire extinguishers:

(a) describe the examination and testing of portable fire extinguishers as specified in the UK and Internatinal legislation. (6)

(b) state the classes of fire that Dry powder extinguishers may be safely used; (2)

(c) describe the operation of a portable CO_2 fire extinguisher. (2)

Portable Fire Extinguisher Examination and Testing (UK & International)

(a) Examination and Testing:

Both UK and international regulations emphasize the importance of regular examination and testing of portable fire extinguishers to ensure their functionality and safety. Here's a breakdown of the key points:

UK Regulations:

- The **British Standards Institution (BSI)** sets standards for fire extinguisher maintenance in the UK. The most relevant standard is **BS 5306 - Part 8: Servicing and maintenance of portable fire extinguishers**.
- This standard recommends the following schedule for examination and testing:
    - **Monthly Visual Inspections:** These basic checks ensure the extinguisher is readily available and undamaged. (See previous answer for details)
    - **Six-Monthly Service:** A qualified engineer performs a more detailed service, including:
        - Internal and external inspection for damage or corrosion.
        - Functional checks of pressure gauges, discharge levers, and safety pins.
        - Cleaning and lubrication if necessary.
    - **Five-Yearly Internal Inspection:** A more thorough inspection by a qualified engineer, including:
        - Disassembly and internal examination for signs of wear or deterioration.
        - Pressure testing of the extinguisher shell.
        - Replacing any worn or faulty components.

International Regulations:

- The **International Maritime Organization (IMO)** has guidelines for fire safety on ships in the **International Code for Fire Safety Systems (FSS Code)**.
- This code requires fire extinguishers on board vessels to be serviced in accordance with the manufacturer's instructions and relevant national regulations. (Similar to the UK approach)
- The **Solas Convention** (International Convention for the Safety of Life at Sea) also mandates fire extinguisher maintenance on passenger ships.

General Considerations:

- Both UK and international regulations emphasize the importance of using qualified engineers for servicing and testing portable fire extinguishers.
- Records of all examinations and tests should be maintained for future reference.

Dry Powder Fire Extinguishers (Classes of Use)

(b) Classes of Fire:

Dry powder fire extinguishers are versatile and can be used safely on several fire classes:

- **Class A Fires:** Ordinary combustibles like wood, paper, and textiles.
- **Class B Fires:** Flammable liquids like gasoline, oil, and grease.
- **Class C Fires:** Flammable gases like propane and methane. (**Note:** While dry powder can extinguish the flame, it won't stop the gas leak. Shutting off the gas source is crucial)

However, they are **not** suitable for the following fire classes:

- **Class D Fires:** Combustible metals like magnesium or sodium. Dry powder might react with some metals, worsening the fire.
- **Class F Fires:** Cooking oils and fats. Dry powder might not be effective in smothering these types of fires.

Operation of a Portable CO2 Fire Extinguisher

(c) Operation of a CO2 Fire Extinguisher:

Caution: CO2 extinguishers displace oxygen. Never use them in confined spaces without proper ventilation.

Here's how to operate a portable CO2 fire extinguisher:

1. **Pull the safety pin.** This allows you to discharge the extinguisher.
2. **Aim the nozzle** at the base of the flames.
3. **Squeeze the discharge lever** to release the CO2 gas. The CO2 will be expelled as a cold, dense gas that smothers the fire by displacing oxygen.
4. **Keep discharging** the extinguisher in short bursts, sweeping the nozzle back and forth at the base of the flames until the fire is extinguished.
5. **Maintain a safe distance** from the fire while discharging. The CO2 gas can be extremely cold and cause frostbite.
6. **Evacuate the area** once the fire is out and ensure proper ventilation to avoid oxygen depletion.

Remember: Portable fire extinguishers are for small fires only. If the fire is large or spreading rapidly, evacuate the area immediately and call the fire department.

june 2021

June 2021

9. Describe, with the aid of a sketch, the construction and operation of a *thermistor* type rate of rise heat detector. (10)

april 2021

April 2021

9. Describe, with the aid of a sketch, the construction and operation of a *thermistor* type rate of rise heat detector. (10)

Thermistor Rate of Rise Heat Detector: Construction and Operation

A thermistor type rate of rise heat detector utilizes the **temperature-dependent resistance** of a thermistor (Thermally Sensitive Resistor) to detect rapid increases in temperature, indicating a potential fire. Here's a breakdown of its construction and operation:

Construction:

- **Thermistor:** The core component is a thermistor, a small, bead-shaped semiconductor device with a high resistance that decreases significantly as the temperature rises.
- **Circuit Board:** The thermistor is integrated into an electronic circuit board.
- **Voltage Source:** The circuit is powered by a constant voltage source, typically a battery.
- **Comparator:** The circuit includes a comparator, an electronic component that compares two voltage inputs.
- **Fixed Resistor:** A fixed resistor with a known resistance value is also part of the circuit, creating a voltage divider with the thermistor.
- **Alarm Mechanism:** The circuit is connected to an alarm mechanism, such as a buzzer or flashing light.

Operation:

1. **Normal Conditions:** When the ambient temperature is stable, the thermistor's resistance remains high. This results in a specific voltage drop across the thermistor in the voltage divider circuit. This voltage is fed to one input of the comparator.
2. **Temperature Rise:** If a fire starts, the temperature surrounding the detector increases rapidly.
3. **Thermistor Resistance Decrease:** As the temperature rises, the thermistor's resistance decreases significantly. This alters the voltage drop across the thermistor in the voltage divider circuit.
4. **Comparator Trigger:** The voltage change at the thermistor is compared to a fixed reference voltage (set by the comparator) at the other input. When the temperature rise is rapid enough to cause the voltage drop across the thermistor to fall below the reference voltage, the comparator triggers.
5. **Alarm Activation:** The comparator's output signal activates the alarm mechanism, typically a loud buzzer or flashing light, alerting occupants to a potential fire.

Key Points:

- **Rate of Rise Detection:** These detectors are designed to be more sensitive to rapid temperature increases rather than absolute temperature. This helps to distinguish between a gradual rise in ambient temperature (e.g., due to heating system) and a sudden increase indicative of a fire.
- **Sensitivity Adjustment:** Some detectors offer sensitivity adjustments to match the specific environment.
- **Simple Design:** Compared to more complex fire detection systems, thermistor rate of rise detectors are relatively simple and cost-effective.

Limitations:

- **Limited Area Coverage:** These detectors typically have a limited detection range. Multiple detectors are needed to cover a large area effectively.
- **Susceptibility to Dust:** Dust buildup on the thermistor can affect its sensitivity and require regular cleaning.
- **False Alarms:** Sudden, non-fire-related temperature changes (e.g., steam release) might trigger false alarms.

Thermistor rate of rise heat detectors offer a reliable and cost-effective solution for early fire detection in various applications, particularly in residential and commercial buildings. Their focus on rapid temperature rise helps to minimize false alarms due to gradual temperature changes. However, proper placement, regular maintenance, and potential limitations should be considered for optimal fire safety.

nov 2020

Nov 2020

9. Define EACH of the following, stating an example in EACH case where a fire could be caused:

(a) spontaneous combustion; (4)

(b) flash point; (3)

(c) auto ignition temperature. (3)

Fire Starters: Definitions and Examples

Here's a breakdown of each term with a fire cause example:

(a) **Spontaneous Combustion:**

- **Definition:** Spontaneous combustion is a process by which a substance heats up internally and ignites without the presence of an external ignition source like a flame or spark. This typically occurs due to a combination of factors that generate heat within the material.
- **Example:** Oily rags left bunched up in a closed container can undergo spontaneous combustion. The oil oxidizes (reacts with oxygen) slowly, generating heat. If the rags are bunched up and don't allow proper ventilation, this heat can't escape and can build up to the point of ignition.

(b) **Flash Point:**

- **Definition:** The flash point of a liquid is the lowest temperature at which the liquid vaporizes enough to form an ignitable mixture with air in the presence of an ignition source. Below the flash point, there are not enough flammable vapors present to ignite.
- **Example:** Gasoline has a low flash point (around -40°C or -40°F). If gasoline spills and the surrounding temperature rises above its flash point, the gasoline vapors can mix with air and ignite easily from a spark caused by static electricity or even a lit cigarette.

(c) **Autoignition Temperature:**

- **Definition:** The autoignition temperature of a substance is the minimum temperature at which the substance will spontaneously ignite in a normal atmosphere without the need for an external ignition

source. At or above this temperature, the material generates enough heat through self-heating processes to reach its ignition point.

- **Example:** Oily rags, again! If left lying around for a long time exposed to high temperatures (e.g., near a heater or in direct sunlight), oily rags can reach their autoignition temperature and ignite spontaneously. This is why oily rags should be stored in properly ventilated containers to prevent heat buildup.

feb 2021jan 2021

29 January 2021

9. (a) Define EACH of the following:

(i) Flash Point; (2)

(ii) Ignition Point (2)

(iii) Auto Ignition Temperature. (2)

(b) Explain the requirements for the discharge of CO_2 of a machinery space fixed firefighting installation with regard to volume and time. (4)

(a) Engine Room Fire Main Isolation Valve

- **Need:** Isolates the fire main within the engine room in case of a fire. This allows firefighters to:
  - Maintain firefighting capabilities in other areas using water from auxiliary pumps.
  - Minimize water damage in other compartments if a fire main pipe ruptures.
- **Location:** Outside the engine room in a readily accessible and tenable position.
- **Operation:** Manually operated (handwheel or lever) to shut off water flow to the engine room section. May also have remote operation capability.

(b) Valve Type:

- **Gate Valve:** Provides positive shutoff, durability, and a relatively simple design for easy operation and maintenance.

(c) Sprinkler Head Construction

- **Frame:** Houses internal components and connects to piping.
- **Sealing Element:** Heat-sensitive element (glass bulb with liquid or bi-metallic strip) that keeps the opening sealed.
- **Deflector:** Distributes discharged water in a spray pattern.
- **Sprinkler (Optional):** May provide a pre-discharge misting effect.

I hope this summary is helpful! If you have any further questions or require explanations for different fire safety components, feel free to ask.

Feb 2021

9. (a) Explain the need for fitting, location, and operation of an engine room fire main isolation valve. (4)

(b) State the type of valve used in part (a). (1)

(c) Describe, with the aid of a sketch, the construction of a sprinkler head. (5)

Engine Room Fire Main Isolation Valve

(a) Need, Location, and Operation:

The engine room fire main isolation valve plays a crucial role in isolating the fire main within the engine room in case of a fire. Here's a breakdown of its importance:

- **Need:**
  - Fire in the engine room presents a serious threat to the entire vessel.
  - The isolation valve allows for:
    - **Maintaining firefighting capabilities:** By isolating the engine room section of the fire main, firefighters can continue using the fire main system in other parts of the ship with water from auxiliary pumps or an emergency fire pump located outside the engine room.
    - **Minimizing water damage:** If a fire main pipe ruptures due to fire damage, the isolation valve allows for quick isolation of the engine room section, preventing excessive water flooding in other compartments.
- **Location:** The isolation valve is typically located outside the engine room in a readily accessible and tenable (safe and easily reached) position. This allows firefighters to access and operate the valve safely even during a fire.
- **Operation:** The isolation valve is designed for manual operation. It has a handwheel or lever that allows personnel to quickly shut off the water flow to the engine room section of the fire main. Some may also have remote operation capability from the fire control station.

(b) Valve Type:

The engine room fire main isolation valve is typically a **gate valve**. Here's why:

- **Positive Shutoff:** Gate valves provide a positive shutoff, completely stopping water flow when closed. This is crucial for isolating the engine room section in case of a fire.
- **Durability:** Gate valves are known for their robustness and ability to withstand high pressures, making them suitable for the demands of a fire main system.
- **Relatively Simple Design:** Gate valves have a relatively simple design with a sliding wedge that blocks the flow path. This allows for easy operation and maintenance.

(c) Sprinkler Head Construction:

A sprinkler head is a heat-sensitive device installed in a sprinkler system that automatically discharges water when a fire is detected. Here's a breakdown of its key components:

- **Frame:** The frame houses all the internal components and provides a connection to the sprinkler piping.

- **Sealing Element:** A heat-sensitive element seals the opening of the sprinkler head, typically a glass bulb filled with a liquid that expands rapidly at a specific temperature. Some heads use bi-metallic strips that deform with heat.
- **Deflector:** Once the sealing element ruptures, the deflector distributes the discharged water in a spray pattern to cover the designated area.
- **Sprinkler (Optional):** Some sprinkler heads include a small sprinkler within the frame that provides a pre-discharge misting effect to potentially suppress a fire in its early stages before the full water flow activates.

Activation Process:

- In a normal state, the sealing element keeps the water supply blocked.
- When a fire raises the surrounding temperature above the designed activation temperature of the sealing element:
    - **Glass Bulb:** The liquid in the glass bulb expands rapidly, shattering the bulb.
    - **Bi-metallic Strip:** The bi-metallic strip bends due to thermal expansion, releasing the sealing mechanism.
- Water from the fire main system flows through the now open sprinkler head and is distributed by the deflector to extinguish the fire.

aug 2021

Aug 2021

9. (a) Describe, with the aid of a sketch, how a pressurised system sprinkler head is constructed. (5)

(b) Explain the operation of the sprinkler head and bulb assembly described in part (a), stating how the alarm is initiated. (5)

Pressurized System Sprinkler Head Construction and Operation

Here's a breakdown of a pressurized system sprinkler head construction and operation, focusing on the heat-sensitive bulb assembly and alarm initiation:

Construction:

- **Frame:** The frame is typically made of metal and provides a connection to the sprinkler piping system. It houses the internal components.
- **Sealing Element:** This is the heat-sensitive component responsible for triggering water flow. There are two main types:
    - **Glass Bulb:** A small, frangible glass bulb filled with a liquid that expands rapidly at a specific temperature (typically around 57°C to 74°C or 135°F to 165°F).
    - **Bi-metallic Strip:** A strip composed of two different metals with different thermal expansion rates. As the temperature rises, the strip bends due to the unequal expansion, releasing a mechanical latch.
- **Sprinkler (Optional):** Some sprinkler heads incorporate a small sprinkler within the frame. This pre-discharge sprinkler might release a misting spray upon activation to suppress the fire in its early stages before full water flow begins.
- **Deflector:** Once the sealing element ruptures or releases, the deflector distributes the discharged water in a predetermined spray pattern to effectively cover the designated area.

Operation:

1. **Normal State:** In normal conditions, the sprinkler system is pressurized with water. The sealing element (glass bulb or bi-metallic strip) keeps the sprinkler head outlet closed, preventing water flow.
2. **Fire and Heat Rise:** When a fire breaks out, the surrounding temperature increases.
3. **Heat-Sensitive Activation:**
    - **Glass Bulb:** The liquid inside the glass bulb expands rapidly at its designated activation temperature, shattering the bulb.
    - **Bi-metallic Strip:** As the temperature rises, the bi-metallic strip bends due to the unequal expansion of the two metals. This bending triggers the release of a mechanical latch holding the sealing mechanism in place.
4. **Water Discharge:** With the sealing element no longer in place, the pressurized water from the sprinkler system flows through the opened sprinkler head.
5. **Water Distribution:** The deflector directs the water flow in a specific spray pattern to suppress the fire.
6. **Alarm Initiation:** When a sprinkler head activates and water flow starts, a **waterflow alarm** is triggered. This alarm is typically connected to the fire alarm system, alerting occupants to the fire and initiating emergency procedures.

Additional Considerations:

- The specific activation temperature of the sprinkler head depends on the application and potential fire hazards.
- Some sprinkler heads might have a combination of a heat-sensitive element and a mechanical trigger for added functionality.
- Regular inspection and maintenance of sprinkler heads are crucial to ensure their proper operation in case of a fire.

In summary, pressurized system sprinkler heads rely on a heat-sensitive element to initiate water flow when a fire raises the surrounding temperature. The ruptured bulb or released latch allows pressurized water to flow through the head and be distributed by the deflector to extinguish the fire. The water flow also triggers a waterflow alarm, alerting occupants to the emergency.

oct 2018

Oct 2018

9. Describe, with the aid of a sketch, a multiple bottle CO_2 gas system suitable for the protection of machinery spaces. (10)

aug 2020

Aug 2020

9. Describe, with the aid of a sketch, a multiple bottle CO_2 gas system suitable for the protection of machinery spaces. (10)

Multiple Bottle CO2 Gas System for Machinery Spaces

A multiple bottle CO2 gas system is a fire suppression system that utilizes carbon dioxide (CO2) gas flooding to extinguish fires within enclosed machinery spaces on marine vessels. Here's a breakdown of its components and operation:

Components:

- **CO2 Storage Bank:** This consists of multiple high-pressure CO2 cylinders manifolded together to provide a sufficient volume of CO2 gas for extinguishing a fire in the machinery space.
- **Pilot Cylinders:** Separate, smaller cylinders containing CO2 gas used to initiate the release of the main CO2 bank.
- **Control Panel:** The control panel houses the system's activation mechanisms, pressure gauges, and alarms. It might have manual release levers and may also be integrated with the ship's fire alarm system.
- **Release Solenoid Valves:** Solenoid valves control the flow of CO2 gas from the pilot cylinders to the main CO2 bank.
- **Distribution Piping:** A network of pipes carries the CO2 gas from the CO2 bank throughout the machinery space, with discharge nozzles strategically placed for optimal distribution.
- **Pressure Relief Valves:** Safety valves installed on the CO2 bank and piping to prevent excessive pressure buildup in case of malfunctions.

Operation:

1. **Fire Detection:** A fire within the machinery space is detected by a fire alarm system (heat detectors, smoke detectors, etc.).
2. **Alarm Activation:** The fire alarm triggers an audible and visual alarm on the control panel and throughout the vessel.
3. **Manual or Automatic Activation:** The CO2 system can be activated manually using a lever on the control panel or automatically through the fire alarm system (depending on the system configuration).
4. **Pilot Cylinder Release:** Once activated, the control panel energizes the solenoid valves, allowing the CO2 gas from the pilot cylinders to flow.
5. **Main CO2 Bank Release:** The pressurized CO2 gas from the pilot cylinders triggers the release mechanism of the main CO2 bank, typically a pneumatic or hydraulic actuator.
6. **CO2 Flooding:** The CO2 gas from the main bank is rapidly discharged into the machinery space through the distribution piping and discharge nozzles.
7. **Fire Extinguishment:** The CO2 gas displaces oxygen within the space, creating an oxygen-deficient environment that suffocates the fire.

Advantages:

- **Rapid Fire Extinguishment:** CO2 gas flooding can extinguish fires quickly and effectively.
- **Clean Extinguishing Agent:** CO2 leaves no residue after discharge, minimizing cleanup efforts.
- **Penetrates Enclosed Areas:** CO2 gas can penetrate enclosed spaces and reach hidden pockets of fire.

Disadvantages:

- **Oxygen Depletion Hazard:** CO2 flooding can displace oxygen, posing a risk of suffocation to personnel trapped within the machinery space during discharge. Evacuation procedures are crucial before system activation.
- **Temperature Extremes:** CO2 gas discharge can cause a rapid temperature drop, potentially causing damage to some machinery components.
- **Limited Visibility:** CO2 gas flooding can significantly reduce visibility within the machinery space, hindering firefighting efforts after the initial fire suppression.

Suitability:

Multiple bottle CO2 gas systems are suitable for protecting machinery spaces on marine vessels due to their rapid fire extinguishing capabilities. However, proper training, procedures, and safety precautions are essential to ensure the safe and effective use of these systems. Alternative fire suppression systems, like water mist systems, might be used in some cases where CO2 poses a risk to personnel or equipment.

may 2021

May 2021

9. With reference to a machinery space carbon dioxide smothering system:

(a) state the regulation regarding the rate of flooding with respect to time; (4)

(b) state the precautions to be taken before activating the system. (6)

CO2 Smothering System in Machinery Spaces: Regulations and Precautions

Here's a breakdown of the regulations and precautions regarding CO2 smothering systems for machinery spaces on marine vessels:

(a) Rate of Flooding Regulation:

There are two main regulatory bodies that set guidelines for CO2 flooding systems:

- **International Maritime Organization (IMO):** The **International Code for Fire Safety Systems (FSS Code)** by the IMO doesn't explicitly specify a set rate of flooding. However, it requires the system to achieve an effective CO2 concentration (typically around 30-35% by volume) within the machinery space in a timeframe sufficient to extinguish the fire. This timeframe should be based on the specific volume of the machinery space and the CO2 discharge capacity of the system design.

- **National Regulations:** Many countries have national regulations that may provide more specific requirements regarding the rate of flooding. These regulations might reference standards set by classification societies (e.g., Lloyd's Register, American Bureau of Shipping). In general, the goal is to achieve an effective CO2 concentration quickly, but also allow enough time for safe evacuation of personnel.

(b) Precautions Before Activation:

CO2 smothering systems are powerful tools, but their use poses a serious risk of suffocation to personnel trapped within the machinery space during discharge. Here are some crucial precautions to take before activating the system:

1. **Fire Alarm Activation:** Ensure the fire alarm has been activated to alert personnel and initiate evacuation procedures.
2. **Evacuation and Muster:** All personnel must evacuate the machinery space and surrounding areas at risk of CO2 exposure. A muster point should be designated for headcount to ensure everyone has cleared the area.

3. **Stoppage of Machinery:** If possible, stop all machinery operation within the space to minimize potential hazards from equipment malfunctions during CO2 discharge.
4. **Ventilation System Shutdown:** Close all ventilation openings to prevent CO2 gas from escaping the machinery space and potentially affecting other compartments.
5. **Confirmation of Evacuation:** Verify that the machinery space and surrounding areas are clear of personnel before initiating CO2 discharge.

Additional Considerations:

- **Training:** Crew members must be properly trained on the operation of the CO2 smothering system and emergency procedures.
- **Warning Signs:** Clear warning signs should be posted at the entrance to the machinery space indicating the presence of a CO2 smothering system.
- **System Testing and Maintenance:** Regular testing and maintenance of the CO2 smothering system are crucial to ensure its functionality and safety.

Following these regulations and precautions ensures the safe and effective use of CO2 smothering systems for fire suppression in machinery spaces while minimizing risks to personnel.