**Advanced Firefighting**

**STUDENT MANUAL**



**Maritime & Industrial Training Center**

**Day 1 Classroom**

**Lesson 1**

**Fire Detection Systems Page 4**

**Fixed fire detection and alarm systems Inspection & Maintenance Page 10**

**Lesson 2**

**Portable and Semi-portable Fire Extinguishers Page 10**

**Portable foam applicators Inspection & Maintenance Page 12**

**Wheeled (mobile) fire extinguisher Inspection & Maintenance Page 15**

**Portable fire extinguishers Inspection & Maintenance Page 15**

**Lesson 3**

**Fixed Fire Suppression Systems Page 16**

**Fire mains, fire pumps, hydrants, hoses and nozzles Inspection & Maintenance Page 18**

**Carbon Dioxide fixed gas fire-extinguishing system Inspection & Maintenance Page 21**

**Sprinkler System Inspection & Maintenance Page 22**

**Water Mist Inspection & Maintenance Page 24**

**Foam Suppression Systems Inspection & Maintenance Page 25**

**Day 2 Classroom**

**Lesson 4**

**NVIC 9-14 Page 26**

**Lesson 5**

**Organization & Training Page 27**

**Firefighters Outfit Inspection & Maintenance Page 30**

**Self Contained Breathing Apparatus Inspection & Maintenance Page 30**

**Lesson 6**

**Ships Fire Plan Page 32**

**Stability Page 34**

**Bulkhead Classes Page 38**

**Watertight & Fire Doors Page 38**

**Fire Doors Inspection & Maintenance Page 39**

**Ventilation System Inspection & Maintenance Page 40**

**Lesson 7**

**Strategy & Tactics Page 44**

**Initial Actions Page 44**

**Incident Strategy Options Page 45**

**Tactics & Size-up Page 47**

**Communications Page 48**

**Fire Cause Investigation Page 50**

**Critique Page 51**

**Day 3 Classroom**

**Lesson 8**

**Incident Command System Page 52**

**Lesson 9**

**Hazardous Materials Page 59**

**Lesson 10**

**Preparing Contingency Plans Page 67**

**Lesson 11**

**Fire Cause Investigation Form for the video Fire Down Below Page 70**

**IMO Circular 1432: Page 73**

Guidelines for the Maintenance

And Inspection of Fire Protection

Systems and Appliances

**IMO Circular 1318: Page 85**

Guidelines for the Maintenance and

Inspections of Fixed Carbon Dioxide

Fire-Extinguishing Systems

**IMO Resolution A.951(23) Page 91**

Guidelines for Marine Portable Fire

Extinguishers

*To the student:*

**This manual contains the IMO Circulars & Resolution:**

# Circular 1432: REVISED GUIDELINES FOR THE MAINTENANCE AND INSPECTION OF FIRE PROTECTION SYSTEMS AND APPLIANCES

1. **Circular 1318: GUIDELINES FOR THE MAINTENANCE AND INSPECTIONS OF FIXED CARBON DIOXIDE FIRE-EXTINGUISHING SYSTEM**
2. **Resolution A.951(23): IMPROVED GUIDELINES FOR MARINE PORTABLE FIRE EXTINGUISHERS**

**These Maintenance and Inspection Guidelines are incorporated into the Student Manual.**

***The student who has STCW advanced fire training should know and understand the inspection and maintenance requirements that the advanced firefighter must know under the IMO-STCW requirements.***

**Day One Classroom**

BACKGROUND.

The STCW Convention and STCW Code set forth standards for training and certification for merchant mariners, including qualification requirements and standards of competence for proficiency in Advanced Firefighting.

In order to implement the 1995 amendments to STCW, the Coast Guard published NVIC 01-02 providing guidance on how mariners may demonstrate proficiency in Advanced Firefighting.

The International Maritime Organization (IMO) amended the STCW Convention and STCW Code on June 25, 2010. These amendments entered into force for all ratifying countries on January 1, 2012.

The Convention is not self-implementing; therefore, the U.S., as a signatory to the STCW Convention, must initiate regulatory changes to ensure full implementation of the amendments to the STCW

Convention and STCW Code. The U.S. implements these provisions under the Convention and under the authority of United States domestic laws in United States Code, Titles 33 and 46.

The Coast Guard published a final rule on December 24, 2013 (78 FR 77796) that implements the STCW, including the 2010 amendments. The Coast Guard is publishing this NVIC to provide guidance on complying with the new regulations and is cancelling previous policy. Accordingly, this NVIC cancels NVIC 01-02.

DISCUSSION.

As specified in 46 CFR 11.201(h), each applicant for an original STCW officer endorsement must present a certificate of completion from a Coast Guard approved or accepted Advanced Firefighting course. The course must have been completed within the 5 years before the date the completed application was received by the Coast Guard.

Policy regarding proficiency in Advanced Firefighting is located in this NVIC. Enclosure (1) gives specific requirements for qualifying for proficiency in Advanced

Firefighting; Enclosure (2) contains the national assessment guidelines; and Enclosure (3) contains relevant excerpts from the STCW Convention and STCW Code.

Training providers may use the guidelines in Enclosure (2) to determine whether students have achieved competency in Advanced Firefighting, or they may develop and use alternatives. Under 46 CFR 10.402(e), if developing alternatives, a training institution must submit any deviations from these guidelines to the Coast Guard for approval before use. A training institution submitting a course should state that the guidelines in Enclosure (2) will apply, or provide the alternative guidelines it proposes to use.

As specified in 46 CFR 11.303(b), mariners holding STCW officer endorsements are required to demonstrate continued proficiency for the revalidation of the Advanced Firefighting endorsement. Mariners who have at least 1 year (360 days) of seagoing service within the previous 5 years will be considered to have met a portion of this requirement; the remainder must be demonstrated ashore in Coast Guard approved or accepted Advanced Firefighting Revalidation training that includes assessment in those Advanced Firefighting competencies that cannot be demonstrated through sea service. Mariners who do not have 1 year of service in the previous 5 years must either take the original course, or an approved or accepted Advanced Firefighting Refresher course that assesses continued proficiency in all competencies related to Advanced Firefighting.

To demonstrate original or continued proficiency in Advanced Firefighting, the mariner need only submit the course completion certificate(s) to the Coast Guard. The Coast Guard recommends that the mariner retain a copy of the course completion certificate(s) for his or her records

This NVIC primarily provides guidance for those officers’ endorsement candidates seeking to demonstrate proficiency in Advanced Firefighting. There are no regulatory requirements for any rating to hold an Advanced Firefighting Endorsement. Nonetheless, either it is possible for a rating to obtain an Advanced Firefighting Endorsement because of an employer requirement or the nature of the vessel upon which he or she serves requires competence in those skills associated with advanced firefighting

Ratings may qualify for and obtain an Advanced Firefighting Endorsement by using this NVIC.

**Lesson 1**

**NVIC 9-14**

**GUIDELINES FOR QUALIFICATION FOR STCW ENDORSEMENTS FOR ADVANCED FIREFIGHTING**

**Inspect and service fire detection and fire extinguishing systems and equipment**

1. **Demonstrates and describes the proper inspection and service requirements of each system or piece of equipment without actually activating, de- activating, or disabling any system or item of equipment.**
2. **Simulate the inspection and service of each system**
3. **Demonstrates and describes the proper inspection and service requirements of each system or piece of equipment without actually activating, de- activating, or disabling any system or item of equipment.**
   1. **Fire detection system**
   2. **CO2 flooding system**
   3. **Fixed fire extinguishing system**
   4. **Mobile and portable fire extinguishers**
   5. **Fire alarm system**
   6. **Fire-main system including hydrants, hoses, and nozzles**
   7. **Fire pump**
   8. **Submersible or de-watering pump**
   9. **Fire-fighter's outfit**
   10. **Breathing apparatus**
   11. **Portable two-way radio**

**Fire Detection Systems:**

* **Most proficient means for early fire detection**
* **Different types-different detectors**
* **Automatic and manual devices**
* **Systems and equipment designed for Maritime**

**Many different types**

* **Smoke**
  + **Every fire produces smoke**
  + **Large and small particles**
  + **Small amount triggers alarm**
  + **Ionization and photoelectric most common**
  + **Air sampling devices usually in remote locations such as cargo holds**
* **Ionization Detector**
  + **Molecules (ionize) lose electrons during combustion**
  + **Radioactive material ionizes negative plate**
  + **Causes electric current**
  + **Smoke causes interference with current flow**
  + **Alarm sounds**
* **Beam Type Photoelectric Detector**
  + **Responds quicker than ionization**
  + **Photoelectric cell with a light source**
  + **Smoke refracts light**
  + **Stops current flow**
  + **Switch closes**
  + **Automatically resets**
* **Refractory Photoelectric Detector**
  + **Light beam passes through tube**
  + **Light does not strike photocell**
  + **Smoke causes light to refract(scatter)**
  + **Light strikes photocell**
  + **Causes current to flow**
  + **Closes switch**
* **Air sampling**
  + **Detector not located in protected space**
  + **Air is continuously sampled from protected space**
  + **Air sample channeled to cabinet on bridge**
  + **Portion sent to detector**
  + **Similar systems used in HVAC units**
  + **Shuts HVAC unit down when smoke detected**
* **Heat**
  + **Three principles of physics**
  + **Heat causes an expansion action of material**
  + **Heat causes a melting action of material**
  + **Heated materials have thermoelectric properties that are detectable**
  + **Placed at highest point of space protected**
* **Fixed temperature**
  + **Initiates at pre-set temp**
  + **Spot detector**
  + **Others over larger areas**
  + **Located in a specific hazard area**
  + **Ordinary**
    - **135ºF to 175ºF**
  + **Intermediate**
    - **175ºF to 225ºF**
  + **Hard**
    - **250ºF to 300ºF**
  + **Activation Means**
    - **Fusible devices**
      * **Spring loaded contact held in place with solder**
      * **Solder melts**
      * **Releases contact, and completes circuit**
      * **Alarm sounds**
      * **Usually entire detector is replaced**
    - **Frangible/quartzoid bulbs**
      * **Glass bulb holds contacts apart**
      * **Heat causes different liquids to expand at different temperatures**
      * **Bulb breaks**
      * **Contact complete**
      * **Alarm sounds**
      * **Detector must be replaced**
    - **Bi-metallic**
      * **Two different metals**
      * **Different heat expansion rates**
      * **Heat cause one metal to distort to an arched shape**
      * **Either one or both ends secured**
      * **Bowing action opens/closes circuit**
      * **Activates alarm**
    - **Snap-Action Disk Bimetallic**
      * **Same as Bimetallic**
      * **Surer more positive movement**
      * **Natural concave shape**
      * **Temperature rise causes expansion**
      * **Snaps to close circuit**
      * **Activates alarm**
    - **Continuous-line**
      * **Provides protection for large areas**
      * **Cost effect vs. spot detectors**
      * **Disadvantage-does not indicate precise location of fire**
    - **Types**
      * **Resistance detector**
        + **Small amount of electricity flows**
        + **Insulation loses resistance when heated**
        + **Current between two increases**
        + **Alarm sounds**
        + **Restores at lower heat**
      * **Thermostatic cable**
        + **One actuator energized**
        + **Insulation melt, wires contact and complete circuit**
        + **Alarm sounds**
        + **Affected section must be replaced**
      * **Heat detection loop system**
        + **Often found on off-shore drilling platforms**
        + **Flexible plastic tubing**
        + **Stainless tubing with fusible caps**
        + **Connected to pressure switches and circuits**
        + **Tube pressurized with air**
        + **Plastic/cap melts and releases air**
        + **Pressure switch initiates alarm**
        + **Replace damaged area**
    - **Rate of rise**
      * **Senses temperature change**
      * **Respond at lower temperatures than fixed temp. devices**
      * **Activates with a rise exceeds 12-15 degrees per minute**
      * **Reliable and not subject to false activations**
      * **Can activate in non-fire condition**
      * **Example: Detector is placed near the discharge of heating system**
      * **Change or relocate detector**
    - **Types**
      * **Pneumatic rate-of-rise spot detector**
        + **Most common type**
        + **Air inside chamber expands**
        + **Diaphragm flexes**
        + **Opens or closes circuit**
        + **Vent prevents normal expansion from activating**
      * **Pneumatic rate-of-rise line detector**
        + **Monitors large areas**
        + **Contains diaphragm and air vents**
        + **Tubing arraigned over protected area**
        + **Limited to 1000 ft.in length**
        + **Rows < 30 ft. apart**
        + **15 ft. from bulkheads**
      * **Rate-compensated detector**
        + **Areas subject to temperature change**
        + **Outer bimetallic sleeve**
        + **Bowed struts have contacts**
        + **Outer sleeve expands with heat**
        + **Contacts close**
      * **Thermoelectric detector**
        + **Contains 2 wires made of dissimilar metals twisted together**
        + **Wires are heated at one end**
        + **Electric current is generated at the other end**
        + **Rate of heating determines the amount of current generated**
        + **Dissipate smaller amounts of current**
        + **Reduces chance of small temperature change activating the alarm**
        + **Large changes in temperature results in more current flowing**
        + **Alarm activat**
* **Flame**
  + **Also called light detectors**
  + **Three types**
  + **UV(ultraviolet wave spectrum)detectors**
  + **IR(infrared wave spectrum)detectors**
  + **UVIR(ultraviolet and infrared waves)**
  + **Negative detectors-boiler rooms**
  + **Prevent explosion due to (flameout)**
  + **Used with smoke or heat detectors**
  + **Accidental activation from similar light sources**
* **Other Fire Detection Methods**
  + **Fixed fire suppression systems**
    - **Detection and suppression**
  + **Manual fire alarms**
    - **Multiple locations**
  + **Watch and supervised patrols**
    - **Makes rounds in a certain time frame**
* **Alarm System Control Units**
  + **“Brain” of the system**
  + **Processes signals**
  + **Assures proper operation of system**
  + **Main system control unit**
  + **Secondary or remote panel in engine room**
  + **Components**
    - **Power supplies**
      * **Primary and secondary**
    - **Alarm indicators** 
      * **Bells, horns, strobes**
    - **Visual indicators**
      * **Alert hearing impaired**
      * **Identify location**
      * **Also at control panel**
* **Automatic System Operations**
  + **Automatic operation of fire control devices**
  + **Air handling equip.**
  + **Fire doors/dampers**
  + **Air vents and ventilation systems**
  + **Heat and smoke vents**
  + **Activate fixed systems such as sprinklers**
  + **Shut down engines or other systems**
  + **Releases personnel for other duties**
* **Inspection, Testing, and Maintenance**
  + **Two types of tests:**
    - **Acceptance test**
    - **Service test**
  + **Crew members assigned testing and maintenance duties**
  + **Must have knowledge and training**
  + **Engineering dept. for manuals**
  + **Maintain complete records**
* **Alarm Initiating Devices**
  + **Reliability of system based on detector**
  + **Access unobstructed**
  + **Housing tightly closed**
  + **Test after repairs or fire**
  + **Records shall include:** 
    - **Date of test**
    - **Initiating type**
    - **Location**
    - **Type of test**
    - **Results**
  + **Replace detectors if:**
    - **System being restored after fire**
    - **Corrosion**
    - **Mechanical damage**
    - **Abuse**
    - **Painted**

**IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**

|  |
| --- |
| **Fixed fire detection and alarm systems** |
| Weekly: Verify all fire detection and fire alarm control panel indicators are functional by operating the lamp/indicator test switch. |
| Monthly: Test a sample of detectors and manual call points so that all devices have been tested within five years. |
| Yearly: Test all fire detection systems and fire detection systems used to automatically release fire-extinguishing systems for proper operation, as appropriate; |
| Yearly: Visually inspect all accessible detectors for evidence of tampering obstruction |
| Yearly: Test emergency power supply switchover |

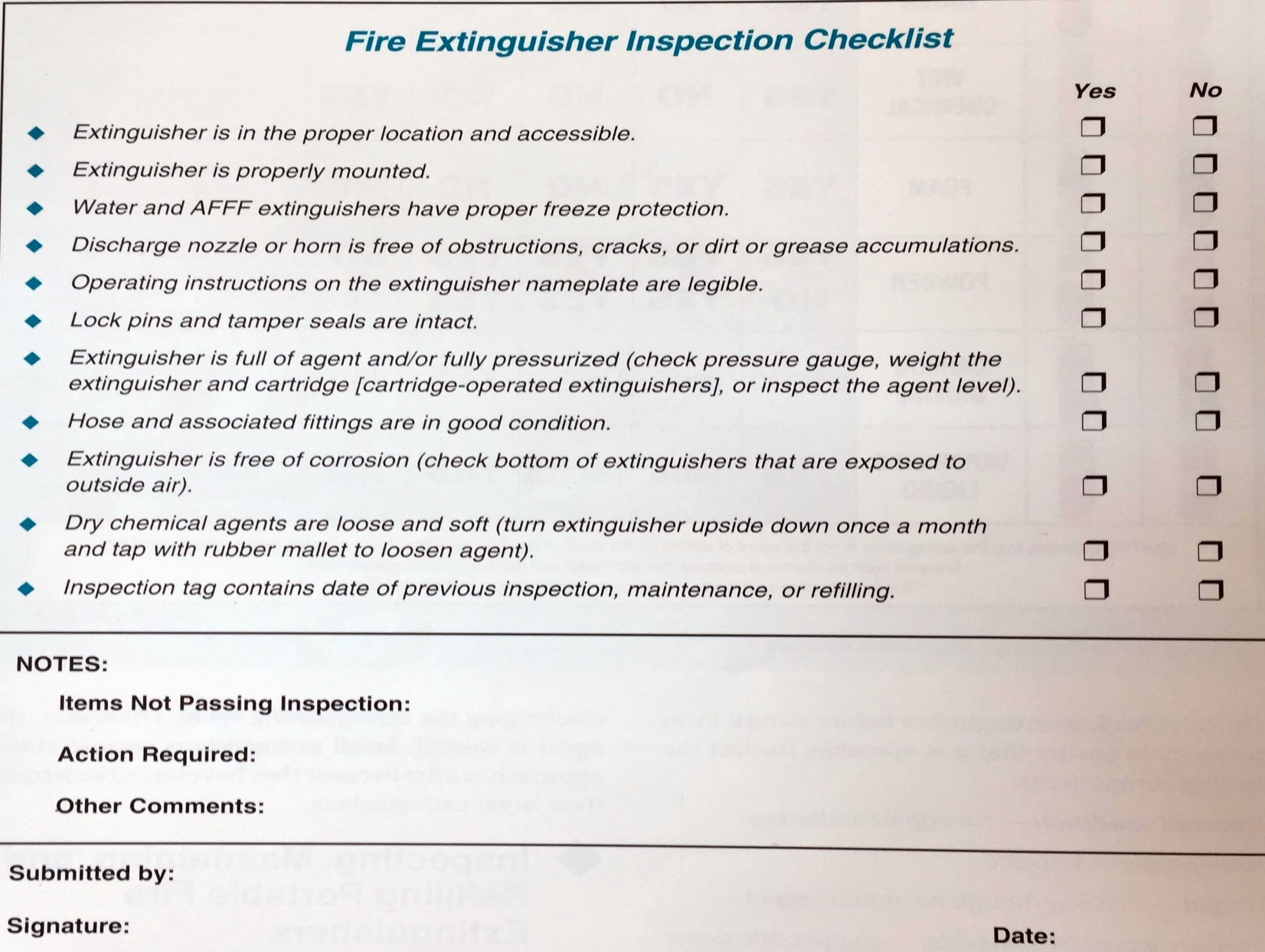
**Lesson 2**

**Portable and Semi-portable Fire Extinguishers**

* **Portable Fire Extinguishers**
* **Carbon Dioxide**
  + **Removes oxygen – inerts the atmosphere**
  + **Odorless & tasteless at normal levels**
  + **Acidic odor at higher concentrations**
  + **Colorless at ambient temperature**
  + **Discharges at –110 degrees below zero**
  + **Expands 790 to 1 when discharged**
  + **Vapor density 1.529**
  + **Non-conducting**
  + **Non-corrosive**
  + **True neurotoxin**
  + **8% per volume & above**
  + **Part of our life process.**
  + **We exhale CO2 – stimulates nerves in our lungs.**
  + **At higher percentages over-stimulation**
  + **Rate of breathing increases**
  + **As percentages rise – breathing rate will cease completely at 15%**
  + **Rating 5-10B;C**
  + **Pressure**
  + **850 psi @ 70˚F**
  + **2700 psi @ 135˚F**
  + **Discharge**
  + **17 seconds for 15 pound unit**
  + **Range**
  + **3-8 ft. interior**
  + **1-5 ft. exterior**
  + **Static electricity build-up**
  + **Not effective on Class D fires.**
  + **Heat from Class D fire will break the Oxygen out of the formula & intensify the fire**
  + **Safety devices**
    - **Relief valve (nut with holes on each side) on the valve**
    - **Frangible disk in cartridge for cartridge operated dry chemical** 
      * **Both relieve at 2700 psi**
    - **Insulated grip**
  + **Maintenance**
    - **No protection from cold needed**
    - **Pressure reduced with temperature**
    - **Protect from heat**
    - **At 135 degrees pressure rises to 2700**
    - **Relief valve located on stem relieves @ 2700 psi**
    - **Tested to 3000 psi every 5 years**
    - **Test date stenciled on top of cylinder**
    - **Check cylinder for damage**
    - **Weigh on calibrated scale**
    - **10% weight loss or greater – recharge**
    - **Full & empty weight marked on rectangle on the valve**
    - **Check hose and horn**
    - **No rust pits – weakens cylinder**
* **Dry Chemical**
  + **Breaks chemical chain reaction**
  + **Two types of extinguishers**
    - **Cartridge operated**
    - **Stored pressure**
  + **Effects Of Dry Chemical**
    - **Very limited cooling**
    - **Opaque cloud shields radiant heat**
    - **Opaque cloud reduces visibility**
    - **Not effective on combustible metal fires.**
    - **Heat from Class D fire will break the Oxygen out of the chemical & intensify the fire**
    - **Large amounts can affect breathing**
    - **Chemical is slightly corrosive**
* **Foam**
  + **Protein**
    - **Suppresses vapors/excludes oxygen**
    - **Made from either animal and vegetable waste**
    - **Organic compound**
    - **Mineral added to resist burn-back**
    - **Not compatible with dry chemical**
    - **1%-3%-6%**
  + **AFFF - Aqueous Film Forming Foam**
    - **Suppresses vapors/excludes oxygen**
    - **Fluorinated Surfactant added**
    - **One end of molecule attaches to hydrocarbon, the other end attaches to water**
    - **Water floats on hydrocarbon**
    - **Vapor suppressant barrier**
    - **Bubbles burst-barrier protection & cooling**
    - **Percentages 1%, 3%, 6%**
    - **1% more concentrated**
    - **Developed for the “BIG” Class B fires**
    - **Best used on straight steam at a distance. Sweep slowly side to side. Move in after knocking down the fire**
    - **Breaks surface tension on bailed goods (Class A)**
    - **Need eductor -**
    - **Rated at certain psi**
    - **Rated at certain GPM – nozzle must match GPM**
    - **70% rule applies. Outlet pressure of eductor cannot exceed 70% of the inlet pressure.**
    - **Pressure in the eductor tends to stabilize and the foam will stay in the bucket**
  + **AFFF / ATC**
    - **Used on polar solvent fires**
    - **alcohols, ketones, ethers, aldehydes, esters, amines**
    - **These groups of hydrocarbons dissolve in water & pull the water out of regular AFFF**
    - **Polymer added**
    - **Forms polymetric barrier**
    - **Can be used on polar & non-polar solvents**
    - **3%-- regular hydrocarbons, 6%--polar solvents**
* **IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**

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| **Portable foam applicators**  Monthly: Verify all portable foam applicators are in place, properly arranged, and are in proper condition. |
| Quarterly: Verify the proper quantity of foam concentrate is provided in the foam system storage tank. |
| Yearly: Verify all portable foam applicators are set to the correct proportioning ratio for the foam concentrate supplied and the equipment is in proper order |
| Yearly: Verify all portable containers or portable tanks containing foam concentrate remain factory sealed, and the manufacturer's recommended service life interval has not been exceeded; |
| Yearly: Portable containers or portable tanks containing foam concentrate, excluding protein based concentrates, less than 10 years old, that remain factory sealed can normally be accepted without the periodical foam control tests required in MSC.1/Circ.1312 being carried out; |
| Yearly: Protein based foam concentrate portable containers and portable tanks should be thoroughly checked and, if more than five years old, the foam concentrate should be subjected to the periodical foam control tests required in MSC.1/Circ.1312, or renewed; |
| Yearly: The foam concentrates of any non-sealed portable containers and portable tanks, and portable containers and portable tanks where production data is not documented, should be subjected to the periodical foam control tests required in MSC.1/Circ.1312 |

* + - **Wet Chemical**
      * **Types of Wet Chemical:**
        + **Potassium Acetate**
        + **Potassium Carbonate**
        + **Potassium Citrate**
      * **In Commercial situations with deep fat fryers, only used in conjunction with the wet chemical fixed system**

****

* **Semiportable Extinguishers**
* **Wheeled unit**
* **Easily moved**
* **Greater capacity**
* **Must be secured during passage**
* **Difficult to move in rough seas**
* **Sizes: 150, 250 & 350 lb. units**
* **Usually contain** 
  + **CO2**
    - **Wheeled Unit**
    - **Rating:**
      * **Class B & C fires**
    - **Size:** 
      * **50 to 100 lb.**
    - **Hose:** 
      * **Less than 15 ft.**
      * **Deployed before use**
    - **Reach:** 
      * **8 to 10 ft.**
    - **Discharge** 
      * **26 to 65 seconds**
    - **Operated according to the manufactures instructions**
  + **Dry chemical**
    - **Rating** 
      * **Class A,B, & C fires**
    - **Size** 
      * **75 to 350 lb.**
    - **Hose** 
      * **50 to 100 ft.**
      * **Deployed before charging the unit**
    - **Reach** 
      * **Up to 45 ft.**
    - **Discharge:** 
      * **20 seconds to 2 minutes**
  + **Foam**
    - **Aqueous Film Forming Foam (AFFF) (ATC) mixed**
    - **Commonly found in machinery spaces**
    - **33 gallons**
    - **Highly effective on Class B fuel fires**
    - **Penetrating and wetting agent on fires involving Class A materials**
    - **Excellent when used as a vapor suppressant on fuel spills to prevent ignition.**
    - **Read manufactures instructions for** 
      * **Specific discharge time**
      * **Stream reach**
      * **Operating procedures**
  + **Wheeled Unit Maintenance**
    - **Check Gauges**
    - **Overall condition of tank**
    - **Shell - inner and outer**
    - **Surface rust vs. pitting**
    - **Hoses**
    - **Nozzles**

**IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**

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| --- |
| **Wheeled (mobile) fire extinguisher**  Monthly: Verify all extinguishers are in place, properly arranged, and are in proper condition. |
| Yearly: Perform periodical inspections in accordance with the manufacturer's instructions |
| Yearly: Visually inspect all accessible components for proper condition; |
| Yearly: Check the hydrostatic test date of each cylinder; |
| Yearly: For dry powder (chemical) extinguishers, invert extinguisher to ensure powder is agitated. |
| Five Years: Visually examine at least one extinguisher of each type manufactured in the same year and kept on board |
| Ten Years: All extinguishers together with propellant cartridges should be hydrostatically tested by specially trained persons in accordance with recognized standards or the manufacturer's instructions. |
| **Portable fire extinguishers** |
| Annual: Check to see if the extinguisher may have been operated |
| Annual: Inspect for corrosion, dents, or damage which may affect the safe operation of the extinguisher |
| Annual: Weigh the extinguisher and check the mass compared to the fully charged extinguisher |
| Annual: Check that hoses and nozzles are clear & undamaged |
| Annual: Check that the operating instructions are in place & legible |

**Lesson 3**

* **Fixed Fire Suppression Systems**
  + **Fire Main System**
    - **Primary device to move water to fire**
    - **Required no matter what other systems are installed**
    - **Supplies water to all areas of vessel**
    - **Fire pumps**
      * **Number and Location**
      * **2 independent pumps on tank ship 250 feet or more or 1,000 gross tons on International voyage**
      * **Cargo or miscellaneous vessels of 1,000 gross tons require at least 2 pumps with independent power sources**
      * **All passenger vessels up to 4,000 gross tons on I/ voyage 2 pumps**
      * **Over 4,000 gross tons must have 3 pumps regardless of size**
      * **Vessels requiring 2 pumps- must be located in separate spaces**
      * **Crew is responsible for upkeep**
      * **Types Of Fire Pumps**
        + **Centrifugal pumps**

**Most widely used.**

**Water pumped from center outward**

* + - * + **Positive Displacement Pump**

**Used where intake is above sea level.**

**Can pump air where a centrifugal pump cannot**

* + - * + **Piston Pump**

**Piston compression.**

**Single action - double action**

* + - * + **Rotary Pump**

**2 rotating gears in watertight case**

* + - * + **Rotary Vane Pump**

**Off center mounted rotor**

* + - * + **Alternatives To Main Fire Pumps**

**Bilge pumps**

**Ballast pumps**

**General service pumps**

**Sanitary pumps**

**Tank cleaning pumps**

**Cooling pumps**

**Fixed and portable dewatering pumps with eductors**

* + - **Piping**
      * **Two Types of Systems**
      * **Single main & Horizontal Loop**
        + **Single main**

**Sometimes called direct main.**

**Single main pipe running fore to aft**

**Usually at main deck level**

**May run centerline, port, or starboard edge**

**Disadvantage**

**Cannot supply water past a serious break**

* + - * + **Horizontal loop system**

**2 parallel main pipes connected at their farthest points fore and aft to form a loop**

**Isolation valves located forward of each hydrant**

**Advantage**

**Ruptured section of main pipe can be isolated**

**System can then deliver water to other parts**

* + - **Fire station**
      * **A place on board a vessel where fire hoses and other equipment are stored, ready for immediate use**
      * **Numbered sequentially for quick recall**
      * **Fire hose, wrenches, nozzles, hydrant valve/ outlet, marine strainer**
      * **Also-Portable extinguishers, axes, damper keys, gated wyes, etc.**
      * **Painted red for higher visibility-may be misused –abused**
      * **Hydrant outlets**
        + **Self-cleaning marine strainers**
        + **Remove material that clog nozzles**
      * **Fire Hose**
        + **Types**
        + **Single jacket**
        + **Double jacket**
        + **Woven jacket**
        + **Rubber coated**
        + **Cotton, nylon, rayon, vinyl, rubber blends, polyester blends**
        + **Sizes**
        + **Utility hose 3/4 in.**
        + **Attack hose 1½, 1¾**
        + **Supply hose 2½**

**Also used as an attack line on large fires**

* + - * **Protecting hose**
        + **Mechanical**
        + **Thermal**
        + **Organic**
      * **Care**
        + **Washing**
        + **Drying**
        + **Storing**
    - **Water Streams & Nozzles**
      * **Used to put water in GPM’s onto a fire for extinguishment**
      * **Solid stream**
      * **Stream of water as compact as possible** 
        + **10% effective in absorbing heat**
        + **90% ineffective – runs off**
      * **Fog stream**
        + **Very fine water droplets**
        + **90% effective in absorbing heat**
        + **10% ineffective – little runoff**
      * **Nozzles**
        + **Adjustable Nozzle**

**G.P.M. –fixed adjustable**

**30-60-95-125 >**

**Multi-pattern adjustment**

**Pistol grip**

**Ball and bail**

**Screw nozzle**

* + - * + **Marine All Purpose Nozzle**
        + **Pattern determined by position of bail**
        + **High velocity fog - 60 gpm**
        + **Solid stream - 90 gpm**
        + **Low velocity fog- 30-40 gpm**
        + **Applicator- 1 ½”**
        + **4ft -60 degree angle**
        + **10ft - 90 degree angle**
        + **Applicator- 2 ½”**

**12ft - 90 degree angle**

* + - **Control valves**
    - **One or more shore connections for shore side water supply**
    - **Sea chest**
      * **Frequently covered by marine growth**

**IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**

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| **Fire mains, fire pumps, hydrants, hoses and nozzles**  Monthly: Verify all fire hydrants, hose and nozzles are in place, properly arranged, and are in serviceable condition; |
| Monthly: Operate all fire pumps to confirm that they continue to supply adequate pressure; |
| Monthly: Emergency fire pump fuel supply adequate, and heating system in satisfactory condition, if applicable. |
| Quarterly: Verify international shore connection(s) is in serviceable condition. |
| Yearly: Visually inspect all accessible components for proper condition |
| Yearly: Flow test all fire pumps for proper pressure and capacity. |
| Yearly: Test emergency fire pump with isolation valves closed; |
| Yearly: Test all hydrant valves for proper operation; |
| Yearly: Pressure test a sample of fire hoses at the maximum fire main pressure, so that all fire hoses are tested within five years; |
| Yearly: Verify all fire pump relief valves, if provided, are properly set; |
| Yearly: Examine all filters/strainers to verify they are free of debris and contamination; |
| Yearly: Nozzle size/type correct, maintained and working. |

* **Fixed firefighting system procedures**
* **Following safety procedures to be utilized when a fixed firefighting system is to be employed:**
  + **All crewmembers must be instructed in the evacuation procedures to be taken when the alarm is activated – leave immediately**
  + **Complete crew muster must be taken;**
  + **Proper authorization must be granted to use the system;**
  + **Only trained personnel should operate the system. Factors effecting fixed system installation aboard ship**
  + **Only allow reentry to personnel wearing SCBA**

* **Carbon Dioxide**
  + **Types**
    - **Local application Particular machinery & equipment**
      * **Paint lockers ,lamp lockers**
    - **Total flooding - Protects entire spaces**
      * **Engine rooms, cargo holds**
* **System Components**
  + **Piping**
  + **Storage cylinders**
  + **Discharge heads**
  + **Control mechanisms**
  + **Cylinders connected thru manifold**
  + **Agent propels alarm**
  + **May operate pressure switches for ventilation**
  + **Separate supply not needed for each protected space**
  + **Enough required for the largest space protected**
  + **Percentage varies from 30-60% per gross volume**
  + **Success of system depends on ability of area to be sealed**
  + **Pull boxes located outside protected area**
  + **CFR mandates minimum 20 second delay**
  + **85% capacity discharged within 2 minutes**
  + **Once system starts you can’t stop it**
  + **System discharged- What next?**
  + **Leave sealed 24-72 hours**
    - **Why?**
      * **Unburned vapors**
      * **High temperatures**
      * **Re-flash or explosion**
  + **People trapped**
  + **Hose lines for extensions**
    - **6 sides to protect**
    - **Water protects boundaries.**
    - **Prepare for stability problems**
  + **Reentry protection**
* **Inspection and Maintenance**
  + **Most system failures due to neglect or operator error:**
  + **Access to controls**
  + **Excessive corrosion, general condition**
  + **Nozzles and piping clear**
  + **Weigh cylinders-hydro every 5 years**
  + **Ventilation top and bottom for positive circulation**
* **Intergen**
  + **Mixture of three inerting (oxygen diluting) gases: 52% nitrogen, 40% argon, and 8% carbon dioxide.**
  + **Plentiful, non-corrosive gas that does not support combustion**
  + **Will not react with most substances.**
  + **Naturally occurring gases, which have no impact on the ozone or the environment in general.**
  + **Extinguishes fire by lowering the oxygen content below the level that supports combustion.**
  + **Discharged into a room, it introduces the proper mixture of gases that still allow a person to breathe in a reduced oxygen atmosphere.**
  + **Enhances the body’s ability to assimilate oxygen.**
  + **Reduces the oxygen to 12.5%**
  + **Increases the carbon dioxide to 4%.**
  + **Increase in the carbon dioxide content increases a person’s respiration rate and the body’s ability to absorb oxygen.**
  + **Normal atmosphere in a room contains approximately 21% oxygen and less than 1% carbon dioxide.**
  + **Designed for total flooding protection against Class A surface burning, Class B flammable liquid, and Class C fires**
  + **Design concentrations between 40% and 50% has successfully inerted mixtures of propane/ air, and methane/air.**
* **Novec 1230**
  + **Extinguishes by heat reduction**
  + **Fluorinated ketone. CF3CF2C(O)CF(CF3)2**
  + **Clear, colorless, odorless liquid**
  + **Super-pressurized with nitrogen**
  + **Stored in high pressure cylinders**
  + **Turns to a gas upon discharge**
  + **Leaves no residue**
  + **Will not damage high valued electronics**
  + **Zero “Ozone Depletion Factor”**
  + **1 rating for Global Warming Potential**
  + **Atmospheric lifetime of 5 days**
  + **Approved for use as a Halon 1301 alternative**
* **FM-200**
  + **Ozone depletion factor-0**
  + **Atmospheric lifetime- 36.5 yrs.**
  + **Global warming #-2,900**
  + **8.6 concentration in rooms**
  + **Recommended human exposure limited to 5 minutes**
  + **Forms hydrogen fluoride gas when extinguishing a fire**
  + **½ less efficient than Halon 1301**
  + **Electrically non conductive**
  + **Used in computer rooms, process control centers Electromechanical equipment rooms**
* **Halon 1301 Fixed System**
  + **Bromo-trifluoro-methane**
  + **4% to 7% concentration**
  + **Interrupts chemical chain reaction**
  + **B and C class fires**
  + **Decomposes at 900 degrees**
  + **Forms Hydrogen Fluoride gas & Hydrogen Bromide gas: Add water forms acid**
  + **Maintenance and inspection same as Carbon Dioxide**
  + **Banned production since 1994**
  + **High Ozone Depletion Factor (ODF) of 16**
* **Other Halogenated Systems**
  + **Fe-13 A-B-C**
  + **Fe-25 A-B-C and explosion suppression**
  + **Fe-36 normally used for explosion suppression**
  + **Fe-241 Only used in non-occupied spaces because of toxicity**
  + **All are limited to 5 minute human exposure due to toxicity**
  + **Used in smaller applications**

**IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**

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| **Carbon Dioxide fixed gas fire-extinguishing system** |
| * 1. Weekly: Verify all fixed fire-extinguishing system control panel indicators are functional by operating the lamp/indicator test switch. |
| * 1. Weekly: Verify all control/section valves are in the correct position. |
| * 1. Monthly: Verify containers/cylinders fitted with pressure gauges are in the proper range and the installation free from leakage |
| * 1. Yearly: Visually inspect all accessible components for proper condition; |
| * 1. Yearly: Externally examine all high pressure cylinders for evidence of damage or corrosion; |
| * 1. Yearly: Check the hydrostatic test date of all storage containers; |
| * 1. Yearly: Functionally test all fixed system audible and visual alarms; |
| * 1. Yearly: Verify all control/section valves are in the correct position; |
| * 1. Yearly: Check the connections of all pilot release piping and tubing or tightness; |
| * 1. Yearly: Examine all flexible hoses in accordance with manufacturer's recommendations; |
| * 1. Yearly: Test all fuel shut-off controls connected to fire-protection systems for proper operation; |
| * 1. Yearly: The boundaries of the protected space should be visually inspected to confirm that no modifications have been made to the enclosure that have created un-closeable openings that would render the system ineffective; |
| * 1. Yearly: If cylinders are installed inside the protected space, verify the integrity of the double release lines inside the protected space, and check low pressure or circuit integrity monitors on release cabinet, as applicable. |
| * 1. Two Years All high pressure extinguishing agent’s cylinders and pilot cylinders should be weighed or have their contents verified by other reliable means to confirm that the available charge in each is above 95 per cent of the nominal charge. Cylinders containing less than 95 per cent of the nominal charge should be refilled; |
| * 1. Two Years Blow dry compressed air or nitrogen through the discharge piping or otherwise confirm the pipe work and nozzles are clear of any obstructions. This may require the removal of nozzles, if applicable. |
| * 1. Five Years: Perform internal inspection of all control valves |
| * 1. Ten Years: Perform a hydrostatic test and internal examination of 10 per cent of the system's extinguishing agent and pilot cylinders. If one or more cylinders fail, a total of 50 per cent of the onboard cylinders should be tested. If further cylinders fail, all cylinders should be tested |
| * 1. Ten Years: Flexible hoses should be replaced at the intervals recommended by the manufacturer and not exceeding every 10 years; |
| * 1. Ten Years: If permitted by the Administration, visual inspection and NDT (non-destructive testing) of halon cylinders may be performed in lieu of hydrostatic testing. |

* **Chemical Agent Suppression Systems**
  + **Dry Chemical and Wet Chemical**
  + **Dry Chemical used for quick knock down**
  + **Most common-galley systems and deck systems**
  + **Wet Chemical Systems**
  + **Best suited:**
  + **Galley cooking hoods, Plenums, Ducts, Cooking appliances**
  + **Consists of:**
  + **Water and Potassium Carbonate, Potassium Acetate and Potassium Citrate**
  + **Extinguishes by fuel removal, cooling, and smothering**
  + **5% extinguishing failure rate due to splashing**
  + **Standard requires class K portable extinguisher as a backup**
  + **Deck System**
    - **Required on many liquefied gas vessels**
    - **Twin agent systems used for combo attack**
    - **Units are self contained and mostly skid mounted**
    - **3000 lb. Agent**
    - **Nitrogen propellant cylinder-400 cubic ft.**
    - **100-150 ft. hose**
    - **May have up to 6 hoses**
    - **Discharges not less than 22 lb. Second**
    - **Discharge distance 30-130ft**
* **Water Based Suppression Systems**
  + **Types**
    - **Automatic sprinkler systems**
      * **Components**
    - **Piping**
    - **Control valves**
    - **Sprinkler heads**
    - **Water supply**
    - **Water supply may require pressure tank and pump**
    - **96 % effective 4% failure**
    - **Repairs to system, painted heads, obstructed heads, corroded pipes**

**IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**

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| **Sprinkler System**  Weekly: Verify all control panel indicators and alarms are functional; |
| Weekly: Visually inspect pump unit and its fittings; and |
| Weekly: Check the pump unit valve positions, if valves are not locked, as applicable. |
| Monthly: Test automatic starting arrangements on all system pumps so designed; |
| Monthly: Verify all control, pump unit and section valves are in the proper open or closed position; |
| Monthly: Verify sprinkler pressure tanks or other means have correct levels of water; |
| Monthly: Verify all standby pressure and air/gas pressure gauges are within the proper pressure ranges. |
| Monthly: Test a selected sample of system section valves for flow and proper initiation of alarms. |
| (**Note** – The valves selected for testing should be chosen to ensure that all valves are tested within a one-year period.) |
| Yearly: Verify proper operation of all water mist, water-spray and sprinkler systems using the test valves for each section; |
| Yearly: Externally examine all high pressure cylinders for evidence of damage or corrosion; |
| Yearly: Check the hydrostatic test date of all high pressure cylinders; |
| Yearly: Visually inspect all accessible components for proper condition; |
| Yearly: Functionally test all fixed system audible and visual alarms; |
| Yearly: Test all antifreeze systems for adequate freeze protection; |
| Yearly: Test all system cross connections to other sources of water supply for proper operation; |
| Yearly: Verify all pump relief valves, if provided, are properly set; |
| Yearly: Examine all filters/strainers to verify they are free of debris and contamination; |
| Yearly: Verify all control/section valves are in the correct position; |
| Yearly: Blow dry compressed air or nitrogen through the discharge piping of dry pipe systems, or otherwise confirm the pipework and nozzles are clear of any obstructions. This may require the removal of nozzles, if applicable; |
| Yearly: Test emergency power supply switchover, where applicable; |
| Yearly: Visually inspect all sprinklers focusing in areas where sprinklers are subject to aggressive atmosphere (like saunas, spas, kitchen areas) and subject to physical damage (like luggage handling areas, gyms, playrooms, etc.) So that all sprinklers are inspected within one year; |
| Yearly: Check for any changes that may affect the system such as obstructions by ventilation ducts, pipes, etc.; |
| Yearly: Test a minimum of one section in each open head water mist system by flowing water through the nozzles. The sections tested should be chosen so that all sections are tested within a five-year period; and test a minimum of two automatic sprinklers or automatic water mist nozzles for proper operation. |
| Five Year Flush all ro-ro deck deluge system piping with water, drain and purge with air; |
| Five Year Perform internal inspection of all control/section valves; and |
| Five Year Check condition of any batteries, or renew in accordance with manufacturer's recommendations |
| Ten Years: Perform a hydrostatic test and internal examination for gas and water pressure cylinders per flag Administration guidelines or, where these do not exist, |

* + - **High pressure water mist systems**
      * **Best used for machinery space protection**
      * **Uses a combination of high pressure pump or compressed nitrogen to atomize water**
      * **Faster fire extinguishment and lower levels of fire and smoke damage**
      * **Less danger of re-ignition**
      * **Minimal water damage**
      * **Uses 1/10 the flow rate of traditional deluge systems**

**IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**

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| **Water Mist Systems**  **Yearly: Test a minimum of one section in each open head water mist system by flowing water through the nozzles.** |
| **Yearly: The sections tested should be chosen so that all sections are tested within a five- year period; and test a minimum of two automatic sprinklers or automatic water mist nozzles for proper operation.** |

* + - **Water spray systems**
      * **Designed to protect exposures, not fire**
      * **Life boats, loading stations and manifolds, storage tanks and some cargo pump rooms**
      * **May be used to protect superstructures when exposed to large liquid fires**
      * **Applied directly to bulkheads and decks**
      * **Many are manually operated, but some may be automatic in response to detection devices**
      * **Uses open nozzles that shape water into cone**
      * **Volume of water required is substantial**
    - **Deluge systems**
      * **Often referred to as a *manual sprinkler* *system***
      * **Similar toautomatic except:**
      * **All heads open**
      * **No water in pipes**
      * **Manually activated by valve**
      * **Used to protect high hazard areas**
      * **Construction details similar to automatic systems**
    - **Foam Suppression Systems**
      * **Used in locations where water alone may not be an effective extinguishing agent**
      * **Mechanical foam systems found in 2 varieties:**
        + **Machinery space systems**

**Primary job– Cover the involved area**

**Above or below deck plates**

**Most are manually operated**

**Some may have automatic or partial automatic activation**

* + - * + **Deck foam system**

**Used on tank vessels, vessels prone to F/C liquid spills, areas capable of receiving helicopters on deck**

* **IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**
  + **Foam Suppression Systems**
    - **Monthly**
      * **Verify all control and section valves are in the proper open or closed position, and all pressure gauges are in the proper range**
    - **Quarterly**
      * **Verify the proper quantity of foam concentrate is provided in the foam system storage tank.**
    - **Yearly:**
      * **Visually inspect all accessible components for proper condition;**
      * **Functionally test all fixed system audible alarms;**
      * **Flow test all water supply and foam pumps for proper pressure and capacity, and confirm flow at the required pressure in each section (Ensure all piping is thoroughly flushed with fresh water after service.);**
      * **Test all system cross connections to other sources of water supply for proper operation;**
      * **Verify all pump relief valves, if provided, are properly set;**
      * **Examine all filters/strainers to verify they are free of debris and contamination;**
      * **Verify all control/section valves are in the correct position;**
      * **Blow dry compressed air or nitrogen through the discharge piping or otherwise confirm the pipework and nozzles of high expansion foam systems are clear of any obstructions, debris and contamination. This may require the removal of nozzles, if applicable;**
      * **Take samples from all foam concentrates carried on board and subject them to the periodical control tests in MSC.1/Circ.1312, for low expansion foam, or MSC/Circ.670 for high expansion foam.**
      * **(Note: Except for non-alcohol resistant foam, the first test need not be conducted until 3 years after being supplied to the ship.); and**
      * **Test all fuel shut-off controls connected to fire-protection systems for proper operation.**
    - **Five Years:**
      * **Perform internal inspection of all control valves;**
      * **Flush all high expansion foam system piping with fresh water, drain and purge with air;**
      * **Check all nozzles to prove they are clear of debris; and**
      * **Test all foam proportioners or other foam mixing devices to confirm that the mixing ratio tolerance is within +30 to -10% of the nominal mixing ratio defined by the system approval.**

**Day 2**

**Lesson 4**

* **“Firefighting”:** 
  + **Engine Room**
  + **Cabin**
  + **High Pressure Fuel**
  + **Insulation**
  + **Paint Locker**
  + **Cleaning Gear Locker**
  + **Service Space**
  + **Cargo Hold**
  + **Galley**
* **Note: These are the fire scenarios that NVIC 9-14 references and the student may encounter in the assessment simulations.**
* **NVIC 9-14  
  GUIDELINES FOR QUALIFICATION FOR STCW ENDORSEMENTS FOR ADVANCED FIREFIGHTING**
  + **Control firefighting operations aboard ships**
    - **Upon receipt of a report or other indication of fire, the candidate takes all required initial actions to alert required parties and dispatch appropriate assistance.**
    - **Promptly orders the sounding of the correct signals**
    - **Takes all initial actions in a timely manner in accordance with the ship’s fire and emergency plans and procedures**
    - **Upon receipt of initial on-scene reports from fire party or parties, the candidate makes an initial assessment of the fire (location, extent, and severity) and determines courses of action to control and extinguish the fire.**
    - **Uses initial reports in conjunction with the ship’s fire and emergency plans and procedures to correctly determine the location, extent, and severity of the fire**
    - **Courses of action are consistent with the ship’s fire and emergency plans and procedures, and accepted strategies, tactics, and doctrines of shipboard firefighting including the selection of:**
    - **Proper extinguishing media to combat the fire**
    - **Proper fire extinguishing techniques to combat the fire**
    - **Demonstrates command, control, communication, and coordination of a simulated shipboard firefighting operation by:**
      * **Ordering all necessary system shutdowns, notifications, and movements of passengers and crew; and**
      * **Deploying added fire parties to confine and extinguish the fire, rescue, remove, and treat casualties, and overhaul the fire.**
    - **Actions are timely, complete, and in accordance with the ship’s fire and emergency plan**
    - **Actions minimize or mitigate risk to the injured. And to other passengers and crew**
    - **Actions are appropriate to the scenario and information received from periodic progress reports**
    - **Courses of actions are consistent with the ship’s fire and emergency plans and procedures**
    - **Communications are clear, concise, and readily understood; fire parties and crew respond to orders as intended;**
    - **Actions taken to coordinate operations achieve desired results;**
    - **Actions taken to minimize spread of smoke using ventilation controls are timely, effective, and consistent with the ship's fire and emergency plans and procedures;**
    - **Actions taken to secure fuel and electrical systems are timely, effective, and consistent with the ship's fire and emergency plans and procedures; and**
    - **Management and control of injured persons are timely, consistent with the ship's fire and emergency plans and procedures, and in accordance with accepted emergency medical practice.**
    - **Consider the effect of the firefighting water on the vessels stability**
    - **Determines the effect of streams of firefighting water on ship's stability and describes appropriate precautionary and corrective measures that could be taken in accordance with the ship's fire and emergency plans and procedures to maintain or prolong stability.**
      * **Amount of water used in gallons**
      * **De-watering**
      * **Pumps**
      * **De-watering educator**
  + **Demonstrates command, control, communication, and coordination with shore-side firefighting personnel**
    - **Contacts the local fire department of the port the vessel is in or heading to:**
    - **Request assistance;**
    - **Provide information concerning the nature of the fire and what actions have been taken;**
    - **The equipment or supplies that will be needed; and**
    - **Integrating into the local incident command system; and**
    - **Assists the local fire department with:**
    - **The logistics of getting people and equipment on board;**
    - **Maintaining ship stability;**
    - **Advice about shipboard strategy and tactics; and**
    - **Provides information as needed and assists with post incident reports and planning.**
  + **Prepares a contingency plan that includes the composition and allocation of personnel to fire parties and has a stated strategy and tactics for controlling and extinguishing a fire.**
    - **Plan, execute and evaluate a fire drill for controlling and extinguishing a fire**
    - **Is consistent with ship's fire and emergency plans and procedures.**
    - **Makes fire-party assignments consistent with training and physical abilities of personnel.**
    - **Includes specific performance goals and standards for acceptable versus unacceptable drill execution, and**
    - **Employs strategy and tactics consistent with accepted doctrines and procedures of shipboard firefighting for the situation given and resources available.**

**Lesson 5**

* **Organization & Training**
  + **Aboard a ship, rig or platform the crew is the Fire Department.**
  + **There is in place a chain of command.**
  + **This should not change during an emergency.**
  + **Master is the top executive.**
    - **Subject to applicable laws as set forth in “Governing Marine Inspection” and U.S. Coast Guard rulings and regulations.**
    - **Designed to provide safety at sea for passengers, the crew, and the ship.**
    - **Laws are strict.**
    - **The Master is charged with the responsibility for violations.**
    - **Aboard the ship the Master’s authority is second only to God.**
    - **The ship’s owners cannot authorize the Master to act contrary to any federal law.**
    - **The Master may delegate authority but he cannot relieve himself of the responsibility.**
    - **Ensures through one or more junior officers that all firefighting and emergency equipment is in proper working order**
    - **Supervise and periodically review the pre-fire planning for the vessel**
    - **Appoint a safety officer and supervise activities to ensure that all personnel are properly trained**
    - **Utilize all resources available through pre-fire planning, training meetings, inspections, drills, and reference sources**
  + **Organization**
    - **Master**
      * **Ensures proper communications, both onboard and with other agencies**
      * **Control the operation and use of all shipboard fixed firefighting systems**
      * **Coordinates the efforts of shipboard fire teams with an overall emergency plan. Generally, this coordination (strategy) will originate from the bridge with the chief mate or an engineering officer supervising tactical operations at the scene or in proximity of the fire**
      * **Decides if it is necessary to abandon ship. When the crew is ordered to abandon ship, the master ensures that proper procedures are implemented. Although the crew may be summoned to boat stations by ringing alarm bells or sounding the ship’s whistle, the Master verbally gives the final order to abandon ship**
      * **Coordinates activities with outside agencies when appropriate, for example fully participate in the incident management Unified Command with the local fire department**
    - **Chief Mate** 
      * **Second in command.**
      * **Responsible for carrying out the Master’s orders.**
      * **Usually in charge of Safety.**
        + **Lifesaving equipment.**
        + **Firefighting equipment.**
        + **Training the crew.**

**Emergency squad.**

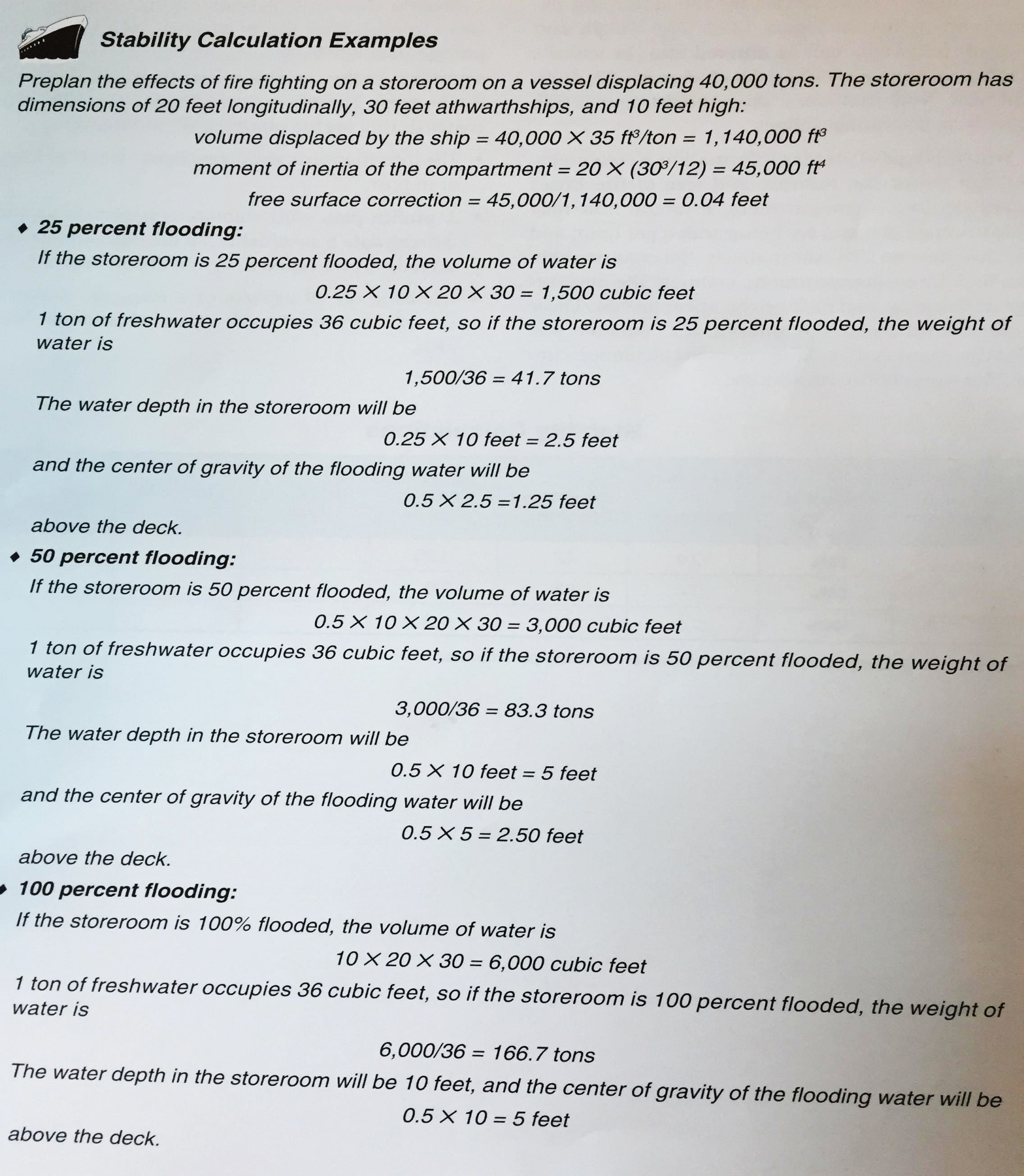
* + - * + **Group of crewmen selected for their special training.**
    - **Chief Mate or Chief Engineer**
      * **Report to the scene or general vicinity of the fire**
      * **Take overall command of fire suppression activities - supervise tactical activities if the fire is in their own area or act as second in command if it is not**
      * **Oversee the implementation of the chosen fire suppression strategy**
      * **Monitor the actions and status of tactical units; necessitates the establishment of communications with all tactical units**
      * **Ensure the safety of all emergency response team members**
      * **Keeps the vessel’s Master informed of the state of the fire and the status of firefighting and rescue efforts**
    - **Engineering & Deck Officers.**
      * **Perform as assigned, and supervise the tactical activities of the crew members under their command**
      * **Ensure the safety of the crew members as they carry out tactical operations**
      * **Maintain communications with the overall scene leader and keep him/her informed as to the fire and team status**
    - **Safety officer**
      * **Report directly to the master on all matters concerning emergency equipment and emergency training of the crew**
      * **Inspect and report any deficiencies on all shipboard emergency equipment**
      * **Prepare and conduct a useful, dynamic emergency training program for the vessel**
      * **Review, evaluate, and assist in assigning personnel to emergency teams**
      * **Ensure the correct, proper posting and updating of station bills**
      * **Perform in the emergency organization as assigned**
  + **Fire Locker Gear**
    - **Fire fighters Outfit**
      * **Helmet**
        + **Protects the head from impact and puncture injuries as well as from scalding water**
        + **Protects from both heat and cold**
        + **Ear covers and chin straps required**
        + **Faceshield gives secondary protection to the face and eyes**
      * **Flash hood**
        + **Protects ears, neck, and portions of the face not covered by the helmet or coat**
        + **Protects from exposure to extreme heat**
      * **Turnout pants and coat**
        + **Composed of an outer shell, moisture barrier, and a thermal barrier. All liners must be in place during firefighting operations**
        + **Protects the trunk and limbs from cuts, abrasion, burns injuries**
        + **Provides limited protection from corrosive liquids**
      * **Wristlets** 
        + **Prevents materials from entering sleeves**
      * **Boots**
        + **Protects the feet from burn injuries and puncture wounds**
      * **Gloves**
        + **Protects the hands from cuts, punctures, burns, liquid absorption, and heat/cold**
      * **SCBA - Self Contained Breathing Apparatus**
        + **Protects the face and lungs from heat and toxic products**
        + **Has to be Positive Pressure type**
        + **Typically 20 minutes of use when firefighting**
      * **EEBD - Emergency Escape Breathing Devise**
        + **Used for escape from hazardous atmospheres**
        + **5 minutes**
        + **Not to be for firefighting**
    - **Personal equipment such as the following, which may be carried during fire fighting operations:**
      * **Flashlight**
        + **Used for illumination in dark areas**
      * **Life line**
        + **Used to connect to SCBA and a point outside of the entry**
        + **It must be not less than 50 feet in length**
        + **It must be made of steel or bronze wire rope**
        + **It must be corrosion resistant**
      * **Personal Alarm Safety System (PASS) device**
        + **Will loudly alarm when motionless for 30 seconds**
      * **Personal atmospheric meters**
        + **Measures toxic gases in the atmosphere**
    - **Dangers/Limitations of a fire fighters outfit.**
      * **Tendency to induce heat exhaustion**
      * **Decrease in mobility/dexterity/endurance and limits to protective qualities**

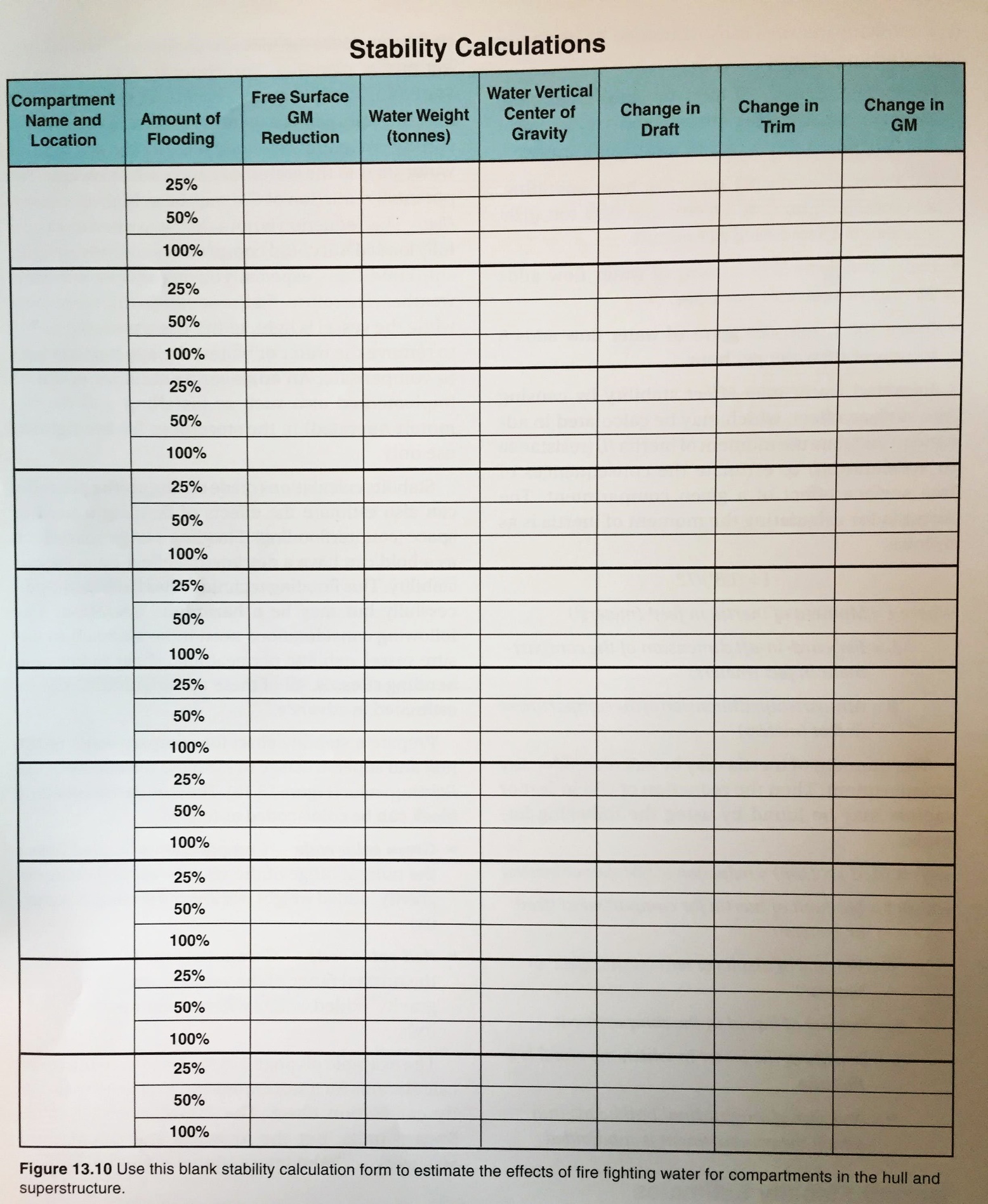
**IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**

* **Firefighters Outfit**
  + **Monthly**
    - **Verify lockers providing storage for firefighting equipment contain their full inventory and equipment is in serviceable condition**
* **Self Contained Breathing Apparatus**
  + **Weekly:** 
    - **Examine all breathing apparatus & EEBD cylinder gauges to confirm that they are in the correct pressure range**
    - **SCBA**
      * **30 minute – 2216 psi**
      * **45 minute – 3000 psi**
      * **60 minute – 4500 psi**
      * **Check all breathing apparatus face masks and air demand valves are in serviceable condition**
    - **EEBD**
      * **Look in window, If gauge is out of the green zone remove from service**
      * **Yearly:**
      * **Check EEBD’s per maker’s instructions**
* **SCBA Breathing Air Recharging System**
  + **Yearly:**
    - **Test breathing apparatus air recharging system, if fitted. For air quality**
* **Station Bills**
  + **Station bill lists the duties of crew members during an emergency.**
  + **46 CFR Subpart 97.13. applies to all vessels of over 500 gross tons except barges.**
  + **Prepared by the Master of the vessel and must be signed by him.**
  + **Must be duly posted in conspicuous locations in the vessel, particularly in the crew quarters, before the vessel sails.**
  + **Sets forth the special duties and the duty station of each member of the crew for various emergencies.**
  + **As far as possible the duties should be comparable to the regular work of the individual.**
  + **The duties shall in include the following, and any other duties that shall be assigned as necessary for the proper handling of the particular emergency.**
  + **The closing of:**
    - **Airports**
    - **Watertight doors**
    - **Scuppers**
    - **Sanitary and other discharges which lead through the hull below the margin line**
    - **etc.,**
    - **The stopping of:**
      * **Fans and ventilation systems.**
    - **The operation of all safety equipment.**
    - **The preparation and launching of lifeboats and life rafts.**
    - **The extinguishment of fire.**
  + **The muster of passengers, visitors, or vendors**
  + **Warning and assisting, plus other duties relating to life preservers and lifeboats.**
  + **Emergency signals.**
    - **Fire alarm signal shall be a continuous blast of the whistle for a period of not less than 10 seconds supplemented by the continuous ringing of the general alarm bells for not less than 10 seconds.**
    - **For dismissal from fire alarm stations, the general alarm shall be sounded 3 times supplemented by 3 short blasts of the whistle.**
  + **Fire, Abandon, Man overboard and Collision duties**
  + **Responding to station**
  + **Prevents Freelancing**
  + **Importance of closing doors**
  + **Know signals**
  + **When do you find out this information?**
* **Training**
  + **Absolutely essential.**
  + **Without training there is little or no coordination or cooperation.**
  + **The duties assigned in the station bill are not enough.**
  + **Cross training required by CFR’s**
* **Cross Training**
  + **Everybody has to be cross trained for every job during an emergency.**
  + **This is absolutely essential.**
  + **Every job in a firefighting effort is important.**
  + **Every member of the crew’s life is at stake. There is no where to run when at sea.**
  + **Because of this, any function that is not performed can have an impact on life.**
  + **A member may not report to his or her station for many reasons.**
    - **Sick.**
    - **May have been hurt or killed before reaching the station.**
    - **May become injured during the firefighting effort.**
* **Preplanning**
  + **SOLAS and IMO Requirement**
  + **Ships Plan/Written/Plan of Action**
    - **Hazards & Classes**
    - **Shutoffs**
    - **Fuel Loads**
    - **Fire Controls**
    - **Fixed Systems**
    - **Portable Extinguisher & Semi Portable**
    - **Ventilation**
    - **Access and Egress**
    - **Construction**
    - **Search and Rescue**
    - **Personnel**
    - **Dewatering**
    - **HazMat**
* **Training for Firefighting**
  + **Required by SOLAS**
  + **Weekly**
  + **At sea & in port**
  + **Simulate actual conditions as closely as possible**
  + **Require crew members to perform as though it is an actual fire or emergency**
  + **Make adequate arrangements for water removal used to extinguish simulated fires**
  + **Provide sufficient refills or replacements for portable fire extinguishers**
  + **Review and discuss the drills**
  + **Maintain written records of drills in logbooks**
  + **Conduct fire and emergency drills with as much realism as possible**
  + **Conduct simulated fire outbreaks in high risk areas**
  + **Change the location each time**
  + **What time of day?**
  + **During shift change?**
  + **Is it really effective training?**
  + **Is there cross training?**
  + **What subjects covered?**
    - **Prevention, SCBA, Extinguishers, S&R, Foam, Fire Protection Systems, Strategy and Tactics, Incident Command and Safety, etc.**

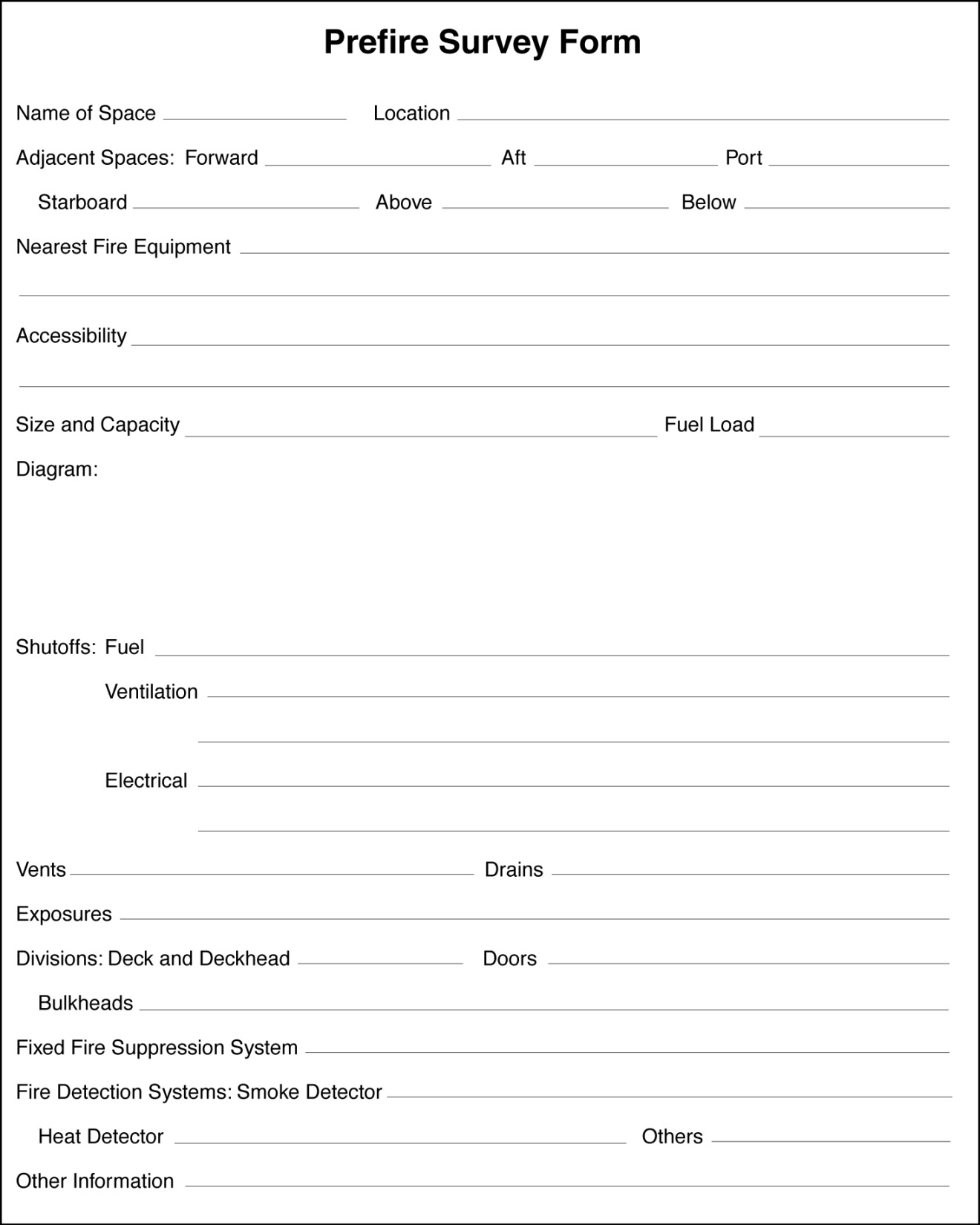
**Lesson 6**

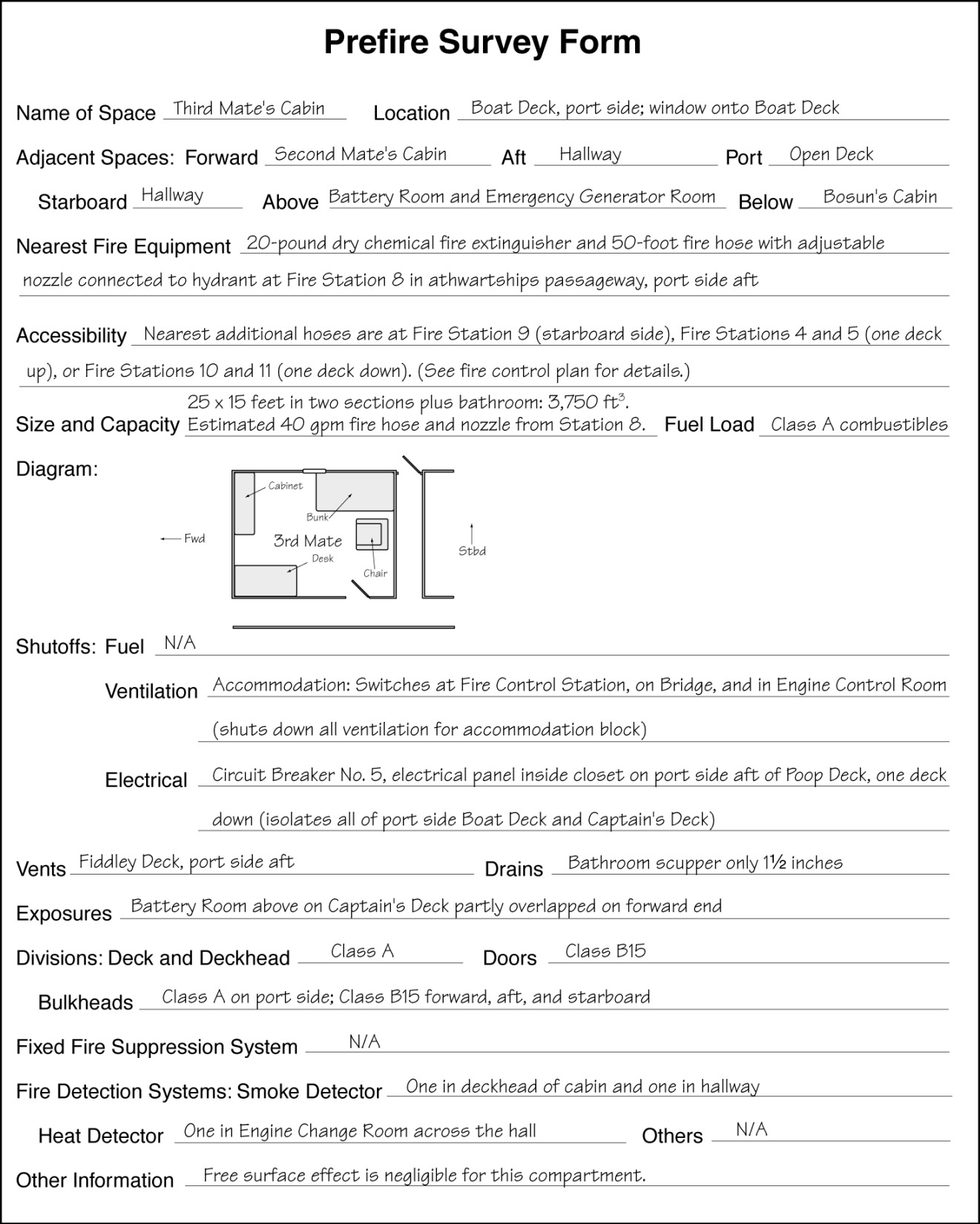
* **Ships Fire Plan**
  + **The plan should consist of the following:**
    - **General arrangement for each deck**
    - **Fixed fire suppression systems**
    - **Location of**
    - **Fire main**
    - **Hydrant fire stations**
    - **Valves**
    - **Fire pumps and their capacities**
    - **Spaces protected by fixed fire suppression systems**
    - **Flooding agent cylinders**
    - **Release controls for these agents**
    - **Deck monitors**
    - **Foam proportioning equipment**
    - **Types of sprinkler systems installed**
    - **International shore connection**
    - **Portable firefighting tools/equipment**
    - **Portable/semiportable fire suppression equipment**
      * **Locations**
      * **Portable/semiportable fire extinguishers**
      * **Classes and types consistent with requirements**
    - **Ship construction features**
      * **Locations**
      * **Fire resistive bulkheads and decks**
      * **Fire retardant bulkheads and decks**
      * **Watertight bulkheads**
      * **Watertight doors including all local and remote controls for such**
    - **Fire detection systems**
      * **Locations**
      * **Smoke and heat detectors**
      * **Zones and areas served by each**
      * **Alarm and control panels**
      * **Alarm pull stations**
    - **Ventilation system**
      * **Locations**
      * **Ventilation fans and areas served**
      * **Fans controls and whether or not they are reversing**
      * **Dampers and areas served**
      * **Damper controls**
    - **Means of access and egress**
      * **Locations**
      * **Normal paths of travel**
      * **Companionways between decks and doors and doors between horizontal areas**
      * **Escape hatches and escape trunks**
    - **Various fire sections enclosed by fire resisting bulkheads.**
    - **Arrangement of the alarm system.**
    - **Arrangement of the extinguishing systems.**
      * **Fixed water system.**
      * **Number 1 firefighting fixed system.**
      * **CO2.**
      * **Halon.**
      * **Foam.**
      * **Sprinkler systems.**
    - **Means of access to different compartments and decks.**
    - **Ventilation system**
      * **Location of ventilation shutdowns.**
      * **Position of dampers.**
      * **Identifying each type system.**
  + **The Plan for the Engine Room**
    - **Who is assigned to the Engine Room?**
    - **Muster**
    - **This will dictate whether the firefighting effort will be done as safely as possible.**
    - **If someone is trapped in the space then the fire team may have to risk their lives to save life.**
    - **What can burn**
    - **The quantity**
    - **The location.**
    - **Location of fuel shutoff.**
    - **Exits and access.**
      * **Everyone should know the alternate ways out of any space.**
      * **Knowing where the fire is located will determine the best point of entry.**
    - **How can the fire spread? In the space and beyond the space.**
    - **Need an overview of the entire structure.**
    - **Fixed firefighting systems.**
      * **Water system.**
        + **Fire station locations in the space and surrounding spaces.**
        + **Main fire pumps and backup fire pumps.**
        + **GPM rating for each.**
        + **Hose and nozzles.**
    - **CO2, Halons, Intergen, Pro-Inert, Novec, High Pressure Water Mist, & others** 
      * **How to fire off the systems**
      * **Location of discharge nozzles and warning lights.**
    - **Foam.**
    - **Dry chemical**
    - **Ventilation.** 
      * **To confine the fire.**
      * **How to seal the space.**
      * **To exhaust heated fire gases when making entry.**
      * **Natural ventilation - using the wind.**
      * **Forced ventilation - using fans or hose streams.**
    - **Hazards**
      * **Trip**
      * **Fall**
      * **Overhead**
      * **Electrical**
      * **Chemical**
      * **Heat**
    - **Communications**
      * **Portable radios.**
      * **Telephones.**
    - **Messengers.**
    - **Stability.**
      * **Measure of a vessel’s ability to return to an upright position when heeled by an external force**
      * **Weight of the water can change the center of gravity (G).**
      * **1 1/2” nozzle flowing 100gpm =**
      * **1 ton (2000lb) of water every 2.5 minutes**
      * **24 tons of water every hour**
      * **Free surface effect can dramatically change the center of gravity when the water starts shifting**
    - **Pre-fire planning**
      * **Potential for excess firefighting water becoming a hazard – rarely planned for**
      * **Not recognized as being capable of pre-planned**
      * **Vessels have been lost with minor fires that were extinguished using excessive amounts of water**
      * **Estimate the amount of water for a given scenario and its potential effects on vessels stability**
      * **Vessel usually has stability charts for each space.**
      * **Plans should be made to pump water overboard as soon as possible**
      * **Location and GPM rating of bilge and other pumps**
      * **Dewatering eductor**
      * **Make estimated stability calculations during pre-fire planning**
      * **Example:**
        + **Fire in the aft storeroom**
        + **Requires *x gpm* for *y minutes* to extinguish = a quantity of retained water ( free surface) weighing *X tons***
        + **Assume the firefighting water stays and cannot escape**
        + **The potential reduction of GM may be as high as *z meters***
        + **Not a problem when a vessel is fully loaded**
        + **Could compromise stability in light ship conditions especially during adverse wind and weather**
        + **If a fire occurs when the vessel is light, either use a portable pump to dewater or ballast the appropriate tank to compensate**

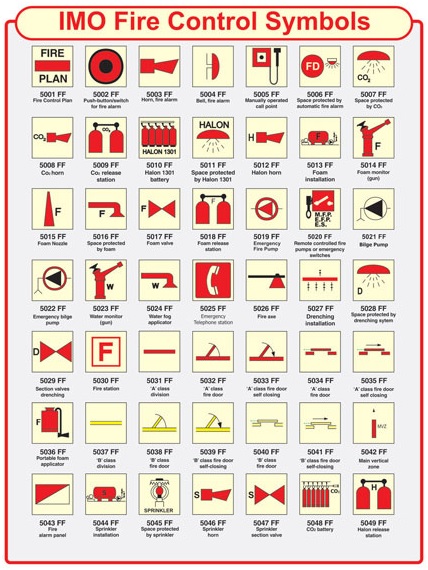
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* **Organization.**
  + **Station bill.**
    - **Every member must know his job to the best of his ability**
    - **Not enough just to know your job**
    - **Cross train – must know everyone’s job**
* **Alarm system**
  + **Heat detectors**
  + **Smoke detectors**
  + **Gas detectors**
  + **Flame detectors**
* **Vessel Construction**
* **Vessels are built to withstand the conditions and stresses for the trade in which they were intended**
* **Components**
  + **Bulkheads**
    - **Bulkheads and decks that form fire divisions are in 3 classes**
    - **Fire resistance information found in SOLAS Chapter II-2**
    - **Classes based on construction methods and materials**
    - **Materials are noncombustible- will not burn or give off vapors to self-ignite**
    - **Class A Division**
      * **Constructed of steel or equivalent**
      * **Stiffened and constructed to prevent passage of smoke and flame for 1-hour**
      * **Insulated so that average temperature on unexposed side does not rise more than 282 degrees above original temperature.**
      * **Does not rise more than 356 degrees above original temperature within time listed**
      * **Class A 60: 60 minutes- resists 1700° F**
      * **Class A 30: 30 minutes- resists 1550 ° F**
      * **Class A 15: 15 minutes**
      * **Class A 0 : 0 minutes**
    - **Class B Division**
      * **Formed by bulkheads, decks, deckheads, (overheads or ceilings) or linings**
      * **Construction- noncombustible material except approved veneers**
      * **Capable of preventing passage of flame and smoke for ½ hour**
      * **Unexposed side > 282 degrees**
      * **Rise no more than 437 degrees within**
      * **Class B 15: 15 minutes**
      * **Class B 0: 0 minutes**
    - **Class C Division**
      * **Constructed of approved noncombustible material**
      * **Does not need to meet requirements for smoke and flame passage**
      * **SOLAS approved combustible veneers allowed**
  + **Watertight Doors**
    - **Used to protect from flooding and fire**
    - **Also traps crews and severs fire hoses**
    - **Can be under pressure**
    - **Three types**
      * **Individually dogged**
        + **Manually opened and closed**
        + **Held in place by slip hinges and usually 6 to 8 locking levers or bolts called Dogs**
        + **Release the dogs on the hinged side first to relieve pressure**
      * **Quick acting**
        + **All 6 to 8 dogs used to open or close are activated by a central mechanism (wheel or a single lever)**
        + **Rotate halfway to relieve pressure**
      * **Power driven**
        + **Opened or closed by either electric or hydraulic motors**
        + **Remotely controlled at an operating station by a**
        + **Electric switch**
        + **Hand crank**
        + **Pump**
        + **Equipped with alarms that sound when the doors are closing**
        + **Person standing in the door when closing can be injured or killed**
        + **Too powerful to hold back**
    - **SOLAS & IMO requirement**
    - **Required for openings in Class A bulkheads**
    - **Intended to prevent compromising the integrity of the bulkhead**
    - **Seal must be approved**
    - **Gaskets not permitted to achieve the seal**
    - **Double swinging and revolving doors not allowed**
  + **Fire Doors**
    - **Requirements ( not limited to the following)**
    - **Approved closure construction material - must match bulkhead class**
    - **Permissible size of the closure**
    - **Arrangements for electrical closing of the door normally held open**
    - **Indicators on the navigating bridge showing when the door is open**
    - **Instructions for opening**
    - **Amount and type of glass used for windows in doors (must be compatible with the bulkhead rating)**
    - **Identification plate**
    - **Inspection & Maintenance**
* **IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**
  + - **Fire Doors**
    - **Weekly**
      * **Verify all fire door control panel indicators, if provided, are functional by operating the lamp/indicator switch.**
    - **Quarterly**
      * **Test all fire doors located in main vertical zone bulkheads for local operation.**
    - **Yearly**
      * **Test all remotely controlled fire doors for proper release.**
  + **Ventilation Systems**
    - **Can be used to remove smoke and byproducts of combustion**
    - **Can be used to stop the spread of fire by shutting down**
    - **Fresh air intake or recirculated air**
    - **Can be negative or positive pressure. Some can be reversed**
    - **Fixed system- shut down**
    - **Fire damper equipped**
    - **Inspection & Maintenance**
* **IMO Circular 1432: revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances**
* **Ventilation Systems**
* **Quarterly**
  + **Test all fire dampers for local operation.**
* **Yearly**
  + **Test all fire dampers for remote operation;**
  + **Verify galley exhaust ducts and filters are free of grease build-up; and**
  + **Test all ventilation controls interconnected with fire-protection systems for proper operation.**
  + **Electrical systems**
    - **Vital aboard vessel**
    - **Extremely hazardous to crew**
    - **Important to know ships system**
    - **May penetrate rated bulkhead/s**
    - **Equipment may be:**
      * **Explosion proof – designed so as not to provide an ignition source in an explosive atmosphere**
      * **Intrinsically safe - not capable of releasing *enough* electrical energy to cause ignition of a flammable atmosphere**
* **Structural Components and Fire**
  + **Know the capabilities and weaknesses in system**
  + **Fire rated Bulkheads/Watertight**
  + **Integrity of these bulkheads**
  + **Doors closed**
  + **Isolating electricity**
  + **Air ducts closed**
  + **Dewatering**
  + **Ventilation**
* **Pre-fire Survey Form**

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**Lesson 7**

* **Strategy & Tactics**
  + **Strategy**
    - **Overall plan for incident attack and control**
    - ***Initial actions***
      * ***Start*** 
        + ***Fire pumps including emergency (backup) pumps***
        + ***Generators***
        + ***Additional steering motors***
        + ***Engineers usually perform these functions***
        + ***On some vessels could be done on the bridge***
      * ***Account for crewmembers/passengers***
      * ***Control or secure ventilation***
      * ***Confine/isolate the fire by closing***
        + ***Doors***
        + ***Hatches***
        + ***Other openings***
        + ***Use the vessels zoning capabilities***
      * ***Isolate power to the involved area/space***
      * ***Operate fuel shutoffs if required***
      * ***Establish staging areas for necessary equipment and crew members in a safe area near the fire area***
        + ***Assemble additional crew members in proper PPE and SCBA***
        + ***Make ready to relieve crew members currently fighting the fire***
      * ***Protect exposures***
        + ***Set fire boundaries on all six sides***
        + ***Consider the use of fixed firefighting systems to establish boundaries***
    - ***Attack actions***
      * ***Attack the fire***
        + ***Offensive - Direct attack***
        + ***Defensive - Indirect attack***
        + ***Combination***
      * ***Continue to size-up the fire and gather and report information***
      * ***Ventilate the fire area to the advantage of the fire teams and the disadvantage of the fire***
      * ***Practice good water management to avoid stability problems***
      * ***Alert other vessels in the area of the need for assistance if necessary***
      * ***Proceed to the nearest port if possible***
      * ***Provide appropriate medical attention for those in need***
    - **Rescue**
    - **Exposure**
    - **Confine**
    - **Extinguish**
    - **Overhaul**
    - **Dewatering**
    - **Ventilation**
    - **Salvage**
    - **Note: Last 3 can be done at any time as long as it is done “SAFELY”**
  + **Incident Strategy options**
    - **Three strategy options**
      * **Offensive**
        + **Aggressive attack is made on the fire**
        + **Expectations of success in extinguishment**
        + **Limiting the danger to firefighting crew members**
        + **Goal is to stop the fire’s progress and extinguish it**
        + **Limit damage**
        + **Requires adequate resources and a tenable environment**
        + **Does not mean a face to face interior attack**
        + **Could also use fixed firefighting system or foam monitors**
      * **Defensive**
        + **Impossible to reach the seat of the fire**
        + **Goal is to contain the fire and protect exposures**
        + **Chosen when resources are inadequate and/or exposing personnel to extreme danger would be necessary for extinguishment**
        + **If conditions are extreme**
        + **May move vessel from exposures while in port**
        + **Dropping anchor while at sea**
        + **May involve a holding action on the fire to prevent spread to other parts of the vessel or external exposures**
      * **Abandon ship**
        + **Not made lightly**
        + **Fire cannot be contained**
        + **Resources not available to yield a positive outcome**
        + **TIME TO ABANDON SHIP**
        + **Make every effort to save the vessel**
        + **Stay with it as long as possible**
        + **Crew members have reboarded a vessel when conditions have improved**
    - **Depends on several variables**
      * **Size of the fire**
      * **Resources available**
    - **Location of the fire**
      * **Identified by three methods**
      * **Pre-fire planning**
      * **Particular emergency situation**
    - **Officers in charge**
    - **Key is to develop a plan by**
      * **Sizing up the situation**
      * **Communicating the information**
    - **Completing the plan of action**
    - **Three Priorities:**
      * **1st - Life**
        + **Those who may have to be rescued**
        + **Team members**
      * **2nd - Incident Stabilization**
        + **Exposure protection – 1st priority in incident stabilization**

**Cargo**

**Adjacent spaces – 6 sides to consider**

**Ductwork**

**Cable and piping runs**

**Protect other vessels or structures that may be threatened**

* + - * + **Confine the fire**

**Can be viewed as protection of interior exposures**

**Identify the fire location during size-up**

**Ventilation part of the confinement**

**Command officers evaluate the need and determine when to use**

**Can be used at any time to achieve tactical priorities**

**Can be absolutely critical in extinguishment of a fire**

**Also provides a cleaner, cooler atmosphere for firefighters to work in**

**Greatly enhance visibility in locating the seat of the fire**

**Assist firefighters in finding their way in a space**

**Can mean one of 3 actions**

**Provision of fresh air into a fire area**

**Means for hot gases and smoke to escape**

**Sealing off of fresh air from a fire area**

* + - * + **Extinguish**

**Only after an advanced fire has been contained**

**May include**

**Smothering**

**Use of fixed firefighting systems**

**Turning off fuel supply**

**Indirect and direct attacks by fire hose teams**

**Plan for relief of fire team members**

**Overhaul**

**Process of ensuring fire is extinguished**

**Preventing re-ignition/reflash**

**Includes**

**Fire cause determination**

**Salvage – property conservation**

**Dewatering**

* + - **Basic rules of fire fighting strategy**
      * **The highest priority is to determine the degree of danger to personnel.**
      * **Where the fire poses a threat to the safety of people, they should be removed.**
      * **If fire threatens to cut off the escape route, a hose stream must be directed between the threatened egress and the fire.**
      * **Countermand any previous orders that are contrary to good fire tactics.**
      * **Cover exposures first, attack the fire later.**
      * **The safety of men operating at a fire should not be dependent on a single hose line.**
      * **As soon as it is evident that water is not reaching the seat of the fire, men whose sole egress may be cut off by an extension of the fire should be withdrawn.**
      * **Whenever it is necessary to withdraw a line from a position rendered untenable by the extending fire, keep the stream in operation until the men get out safely.**
      * **Don’t let the natural impulse to attack a fire induce you to do so in such a way as to spread the fire.**
  + **Tactics**
    - **Specific tasks/duties that are completed in order to meet the overall strategy**
  + **Size-up**
    - **Size-up is continuous.**
    - **What have I got?**
    - **What are the facts?**
      * **Initial report**
      * **Visual factors**
      * **Reconnaissance**
      * **Search and rescue**
    - **What are the probabilities?**
      * **Life hazards**
      * **Explosions**
      * **Damage**
    - **Where is it going?**
      * **Extension of the fire**
      * **What resources are available?**
        + **Personnel resources**
        + **Crew members**
        + **Outside assistance**
    - **Extinguishing resources**
      * **Foam or water agents**
      * **Portable/semiportable fire extinguishers**
      * **Fixed fire suppression systems**
    - **Safety resources**
      * **PPE**
      * **SCBA**
    - **What do I have to do to stop it?**
    - **What is the best strategy?**
    - **Offensive versus defensive**
    - **Proper extinguishing agent and method for the type of fire or hazard**
    - **Indirect attack versus direct attack or fixed fire suppression systems**
    - **What tactics are necessary to achieve the strategy?**
    - **Protection of responding crew members**
    - **Assessing the fire**
    - **Containing the fire**
    - **Establish boundaries**
    - **Hose lines - all six sides**
    - **Delegation of tactical aspects**
    - **How are the strategies implemented?**
    - **Fire extinguisher teams**
    - **Fire hose teams**
    - **Fixed fire suppression systems**
    - **Can be done during pre-planning**
  + **Staging areas.**
    - **Smoke free area close to the fire.**
    - **Not located where it may be endangered by extension of the fire.**
    - **Assembly area for manpower and equipment.**
  + **Communications**
    - **Essential.**
    - **Types**
      * **Internal**
        + **Fixed system routed to all areas for 2 way talk-back or open communications via a transceiver to each compartment**
        + **Public address**

**System difficulties**

**Lack of power**

**Poor maintenance**

**Limited to one way communication only**

**External noises**

* + - * + **Telephones**

**System difficulties**

**Noisy areas**

**Damage to wiring**

**Poor maintenance**

**Electrical service failures**

**Human factors such as stress excitement, etc**

* + - * + **Hand/visual signals**

**System difficulties**

**Misinterpretation**

**Distance**

**Environment - smoke, weather, etc.**

**Face to face/messengers/runners**

**System difficulties**

**Language barriers**

**Information overload/memory**

**Noise**

**Wearing SCBA**

**Elapsed time from receiving the information until conveying it**

**Environmental conditions**

**Human factors - stress excitement, etc.**

* + - * + **Electronic communications**

**System difficulties**

**Vessel construction features**

**Decks and bulkheads can create dead spots**

**Low batteries**

**Noisy areas**

**Weather conditions**

**Poor maintenance**

**interference**

* + - * + **Voice pipes**

**System difficulties**

**Noisy areas**

**Obstructions**

**Poor maintenance**

**Not available in all areas**

* + - * + **Vessel alarms**

**System difficulties**

**Loss of the system**

**Noise level**

**Poor maintenance**

**Lack of training**

**Limited access to controls**

* + - * + **Lifeline commands**

**O Okay: one short pull**

**A Advance: Two short pulls**

**T Take up Slack: Three short pulls**

**H Help: Four short pulls**

**System difficulties**

**Lack of knowledge**

**Lack of training**

* + - * **Vital elements**
        + **Words used**
        + **Meanings taken from the words used**
      * **Miscommunications**
        + **Not hearing fully because of the following**
        + **Our own hearing level**
        + **Noise interference**
        + **Senders location**
        + **Receivers location**
        + **Transmission medium**
        + **Not listening properly**
        + **Distraction**
        + **Boredom**
        + **Not understanding the words used**

**Lack of common language**

**Unfamiliar technical language**

**Poor speaking ability**

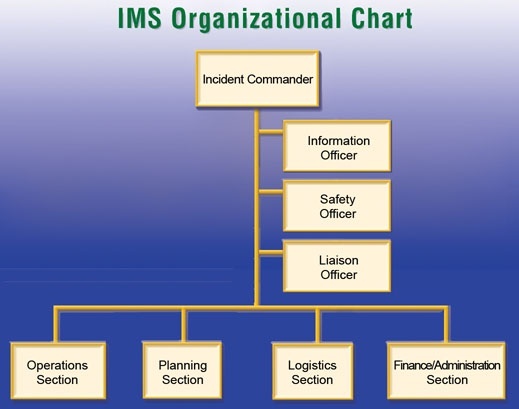
**Words spoken hurriedly because of stress, excitement, etc**

**Words garbled when spoken while wearing SCBA**

* + - * + **Unfamiliar or faulty communication equipment**
        + **Radio transmission sometimes are garbled due to location or dead spots**
      * **Points that are vital to free-flowing radio communications**
        + **Keep the channel clear for messages related tto the incident**
        + **Keep messages brief and accurate**
        + **Speak clearly, slowly and distinct**
        + **ACKNOWLEDGE UNDERSTANDING BY REPEATING THE MESSAGE**
      * **When wearing a SCBA. Use one of the following**
        + **Place the radio mike directly on the facepiece and talk slightly louder - do not scream**
        + **Hold the radio mike against the speaking diaphragm**
        + **Hold the mike against the throat**
        + **Hold the mike against the exhalation valve**
        + **Use an internal microphone**
        + **Use a throat microphone**
      * **To ensure the best possible communications between emergency response teams and command**
        + **Make sure that all crew members are proficient in communication skills**
        + **Identify the location of the fire or incident and the requirements for maneuvering the vessel**
        + **Ensure that all members of the emergency response team know in advance exactly what emergency hand, audio or radio call signs are in use**
        + **Place backup team members where they can keep in contact with emergency response team members so that hand signals will be visible if radio communications fail**
        + **Learn the proper terminology for various parts of the vessel - avoid use slang terms**
      * **Enter into logs of response actions taken and the times they occurred**
        + **Gives better on-scene control**
        + **Essential for post incident review**
        + **Required for legal purposes**
  + **Fire cause – Investigation**
    - **Determined in order**
    - **To avoid similar fire**
    - **Identify hazardous conditions or practices**
    - **Find evidence of arson**
    - **Officers can usually ascertain the cause because of knowledge of the vessel**
      * **Accommodation area fires causes**
      * **Careless smoking**
      * **Cooking**
      * **Heating appliances**
      * **Electric wiring**
      * **Arson**
    - **Engine room fires**
      * **Engineers most knowledgeable in determining the cause**
    - **Take photographs before removing debris if possible**
    - **Make notes**
    - **Safeguard evidence – Chain of custody**
    - **If arson suspected or a fatality, close off the area until a shore based investigation team can examine the scene**
    - **Interview crew members**
      * **Include a current crew list**
      * **Establish their identities**
      * **Prepare a list of questions**
      * **Take statements from involved persons**
    - **Record all actions in the casualty book**
    - **Importance for the industry**
  + **Critique**
    - **Held after the fire is completely extinguished**
    - **After all fire protection equipment has been restored to service**
    - **Held before releasing crew members to regular duty**
    - **Anything that happened**
    - **Encourage suggestions & recommendations**
    - **Compare actions to preplan**
    - **Determine the good the bad the ugly**
    - **What was the situation**
    - **What was done well**
    - **What could have been done differently**
    - **Could the fire have been prevented? If so how?**
    - **Could other equipment or resources have prevented the fire or enabled a better response? If so, which ones?**
    - **Implement changes**
    - **Pass info to industry**

**Day Three - Classroom**

**Lesson 8**

* **Incident Command System - Incident Management System**
  + **Have an understanding of operations within an incident management system.**
  + **Have an understanding of SOPs for mutual aid response and *communication* protocols so that a unified command can be established and maintained.**
  + **IMS is a management structure based on business management principles.**
  + ***IMS should be used for all operations and training.***
  + **IMS is a concept or model.**
  + **Variations exist.**
  + **Every crew member must know it thoroughly.**
  + **Pre-1970s**
    - **Every fire department had its own methods of incident management.**
    - **Organization often depended on the style of the leader on duty.**
    - **Such an approach was not expandable.**
  + **1970s**
    - **FIRESCOPE:**
    - **FI refighting**
    - **RE sources of**
    - **S outhern**
    - **C alifornia**
    - **O rganized for**
    - **P otential**
    - **E mergencies**
    - **Established in response to several large-scale wildland fires in California**
    - **Developed first standard Incident Command System (ICS)**
    - **Fireground Command System**
    - **Initially developed for day-to-day fire department incidents, but could be expanded**
  + **1980s**
    - **FIRESCOPE adopted by all federal and most state wildland firefighting agencies**
    - **Several federal regulations and consensus standards adopted**
  + **2003** 
    - **President Bush directed the Department of Homeland Security to institute NIMS (National Incident Management System)**
    - ***The IMS can be used at any type or size of emergency incident***
  + **IMS Characteristics** 
    - **Jurisdictional authority**
      * **Clearly identifies the individual that will be in charge**
      * **Unified command**
      * **Brings agencies together to work under one plan**
      * **Ship’s Master with the local Fire Department and other agencies**
      * **Mutual aid**
      * **Can help a facility meet its need for resources**
      * **Partnerships should be made prior to the incident.**
    - **All risk and all hazard system**
      * **IMS works equally well at all types of incidents.**
      * **Emergencies**
      * **Non-emergency events**
    - **Everyday applicability**
      * **Facilities should adopt NIMS/ICS as a corporate policy.**
      * **Integration of all levels of government and industry will help should a large event take place.**
      * **IMS can be used for everyday operations and major incidents.**
      * **Regular use of IMS builds familiarity with procedures and terminology.**
    - **Unity of command**
      * **Each person has only one supervisor.**
      * **All orders and assignments come from that supervisor.**
      * **IMS is not necessarily a ranked system.**
      * ***The best qualified person should be assigned at the appropriate level for each situation, even if a lower ranking member is temporarily assigned to a higher position***
    - **Span of control**
      * **The number of subordinates a supervisor has**
      * ***In most situations, three to seven is the most one person can manage.***
      * ***In IMS, span of control should be limited to five.***
    - **Modular organization**
      * **IMS designed to be modular and flexible.**
      * **Not every component must be used.**
      * **Additional components added as needed.**
      * ***Likened to an organizational toolbox***
      * ***Only the tools needed for the specific incident are taken out***
    - **Common terminology**
      * **Terminology is common and consistent within and among agencies in the IMS.**
      * **Common terminology eliminates confusion.**
    - **Integrated communications**
      * **A major component of the IMS**
      * **Communications supported up and down the chain of command**
      * **Messages must move efficiently through the system.**
      * **Usually done via radio by the Fire Department**
    - **Consolidated action plans**
      * **Everyone follows one overall plan.**
      * **May be developed by the IC alone at small incidents**
      * **Developed in collaboration with all agencies involved on larger incidents**
        + **Master**
        + **Fire Chief**
        + **USCG**
        + **Other agencies**
    - **Emergency Response Operations Plan**
      * **Required by OSHA, NFPA, USCG**
      * **Designed to identify levels of response needed for certain locations**
      * **USCG NVIC 9-14 Task # 1.7.A mandates** 
        + **Command, control, communication and coordination with shoreside firefighting personnel.**
        + **Contacts the local fire department of the port the vessel is in or heading to:**
        + **request assistance;**
        + **provide information concerning the nature of the fire and what actions have been taken;**
        + **the equipment or supplies that will be needed; and**
        + **integrating into the local incident command system; and**
        + **Assists the local fire department with:**
        + **the logistics of getting people and equipment on board;**
        + **maintaining ship stability;**
        + **advice about shipboard strategy and tactics; and**
        + **providing information as needed and assisting with post incident reports and planning.**
    - **Designated Incident Facilities**
      * **Required facilities established according to the IMS plan**
      * **Includes standard designations for commonly needed facilities:**
      * **Rehabilitation sector**
      * **Command post**
      * **Staging area**
    - **Resource Management**
      * **Standard system of assigning and tracking resources involved on the incident**
      * **In structural firefighting, basic units are companies.**
      * **Staging area (reserves)**
  + **The IMS Organization**
  + ****
    - **Command**
      * ***The IC is ultimately responsible for managing the incident.***
      * ***This position must be filled.***
      * **Command is established by the first unit on scene.**
    - **Unified Command**
      * ***Used when agencies overlap***
      * ***Representatives from each agency cooperate to share command authority.***
      * ***The Master of the vessel is still in charge of the vessel and crew***
      * ***The Fire Department is in charge of the firefighting effort with advice from the Master of the vessel***
      * ***Captain of the Port representative resolves command and legal issues***
    - **Command Post**
      * ***Headquarters location for the incident***
      * ***Should be in a nearby, protected location***
      * **Enables command staff to function without distractions or interruptions**
      * ***Determined by the Master of the vessel***
      * ***May have to be located onshore***
    - **Command Staff** 
      * **Individuals who answer directly to the IC and cannot be delegated to other positions** 
        + **Safety Officer**

**Responsible for the safety of all personnel**

**Can stop or suspend unsafe operations**

* + - * + **Liaison Officer**

**The IC’s point of contact for outside agencies**

* + - * + **Public Information Officer**

**Gathers and releases incident information to the news media**

* + - **Deputies and Assistants**
      * **Deputy**
        + **Delegates authority to manage a specific task or functional operation in the absence of a superior**
        + **Can act as the relief for the superior**
      * **Assistant** 
        + **Subordinates of the principal command staff positions**
        + **May also be assigned to unit leaders**
    - **General Staff Functions**
      * **IC may appoint people to oversee parts of the operation.**
      * **Four section chiefs for the major IMS components:**
        + **Operations**

***Responsible for all actions that are directly related to controlling the incident***

**Fire suppression**

**Rescue**

**EMS**

**Conducted in accordance with an Incident Action Plan (IAP)**

* + - * + **Planning**

**Responsible for the collection, evaluation, dissemination, and use of information relevant to the incident**

***Also responsible for developing and updating the IAP***

* + - * + **Logistics**

***Responsible for providing supplies, services, facilities, and materials during the incident***

* + - * + **Finance/Administration**

***Responsible for accounting and financial aspects of an incident***

***Responsible for any legal issues that may arise***

**Not staffed at most incidents**

* + **Standard IMS Concepts and Terminology**
    - **A common language is essential for different agencies to work together toward a goal.**
    - **Shipboard terms may be foreign to most fire departments**
    - **The Fire Department IC should have a good understanding of shipboard terminology**
    - **The IC must always ask what some terminology means if unsure**
    - **There are different languages spoke and even if English is spoken it may be hard to understand**
    - **A common language eliminates wasting time due to miscommunication.**
  + **Single Resources and Crews**
    - **Single resource**
      * **A vehicle and its assigned personnel**
    - ***Crew***
      * ***Groups of firefighters working without apparatus***
  + **Divisions and Groups**
    - **Division**
      * **Companies/crews working in the same geographic area**
    - **Group**
      * **Companies/crews working on the same task or objective**
      * **Not necessarily in the same area**
    - **Sector**
      * **Companies/crews assigned by geography or function**
  + **Branches**
    - **Higher level of combined resources working on a particular aspect of the overall emergency**
    - **A branch director can oversee several divisions and groups.**
  + **Location Designators**
    - **Identify different parts of a fire scene**
      * **Sides: Units at Side A are “Division A”.**
      * ***Exposures: Closest exposure takes same designator as side.***
      * **Decks: Deck number is designator. Deck 1 is “Division 1”**
      * **On vessels “Frames” may be used or different terminology for the different sections of the vessel**
  + **Implementing IMS**
    - ***Helps organize every incident scene in a standard, consistent manner***
    - **Provides for effective mutual aid**
    - **Modular design allows for expansion.**
    - **Divisions, groups, branches**
    - **In the largest and most complex incidents, other IMS components**
  + **Standard Position Titles**
    - **Clarify roles within the IMS organization**
    - **Different designator for each level for the individual in charge**
    - **All individuals should understand their roles and be able to meet the responsibilities of these positions.**
  + **Working within the IMS**
    - ***Every fire member must understand the IMS and his/her role within it.***
    - ***Three basic components:***
      * ***Someone is in command of every incident.***
      * ***You always report to one supervisor.***
      * ***The scene leader reports to the IC.***
  + **Responsibilities of First-Arriving Brigade Members**
    - **IMS organization built around the units that take initial action**
    - **Officer in charge of the first-arriving unit assumes command**
    - **This can also be an individual who is first on the scene**
  + **Assuming Command**
    - **This is formally announced on the radio.**
    - ***An initial report should be given as well.***
    - ***Command designation***
    - ***Unit or individual who is assuming command***
    - ***An initial situation report***
    - ***Initial action being taken***
    - **First in Fire Department officer who initially assumes command must decide**
      * **To take action directly supervising the initial attack crew**
      * **Or to concentrate managing the incident as the IC**
    - ***If the incident is large and complicated, the best option for the IC to do is***
      * ***Establish a command post***
      * ***Focus on sizing up the situation***
      * ***Direct incoming units***
      * ***Request additional units***
  + **Confirmation of Command**
    - **Initial radio report lets everyone know that command has been established.**
    - **An incident identifier should be chosen.**
      * **Name of (Vessel) Command**
      * **Example: Bamoral Sea Command**
    - **Passing command**
      * **First-in unit can pass command to second-in if conditions warrant it.**
      * **Second-in unit must assume command.**
  + **Transfer of Command**
    - **One person relinquishes command to another.**
    - **Current situation status report is given to the new IC.**
    - **Information transfer must be complete and accurate.**
    - **Know your brigade’s SOPs for transferring command.**
    - ***Command is always maintained for the entire duration of an incident***
    - ***When the incident is under control, command could be transferred to a lower level commander***
    - ***Requires the same type of briefing and exchange of information as an upward command transfer***
    - ***Command is terminated when the last brigade leaves the scene***
  + **Command Transfer Rationale**
    - **Transfer of command determined by a variety of factors:**
    - **Complexity of the incident**
    - **Leader’s level of experience**
    - **Involvement of multiple agencies**
  + **Situation Status Report Information** 
    - **Tactical priorities**
    - **Action plans**
    - **Hazardous or potentially hazardous conditions**
    - **Accomplishments**
    - **Assessment of effectiveness of operations**
    - **Current status of resources and additional resource requirements**
  + **Summary** 
    - ***IMS is applicable to incidents of any size.***
      * **All functions in the IMS must be addressed at every incident.**
      * **On smaller incidents, this may only require one person to handle all functions.**
    - ***The IC has ultimate responsibility to meet incident requirements.***
      * **All brigade members must understand the IMS and what their role in an IMS is.**

**Lesson 9**

**Hazardous Materials:**

1. **What are Hazardous Materials?**
   1. **D.O.T. definition:**
      1. **Any substance or material in a quantity or form that poses an unreasonable risk to safety or health and property when transported in commerce.**
      2. **Any substance that must be placarded when moving in interstate commerce.**
   2. **Emergency Response Personnel definition:**
      1. **Any element, compound, or combination thereof, which is flammable, corrosive, etc. and which because of handling, storage, processing, or packaging may have detrimental effects on operating and emergency personnel, the public, equipment, and, or the environment.**
2. **Properties of Hazardous Materials**
   1. **Vapor density**
      1. **The weight of a gas or vapor compared to an equal volume of air, with air being assigned a vapor density of 1. Vapors with a density of less than 1 tend to rise, while vapors with a density greater than 1 tend to settle**
      2. **This is at ambient temperature. Any gas that is heated will become less dense and any gas that is cooled becomes more dense**
   2. **Specific gravity**
      1. **The weight of a solid or liquid compared to the weight of an equal volume of water, with water being assigned a specific gravity of 1**
      2. **Substances having a specific gravity of less than 1 are lighter than water and will float on water, while those having a specific gravity greater than 1 are heavier than water and will sink in water**
   3. **Water solubility**
      1. **The ability of a substance to mix with water**
   4. **Flash point**
      1. **The lowest temperature a liquid has to be at which a flammable liquid produces enough vapors and when mixed with the oxygen in the air will burn if given an ignition source.**
   5. **Ignition temperature**
      1. **The minimum temperature required to initiate or cause self sustained combustion independent of an ignition source.**
   6. **Flammable range**
      1. **Percentage range of flammable vapors per volume of air.**
   7. **L.E.L Lower Explosive Limit**
      1. **The lower percentage of the explosive range**
   8. **Too lean to burn**
      1. **Percent vapors below the L.E.L.**
   9. **U.E.L. Upper Explosive Limit**
      1. **The higher percentage of the explosive range**
   10. **Too rich to burn**
       1. **Percent vapors above the U.E.L.**
       2. **D.O.T classifies a gas as flammable if it;**
          1. **Has a L.E.L. below 13% in air**
          2. **Has a flammable range greater than 12 percentage points no matter how wide or narrow the range**
   11. **Toxicity**
       1. **The ability of a chemical substance to produce injury once it reaches a susceptible site in or on living tissue.**
       2. **T.L.V. Threshold Limit Value:** 
          1. **The maximum exposure a person should receive over an 8 hour shift during a 40 hour work week.**
       3. **S.T.E.L. Short Term Exposure Limit**
          1. **The maximum exposure a person should receive in a 15 minute period. Limit of 4 exposures in 1 day with an one hour break after each exposure**
       4. **I.D.L.H. Immediately Dangerous To life & Health**
          1. **The exposure that is dangerous to the life and health of people.**
   12. **Oxidizing Ability**
       1. **Any substance that yields oxygen readily to stimulate combustion**
   13. **Corrosive / Caustic**
       1. **Terms used to describe substances that actively attack metal or skin**
3. **Where can Hazardous Materials be found?** 
   1. **Everywhere**
4. **How can Hazardous Materials be recognized?**
   1. **By placards and labels**
5. **Recognition information**
   1. **UN Class number   
      (bottom of placard)**
   2. **Hazard class or ID number  
      on placard or orange panel**
   3. **Symbols and colors**
   4. **Name of material**
6. ***CLASSES & DIVISIONS***
   1. **The DOT has classified hazardous materials according to their primary danger and assigned standardized symbols to identify the classes**
   2. **Materials are grouped by their major hazardous characteristic and many materials will have other hazards as well**
   3. ***Example: A material may be poisonous, corrosive, and flammable but will only be grouped with whichever is considered the worst***
   4. **Anhydrous ammonia F.R. 16-23% but listed as nonflammable**
7. **Explosive placard.**
   1. **Color**
      1. **Orange with black lettering**
   2. **Symbol**
      1. **Bursting ball**
   3. **U.N. # 1 at bottom**
   4. **Hazard class or 4 digit number I.D. in center**
   5. **Explosive A** 
      1. **Detonating or otherwise of maximum hazard.**
   6. **Explosive B**
      1. **In general, function by rapid combustion (deflagrate) rather than detonation and include some explosive devices such as special fireworks, flash powders, etc.**
   7. **Explosive C** 
      1. **Certain types of manufactured article containing “A” explosives or “B” explosives, or both, as components but in restricted quantities and certain types of explosives.**
   8. **Blasting Agent**
      1. **A material designed for blasting which has been tested and found to be so insensitive that there is very little probability of accidental initiation to explosion or of transition from deflagration to detonation.**
   9. **Explosive Definition**
      1. **Explosive**
         1. **Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion, with substantially instantaneous release of gas and heat.**
      2. **Detonation**
         1. **Almost instantaneous decomposition of an explosive accompanied by high temperature shock wave. Gas pressures can soar above one million psi and temperatures of 6000°F are common.**
         2. **It occurs at supersonic speed, above 3,300 feet per second and up to 29,000 feet per second.**
      3. **Deflagration**
         1. **Burn intensely. A very rapid auto-combustion of particles of an explosive as a surface phenomenon occurring at a subsonic rate below 3,300 feet per second**
8. **Flammable & Non-Flammable Gas Placards**
   1. **Color** 
      1. **Green or red with white lettering**
      2. **White or yellow with black lettering**
   2. **Symbol**
      1. **Cylinder**
      2. **Flame**
      3. **Skull**
      4. **Flaming ball**
   3. **U.N. # — 2**
   4. **Hazard class or 4 digit ID**
   5. **Always cool or remove from a fire area**
   6. **Best extinguished by stopping the flow of gas**
9. **Flammable or Combustible Placard**
   1. **Color**
      1. **Red with white lettering**
   2. **Symbol**
      1. **Flame**
   3. **U.N. # 3**
   4. **Hazard class or 4 digit # I.D.**
      1. **Combustible**
      2. **Flammable**
   5. **Flammable liquid**
      1. **Any liquid having a flash point at or below 141°F. DOT**
      2. **Any liquid having a flash point at or below 100°F. NFPA**
      3. **For the Coast Guard it is 80°F or below**
   6. **Combustible liquid**
      1. **Any liquid having a flash point above 141°F. DOT**
      2. **Any liquid having a flash point above 100°F. NFPA**
      3. **For the Coast Guard it is above 80°F.**
   7. **Flammable gas**
      1. **Any material or mixture having in the container an absolute pressure exceeding 40 psi at 70°F or regardless of the pressure at 70°F having an absolute pressure exceeding 104 psi at 130°F or any liquid flammable material having a vapor pressure exceeding 40 psi at 100°F and provided that either a mixture of 13% or less by volume with air forms a flammable mixture or the flammable range with air is wider than 12 percentage points regardless of the lower limit.**
10. **Flammable Solids Placard**
    1. **Flammable solids**
       1. **Any solid material, other than the one classified as an explosive, which, under conditions normally incident to transportation is liable to cause fires through friction, retained heat from manufacturing or processing or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation hazard.**
    2. **Flammable Solid Dangerous When Wet:**
       1. **Same definition as above with the additional fact that water will accelerate the reaction.**
    3. **Spontaneously combustible substances**
    4. **Color**
       1. **Varies with black or white lettering**
    5. **Symbol**
       1. **Flame / slash W**
    6. **U.N. # - 4**
11. **Oxidizing Materials Placard**
    1. **Oxygen**
       1. **A colorless, odorless, gaseous chemical element, essential to life, which supports combustion. At extremely low temperature the gas liquefies.**
    2. **Oxidizer**
       1. **A substance that yields oxygen readily to stimulate the combustion of organic matter.**
    3. **Organic Peroxide**
       1. **An organic compound containing the —O—O— structure and which may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals.**
    4. **Color**
       1. **Yellow with black lettering**
    5. **Symbol**
       1. **Circle with flame**
    6. **U.N. # 5**
    7. **Hazard class or 4 digit ID**
12. **Poisonous Materials Placard**
    1. **Poison**
       1. **Poison A:**
          1. **Poisonous gases or liquids of such a nature that a very small amount of the gas or vapor of the liquid mixed with air is dangerous to life.**
       2. **Poison B:**
          1. **Poisonous liquid or solid which are known to be so toxic to humans as to afford a hazard to health during transportation.**
    2. **Poison Gas**
       1. **Chlorine**
    3. **Biohazard**
    4. **Color**
       1. **White with black lettering**
    5. **Symbol**
       1. **Skull & Crossbones**
    6. **U.N. # 6**
    7. **Hazard class or 4 digit ID #**
13. **Radioactive Material Placard**
    1. **Vehicle placards are not required for Radioactive I and II materials.**
    2. **Radioactive III materials require vehicle placards.**
    3. **Packages containing Radioactive I, II, or III materials require labels.**
    4. **Radioactive I**
       1. **Packages which may be transported in unlimited numbers and in any arrangement, and which require no nuclear criticalness safety controls during transportation**
    5. **Radioactive II**
       1. **Packages which may be transported together in any arrangement but in numbers which do not exceed an aggregate transport index of 50.**
       2. **No nuclear criticalness safety control by the shipper during transportation.**
    6. **Radioactive III**
       1. **Shipment of packages which do not meet the requirements of Class I and Class II and which are controlled to provide nuclear criticalness safety in transportation by special arrangements between the shipper and the carrier.**
    7. **Color**
       1. **White and yellow with black lettering — Radioactive III.**
    8. **Symbol**
       1. **Propeller**
    9. **U.N. # — 7**
    10. **Hazard class or 4 digit ID #**
14. **Corrosive Materials Placard**
    1. **Corrosive**
       1. **A liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact, or in the case of leakage from it’s packaging, a liquid that has a severe corrosion rate on steel.**
    2. **Color**
       1. **White lettering on a black background & Black lettering on a white background**
    3. **Symbol**
       1. **Test Tube dripping a liquid on a hand & metal.**
    4. **U.N. # — 8**
    5. **Hazard class or 4 digit ID #.**
15. **ORM Placard**
    1. **Miscellaneous hazardous materials not covered by any of the other classes**
    2. **ORM –D**
    3. **Forbidden**
    4. **Marine Pollutant**
    5. **Elevated Temp.**
16. **Hazardous Material Release**
    1. **Containers**
       1. **Type, design, and construction**
       2. **Pressurized vs. non-pressurized**
    2. **Container stress**
       1. **Thermal**
       2. **Mechanical**
       3. **Chemical**
       4. **Internal vs. External**
          1. **Internal**
             1. **Overfill**
             2. **Reaction of chemicals**
          2. **External**
             1. **Fire**
             2. **Collision**
             3. **Breach types**
             4. **Crack**
             5. **Puncture**
             6. **Split**
             7. **Tear**
             8. **Disintegration**
    3. **Release and Exposures** 
       1. **Release** 
          1. **Cloud**
          2. **Plume**
          3. **Stream**
       2. **Irregular**
          1. **Exposures**
          2. **People**
          3. **Systems**
          4. **Property**
          5. **Environment**
    4. **Information needed at the scene. Where does it come from?** 
       1. **The container.**
          1. **Placards**
          2. **Labels on the container**
          3. **SDS**
       2. **Type of container**
          1. **Pressurized?**
          2. **Special shape**
    5. **Information to get**
       1. **Name of product**
          1. **Chemical name.**
          2. **Trade name.**
       2. **Manufacturer.**
          1. **Name**
          2. **Address**
          3. **Telephone number.**
       3. **Type container and size.**
          1. **Drum**
          2. **Cylinder**
          3. **Carton.**
          4. **Etc.**
       4. **Size of spill or leak.**
          1. **Gallons per minute**
          2. **Square feet.**
          3. **Pounds spilled.**
       5. **Physical state of the chemical.**
          1. **Solid**
          2. **Liquid.**
          3. **Gas.**
    6. **Reference materials**
       1. **Ship’s Hazardous Cargo Manifest.**
       2. **Pre-plans**
       3. **S.D.S. - Safety Data Sheets**
       4. **Reference Books**
       5. **D.O.T. Emergency Response Guidebook**
       6. **CHRIS Manual**
       7. **Chemical Data Guide**
       8. **Many other books.**
       9. **CHEMTREC**
          1. **Service provided by chemical manufactures**
          2. **1-800-424-9300**
          3. **Call only for emergencies**
    7. **What information can you get from these references.**
       1. **Flash point.**
       2. **Vapor density**
       3. **Specific gravity.**
       4. **Explosive range.**
       5. **Solubility**
       6. **Reactivity**
       7. **Health hazards**
       8. **Level of protective clothing needed.**
          1. **Level A: Total encapsulating - suit resists chemicals - no penetration.**
          2. **Level B: Respiratory protection - turnout gear**
          3. **Level C: Air purifying respirators**
    8. **Size-up of Hazardous Material Incident**
       1. **Problem Definition**
       2. **Type of material involved.**
       3. **Potential hazards.**
       4. **Stage of incident.**
       5. **Type of container**
       6. **Condition of the container**
       7. **Behavior of the container**
    9. **Modifying conditions**
       1. **Location.**
       2. **Time**
       3. **Weather**
       4. **Temperature**
       5. **Rain**
       6. **Wind direction.**
    10. **Potential hazards**
        1. **Life hazard.**
           1. **Civilian**
           2. **Emergency response personnel**
        2. **Area that may be affected.**
        3. **Physical state of the material.**
        4. **How will it spread**
        5. **Control measures.**
        6. **Resources.**
        7. **Number of trained personnel.**
        8. **Amount and capability of equipment.**
        9. **Type of extinguishing agent.**
        10. **Diking material**
        11. **Control of the area.**
        12. **Hot zone**
        13. **Decontamination zone.**
        14. **Safe zone.**
    11. **Basic objectives**
        1. **Only rescue injured or endangered persons if you won’t become part of the problem.**
           1. **If you have to be rescued, you have made the situation worse.**
        2. **Prevent container failure.**
        3. **Contain or neutralize the material.**
        4. **Extinguish ignited material.**
        5. **Protect all exposures.**
        6. **Use all additional resources that are available.**
    12. **Size-Up of Hazardous Material Incident**
        1. **What Do I Have?**
           1. **Type of Material**
           2. **Immediate and Potential Hazards**
           3. **Stage of Incident**
           4. **Spill, spill with fire, spill with fire-people trapped, explosion……**
           5. **Type and Condition of container**
           6. **Behavior of Release- air, ground, water**
        2. **Where Is It Going?**
           1. **Modifying Conditions**
              1. **Location**
              2. **Time**
              3. **Weather**
              4. **Temperature**
              5. **Rain**
              6. **Wind and tide**
              7. **Potential Hazards**
           2. **Life hazard**
              1. **Emergency response personnel**
           3. **Uphill, upwind, upstream**
           4. **Areas that may be affected**
           5. **Physical state of material and how it will spread**
        3. **What Do I Have To Do To Stop It?**
           1. **Resources**
              1. **Number of trained personnel**
              2. **Amount and capacity of equipment**

**Level A- total encapsulating- chemical resistant-no penetration**

**Level B- respiratory protection- turnout gear**

**Level C- APR- gloves-splash protection**

* + - 1. **Type of extinguishing / containing equipment**
      2. **Additional Resources**
         1. **Coast Guard, EPA, private resources, etc.**
      3. **Control of Zone**
         1. **Hot zone**
         2. **Decontamination zone**
         3. **Safe zone**

**Lesson 10: Students prepare contingency plans to use for drills and for fighting actual fires**

1. **Emergency Muster List**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Station  No. | Rating | Name | Emergency  Station | Boat  No. | Abandon Ship Station |
| A | Master |  | Bridge in Command |  |  |
| 1 | Chief Officer |  | On Scene in Charge |  |  |
| 2 | Second Mate |  | Fire Team #1 Leader |  |  |
| 3 | Third Mate |  | On Bridge Communications |  |  |
| 4 | Chief Engineer |  | Engine Spaces in Charge |  |  |
| 5 | Third Engineer |  | Engine Control Room |  |  |
| 6 | AB #1 |  | Relieve the Wheel |  |  |
| 7 | AB #2 |  | Fire Team #1 Nozzle |  |  |
| 8 | AB #3 |  | Fire Team #1 Hose |  |  |
|  |  |  | Fire Team #2 Leader |  |  |
|  |  |  | Fire Team #2 Nozzle |  |  |
|  |  |  | Fire Team #2 Hose |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

1. **Muster List by Location**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Station  No. | Rating | Name | Emergency  Station | Boat  No. | Abandon Ship Station |
| **BRIDGE** | | | | | |
| A | Master |  | Bridge in Command |  |  |
| 1 | Chief Officer |  | On Scene in Charge |  |  |
| 3 | Third Mate |  | On Bridge Communications |  |  |
| 6 | AB #1 |  | Relieve the Wheel |  |  |
| **ENGINE CONTROL ROOM** | | | | | |
| 4 | Chief Engineer |  | Engine Spaces in Charge |  |  |
| 5 | Third Engineer |  | Engine Control Room |  |  |
| **FIRE TEAM #1** | | | | | |
| 2 | Second Mate |  | Fire Team #1 Leader |  |  |
| 7 | AB #2 |  | Fire Team #1 Nozzle |  |  |
| 8 | AB #3 |  | Fire Team #1 Hose |  |  |
| **FIRE TEAM #2** | | | | | |
|  |  |  | Fire Team #2 Leader |  |  |
|  |  |  | Fire Team #2 Nozzle |  |  |
|  |  |  | Fire Team #2 Hose |  |  |

**Fire Control Plan for any Space**

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
12. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
13. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
14. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Lesson 10: Fire Cause Investigation**

**Video:**

**Fire Down Below**

**Investigative Report**

Investigator Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_

Location of the Incident:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Time & Date of Incident: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Type of Investigation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Personnel Involved: Name Rank

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cause of the Incident: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Factors Leading Up to the Incident: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Contributing Factors: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Time Victim Reported Onboard: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Time Victim Was Put To Work: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What was the Indoctrination Procedure? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Initial Actions Taken to extinguish the Fire: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Actions Taken after the Initial Attempt: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Was Anyone Hurt or Killed? Name Injury

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Who found the Victim? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Where was the Victim Found? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If injured, who provided care?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Investigator’s Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Recommendations:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Lesson 11. XVR Simulations for Advanced Firefighting**

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| --- | --- |
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|  |
| 31 May 2012 |

Circular 1432:

# REVISED GUIDELINES FOR THE MAINTENANCE AND INSPECTION OF FIRE PROTECTION SYSTEMS AND APPLIANCES

1. The Maritime Safety Committee, at its ninetieth session (16 to 25 May 2012), having considered a proposal by the Sub-Committee on Fire Protection, at its fifty-fifth session, and recognizing the need to include maintenance and inspection guidelines for the latest advancements in fire-protection systems and appliances, approved the Revised Guidelines for the maintenance and inspection of fire protection systems and appliances, as set out in the annex.
2. Member Governments are invited to apply the annexed Guidelines when performing maintenance, testing and inspections in accordance with SOLAS regulation II-2/14.2.2.1 on or after 31 May 2013 and bring the annexed Guidelines to the attention of shipowners, shipmasters, ships' officers and crew and all other parties concerned.
3. This circular supersedes MSC/Circ.850.

# ANNEX

**REVISED GUIDELINES FOR THE MAINTENANCE AND INSPECTION OF FIRE PROTECTION SYSTEMS AND APPLIANCES**

1. **Application**

These Guidelines apply to all ships and provide the minimum recommended level of maintenance and inspections for fire protection systems and appliances. This information may be used as a basis for the ship's onboard maintenance plan required by SOLAS regulation II-2/14. These Guidelines do not address maintenance and inspection of fixed carbon dioxide systems or portable fire extinguishers. Refer to the comprehensive instructions provided in the Guidelines for the maintenance and inspections of fixed carbon dioxide fire-extinguishing systems (MSC.1/Circ.1318) for fixed carbon dioxide systems, and in the Improved Guidelines for marine portable fire extinguishers (resolution A.951(23)) for portable fire extinguishers.

# Operational readiness

All fire protection systems and appliances should always be in good order and readily available for immediate use while the ship is in service. If a fire protection system is undergoing maintenance, testing or repair, then suitable arrangements should be made to ensure safety is not diminished through the provision of alternate fixed or portable fire protection equipment or other measures. The onboard maintenance plan should include provisions for this purpose.

# Maintenance and testing

* 1. Onboard maintenance and inspections should be carried out in accordance with the ship's maintenance plan, which should include the minimum elements listed in sections 4 to 10 of these Guidelines.
  2. Certain maintenance procedures and inspections may be performed by competent crew members who have completed an advanced fire-fighting training course, while others should be performed by persons specially trained in the maintenance of such systems. The onboard maintenance plan should indicate which parts of the recommended inspections and maintenance are to be completed by trained personnel.
  3. Inspections should be carried out by the crew to ensure that the indicated weekly, monthly, quarterly, annual, two-year, five-year, and ten-year actions are taken for the specified equipment, if provided. Records of the inspections should be carried on board the ship, or may be computer-based. In cases where the inspections and maintenance are carried out by trained service technicians other than the ship's crew, inspection reports should be provided at the completion of the testing.
  4. In addition to the onboard maintenance and inspections stated in these Guidelines, manufacturer's maintenance and inspection guidelines should be followed.
  5. Where particular arrangements create practical difficulties, alternative testing and maintenance procedures should be to the satisfaction of the Administration.

# Weekly testing and inspections

* 1. Fixed fire detection and alarm systems

Verify all fire detection and fire alarm control panel indicators are functional by operating the lamp/indicator test switch.

* 1. Fixed gas fire-extinguishing systems
     1. verify all fixed fire-extinguishing system control panel indicators are functional by operating the lamp/indicator test switch; and
     2. verify all control/section valves are in the correct position.
  2. Fire doors

Verify all fire door control panel indicators, if provided, are functional by operating the lamp/indicator switch.

* 1. Public address and general alarm systems

Verify all public-address systems and general alarm systems are functioning properly.

* 1. Breathing apparatus

Examine all breathing apparatus and EEBD cylinder gauges to confirm they are in the correct pressure range.

* 1. Low-location lighting

Verify low-location lighting systems are functional by switching off normal lighting in selected locations.

* 1. Water mist, water spray and sprinkler systems

1. verify all control panel indicators and alarms are functional;
2. visually inspect pump unit and its fittings; and
3. check the pump unit valve positions, if valves are not locked, as applicable.

# Monthly testing and inspections

Monthly inspections should be carried out to ensure that the indicated actions are taken for the specified equipment.

* 1. Fire mains, fire pumps, hydrants, hoses, and nozzles

1. verify all fire hydrants, hose and nozzles are in place, properly arranged, and are in serviceable condition;
2. operate all fire pumps to confirm that they continue to supply adequate pressure; and
3. emergency fire pump fuel supply adequate, and heating system in satisfactory condition, if applicable.
   1. Fixed gas fire-extinguishing systems

Verify containers/cylinders fitted with pressure gauges are in the proper range and the installation free from leakage.

* 1. Foam fire-extinguishing systems

Verify all control and section valves are in the proper open or closed position, and all pressure gauges are in the proper range.

* 1. Water mist, water spray and sprinkler systems

1. verify all control, pump unit and section valves are in the proper open or closed position;
2. verify sprinkler pressure tanks or other means have correct levels of water;
3. test automatic starting arrangements on all system pumps so designed;
4. verify all standby pressure and air/gas pressure gauges are within the proper pressure ranges; and
5. test a selected sample of system section valves for flow and proper initiation of alarms.

(Note – The valves selected for testing should be chosen to ensure that all valves are tested within a one-year period.)

* 1. Firefighter's outfits

Verify lockers providing storage for fire-fighting equipment contain their full inventory and equipment is in serviceable condition.

* 1. Fixed dry chemical powder systems

Verify all control and section valves are in the proper open or closed position, and all pressure gauges are in the proper range.

* 1. Fixed aerosol extinguishing systems

1. verify all electrical connections and/or manual operating stations are properly arranged, and are in proper condition; and
2. verify the actuation system/control panel circuits are within manufacturer's specifications.
   1. Portable foam applicators

Verify all portable foam applicators are in place, properly arranged, and are in proper condition.

* 1. Wheeled (mobile) fire extinguishers

Verify all extinguishers are in place, properly arranged, and are in proper condition.

* 1. Fixed fire detection and alarm systems

Test a sample of detectors and manual call points so that all devices have been tested within five years. For very large systems the sample size should be determined by the Administration.

# Quarterly testing and inspections

Quarterly inspections should be carried out to ensure that the indicated actions are taken for the specified equipment:

* 1. Fire mains, fire pumps, hydrants, hoses and nozzles Verify international shore connection(s) is in serviceable condition.
  2. Foam fire-extinguishing systems

Verify the proper quantity of foam concentrate is provided in the foam system storage tank.

* 1. Ventilation systems and fire dampers Test all fire dampers for local operation.
  2. Fire doors

Test all fire doors located in main vertical zone bulkheads for local operation.

# Annual testing and inspections

Annual inspections should be carried out to ensure that the indicated actions are taken for the specified equipment:

* 1. Fire mains, fire pumps, hydrants, hoses and nozzles

1. visually inspect all accessible components for proper condition;
2. flow test all fire pumps for proper pressure and capacity. Test emergency fire pump with isolation valves closed;
3. test all hydrant valves for proper operation;
4. pressure test a sample of fire hoses at the maximum fire main pressure, so that all fire hoses are tested within five years;
5. verify all fire pump relief valves, if provided, are properly set;
6. examine all filters/strainers to verify they are free of debris and contamination; and
7. nozzle size/type correct, maintained and working.
   1. Fixed fire detection and fire alarm systems
8. test all fire detection systems and fire detection systems used to automatically release fire-extinguishing systems for proper operation, as appropriate;
9. visually inspect all accessible detectors for evidence of tampering obstruction, etc., so that all detectors are inspected within one year; and
10. test emergency power supply switchover.
    1. Fixed gas fire-extinguishing systems
11. visually inspect all accessible components for proper condition;
12. externally examine all high pressure cylinders for evidence of damage or corrosion;
13. check the hydrostatic test date of all storage containers;
14. functionally test all fixed system audible and visual alarms;
15. verify all control/section valves are in the correct position;
16. check the connections of all pilot release piping and tubing for tightness;
17. examine all flexible hoses in accordance with manufacturer's recommendations;
18. test all fuel shut-off controls connected to fire-protection systems for proper operation;
19. the boundaries of the protected space should be visually inspected to confirm that no modifications have been made to the enclosure that have created un-closeable openings that would render the system ineffective; and
20. if cylinders are installed inside the protected space, verify the integrity of the double release lines inside the protected space, and check low pressure or circuit integrity monitors on release cabinet, as applicable.
    1. Foam fire-extinguishing systems
21. visually inspect all accessible components for proper condition;
22. functionally test all fixed system audible alarms;
23. flow test all water supply and foam pumps for proper pressure and capacity, and confirm flow at the required pressure in each section (Ensure all piping is thoroughly flushed with fresh water after service.);
24. test all system cross connections to other sources of water supply for proper operation;
25. verify all pump relief valves, if provided, are properly set;
26. examine all filters/strainers to verify they are free of debris and contamination;
27. verify all control/section valves are in the correct position;
28. blow dry compressed air or nitrogen through the discharge piping or otherwise confirm the pipework and nozzles of high expansion foam systems are clear of any obstructions, debris, and contamination. This may require the removal of nozzles, if applicable;
29. take samples from all foam concentrates carried on board and subject them to the periodical control tests in MSC.1/Circ.1312, for low expansion foam, or MSC/Circ.670 for high expansion foam.

(Note: Except for non-alcohol resistant foam, the first test need not be conducted until 3 years after being supplied to the ship.); and

1. test all fuel shut-off controls connected to fire-protection systems for proper operation.
   1. Water mist, water spray and sprinkler systems
2. verify proper operation of all water mist, water-spray and sprinkler systems using the test valves for each section;
3. visually inspect all accessible components for proper condition;
4. externally examine all high pressure cylinders for evidence of damage or corrosion;
5. check the hydrostatic test date of all high pressure cylinders;
6. functionally test all fixed system audible and visual alarms;
7. flow test all pumps for proper pressure and capacity;
8. test all antifreeze systems for adequate freeze protection;
9. test all system cross connections to other sources of water supply for proper operation;
10. verify all pump relief valves, if provided, are properly set;
11. examine all filters/strainers to verify they are free of debris and contamination;
12. verify all control/section valves are in the correct position;
13. blow dry compressed air or nitrogen through the discharge piping of dry pipe systems, or otherwise confirm the pipework and nozzles are clear of any obstructions. This may require the removal of nozzles, if applicable;
14. test emergency power supply switchover, where applicable;
15. visually inspect all sprinklers focusing in areas where sprinklers are subject to aggressive atmosphere (like saunas, spas, kitchen areas) and subject to physical damage (like luggage handling areas, gyms, play rooms, etc.) so that all sprinklers are inspected within one year;
16. check for any changes that may affect the system such as obstructions by ventilation ducts, pipes, etc.;
17. test a minimum of one section in each open head water mist system by flowing water through the nozzles. The sections tested should be chosen so that all sections are tested within a five-year period; and
18. test a minimum of two automatic sprinklers or automatic water mist nozzles for proper operation.
    1. Ventilation systems and fire dampers
19. test all fire dampers for remote operation;
20. verify galley exhaust ducts and filters are free of grease build-up; and
21. test all ventilation controls interconnected with fire-protection systems for proper operation.
    1. Fire doors

Test all remotely controlled fire doors for proper release.

* 1. Breathing apparatus

1. check breathing apparatus air recharging systems, if fitted, for air quality;
2. check all breathing apparatus face masks and air demand valves are in serviceable condition; and
3. check EEBDs according to maker's instructions.
   1. Fixed dry chemical powder systems
4. visually inspect all accessible components for proper condition;
5. verify the pressure regulators are in proper order and within calibration; and
6. agitate the dry chemical powder charge with nitrogen in accordance with system manufacturer's instructions.

(Note: Due to the powder's affinity for moisture, any nitrogen gas introduced for agitation must be moisture free.)

* 1. Fixed aerosol extinguishing systems

Verify condensed or dispersed aerosol generators have not exceeded their mandatory replacement date. Pneumatic or electric actuators should be demonstrated working, as far as practicable.

* 1. Portable foam applicators

1. verify all portable foam applicators are set to the correct proportioning ratio for the foam concentrate supplied and the equipment is in proper order;
2. verify all portable containers or portable tanks containing foam concentrate remain factory sealed, and the manufacturer's recommended service life interval has not been exceeded;
3. portable containers or portable tanks containing foam concentrate, excluding protein based concentrates, less than 10 years old, that remain factory sealed can normally be accepted without the periodical foam control tests required in MSC.1/Circ.1312 being carried out;
4. protein based foam concentrate portable containers and portable tanks should be thoroughly checked and, if more than five years old, the foam concentrate should be subjected to the periodical foam control tests required in MSC.1/Circ.1312, or renewed; and
5. the foam concentrates of any non-sealed portable containers and portable tanks, and portable containers and portable tanks where production data is not documented, should be subjected to the periodical foam control tests required in MSC.1/Circ.1312.
   1. Wheeled (mobile) fire extinguishers
6. perform periodical inspections in accordance with the manufacturer's instructions;
7. visually inspect all accessible components for proper condition;
8. check the hydrostatic test date of each cylinder; and
9. for dry powder extinguishers, invert extinguisher to ensure powder is agitated.
   1. Galley and deep fat cooking fire-extinguishing systems

Check galley and deep fat cooking fire-extinguishing systems in accordance with the manufacturer's instructions.

# Two-year testing and inspections

Two-year inspections should be carried out to ensure that the indicated actions are taken for the specified equipment.

* 1. Fixed gas fire-extinguishing systems

1. all high pressure extinguishing agents cylinders and pilot cylinders should be weighed or have their contents verified by other reliable means to confirm that the available charge in each is above 95 per cent of the nominal charge. Cylinders containing less than 95 per cent of the nominal charge should be refilled; and
2. blow dry compressed air or nitrogen through the discharge piping or otherwise confirm the pipe work and nozzles are clear of any obstructions. This may require the removal of nozzles, if applicable.
   1. Fixed dry chemical powder systems
3. blow dry nitrogen through the discharge piping to confirm that the pipe work and nozzles are clear of any obstructions;
4. operationally test local and remote controls and section valves;
5. verify the contents of propellant gas cylinders (including remote operating stations);
6. test a sample of dry chemical powder for moisture content; and
7. subject the powder containment vessel, safety valve and discharge hoses to a full working pressure test.

# Five-year service

At least once every five years, the following inspections should be carried out for the specified equipment.

* 1. Fixed gas fire-extinguishing systems
  2. Perform internal inspection of all control valves.
  3. Foam fire-extinguishing systems

1. perform internal inspection of all control valves;
2. flush all high expansion foam system piping with fresh water, drain and purge with air;
3. check all nozzles to prove they are clear of debris; and
4. test all foam proportioners or other foam mixing devices to confirm that the mixing ratio tolerance is within +30 to -10% of the nominal mixing ratio defined by the system approval.
   1. Water mist, water spray and sprinkler systems
5. flush all ro-ro deck deluge system piping with water, drain and purge with air;
6. perform internal inspection of all control/section valves; and
7. check condition of any batteries, or renew in accordance with manufacturer's recommendations.
   1. Breathing apparatus

Perform hydrostatic testing of all steel self-contained breathing apparatus cylinders. Aluminum and composite cylinders should be tested to the satisfaction of the Administration.

* 1. Low-location lighting

Test the luminance of all systems in accordance with the procedures in resolution A.752(18).

* 1. Wheeled (mobile) fire extinguishers

Visually examine at least one extinguisher of each type manufactured in the same year and kept on board.

# Ten-year service

At least once every 10 years, the following inspections should be carried out for the specified equipment:

* 1. Fixed gas fire-extinguishing systems

1. perform a hydrostatic test and internal examination of 10 per cent of the system's extinguishing agent and pilot cylinders. If one or more cylinders fail, a total of 50 per cent of the onboard cylinders should be tested. If further cylinders fail, all cylinders should be tested;
2. flexible hoses should be replaced at the intervals recommended by the manufacturer and not exceeding every 10 years; and
3. if permitted by the Administration, visual inspection and NDT (non-destructive testing) of halon cylinders may be performed in lieu of hydrostatic testing.
   1. Water mist, water spray and sprinkler systems

Perform a hydrostatic test and internal examination for gas and water pressure cylinders according to flag Administration guidelines or, where these do not exist, EN 1968:2002 + A1.

* 1. Fixed dry chemical powder systems

Subject all powder containment vessels to hydrostatic or non-destructive testing carried out by an accredited service agent.

* 1. Fixed aerosol extinguishing systems

Condensed or dispersed aerosol generators to be renewed in accordance with manufacturer's recommendations.

* 1. Wheeled (mobile) fire extinguishers

All extinguishers together with propellant cartridges should be hydrostatically tested by specially trained persons in accordance with recognized standards or the manufacturer's instructions.

# Circular 1318

# GUIDELINES FOR THE MAINTENANCE AND INSPECTIONS OF FIXED CARBON DIOXIDE FIRE-EXTINGUISHING SYSTEMS

1. The Committee, at its eighty-sixth session (27 May to 5 June 2009), having considered the proposal by the Sub-Committee on Fire Protection, at its fifty-third session, approved Guidelines for the maintenance and inspections of fixed carbon dioxide fire-extinguishing systems, as set out in the annex.
2. Member Governments are invited to apply the annexed Guidelines when inspecting fixed carbon dioxide fire-extinguishing systems on board all ships and bring them to the attention of ship designers, ship-owners, equipment manufacturers, and other parties concerned.

# ANNEX

**GUIDELINES FOR THE MAINTENANCE AND INSPECTIONS OF FIXED CARBON DIOXIDE FIRE-EXTINGUISHING SYSTEMS**

1. **General**

These Guidelines provide the minimum recommended level of maintenance and inspections for fixed carbon dioxide fire-extinguishing systems on all ships, and are intended to demonstrate that the system is kept in good working order as specified in SOLAS regulation II-2/14.2.1.2. These Guidelines are intended to supplement the fire-extinguishing system manufacturer’s approved maintenance instructions. Certain maintenance procedures and inspections may be performed by competent crewmembers, while others should be performed by persons specially trained in the maintenance of such systems. The onboard maintenance plan should indicate which parts of the recommended inspections and maintenance should be completed by trained personnel.

# Safety

Whenever carbon dioxide fire-extinguishing systems are subjected to inspection or maintenance, strict safety precautions should be followed to prevent the possibility that individuals performing or witnessing the activities are placed at risk. Prior to performing any work, a safety plan should be developed to account for all personnel and establish an effective communications system between the inspection personnel and the on-duty crew. Measures to avoid accidental discharges such as locking or removing the operating arms from directional valves, or shutting and locking the system block valve should be taken as the initial procedure for the protection of personnel performing any maintenance or inspections. All personnel should be notified of the impending activities before work is begun.

# Maintenance and inspection plan

Fixed carbon dioxide fire-extinguishing systems should be kept in good working order and readily available for immediate use. Maintenance and inspections should be carried out in accordance with the ship’s maintenance plan having due regard to ensuring the reliability of the system. The onboard maintenance plan should be included in the ship’s safety management system and should be based on the system manufacturer’s recommendations including:

* 1. maintenance and inspection procedures and instructions;
  2. required schedules for periodic maintenance and inspections;
  3. listing of recommended spare parts; and
  4. records of inspections and maintenance, including corrective actions taken to maintain the system in operable condition.

# Monthly inspections

* 1. At least every 30 days a general visual inspection should be made of the overall system condition for obvious signs of damage, and should include verification that:
     1. all stop valves are in the closed position;
     2. all releasing controls are in the proper position and readily accessible for immediate use;
     3. all discharge piping and pneumatic tubing is intact and has not been damaged;
     4. all high pressure cylinders are in place and properly secured; and
     5. the alarm devices are in place and do not appear damaged.
  2. In addition, on low pressure systems the inspections should verify that:

1. the pressure gauge is reading in the normal range;
2. the liquid level indicator is reading within the proper level;
3. the manually operated storage tank main service valve is secured in the open position; and
4. the vapor supply line valve is secured in the open position.

# Annual inspections

The following minimum level of maintenance and inspections should be carried out in accordance with the system manufacturer’s instructions and safety precautions:

* 1. the boundaries of the protected space should be visually inspected to confirm that no modifications have been made to the enclosure that have created uncloseable openings that would render the system ineffective;
  2. all storage containers should be visually inspected for any signs of damage, rust or loose mounting hardware. Cylinders that are leaking, corroded, dented or bulging should be hydrostatically retested or replaced;
  3. system piping should be visually inspected to check for damage, loose supports and corrosion. Nozzles should be inspected to ensure they have not been obstructed by the storage of spare parts or a new installation of structure or machinery;
  4. the manifold should be inspected to verify that all flexible discharge hoses and fittings are properly tightened; and
  5. all entrance doors to the protected space should close properly and should have warning signs, which indicate that the space is protected by a fixed carbon dioxide system and that personnel should evacuate immediately if the alarms sound. All remote releasing controls should be checked for clear operating instructions and indication as to the space served.

# Minimum recommended maintenance

* 1. At least biennially (intervals of 2 years ± 3 months) in passenger ships or at each intermediate, periodical or renewal survey\* in cargo ships, the following maintenance should be carried out (to assist in carrying out the recommended maintenance, examples of service charts are set out in the appendix):
     1. all high-pressure cylinders and pilot cylinders should be weighed or have their contents verified by other reliable means to confirm that the available charge in each is above 90% of the nominal charge. Cylinders containing less than 90% of the nominal charge should be refilled. The liquid level of low pressure storage tanks should be checked to verify that the required amount of carbon dioxide to protect the largest hazard is available;
     2. the hydrostatic test date of all storage containers should be checked. High pressure cylinders should be subjected to periodical tests at intervals not exceeding 10 years. At the 10-year inspection, at least 10% of the total number provided should be subjected to an internal inspection and hydrostatic test\*\*. If one or more cylinders fail, a total of 50% of the onboard cylinders should be tested. If further cylinders fail, all cylinders should be tested. Flexible hoses should be replaced at the intervals recommended by the manufacturer and not exceeding every 10 years; and
     3. the discharge piping and nozzles should be tested to verify that they are not blocked. The test should be performed by isolating the discharge piping from the system and flowing dry air or nitrogen from test cylinders or suitable means through the piping.
  2. At least biennially (intervals of 2 years ± 3 months) in passenger ships or at each renewal survey\* in cargo ships, the following maintenance should be carried out by service technicians/specialists trained to standards accepted by the Administration:

1. where possible, all activating heads should be removed from the cylinder valves and tested for correct functioning by applying full working pressure through the pilot lines.

In cases where this is not possible, pilot lines should be disconnected from the cylinder valves and blanked off or connected together and tested with full working pressure from the release station and checked for leakage.

In both cases this should be carried out from one or more release stations when installed.

\* Refer to Survey guidelines under the Harmonized System of Survey and Certification, 2007 (resolution A.997(25)).

\*\* Refer to standard ISO 6406 – Periodic inspection and testing of seamless steel gas cylinders.

If manual pull cables operate the remote release controls, they should be checked to verify the cables and corner pulleys are in good condition and freely move and do not require an excessive amount of travel to activate the system;

1. all cable components should be cleaned and adjusted as necessary, and the cable connectors should be properly tightened. If the remote release controls are operated by pneumatic pressure, the tubing should be checked for leakage, and the proper charge of the remote releasing station pilot gas cylinders should be verified. All controls and warning devices should function normally, and the time delay, if fitted should prevent the discharge of gas for the required time period; and
2. after completion of the work, the system should be returned to service. All releasing controls should be verified in the proper position and connected to the correct control valves. All pressure switch interlocks should be reset and returned to service. All stop valves should be in the closed position.

# EXAMPLE SERVICE CHARTS

HIGH PRESSURE CO2 SYSTEM

|  |  |  |  |
| --- | --- | --- | --- |
| Date: | Name of ship/unit: | IMO No.: |  |

**Technical description**

|  |  |  |
| --- | --- | --- |
| No. | Text | Value |
| 1 | Manufacturer |  |
| 2 | Number of main cylinders |  |
| 3 | Main cylinders capacity (each) |  |
| 4 | Number of pilot cylinders |  |
| 5 | Pilot cylinder capacity (each) |  |
| 6 | Number of distribution lines |  |
| 7 | Oldest cylinder pressure test date |  |
| 8 | Protected space(s) |  |
| 9 | Date flexible hoses fitted/renewed |  |

**Description of inspection/Tests**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Description | Carried out | Not carried out | Not applicable | Comment |
| 1 | Release controls and distribution valves secured to prevent accidental discharge |  |  |  |  |
| 2 | Contents in main cylinders checked by weighing |  |  |  |  |
| 3 | Contents in main cylinders checked by liquid level indicator |  |  |  |  |
| 4 | Contents of pilot cylinders checked |  |  |  |  |
| 5 | All cylinder valves visually inspected |  |  |  |  |
| 6 | All cylinder clamps and connections checked for tightness |  |  |  |  |
| 7 | Manifold visually inspected |  |  |  |  |
| 8 | Manifold tested for leakage, by applying dry working air |  |  |  |  |
| 9 | Main valve and distribution valves visually inspected |  |  |  |  |
| 10 | Main valve and distribution valves tested for operation |  |  |  |  |
| 11 | Time delay devices tested for correct setting\* |  |  |  |  |
| 12 | Remote release system visually inspected |  |  |  |  |
| 13 | Remote release system tested |  |  |  |  |
| 14 | Servo tubing/pilot lines pressure tested at maximum working pressure and checked for leakages and blockage |  |  |  |  |
| 15 | Manual pull cables, pulleys, gang releases tested, serviced and tightened/adjusted as necessary |  |  |  |  |
| 16 | Release stations visually inspected |  |  |  |  |
| 17 | Warning alarms (audible/visual) tested |  |  |  |  |
| 18 | Fan stop tested\* |  |  |  |  |
| 19 | 10% of cylinders and pilot cylinder/s pressure tested every 10 years |  |  |  |  |
| 20 | Distribution lines and nozzles blown through, by applying dry working air |  |  |  |  |
| 21 | All doors, hinges and locks inspected\* |  |  |  |  |
| 22 | All instruction and warning signs on installation inspected |  |  |  |  |
| 23 | All flexible hoses renewed and check valves in manifold visually inspected every 10 years |  |  |  |  |
| 24 | Release controls and distribution valves reconnected and system put back in service |  |  |  |  |
| 25 | Inspection date tags attached |  |  |  |  |

\* If fitted as part of the CO2 system.

LOW PRESSURE CO2 SYSTEM

|  |  |  |  |
| --- | --- | --- | --- |
| Date: | Name of ship/unit: | IMO No.: |  |

**Technical description**

|  |  |  |
| --- | --- | --- |
| No. | Text | Value |
| 1 | Manufacturer |  |
| 2 | No. of tanks |  |
| 3 | Tanks capacity (tonnes) |  |
| 4 | Number of pilot cylinders |  |
| 5 | Pilot cylinder capacity (each) |  |
| 6 | Number of distribution lines |  |
| 7 | Protected space(s) |  |

**Description of inspection/Tests**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Description | Carried out | Not carried out | Not applicable | Comment |
| 1 | Tank main service valve closed and secured to prevent accidental discharge |  |  |  |  |
| 2 | Distribution valves verified closed |  |  |  |  |
| 3 | Check correct function of level indicator |  |  |  |  |
| 4 | Contents of CO2 tank checked by tank level indicator |  |  |  |  |
| 5 | Contents of CO2 tank checked by riser tube reading |  |  |  |  |
| 6 | Contents of CO2 tank checked by level control valve |  |  |  |  |
| 7 | Supports of tank inspected |  |  |  |  |
| 8 | Insulation on tank inspected |  |  |  |  |
| 9 | Safety valves of tank inspected |  |  |  |  |
| 10 | Safety valves of tank tested |  |  |  |  |
| 11 | Contents of pilot cylinders checked |  |  |  |  |
| 12 | Start/stop function of cooling compressors tested |  |  |  |  |
| 13 | All connected electrical alarms and indicators tested |  |  |  |  |
| 14 | Main manifold valve inspected |  |  |  |  |
| 15 | Main manifold valve tested |  |  |  |  |
| 16 | Distribution valves inspected |  |  |  |  |
| 17 | Distribution valves tested |  |  |  |  |
| 18 | Release stations inspected |  |  |  |  |
| 19 | Total flooding release mechanism inspected |  |  |  |  |
| 20 | Total flooding release mechanism tested |  |  |  |  |
| 21 | Time delay devices tested for correct setting\* |  |  |  |  |
| 22 | Warning alarms tested |  |  |  |  |
| 23 | Fan stop tested\* |  |  |  |  |
| 24 | Distribution lines and nozzles inspected |  |  |  |  |
| 25 | Distribution lines and nozzles tested |  |  |  |  |
| 26 | Distribution lines and nozzles blown through |  |  |  |  |
| 27 | All doors, hinges and locks inspected\* |  |  |  |  |
| 28 | All instruction plates inspected |  |  |  |  |
| 29 | Tank main service valve reopened and secured open |  |  |  |  |
| 30 | System put back in service |  |  |  |  |
| 31 | Inspection date tags attached |  |  |  |  |

\* If fitted as part of the CO2 system.

# Resolution A.951(23)

**Adopted on 5 December 2003**

**(Agenda item 17)**

**IMPROVED GUIDELINES FOR MARINE PORTABLE FIRE EXTINGUISHERS**

THE ASSEMBLY,

RECALLING Article 15(U) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines concerning maritime safety,

RECALLING ALSO that, by resolution A.602(15), it adopted the Revised Guidelines for Marine Portable Fire Extinguishers, to supplement the relevant requirements of chapter II-2 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, as well as chapter V of the Torremolinos International Convention for the Safety of Fishing Vessels, 1977,

RECOGNIZING the need to further improve the said Revised Guidelines following the adoption of amendments to chapter II-2 of the 1974 SOLAS Convention and of the 1993 Torremolinos Protocol to the 1977 Torremolinos Convention referred to above, and in the light of the experience gained from the application of the Revised Guidelines,

HAVING CONSIDERED the recommendation made by the Maritime Safety Committee at its seventy-fifth session,

1. ADOPTS the Improved Guidelines for Marine Portable Fire Extinguishers, the text of which is set out in the Annex to the present resolution;
2. RECOMMENDS Governments concerned to apply the annexed Improved Guidelines in conjunction with the appropriate requirements of the international instruments referred to above;
3. AUTHORIZES the Maritime Safety Committee to keep the Improved Guidelines under review and amend or extend them as necessary;
4. REVOKES resolution A.602(15).

ANNEX

# IMPROVED GUIDELINES FOR MARINE PORTABLE FIRE EXTINGUISHERS

1. **Scope**

These Guidelines have been developed to supplement the relevant requirements for marine portable fire extinguishers\* of the International Convention for the Safety of Life at Sea 74, as amended, the International Code for Fire Safety Systems (FSS Code) and the 1993 Torremolinos Protocol relating to the Torremolinos International Convention for the Safety of Fishing Vessels, 1977. The Guidelines are offered to Administrations to assist them in determining appropriate design and construction parameters. The status of the Guidelines is advisory. Their content is based on current practices and does not exclude the use of designs and materials other than those indicated below.

# Definitions

* 1. An *extinguisher* is an appliance containing an extinguishing medium, which can be expelled by the action of internal pressure and be directed into a fire. This pressure may be stored pressure or be obtained by release of gas from a cartridge.
  2. A *portable extinguisher* is one, which is designed to be carried and operated by hand, and which in working order has a total weight of not more than 50 pounds or 23 kg.
  3. *Extinguishing medium* is the substance contained in the extinguisher which is discharged to cause extinction of fire.
  4. *Charge of an extinguisher* is the mass or volume of the extinguishing medium contained in the extinguisher. The quantity of the charge of water or foam extinguishers is normally expressed in volume (litres) and that of other types of extinguishers in mass (kilograms) or (pounds).

# Classification

* 1. Extinguishers are classified according to the type of extinguishing medium they contain. At present the types of extinguishers and the uses for which they are recommended are as follows:

|  |  |
| --- | --- |
| **Extinguishing medium** | **Recommended for use on fires involving** |
| Water  Water with additives | wood, paper, textiles and similar materials |
| Foam | wood, paper, textiles and flammable liquids |
| Dry powder/dry chemical (standard/ classes B, C ) | flammable liquids, electrical equipment and flammable gases |
| Dry powder/dry chemical (multiple or general purpose/classes A, B, C) | wood, paper, textiles, flammable liquids, electrical equipment and flammable gases |
| Dry powder/dry chemical (metal) | combustible metals |
| Carbon dioxide | flammable liquids and electrical equipment |
| Wet chemical for class F or K | cooking grease, fats or oil fires |
| Clean agents\*\* |  |

\* Wherever in the text of these Guidelines the word *"portable extinguisher"* appears it *should* be taken as meaning "marine portable fire extinguisher".

\*\* Refer to the recommendations by the International Organization for Standardization, in particular Publication

* 1. A table is provided in the appendix which describes the general characteristics of each type of extinguisher.

# Construction

* 1. The construction of an extinguisher should be designed and manufactured for simple and rapid operation, and ease of handling.
  2. Extinguishers should be manufactured to a recognized national or international standard\*, which includes a requirement that the body, and all other parts subject to internal pressure, be tested:
     1. to a pressure of 5.5MPa (798 psi) or 2.7 times the normal working pressure, whichever is the higher, for extinguishers with a service pressure not exceeding 2.2 MPa (362 psi); or
     2. in accordance with the recognized standard for extinguishers with a service pressure exceeding 2.2 MPa (362 psi).
  3. In the design of components, selection of materials and determination of maximum filling ratios and densities, consideration should be given to the temperature extremes to which extinguishers may be exposed on board ships and operating temperature ranges specified in the recognized standards.

4.3 The materials of construction of exposed parts and adjoining dissimilar metals should be carefully selected to function properly in the marine environment.

# Fire classifications

* 1. Fire classifications are generally indicated as A, B, C, D and F (or K). There are currently two standards, defining classes of fires per the nature of the material undergoing combustion, as follows:

|  |  |
| --- | --- |
| **International Organization for Standardization**  **(ISO standard 3941)\*** | **National Fire Protection Association**  **(NFPA 10)** |
| **Class A:** Fires involving solid materials, usually of an organic nature, in which combustion normally takes place with the formation of glowing embers. | **Class A:** Fires in ordinary combustible materials such as wood, cloth, paper, rubber and many plastics. |
| **Class B:** Fires involving liquids or liquefiable  solids | **Class B:** Fires in flammable liquids, oils, greases, tars, oil base paints, lacquers and flammable gases. |
| **Class C:** Fires involving gases. | **Class C:** Fires, which involve energized electrical equipment where the electrical  non-conductivity of the extinguishing medium is of importance. (When electrical equipment is de-energized, extinguishers for class A or B fires may be used safely.) |
| **Class D:** Fires involving metals. | **Class D:** Fires in combustible metals such as magnesium, titanium, zirconium, sodium, lithium and potassium. |
| **Class F:** Fires involving cooking oils. | **Class K**: Fires involving cooking grease, fats and oils. |

**\*Comite Europeen de Normalisation (CEN standard EN2) closely follows ISO standard 3941.**

# Test specifications

* 1. Construction, performance and fire-extinguishing test specifications should be to the satisfaction of the Administration, having due regard to an established international standard\*.

# Criteria for assessing compliance with chapter 4 of the FSS Code and regulations V/20 and V/38 of the 1993 Torremolinos Protocol relating to the 1977 Torremolinos Convention

* 1. Chapter 4 of the FSS Code requires that extinguishers have a fire-extinguishing capability at least equivalent to that of a 9 L fluid extinguisher having a rating of 2A on class A fire which may be water or foam as required by the Administration. This equivalence may be demonstrated by fire test ratings determined according to an international, national or other recognized standard\*.
  2. The size and type of extinguishers should be dependent upon the potential fire hazards in the protected spaces while avoiding a multiplicity of types. Care should also be taken to ensure that the quantity of extinguishing medium released in small spaces does not endanger personnel.

# Marking of extinguishers

* 1. Each extinguisher should be clearly marked with the following minimum information:

1. name of the manufacturer;
2. types of fire and rating for which the extinguisher is suitable;
3. type and quantity of extinguishing medium;
4. approval details;
5. instructions for use and recharge (it is recommended that operating instructions be given in pictorial form, in addition to explanatory text in language understood by the likely user);
6. year of manufacture;
7. temperature range over which the extinguisher will operate satisfactorily; and
8. test pressure.

# Periodical inspections and maintenance

* 1. Extinguishers should be subject to periodical inspections in accordance with the manufacturer's instructions and serviced at intervals not exceeding one year.
     1. At least one extinguisher of each type manufactured in the same year and kept on board a ship should be test discharged at five yearly intervals (as part of a fire drill).
     2. All extinguishers together with propellant cartridges should be hydraulically tested in accordance with the recognized standard or the manufacturer's instruction at intervals not exceeding ten years.
     3. Service and inspection should only be undertaken by, or under the supervision of, a person with demonstrable competence, based on the inspection guide in table 9.1.3.
  2. Records of inspections should be maintained. The records should show the date of inspection, the type of maintenance carried out and whether or not a pressure test was performed.
  3. Extinguishers should be provided with a visual indication of discharge.
  4. Instructions for recharging extinguishers should be supplied by the manufacturer and be available for use on board.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ANNUAL INSPECTION** | | | | | |
| Safety clip and indicating devices | Check to see if the extinguisher may have been operated. | | | | |
| Pressure indicating device | Where fitted, check to see that the pressure is within limits. Check that dust covers on pressure indicating devices and relief valves are in place. | | | | |
| External examination | Inspect for corrosion, dents or damage which may affect the safe operation of the extinguisher. | | | | |
| Weight | Weigh the extinguisher and check the mass compared to the fully charged extinguisher. | | | | |
| Hose and nozzle | Check that hoses and nozzles are clear and undamaged. | | | | |
| Operating instructions | Check that they are in place and legible. | | | | |
| **INSPECTION AT RECHARGE** | | | | | |
| Water and foam charges | Remove the charge to a clean container if to be reused and check if it is still suitable for further use. Check any charge container. | | | | |
| Powder charges | Examine the powder for reuse. Ensure that it is free flowing and that there is no evidence of caking lumps or foreign bodies. | | | | |
| Gas cartridge | Examine for damage and corrosion. | | | | |
| **INSPECTION AT FIVE AND TEN YEAR INTERVALS** | | | | | |
| **INSPECTION AFTER DISCHARGE TEST** | | | | | |
| Air passages and operating mechanism | Prove clear passage by blowing through vent holes and vent devices in the cap. Check hose, nozzle strainer, discharge tube and breather valve, as applicable. Check the operating and discharge control. Clean and lubricate as required. | | | | |
| Operating mechanism | Check that the safety pin is removable and that the lever is undamaged. | | | | |
| Gas cartridge | Examine for damage and corrosion. Weigh the cartridge to ascertain that it is within prescribed limits. | | | | |
| O-rings washers and hose diaphragms | Check O-rings and replace hose diaphragms if fitted. | | | | |
| Water and foam bodies | Inspect the interior. Check for corrosion and lining deterioration. Check separate containers for leakage or damage. | | | | |
| Powder body | Examine the body and check internally for corrosion and lining deterioration. | | | | |
| **INSPECTION AFTER RECHARGE** | | | | | |
| Water and foam | Replace the charge in accordance with the manufacturer’s instructions. | | | | |
| Reassemble | Reassemble the extinguisher manufacturer’s instructions. | in | accordance | with | the |
| Maintenance label | Fill in entry on maintenance label, including full weight. | | | | |
| Mounting of extinguishers | Check the mounting bracket or stand. | | | | |
| Report | Complete a report on the state of maintenance of the extinguisher. | | | | |