

CHAPTER 6 - FIREFIGHTING

Time: Two hours

GOAL: Students will learn methods of prevention and control of fire aboard the vessel.

NEED STATEMENT:

1. You ARE the fire department when you have a fire at sea.
2. Good safety practices can prevent fires.
3. Hands-on practice with fire extinguishing agents increase your effectiveness in fighting a fire.

OBJECTIVES:

1. State applicable USCG requirements for firefighting equipment aboard own vessel.
2. Identify the four parts of the fire tetrahedron.
3. List five classes of fires and the appropriate extinguishing agent for each.
4. List five tactical considerations for fighting fire aboard the vessel.
5. Identify at least four "special hazard areas" aboard the vessel.

SKILLS CHECKLIST:

1. Extinguish a fire using a portable fire extinguisher.
2. Don a fireman's outfit and SCBA in less than 6 minutes. (If vessel so equipped) SCBA training is not covered here. Appropriate approved training is offered in all regions by various organizations. Find out who offers the training in your region.

EQUIPMENT NEEDED:

Turn-out gear and helmets with face shields recommended.

Burn pan

Fire extinguishers (15# CO₂, 20# dry chem or 2.2 gallon foam) enough for use by each student

Leather gloves

Road flare taped to a long handle or propane torch with long nozzle (for igniting fires)

TEACHING TIPS:

*Local examples of boat fires are plentiful and can be obtained from students, fire department, harbormaster, or USCG. Examine select accounts and discuss how the events were handled.

***WARNING:** Fires and firefighting are dangerous! Beware of toxic fumes produced by fires especially in enclosed spaces.

*Work with your local fire department to conduct a safe and well supervised practical with stand by equipment. They are also a source of turn out gear, coats and helmets with face shields which should be worn by students when extinguishing fires.

*Fire practicals are expensive; figure cost of recharging extinguishers into course fee.

*If the local fire department is not involved in the practical, call and notify them of the burn location.

*For more detailed information see page 5-14 for "Conducting Fire Fighting Practical."

*Check pollution restrictions and fire codes for your area before setting fires. Contact your local fire department to advise the day and time of your firefighting exercise.

INSTRUCTIONAL OUTLINE:

I. USCG REQUIREMENTS

A. Using pamphlet, *Federal Requirements for Commercial Fishing Industry Vessels*, locate the section on firefighting equipment and identify requirements for your own vessel.

1. USCG has their own rating system for fire extinguishing appliances.

a. Uses Roman numerals to indicate sizes of portable and semi-portable extinguishers, I being smallest, V being largest.

b. A,B,C, refer to class or type of fire. B-III indicates a medium size extinguisher for use on Type B fires (flammable liquids and gases).

II. FIRE SCIENCE

A. Fire is a rapid chemical reaction that combines fuel and oxygen to produce heat and light (oxidation).

1. During this reaction, fuels turn to vapor and mix with oxygen at a rapid rate.

2. An external source of heat is usually required to start the reaction.

3. Once started, the fire produces the heat needed to keep burning.

B. Fuel + Oxygen + Heat + Chain Reaction = Fire

1. The fire tetrahedron.

2. If one of these components is missing, a fire reaction cannot occur.

C. Fuels exist in three forms:

1. Solids – Must absorb a high level of heat energy in order to vaporize. Results in cooler burning than liquids or gases.

2. Liquids – most need little heat applied in order to vaporize; give off more heat when burning.

a. Flashpoint – the temperature at which liquids give off enough vapors to form an ignitable mixture at its surface.

3. Gases – exist in a vapor state. Highest heat value. Need little, in some cases, no heat source to ignite.

4. Boats are full of fuel sources for fires. Class should generate a list of sources in all three categories.

D. Oxygen

1. Air contains the oxygen necessary for burning; air is 21% oxygen.
2. Different fuels require varying amounts of oxygen to ignite.

E. Heat

1. Can be produced by:
 - a. Friction
 - b. Chemical reactions
 - c. Spontaneous combustion
 - d. Electricity (arcing, sparks, flame)
 - e. Open flames
2. Heat can travel from its point of origin to ignite nearby fuels:
 - a. Conduction – direct contact from one body to another. Heat can be conducted through solids, liquids and gases (i.e. through bulkheads).
 - b. Convection – transferred by a circulating medium like liquids or gas.
 - c. Radiation – travels via electromagnetic, light or radio wave.

III. CLASSES OF FIRE (based upon type of fuels)

- A. Class A – wood, paper, rubber, plastics. Usually leave ash.
- B. Class B – flammable liquids and gases.
- C. Class C – combination fire involving electricity.
- D. Class D – combustible metals and some chemical compounds.
- E. Class K – cooking oils.
- F. To remember: A (Ash), B (boils), C (current), D (different), K (kitchen)

IV. EXTINGUISHING AGENTS

- A. Break the fire tetrahedron by removing heat, oxygen, or fuels and disrupting the chain reaction.
- B. Water – removes heat. Class A/B fires.
 - 1. Turns to steam at 212 degrees and expands to 1700 times its original volume
 - 2. Use fog spray for protection, heat absorption and ventilation.
 - 3. Disadvantages:
 - a. Mass and weight can adversely affect vessel stability.
 - b. Corrosive.
 - c. Salt and fresh water conduct electricity.
- C. Foam – removes heat and oxygen. Class A/B
 - 1. Forms a blanket of water and chemical mixture which interrupt oxygen supply and cools the fire.
 - 2. Disadvantages:
 - a. Conducts electricity.
 - b. Contains water; can be corrosive.
 - c. Need to keep foam barrier intact.
- D. Carbon Dioxide (CO₂) removes oxygen, cools the fuel. Class B/C fires.
 - 1. Does not conduct electricity.
 - 2. Leaves no residue, but not safe for electronics.
 - 3. Non-toxic.
 - 4. Disadvantages:
 - a. CO₂ displaces oxygen, is heavier than air; in a confined space, operator must guard against suffocation.
 - b. Temperature, 108 degrees below zero, fahrenheit. Can cause frostbite.

- c. High reflash potential, especially if used outside.
- E. Dry Chemical – interrupts chain reaction; Class A/B/C or B/C depending on chemical used.
 - 1. Several types available.
 - 2. Does not conduct electricity.
 - 3. Very effective on Class B gasoline fires.
 - 4. Breaks the chain reaction with little or no cooling; reflash is possible if surrounding surfaces are hot.
 - 5. Disadvantages:
 - a. Corrosive.
 - b. Lots of residue; clean up.
 - c. Non-toxic but irritant; can cause alkaline burns.
- F. Halon – interrupts the chain reaction. Class A/B/C fires.
 - 1. Twice as effective as CO₂.
 - 2. Noncorrosive, nonconductor.
 - 3. No residue. Safe for electronics
 - 4. Disadvantages:
 - a. May become toxic; avoid inhalation. Can displace oxygen and lead to suffocation.
 - b. Destroys ozone; may limit product availability. Replacements are being developed, availability is limited.
- G. Dry Powders – Class D fires only.
Specialty item; must use specific powder for specific metals.
- H. Baking Soda – Class K fire (cooking oils)

V. EXTINGUISHING APPLIANCES

- A. Fixed fire extinguishing systems
 - 1. Designed for engine rooms and high risk enclosed spaces.
 - 2. Halon or CO₂.
 - 3. MUST be evacuated before activating; can suffocate occupants.
 - 4. Should have alarm and time delay on automatic activation device.
 - 5. Manual activation device should be located outside the protected area.
- B. Semi-portable
 - 1. Fixed cylinders.
 - 2. Hose reel to deliver extinguishing agent or cylinder on a wheeled cart.
- C. Portable Extinguishers
 - 1. Up to 55 pounds total weight.
 - 2. Designed for small fires; last 5-40 seconds depending on size.
 - 3. Stored pressure type – agent and pressure stored in the same cylinder; most have pressure gauges or must be weighed annually.
 - 4. Cartridge type – agent contained in main cylinder, expelling gas in separate cartridge that must be punctured to release.
 - 5. Inspect regularly for signs of corrosion, proper location, intact tamper tie and pin, full charge and condition of hose.
 - 6. Should be professionally serviced immediately after use.
 - 7. Stowage – vibration may pack powder. Should be periodically turned upside down and shaken.

VI. TACTICS FOR FIRE ABOARD VESSEL

- A. Alarm
 - 1. Sound the alarm.
 - 2. Account for crew.

3. MAYDAY – do not wait to see how things develop.
- B. Organize and Stage
1. Crew to pre-assigned stations with fire gear.
 2. Move survival gear to protected area – vessel may have to be abandoned.
 3. Lead an organized attack on fire.
- C. Restrict and Confine
1. Shut down fuel, ventilation and electricity to affected spaces.
 2. Position vessel so flames and gases are blown overboard.
 3. Establish boundaries; cool surrounding structures with water to prevent spreading.
- D. Attack and Extinguish
1. Charge hose lines; bring charged fire extinguishers.
 2. Crew works in pairs.
 3. Always have an exit and back up.
- E. Overhaul and Restore
1. Remove flammable residue and wreckage.
 2. Ventilate and inspect space for structural damage and hidden fire.
 3. Remove freestanding water or foam (dewatering).
 4. Soak involved combustibles in a water filled drum or trash can before disposal.

VII.PREVENTION

- A. Maintenance and cleanliness.
1. Engine room
 2. Galley

3. Berthing, accommodation spaces
 4. Storage areas
 5. Cite examples of flammables in each of these areas; ask for examples of those items burning.
- B. Drills – knowing WHAT to do can save you.
1. Suggest weekly.
 2. Required monthly.
- C. Weekly inspections of hazardous areas and equipment.
- D. Hot work (welding, etc.) use precautions and post a fire watch.
- E. Install and maintain smoke detectors.
- F. Smoking – a leading cause of fire. A very mobile heat source. Prohibit in risk areas; provide proper disposal.
- G. Fuel System and hydraulic systems:
1. Flame screens
 2. Spray shields
 3. Remote control
 4. Drip pans
- H. Design protection
1. Plug bulkhead penetrations
 2. Keep doors/hatches closed
 3. Ventilation system/dampers
 4. Wrap/lag exhaust lines

VIII.HAZARDS

- A. Toxic marine paints and coatings.
- B. Plastics – give off toxic fumes when they burn.

- C. Batteries
 - 1. Produce flammable hydrogen gas when being charged. Must be ventilated.
 - 2. Contain sulfuric acid.
- D. Rigid polyurethane insulating foams; flammable and toxic.
- E. Instability of old chemicals.
- F. Dusts.

IX. EMERGENCY INSTRUCTIONS AND STATION BILLS

- A. USCG regulations require emergency instructions to be provided for fire emergency to include:
 - 1. Signal for fire emergency
 - 2. Location of firefighting equipment
 - 3. Procedures for dealing with fire aboard the vessel
 - 4. Instructions/assignments for crew (station bill)
- B. Must be posted on vessels with crews of four or more
 - 1. Readily available on vessels with crews less than four
- C. Review sample emergency instructions for fire
 - 1. Notify pilothouse to sound general alarm and issue MAYDAY
 - a. Signal – continuous ringing of the general alarm
 - 2. Account for personnel
 - 3. Shut off air supply to fire – close hatches, ports, doors, vents, etc. if fighting fire indirectly.
 - 4. De-energize electrical systems supplying affected space
 - 5. Assemble firefighting equipment
 - 6. If fire is in machinery space, shut off fuel supply and used fixed extinguishing system, if appropriate

7. Maneuver vessel to minimize effects of wind on fire
 8. If unable to control fire, notify CG and nearby vessels. Prepare to abandon ship.
 9. Instructions should be customized to suit your vessel and equipment.
- D. Complete station bill for “class crews” for practice drills.
1. Students fill in location of firefighting equipment on practice drill vessel.
 2. Complete station bill if time allows.

X.SUMMARY

- A. Fire on board means no one to call, nowhere to run. Through routine inspection, prevention, and practice with firefighting technique, you can reduce your chances of having to deal with a life threatening fire.
- B. Monthly hands-on drills are required - and a good method for building skills in handling the equipment. In an emergency, you want to act on instinct - which comes from knowing what to do.
- C. Beware of being overcome by toxic fumes and smoke, especially in enclosed spaces. This is an insidious hazard in most fires.
- D. Emergency instructions and station bills regarding fire emergency are required.
 1. Instructions should reflect your vessel and equipment.
 2. Frequent drills will insure cross training of crew.

REVIEW QUESTIONS:

1. The type and amount of fire extinguishing equipment required by the USCG on board your vessel is determined by its length. True or false?

ANS: True.

2. Name the four sides of the fire tetrahedron.

ANS: Fuel, oxygen, heat, and chain reaction.

3. List five classes of fire and the extinguishing agent for each.

ANS: A - Wood plastic, rubber. Water, foam, drychem, Halon.
B - Flammable liquids/gas. Foam, CO₂, Halon, Dry chem, water fog.
C - Electrical. CO₂, Halon, dry chem.
D - Combustible metals. Dry powder.
K- Kitchen (cooking oils)

4. List 5 tactical considerations for fighting a fire on board a vessel.

ANS: 1) Alarm
2) Organize and stage
3) Restrict and confine
4) Attack & extinguish
5) Overhaul and restore

5. Identify at least 4 special hazard areas.

ANS: 1) Engine room, 2) galley, 3) berthing, 4) hot work areas, 5) paint lockers.

SKILLS CHECKLIST:

1. Skills check items can be completed during the firefighting practical or practice drills.
2. If your group requires fireman's outfit and SCBA, add this to your practice session and check it off at this time.

GUIDELINES FOR FIREFIGHTING PRACTICALS

WARNING: Do not attempt this practical unless you are a certified firefighter/marine safety instructor or obtain trained firefighter assistance.

LOCATION: Select an area at least 50 feet square, free of hazards: buildings, fuel tanks, woods, traffic. Be on the lookout for any potential fuel sources.

NOTIFY: Local police and fire departments of your plans. Your local fire department is an excellent resource for this activity; generally they actively support public education and are eager to get involved with your practice session. If possible, request to have trained firefighter support standing by. In addition to their expertise, professional firefighters have the authority to ensure the safety of your practicum site (such as moving vehicles, diverting traffic/pedestrians)

ASSEMBLE: Steel burn pans (halved, clean, 55 gallon drums can be used) Diesel fuel, gasoline and water or a propane system run through a pan of water is better environmentally and presents less risk.

Portable extinguishers (1 per student if possible)

1. Dry chemical
2. CO₂

Long handled tool or propane torch for lighting fires.

First aid kit with burn treatment aids.

Hard hat with face shield for students (at least two)

Students will be putting out pan fires using handheld extinguishers. Fill burn pans to within six inches of the top of the pan with water. Add two gallons of fuel (less if using smaller pans). If using diesel fuel, you may need to add gasoline (about one quart) to ignite the fire. As the exercise proceeds, you may need to add more diesel fuel and or gasoline to help ignition. Beware of reflash when adding additional fuel to hot pans! Use a long handled tool like a propane torch with a metal tube extension to ignite fires. If you are using halved steel drums, be sure they are well seated on the ground so they will remain stable and not roll.

SAFETY FIRST!

AT SITE: Reassess the weather conditions (wind, etc.) for safety and reevaluate the site for hazards. Assemble students and extinguishers. Issue gloves, hard hats and turn-out gear if available to start-up team. Instruct students to work in teams. There should always be a lead person and a back-up. Also have a marked line in front of the fire beyond which students should not pass to help prevent injury. At your signal, students will advance on the fire in twos; one person in the lead and one back-up. As soon as the lead person's extinguisher is exhausted, the backup assumes the lead position and another back up person advances. The next person waiting should be prepared to advance to the backup position at any time. Make sure students

back away from fire once extinguished while facing it (while checking trip hazards behind them).

REMIND STUDENTS:

- * No loose clothing, shorts, open shoes or sandals
- * Stay low
- * Aim at base of the fire
- * Use a sweeping motion on the nozzle to extinguish the fire
- * **NEVER TURN YOUR BACK ON THE FIRE.** Back away when your extinguisher has been exhausted or the fire extinguished.
- * Do not advance on the fire without a back up.
- * Beware of reflash (fire reigniting after it has been extinguished)