Marine fires: preventing them; fighting them

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Another title in the series

Marine safety

Fire is one of a mariner's greatest fears—whether the vessel is large or small. Large vessels ordinarily have extensive firefighting systems installed; smaller vessels ordinarily put to sea with a bare minimum of firefighting equipment.

The common denominator between large and small vessels is that when fire breaks out at sea, there is no fire department available to assist if the fire gets out of hand. Further, if the crew should lose control of the fire, they face the perils of abandoning ship and of hoping to be found in a large and lonely sea. Somber thoughts . . . but the practical mariner should focus on them often and plan how to extinguish any type of fire.

Consider these statistics

- One out of every three ships that has a fire is totally destroyed.
- One-half of all ships under 900 gross metric tons that have fires are totally destroyed.
- *Eighty percent of all fishing vessels* that have fires are totally destroyed.

Those high insurance rates

Do you wonder why marine insurance rates are high? A look at our track record in marine firefighting gives a perspective on the size of the problem. Here are some of the reasons why marine fire-loss figures are so high:

- Small ships and boats do not carry much firefighting equipment.
- Firefighting equipment on small ships and boats is ordinarily not well maintained.
- Crews on these vessels have little or no training or experience in fighting fires.

The crabber Big Dipper *caught fire while at sea, April 1976. The U.S. Coast Guard buoy-tender* Citrus *came to the vessel's aid and put out the fire after it had burned seven hours. The loss was about $250,000. Photo by Norman Holm, Kodiak, Alaska.*

Your business, of course, is not primarily firefighting; it is fishing, towboating, chartering, or recreation. Therefore, you may have small confidence in your firefighting abilities and techniques. It is quite probable, then, that lack of confidence, lack of knowledge, and lack of proper equipment combine to push the loss rate higher than it needs to be.

How much time would you have?

By comparison, fires on board large ships can burn for days—and their crews may have time to make and correct firefighting mistakes. Crews on smaller vessels usually have only one chance to put out a fire. If they miss or muff that opportunity, they may well not have another before the craft is totally destroyed.

Why? Small craft have limited firefighting equipment, few people on board, and probably little knowledge of firefighting techniques. Here's a good rule of thumb: On small ships and boats, if you do not get the fire out *in the first five to ten minutes,* the chances are your craft will be totally destroyed.

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Test yourself

You may consider your crew's knowledge and experience better than the average. Whether that's so or not, answer these questions frankly for yourself:

1. If the fire should break out in my engine room, house, galley, sleeping compartment, could I get to my radio to call for help? Would the radio *work*—or would its power source be dead?
2. What type of extinguisher should I use on a fire in the engine room? in the house? in the sleeping quarters? in the galley?
3. Should I fight the fire first—and then call for help? Or should I first call for help and then fight the fire?
4. Am I familiar enough with locations of emergency equipment (extinguishers, radios, tools, etc.) to find them in the dark, or in heavy black smoke?
5. Do crew members know what I expect of them if fire breaks out?
6. Do I know the locations and operating procedures of all the intake and exhaust ventilators—for engine room, house, galley, sleeping quarters?
7. How much time will I have to extinguish a fire before it gets too large for my firefighting equipment?
8. When was the last time I . . .
   - *inspected* the boat for frayed wiring, internal and external fuel leaks, lube oil leaks, and proper carburetion for galley stove?
   - *cleaned* the grease out of the galley exhaust vent?
   - *checked* for LPG (propane) leaks or fumes in enclosed spaces?
   - *checked* the fiberglass insulation around the engine exhaust stack?
   - *cautioned* my mates about smoking in the bunk?
   - *cleaned* the engine's external surfaces of caked grease and oil?
   - *cleaned* bilges of grease and oil?
   - *checked* the fuel lines, from fuel tanks through filter systems to engine, insuring that adequate flex hose sections were installed, to prevent vibration from breaking the fuel line while running?

As you might guess, neglect of each of these "When was the last time" steps has caused numerous shipboard fires.

What can you do about it?

Your best bet, and your best firefighting tool, is *fire prevention*. Look back over those test questions, take notes, check your housekeeping practices. Emphasize the commonest areas for ship fires:

Engine room
- fuel leaks, fuel-line breaks and loose connections
- lube oil leaks
- electrical shorts
- frayed wiring
- jury-rigged electrical circuits
- improperly stowed equipment, shorting batteries in a seaway
- poorly maintained engine—starting backwards
- exhaust stack fire (poor or no maintenance)

Galley
- heating stove with poor (or no) carburetor
- grease fire on cook stove
- grease fire in galley exhaust stack
- LPG (propane) fumes

Berthing areas
- crew members smoking in bunks
- jury-rigged lighting and heating systems

Put your money and efforts into fire prevention. When you purchase firefighting equipment, shop carefully and wisely. Check the advantages and disadvantages of the various types of extinguishers (see table 1). Remember, you will have only one chance to put out a fire on your boat. Purchase your firefighting equipment accordingly.

Firefighting equipment

Water is an exceptionally good extinguishing agent because it has a tremendous ability to absorb heat. But when you use water to fight shipboard fires, you must use it in the wisest way—that is, to absorb the greatest amount of heat, using the smallest amount of water.

Water is heavy. If you use enough of it, water will eventually cause your vessel to capsize—it's just that simple. Consider this: when a fire occurs in port, the local fire department's pump truck can discharge about 53 liters a second. That may not sound too impressive, but a quick calculation shows that this is almost three *metric tons* of water a minute.

About five minutes' worth of this type of extinguishing would capsize a large number of boats in the Pacific Northwest! Recall the tragedy of the liner *Normandie*, afire alongside a pier in New York City. Too much water was applied—and she rolled over and sank.

Caution: never direct a solid stream of water at electrical, electronic, galley (grease), or oil-heating stove fires. You *can* use a spray-producing *nozzle* on *oil and grease* fires, but you'll need a great amount of spray—and patience.

Recommended ways to use water in a marine fire include firefighting nozzles and hand-pump extinguishers.

Firefighting nozzles make a fine spray or mist that you direct at the fire. You need to cool and hold back the fire with the water, so that you can secure the fuel feeding the fire—or give someone trapped in the space a chance to get out. A proper nozzle should emit a very fine spray that will cool the fire without using more water than really necessary.

Your nozzle may emit *too fine* a spray to be useful in fighting *one* kind of fire—flammable liquids (grease, oil, gasoline). This is particularly true if the flammable liquid is under pressure.

Find a good supplier and ask about the right kind of nozzle for your craft. Find out about flow rate (liters per second or gallons per minute) and other features.

Note, too, that many readily available types are designed to use with water pressures of about 560 kilopascals (kPa) *at the nozzle*, but the average on-board pump cannot supply that pressure. If you put an 560-kPa nozzle on a 175-kPa water line, you will not get a proper spray (too much solid water). You can buy firefighting nozzles that will work at the lower pressures, so be sure you know your pump output before you buy.

Since most serious boat fires that should be extinguished with water occur in the engine room, think *where* your fixed fire pump (if you have one) should be located. Your spray system could be inaccessible when you need it most. Even when you invest in another type of extinguisher, you may still want to keep a water-pump system as additional, cheap insurance, to fight a fire on your vessel or to aid another vessel.

Hand-pump water extinguisher. Every vessel should have one of these, whatever other types may be on board. It is best for fighting small fires in berthing spaces (mattresses and overstuffed furniture). *Remove completely all burned and charred material from the item.* Open it up. Cut out *all* char, well back into sound material. This type of fire can smolder for long periods before breaking out into open flame. (Professional firefighters report that failure to cut out enough charred material has caused "amateurs" more trouble with reflashing fires than almost any other factor).

Solvoid liquid reduces the surface tension of water, allowing it to spread more rapidly over a greater area. Add a little to your pump-type water extinguisher for a more effective firefighting tool.

Carbon dioxide (CO_2) extinguishers. Carbon dioxide is a gas, about one and one-half times heavier than air. When you direct a blanket of it at a fire, the CO_2 displaces the air (oxygen) feeding the fire, and the fire goes out. Keep these points in mind:

- Contrary to popular belief, *CO_2 does not cool the fire—it smothers it.*
- CO_2 is heavier than air, so it will sink to the deck if you direct it at the overhead.
- Therefore, CO_2 will not do a good job on a wood or grease fire in the overhead until enough of it is in the compartment to displace all of the air.

Caution—rapid loss of oxygen. CO_2 displaces oxygen, which fire needs to sustain itself. *You* also need oxygen—to live. So, when you use large amounts of CO_2 in an enclosed space (where it works best), take warning if your breathing rate increases rapidly. This indicates that the CO_2 concentration in that space is high, and it is time for you to get out of there before you pass out.

(After the rapid increase in the rate of breathing, unconsciousness follows, and—if an unconscious person is left in a CO_2 atmosphere—*he or she will die.*)

Remember this also when someone must *reenter* a space that has recently been blanketed with CO_2.

What types of fires? CO_2 puts out these fires best:

- *fires in enclosed spaces.* CO_2 is of little value in controlling fire topside. The wind will blow it away before it can smother the fire. So, when you use CO_2 in an enclosed space, close the ventilator openings to that space *before you turn on the CO_2.*
- *electrical and electronic fires* (where you should never use water). Since CO_2 leaves no residue, you can put the equipment or circuit back in operation again at minimal expense once the cause of the fire has been eliminated.
- *engine-room fires.* CO_2 is excellent here, *provided:* (a) the boat carries enough of it, and (b) you leave the CO_2 blanket on the fire long enough (so that hot surfaces in the vicinity of the fire will not cause the fire to *reflash* once you dissipate the CO_2 blanket).

How much CO_2 should you keep on board? Assume that you use the CO_2 in your sealed engine-room space (ventilators, exhausts, and hatches shut). As a rule of thumb, two kilograms of CO_2 for every cubic meter of space will extinguish a fire, assuming that the space has been secured so that no air can enter or leave *and* that you keep the CO_2 blanket intact long enough to allow hot surfaces to cool (to prevent reflash). Your supply of CO_2 will be limited. Once it is gone, you may have nothing left to fight the fire—a good reason for having a pump-type water extinguisher on hand, no matter what other types you use.

Fixed (built-in) CO_2 systems. You need a professional to install one of these. The rule of two kilograms of CO_2 per cubic meter of space is the same here, too. Check the system from time to time, to insure that no later modification to your boat has made it inoperable. (That may sound strange, but it *has happened.*)

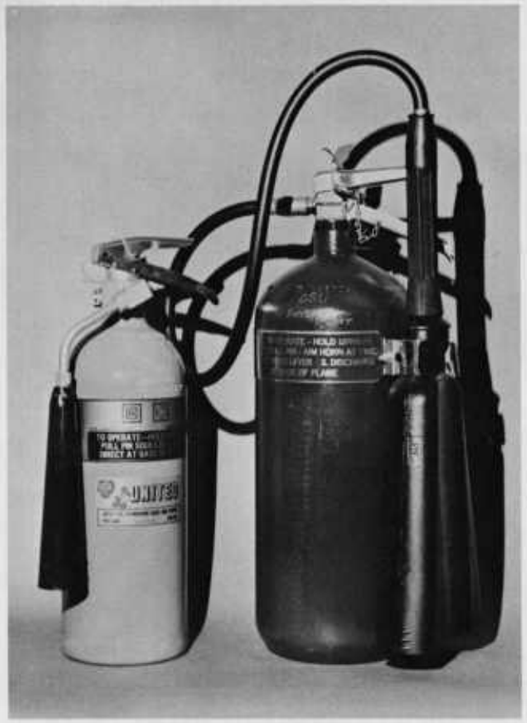
How often should you check your CO_2 extinguisher? Have an expert check it once yearly for bottle content. Additionally, have the bottle hydrostatically tested every fifth year, to insure that it is still sound.

Text continues on page 6

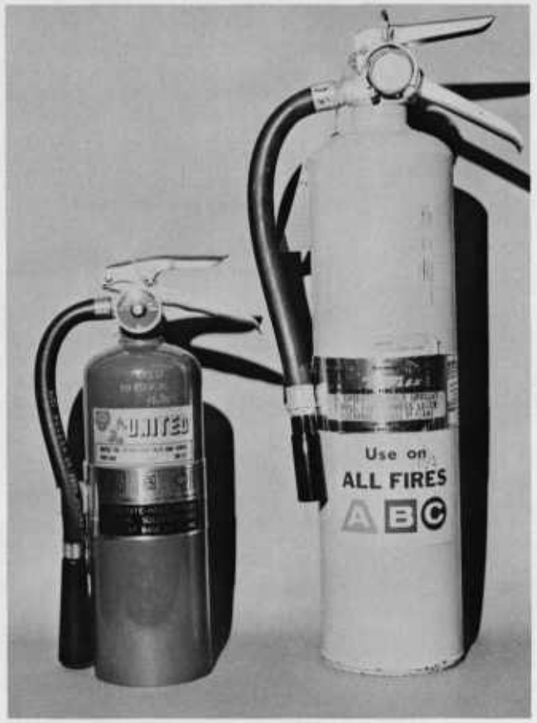
Brand names are used in this bulletin for illustrative purposes only; their mention does not in any way constitute an endorsement of these products.

Table 1.—*Basic firefighting systems and how to use them*

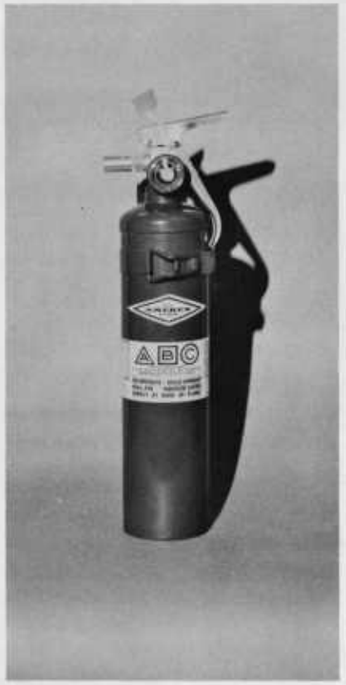
System	Advantages	Disadvantages	Types of fire to use it on	Where to use it
Water (bucket, hose, hand pump)	Cools the fire.	Heavy. Can cause drastic change in vessel stability—and possibly capsize your vessel. Not to be used near engine air intakes or on electronic, electric, galley (grease), and oil-heating stove fires.	Wood, mattresses, paper.	Topside.
Water (under pressure and applied to fire through a nozzle that emits a spray)	Cools the fire. Spray allows firefighters access to burning area.	Difficult to use on grease or oil fires.	Wood, paper, rags. To cool oil fire.	Berthing spaces. Engine-room spaces.
Carbon dioxide (CO_2) (extinguisher)	Compact. Easy to use. Easily transportable throughout the boat. Engines and electronic gear easy to clean after being sprayed with CO_2.	Does not cool the fire, setting up the possibility of a reflash. Requires space to be secured (no drafts or ventilation). Blanket must sometimes be left in place for extended periods. *Cuts down oxygen;* firefighters will collapse if they inhale too much CO_2. Not good for topside fires.	Electrical, electronic, engine-room fires; oil and grease (be careful not to spread the fire by blowing hot oil or grease all around with CO_2).	Electronic spaces, engine room, galley.
Halon (Freon) (extinguisher)	Same as CO_2 but less hazard to firefighters after breathing. Heavier than CO_2—somewhat more useful than CO_2 topside and in drafty spaces.	Expensive to recharge. Possibility of reflash if blanket is not left in place long enough.	Electrical, electronic, engine room, oil and grease.	Electrical and electronic gear, engine room.
Carbon dioxide (CO_2) **Halon (Freon)** (built-in system)	Fast extinguishing for inaccessible areas; can be triggered remotely—if properly installed; allows firefighters to keep away from fire.	More expensive; must be installed by a professional; only covers space where installed; needs periodic check to insure that no modification to boat has made system inoperable.	Electric, electronic, engine room, oil and grease.	Engine room; confined space where electronic gear is concentrated.
Dry chemical	Compact. Easy to use. Easily transportable.	Bottle should be vertical for most effective discharge. After-fire cleanup of chemical powder is time-consuming and difficult. Electronic gear is almost impossible to clean after exposure to dry chemical.	Engine, oil and grease, electrical.	Galley (unless the galley is close to electronic gear); engine room.
Pyrene	DO NOT USE.	When put in contact with fire, phosgene gas is emitted—*toxic to those in the vicinity.*	DO NOT USE.	DO NOT USE.
Can of baking soda	Cheap, effective, easy to clean up.	Difficult to apply to fire without sustaining hand burns.	Grease fires on galley stove tops.	Galley.



A CO_2 fire extinguisher; Halon and Freon extinguishers are similar in appearance.

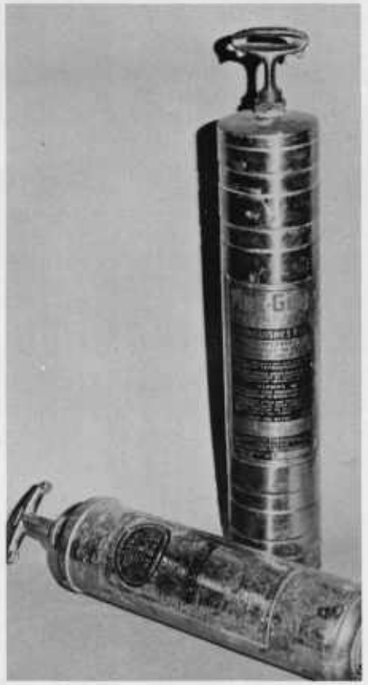


Dry-chemical extinguishers, 5- and 10-pound sizes.



This dry-chemical extinguisher is approved by the Coast Guard, but its owner would be better off with the types shown above (right), with hoses.

If you have one like this—get rid of it! If you were to apply this Pyrene extinguisher to a hot surface, it would generate toxic phosgene gas.



Another dangerous type, carbon tetrachloride. Get rid of this one, too, if you have one! It also generates deadly phosgene gas.

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Halon. A new extinguishing agent on the market, Halon (sometimes called Freon) is a gas system very similar to CO_2. Halon puts out a fire quicker than does CO_2, and you need less of it to put out a fire than you would CO_2. (This suggests that your initial cost would be lower than for a CO_2 system; however, Halon systems are more expensive to recharge than CO_2 systems.)

You can safely stay somewhat longer in a space where you have discharged Halon than you can with CO_2. Halon is reportedly heavier than CO_2, making it better to use in drafty spaces (such as when ventilators are not secured).

Finally (as with CO_2), you must leave a Halon blanket in place long enough for nearby hot surfaces to cool—or the fire will reflash.

Dry-chemical (powder) extinguishers. These work on the principle of smothering the fire (as CO_2 does): Eliminate the source of oxygen, and the fire will go out. They are best for putting out oil or grease fires; they also work on other types (they are excellent for small engine-room and galley fires). But there are three special problems with them:

1. *Very fine powder.* Once you discharge even a small amount of the powder into a space, it will cover everything in that space. *Do not use a dry-chemical extinguisher near electronic equipment:* the powder will coat all interior and exterior surfaces of the equipment, and you will find it almost impossible to clean the equipment and get it operating again.

2. *Correct position.* Because of the way the dry-chemical extinguisher is constructed, there are some physical limitations to what it can do.

So long as you use the extinguisher in the *upright* position, you can discharge almost all its powder toward the fire. However, if you place the unit on its *side* to get at a fire under or behind an obstruction, much or all (depending on the position) of the powder will remain inside the extinguisher.

Therefore, when you buy a dry-chemical extinguisher, pick one with a hose attached to the discharge nozzle—then you can hold it upright at all times.

3. *Vibration* will pack the powder into the bottom of the extinguisher. When that happens, the unit will not work. Once each week, turn your unit upside down, to prevent the powder from packing.

Check after use. Whenever you use a dry-chemical extinguisher—even if only for a short time—take it to the shop at your first opportunity for a check and recharge. When you use it, the powder gets into the discharge valve, preventing the discharge valve from fully sealing and allowing a slow, continuing leakage of gas (and powder) until the unit is finally discharged.

Proper storage temperature. Keep dry-chemical extinguishers in spaces where the temperature stays below 60°C. (Heat causes the powder to lose some of its slippery qualities.) Have your unit checked annually for operability and hydrostatically tested every five years.

Pyrene (pump-type carbon tetrachloride) extinguishers. These are extremely dangerous—*anywhere.* If you have one on your boat or in your home—GET RID OF IT! When pyrene is applied to fire, phosgene gas is produced, and this is highly toxic. When inhaled, it causes extensive liver damage. Again: *get rid of pyrene extinguishers.*

Summary

The best bet for small ships and boats is an energetic fire-*prevention* program. Be on the lookout for possible causes of fire. Remember that frayed wiring, grease and oil buildup, and slow fuel drips or leaks could cost you your boat—and maybe your life.

Finally, if a fire *does* break out on board, get to it with everything you have. You have only one chance—and only five to ten minutes—before it gets so hot that you must abandon ship.

Appendix.—*Metric/English conversion factors (approximate) for the units cited in this bulletin*

To convert	to	multiply by
cubic meters	cubic feet	35.31
cubic feet	cubic meters	0.03
kilograms	pounds	2.20
pounds	kilograms	0.45
metric tons	tons (2000-lb.)	1.1
tons (2000-lb.)	metric tons	0.91
liters per second	gallons per minute	15.85
gallons per minute	liters per second	0.06
kilopascals	pounds per square inch	0.14
pounds per square inch	kilopascals	7.0
degrees Celsius	degrees Fahrenheit	9/5, then add 32
degrees Fahrenheit	degrees Celsius	5/9, after subtracting 32

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