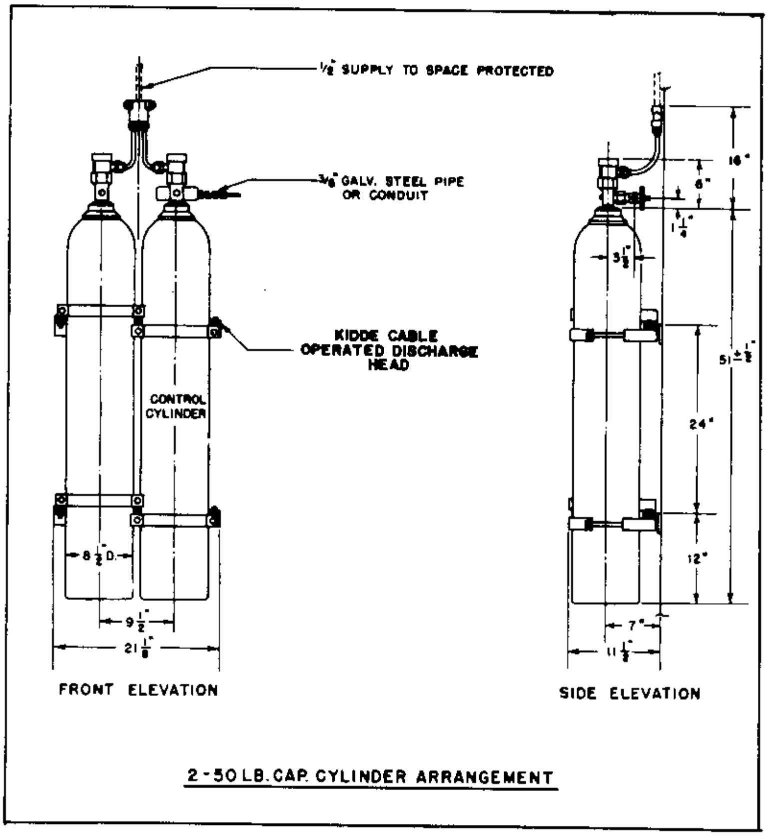


Figure 9930-56.

9930.176 TO OPERATE THE INSTALLED CARBON-DIOXIDE EXTINGUISHER

1. The fire fighter who operates the installed extinguisher that has a length of hose for distribution should proceed as follows:

a. Make sure horn valve is in its closed position. On some installations the valve is closed when lever points away from handle at an angle of approximately 45°.

b. Open control valve on cylinder intended for use with local remote valve operator.

c. Unreel hose and run horn to point of attack on fire.

d. Open horn valve by turning lever or depressing squeeze grip.

e. Direct the discharge close to the near edge of the fire, not toward the center.

2. The fire fighter, who operates the installed extinguisher that has a pipe system of distribution, goes to the pull box, breaks the glass, and pulls the handle of the cable leading to the carbon dioxide cylinders (figure 9930-57). When the control head is tripped from a remote station (R) or by a local control (L) opening pilot valve (a), the pressure from cylinder A passes through channel (b) to top of control head piston (c) depressing valve stem and releasing CO_2 to manifold. Ball check (d) prevents flow from top of piston to manifold. CO_2 from the manifold passes

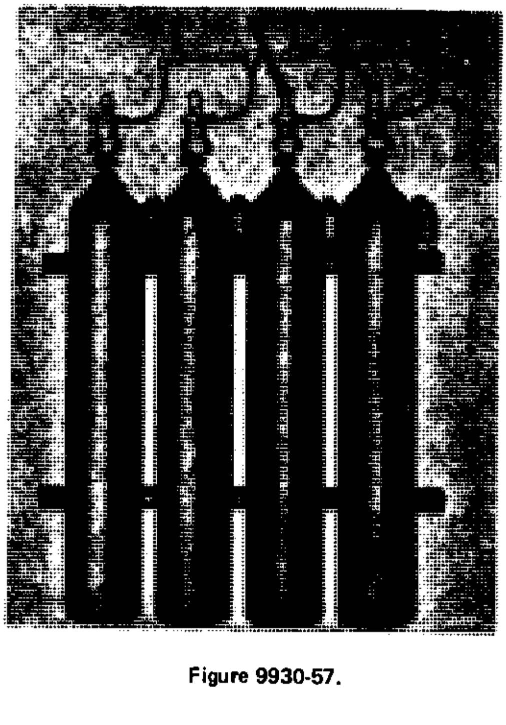


Figure 9930-57.

through channel (e) to top of piston (c3) forcing it downward and unseating valve on cylinder B. Ball check (f) prevents flow of gas into channel (b1). CO_2 from all other cylinders on the manifold is released in the same manner; thus one or two control cylinders will actuate the entire bank. Figure 9930-58 shows the Kidde control system with plain nut discharge heads. CO_2 FYR-FYTER systems are similarly actuated.

9930.177 WEIGHING AND TESTING CARBON-DIOXIDE CYLINDERS AND SYSTEMS

1. The weight record card furnished with each extinguisher (also 50-pound cylinders) is normally attached to the extinguisher and a master record maintained in the log room. Appropriate records of date of last weighing should be maintained. Refer to chapter 9230 for frequency of hydrostatic test of carbon dioxide cylinders.

2. **Active fleet ships.** To ensure readiness in case of fire, cylinders should be weighed when received aboard, and thereafter as follows:

a. Fifteen-pound portable extinguishers monthly.

b. Thirty-five and fifty-pound cylinders when installed and semiannually thereafter.

(1) Test system semiannually as follows:

(a) With all bottles disconnected, apply ships service air pressure to manifold.

(b) Check flooding lines for obstructions to ensure proper distribution.

(c) Check tightness of CO_2 cylinder retaining clamp.

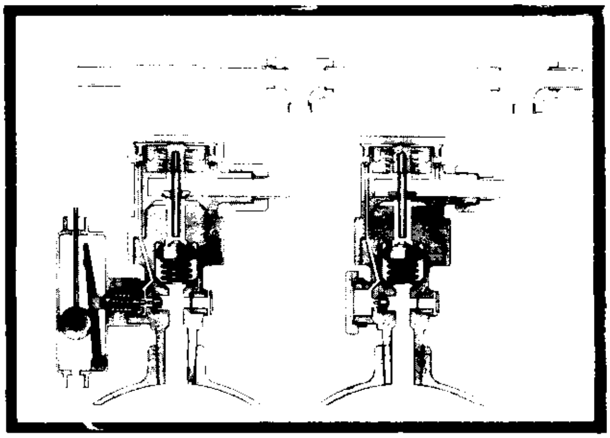
3. The integrity of the lead wire seal on 15-pound extinguishers should be determined as part of the regular weekly compartment inspection. Cylinders with missing or broken seals should be weighed immediately and restored to proper readiness.

a. Any cylinder found to weigh less than 90 percent of its proper weight should be refilled. (See article 9930-163) The accuracy of the scales should be considered in weighing the cylinders.

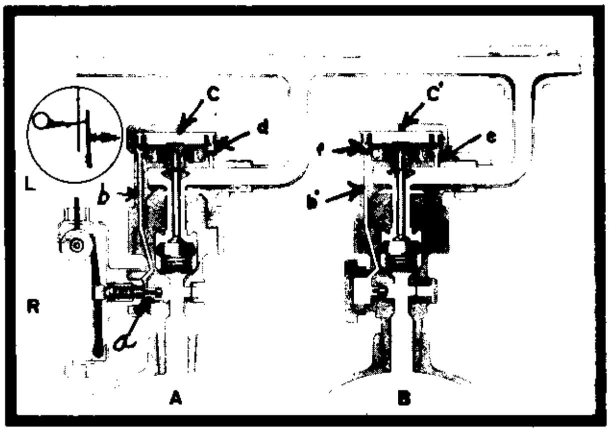
b. CO_2 extinguishers are placed in the coolest parts of machinery spaces.

4. **Reserve fleet ships.**

a. When five or more portable 15-pound CO_2 fire extinguishers are regularly provided in one compartment or locker ready for use of watch and/or fire fighting parties, these extinguishers should be weighed quarterly.



NORMAL POSITION



ACTUATED POSITION

Figure 9930-58.

b. Portable 15-pound CO_2 fire extinguishers normally kept charged and in their regular locations throughout the ship (except those at regularly designated fire stations) should be weighed annually.

c. Cylinders or fixed CO_2 systems protecting spaces containing flammable materials should be stenciled "weigh each months."

d. Cylinders of fixed CO_2 systems installed to protect hazardous spaces which are empty as a result of inactivation need not be weighed. They may be disconnected if desired and the system and pull boxes tagged accordingly. They shall be weighed when the ship is activated.

5. When weighing the cylinders, they should be either stripped, or due allowance made for the parts attached. Remember that the weight stamped on the cylinder valve is always the weight of the cylinder and valve only.

6. The inspection should also include close examination of all nozzles to see that they have not been accidentally damaged, and examination of piping to see that it is properly supported and well strapped in place.

7. All installed system cylinder valves which are not in accordance with MIL-V-17360, Class (c) or as described herein should have been replaced prior to 1960. If any such valves are still in service they should be replaced immediately.

8. When removing CO_2 cylinders from an installed system for weighing or replacement, remove the discharge head from the cylinder valve and let it hang from the manifold by the flexible discharge loop. The discharge head will act as a check valve and prevent release of CO_2 from the manifold in the event the system is actuated. Never remove a discharge head from the flexible loop while other cylinders are connected to the manifold.

9930.178 CO_2 RELEASE ALARM SYSTEM

1. Specifications require the installation of warning devices for CO_2 fixed flooding fire extinguishing systems on Naval ships. The CO_2 release alarm system consists of two pressure operated switches and a visible and audible alarm for compartments protected with a CO_2 fixed flooding system remotely operated from outside the protected area, except O_2 and N_2 compartments, voids, cofferdams, or cargo gasoline tanks. Additionally, this alarm system is not installed for compartments protected by CO_2 hose reel units such as are usually installed in main or auxiliary machinery spaces.

2. In the CO_2 release alarm system, both of the two pressure operated switches and the visible and audible alarms are actuated by the discharge of carbon dioxide. One switch is for shutting down the ventilation system serving the protected space. The other switch serves to energize the CO_2 release alarms, consisting of the alarm bell and two red-lens indicating lights. The ringing bell alarm is located within the compartment protected by the system, and the red indicating lights are located adjacent to the access of the space protected by the CO_2 system. The bell ringing in the protected compartment and the red lights at the actuation station indicate the release of CO_2 in the protected compartment. The snap switch adjacent to the red lights cuts out the bell and the switch must be reset to "normal" position after the pressure switches are reset. At the location of the red indicating lights and the CO_2 pressure switch, manual reset, located adjacent to the access of the protected space, are located two white-lens pilot lights which operate to indicate when the system is in the "normal" reset condition. When the system has been actuated to flood the protected compartment, caution is required in that personnel are not to enter the flooded compartment without respiratory protection when the red light is on, or until ventilation has been operated for at least 15 minutes, and a test made by Gas Free Officer with appropriate test equipment. The ventilation pressure switch at the compartment access must be reset before the ventilation fans can be started.

3. A nameplate in accordance with NAVSHIPS Drawing S6504-74238 should also be installed adjacent to the compartment access to warn personnel against entering the space, in which a carbon dioxide system has been released, without respiratory protection or until the ventilation has been restarted and has opreated for at least 15 minutes.

4. Monthly tests of the pressure actuated toggle switches installed in fixed CO_2 systems shall be accomplished as follows:

a. Walter Kidde Co. installations:

(1) Pull out side button to release latch.

(2) Pull end button to actuate switch.

(3) Inspect ventilation system, audible alarm, and visual alarm circuits to verify circuit actuation.

(4) After completion of the testing of the circuits and operation of the switch, reset the switch by returning end button to set position.

b. CO_2 Co. installations:

(1) Disconnect ¼-inch pipe at union connection.

(2) Insert a small rod in the ¼-inch pipe leading to the cover.

(3) Push upward against the steel piston to actuate the switch.

(4) Inspect ventilation system, audible alarm and visual alarm circuits to verify circuit actuation.

(5) After completion of testing the circuits and operation of the switch, push reset plunger down to reset the switch.

(6) Reconnect ¼-inch pipe at union connection. A tight seal at the union after connection shall be maintained.

(7) When testing, or conducting maintenance or installation, large signs warning personnel of the nature of work in progress shall be displayed at every access to spaces protected by the CO_2 system.

(8) Pull boxes and switches associated with installed CO_2 should be painted red for ready identification.

(9) During the working upon or replacing of CO_2 cylinders the following precautions should be observed:

(a) Place warning signs at entrance to compartment involved.

(b) A man wearing an activated oxygen breathing apparatus should be stationed immediately outside of compartment entrance.

(c) Evacuate all personnel not directly involved with the work being accomplished.

(d) Should accidental discharge of CO_2 occur:

1. Evacuate all personnel from compartment.

2. Secure compartment to maximum degree.

3. Start mechanical exhaust, and vent for 15 minutes before reentering.

4. Use oxygen breathing apparatus when reentering and until compartment is declared CO_2 free by mechanical tests.

Part 6. Dry Chemical Extinguishers

9930.181 DRY CHEMICAL AS AN EXTINGUISHING AGENT

1. An efficient extinguishing agent available for combatting Class B flammable fuel fires is "Purple-K-Powder" dry chemical. It consists almost entirely of crystals of potassium bicarbonate, which is a non-toxic material closely related to the old baking soda extinguishing agent (sodium bicarbonate) but fully twice as powerful in fire-killing ability per pound. It is four times more powerful than equal weights of carbon dioxide when judged on its capability for extinguishing areas of flaming fuel. Like carbon dioxide, however, it is a **temporary** extinguishing or smothering agent. Fires in fuels, like gasoline or hot diesel oil, can be quickly extinguished with P-K-P agent but unless **all** the fire and nearby sources of ignition are fully extinguished, the flames can flash back, and the fire will quickly return to its original intensity. For this reason it is always advisable to back up dry chemical (or carbon dioxide) on hot Class B fuels, with a permanent extinguishing agent such as air foam.

9930.182 THE DRY CHEMICAL EXTINGUISHER

1. Potassium bicarbonate dry chemical is provided in portable fire extinguishers, usually of the 18-pound size. Most of these are of the cartridge type, having the expellent gas (CO_2) in a small cartridge on the outside of the extinguisher shell, figure 9930-59.

2. The extinguisher shell, containing the charge of dry chemical, is not pressurized until the extinguisher is to be used. Before approaching a fire, the seal on the CO_2 cartridge is broken by a **sharp** downward push on the puncture lever which is marked "PUSH". This action causes the CO_2 stored in the small cartridge to fill the extinguisher. The squeeze grip on the nozzle may then be operated to discharge dry chemical from the extinguisher.

3. This type of extinguisher is intended for use primarily on Class B fires (flammable liquids). The chemical discharge should be aimed at the base of the flames and applied in a rapid side to side sweeping motion chasing the flames across the surface of the liquid. If heat radiated by the fire is intense, a short burst of powder into the air will serve as a heat shield between the advancing fire fighter and the fire. In confined spaces it is important that the dry chemical be discharged in short bursts as necessary. Unnecessarily long discharges will reduce visibility, render breathing difficult and waste the agent.

4. Dry chemical is also safe and effective on Class C fires (energized electrical equipment) but should not be used in lieu of carbon dioxide **unless necessary**, due to fouling of electrical and electronic components that may result. This rule should also be applied to dry chemical use on internal fires for gas turbines and jet engines.

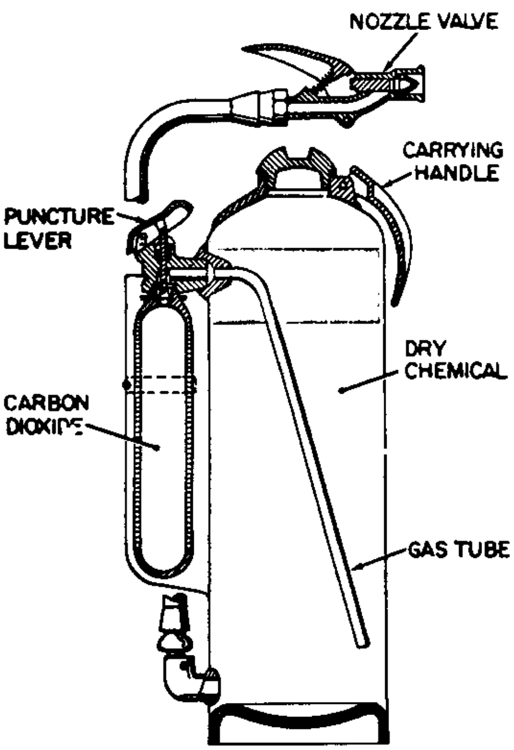


Figure 9930-59. Dry chemical extinguisher.

9930.183 CARBON DIOXIDE CARTRIDGE FOR DRY CHEMICAL EXTINGUISHER

1. The carbon dioxide cartridge supplies the propellant force to discharge dry chemical onto the fire. CO_2 is released through the gas tube when the puncture lever is depressed. The disk which is punctured by this operation is also a safety seal disk which will rupture at 4050 to 4500 psi internal pressure. This disk is held in position by a retaining nut which is hollow to accommodate the puncture pin. Consequently, discharge of CO_2 due to disk rupture on unattached cartridges will be unidirectional and will cause the cartridge to become a missile unless precautionary measures are taken. For this purpose an anti-recoil cap is installed for shipment and storage. This cap must remain in place until the cartridge is installed on the extinguisher.

2. Used cartridges should normally be returned for recharge and replacement of safety disks. If cartridges are recharged in the field, the safety disk and retaining nut must be obtained from the extinguisher manufacturer.

CAUTION: The safety disk furnished for CO_2 cylinder valves (see article 9930-47) is smaller in diameter than the dry chemical extinguisher cartridge disk and will easily go into the disk recess. The CO_2 disk, however, is thinner and the hole in the dry powder retaining nut is larger, consequently the rupture pressure will be less than 2650 psi. Use of CO_2 extinguisher disks as replacement for dry chemical CO_2 cartridge disks will result in an unsafe cartridge.

3. Conversely, alteration of disks intended for dry chemical CO_2 cartridges to fit CO_2 extinguisher valves will result in an assembly which will not afford the required safety for CO_2 extinguisher cylinders.

9930.184 MAINTENANCE AND INSPECTION

1. Remove extinguisher from bracket.
2. Remove fill cap. Pour powder into a dry container, inspecting during pour. Discard if caked.
3. Unscrew hose from elbow and blow through hose to make certain that hose and nozzle are not obstructed. Check elbow to assure that it is not obstructed.
4. Replace hose on elbow, screwing on tightly.
5. Refill extinguisher with 18 pounds potassium bicarbonate powder.
6. Examine fill cap threads and gaskets to see that they are in good condition.
7. Screw fill cap tightly in place.
8. Remove cartridge guard.
9. Unscrew pressure cartridge and inspect cartridge seal to see that it has not been punctured. (Cartridges furnished under FSN 1H4210-935-1669 or 1H4210-935-1670 will have left hand threads.)
10. Weigh cartridge. Determine weight of CO_2 charge from weights stamped on cartridge. Cartridge must contain 5¼ ± ¼ ounces of CO_2. Replace improperly charged cartridges. Do not reinstall cartridge until step 15. Make proper entry on NAVSHIPS 9930/2.
11. Weigh extinguisher less cartridge and enter weight on NAVSHIPS 9930/2. Verify weight of powder.
12. Lift hose from behind puncture lever and make sure puncture lever works freely.
13. Check gasket in cartridge receiver to see that it is in good condition.
14. Return hose to normal position, inserting nozzle in holder.
15. Replace cartridge and guard.
16. Replace pull pin.
17. Return extinguisher to bracket.

9930.185 RECHARGING INSTRUCTIONS

After extinguisher has been used, the following recharge procedure should be followed in detail:

1. To release pressure, invert extinguisher and open nozzle.
2. Return to normal position.
3. Remove fill cap.
4. Unscrew hose from elbow and blow through hose to make certain that hose and nozzle are not obstructed. Check elbow to assure that it is not obstructed.
5. Recharge extinguisher to 18 pounds "Purple K" powder FSN 9C4210-752-9343.
6. Clean seating surfaces and replace fill cap tightly.
7. Remove cartridge guard.
8. Remove empty pressure cartridge (Cartridge has left-hand thread) and screw full cartridge tightly in place.
9. Replace cartridge guard.
10. Replace pull pin and record recharge on NAVSHIPS 9930/2.
11. Return extinguisher to bracket.

NOTE: Cartridges are refillable and reusable. Expended cartridges should be returned to the cognizant supply activity for replacement of the seal and refilling with CO_2.

Part 7. Portable Pumps

9930.191 PORTABLE INTERNAL COMBUSTION ENGINE (I.C.E.) DRIVEN PUMPS

1. Emergency portable pumping equipment is supplied to Naval ships as part of the ship's allowance. It is intended to augment undamaged sections of the firemain system or drainage system, or in case of extensive damage to localize and limit large fires or flooding until such time as permanently installed equipment can be restored to service.

2. The standard equipment now available is:

a. The P-250 I.C.E. pump used for fire fighting and dewatering.

b. The portable electric submersible pump used for dewatering.

c. Eductors used for dewatering and emergency pumping of liquids other than water.

3. There are in ships several types of portable I.C.E. driven pumps. The gasoline handybilly (P-60) and the gasoline driven P-500 pumps, however, are now obsolete and will be replaced by the P-250 I.C.E. pump as their repair and maintenance becomes uneconomical.

9930.192 P-250 I.C.E. DRIVEN 250 G.P.M. PORTABLE PUMP

1. The P-250, 250 g.p.m. pump, (figures 9930-60, 9930-61 and 9930-62) is a self-priming, gasoline engine driven portable pump designed for fire fighting and dewatering functions aboard ship. The pump assembly consists of the following operating components: engine, centrifugal pump, primer pump, water outlet gate, pressure regulator, self-winding pull starter, six gallon fuel tank and pressure regulator and gage. Accessories supplied with the pump include a special tri-gate valve 2½-inches by 1½- by 1½-inches, an additional fuel tank, 3 lengths–10 foot each–hard suction hose, a foot valve and strainer, and a 20-foot length of exhaust hose. The weight of the pump and engine assembly minus gas tanks is 147 pounds. The engine is a 2 cylinder, 2 cycle type rated at 25 horsepower. Ignition is by a magneto built into the flywheel. Lubricating oil is mixed with the gasoline to lubricate the crank shaft bearings and cylinder walls. Engine cooling is accomplished by a small fraction of the pump discharge water which is bypassed through the cylinder block, cylinder head, and receiver and back to the suction side of the pump. Another tube supplies water to the receiver where it cools and contracts the exhaust gases sufficiently to permit use of the 2-inch rubber exhaust hose. Part of this water passes out the exhaust hose and the remainder is drained off through a float valve in the bottom of the receiver.

2. The pump is a centrifugal type connected directly to the engine. The intake part has a male thread which receives the 3-inch suction hose. The discharge outlet has a 2½-inch male thread to which the special trigate can be attached.

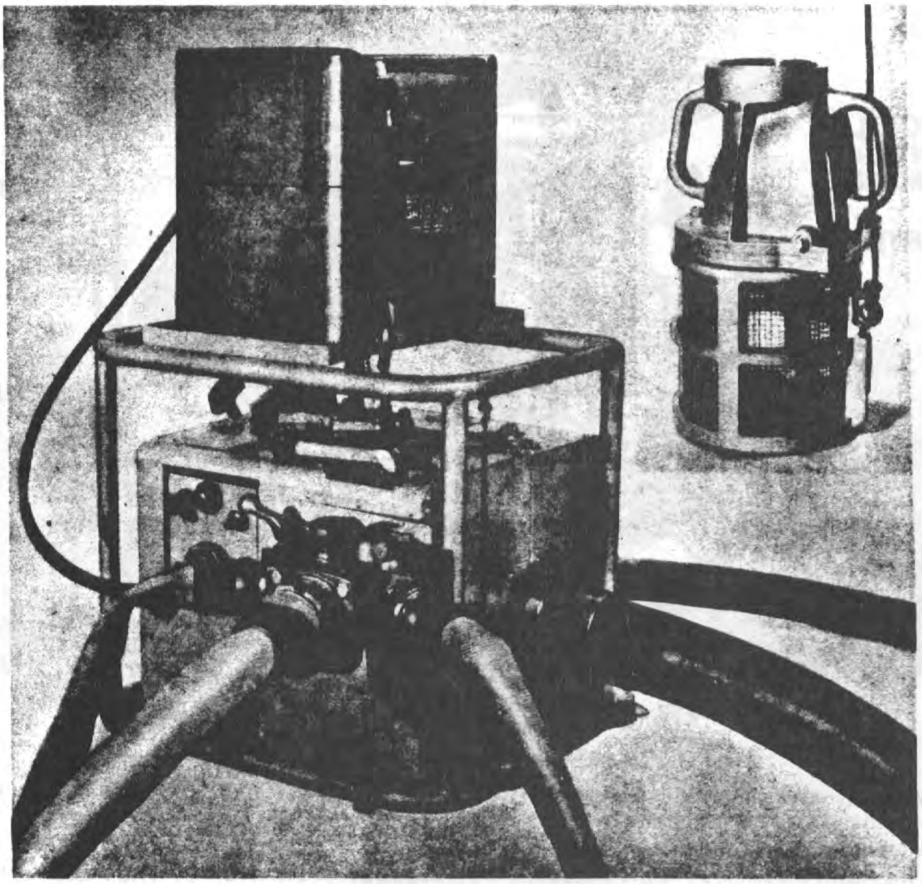


Figure 9930-60. Model P-250 portable gasoline engine driven centrifugal fire pump.

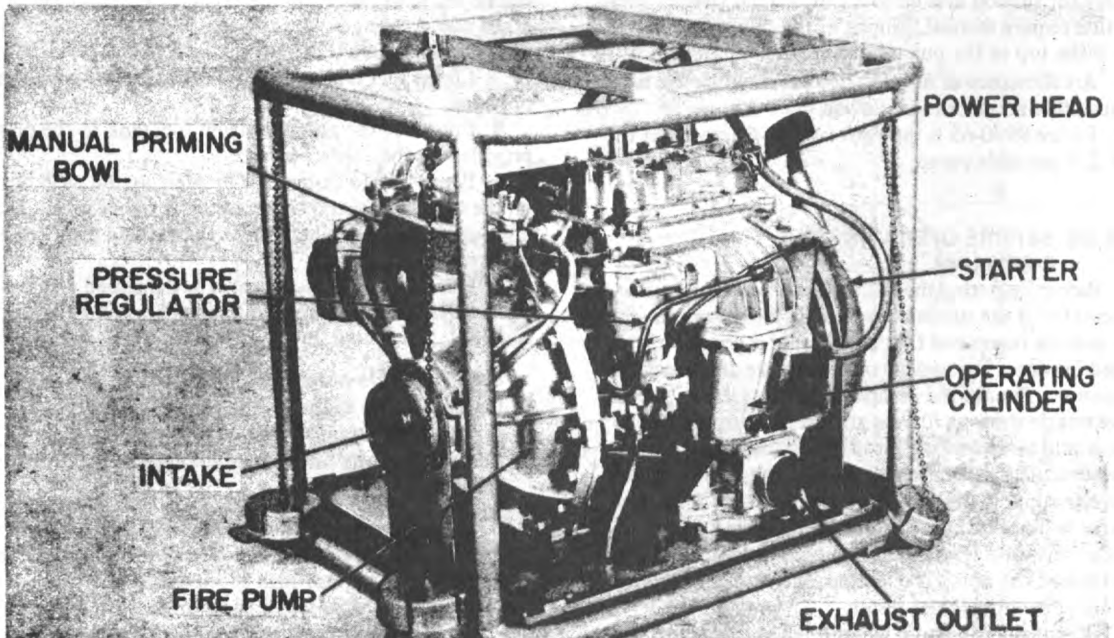


Figure 9930-61. Model P-250 pump, covers removed, exhaust side.

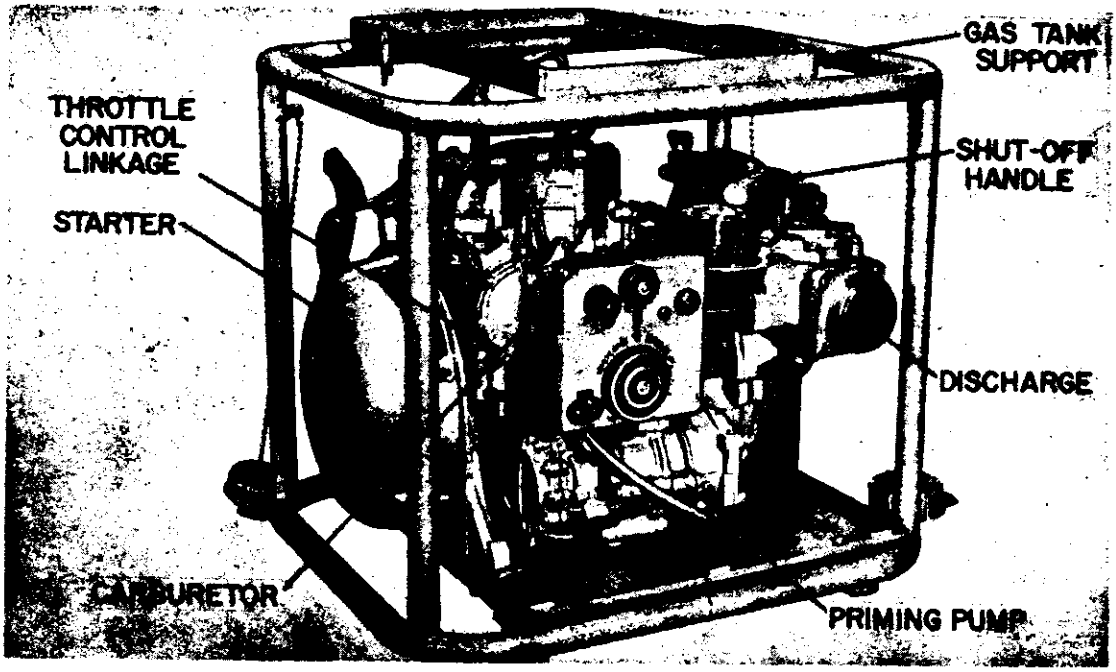


Figure 9930-62. Model P-250 pump, covers removed, carburetor side.

3. The tri-gate is equipped with a 2½-inch to 1½-inch thread reducer which makes it possible to attach three 1½-inch lines or one 2½-inch hose line to the tri-gate as required. When the engine is started, a positive displacement vane type vacuum pump mounted on the engine gear housing draws sufficient air from the centrifugal pump casing and suction hose to make the pump self-priming for suction lifts up to 16 to 20 feet. Greater suction lifts require manual priming of the pump through a plug in the top of the pump housing.

4. An allowance of nozzles, hoses, and educator, and various other accessories is allowed the P-250 pump.

5. Figure 9930-65 is the Performance Curve Chart for the P-250 portable pump.

9930.193 BEFORE OPERATING THE P-250 PUMP

1. Before operating the P-250 pump be sure that all connections of the suction hose are tight between the foot valve and the pump and that the strainer is completely submerged in water. Use gaskets of proper size at all suction connections. Should the pump fail to lift water or the discharge nozzle show an uneven stream the most probable cause would be air leaking into the suction through a poor connection. The suction screen should rest in clear water. Be sure to support the suction hose so that the weight of the hose will not be borne by the pump casing. Make certain the foot valve is completely submerged during the entire period the pump is operated. Severe damage to the equipment may otherwise result.

2. Do not run the pump in confined spaces unless the exhaust hose is connected to carry the toxic engine exhaust gases to the weather.

3. For detailed operating information see NAVSHIPS 347-1878.

9930.194 OPERATION OF THE P-250 PUMP

To operate the unit proceed as follows:

1. Make suction and discharge connections as required.
2. Fill the gasoline tank with a mixture of ½ pint of engine oil, USN No. 3065 (SAE No. 30) to each gallon of 80 to 100 octane gasoline and shake vigorously until the oil and gasoline are thoroughly mixed.
3. Clamp fuel tank to the top of the frame using clamps provided.
4. Connect hose assembly from fuel tank to the plug provided on the control panel.
5. Pump fuel to carburetor by pressing the push button on the tank top several times, until resistance is felt. Do not pump after resistance is felt, as damaged diaphragm may result.
6. Place the water outlet valve in the closed position. Make certain the wing nut on the hand priming filler bowl is tight.

CAUTION: Do not run pump more than 45 seconds unless pressure shows on the gage. If pump is not primed in 45 seconds, stop engine, tighten all suction connections and hose couplings and try priming again.

10. When the pressure shows on gage, open the gate valve slowly, allowing water to enter the discharge hose.
11. Adjust carburetor high speed dial to the best operating position. For slow speed adjustment slow engine to idle by partially closing throttle with stop button.
12. Adjust the water discharge pressure with a screwdriver to the desired setting.

13. While the engine is running, occasionally check water pressure to ensure its remaining at the desired pressure.
14. To stop the unit, press the "STOP" button on the control panel, and keep depressed until the engine comes to a full stop.

CAUTION: If pump is operated for more than 15 to 20 seconds with the outlet valve closed, the pump may begin to cavitate and speed up due to accumulation of air in the impeller housing. Open the water outlet valve momentarily to allow trapped air to escape.

9930.195 AFTER OPERATION

To restart the engine while it is still warm from previous use, it is necessary only to pull the starter rope. No choking should be necessary. If the engine does not start immediately, it is permissible to use the choke but care should be exercised to avoid flooding. If the engine should be flooded, close needle valves and crank until the engine starts. Open needle valves to previously set position. After the pump has been operated and has been shut down, always prepare it for temporary storage in the following manner:

1. Remove the fuel tank from the frame and disconnect from pump. Release tank pressure by loosening filler cap. Retighten cap.
2. Disconnect suction, exhaust, and discharge hoses, and drain hoses.
3. Drain the fire pump and power head by turning the entire unit so the flywheel end is up, and tilt back and forth until all water is drained. Repeat this operation several times, each time returning the unit to its normal position for about 10 seconds, in order to allow more water to drain from the power head to the impeller housing.
4. Flush the fire pump by pouring clean fresh water (if available) into the impeller housing through the manual priming bowl. Drain the impeller housing.
5. Replace the thread protectors on all openings, and clean and dry the entire unit.
6. The unit is to be operated once each month while in temporary stowage if it has been adquately protected from the weather; otherwise, operate once each week. Operate the unit for a short time in accordance with article 9930. 194. Operate pump at discharge pressure 45 psi or greater, to assure disengaging of the primer pump. Pull the choke knob to stop the engine and perform all of the above maintenance operations. Prior to long stowage or shipment perform all of the above operations.

9930.196 FIRE PUMP AND PRIMER PUMP

1. **Pressure Regulating System and Operating Cylinder.** The pressure regulator is mounted on the pump end of the

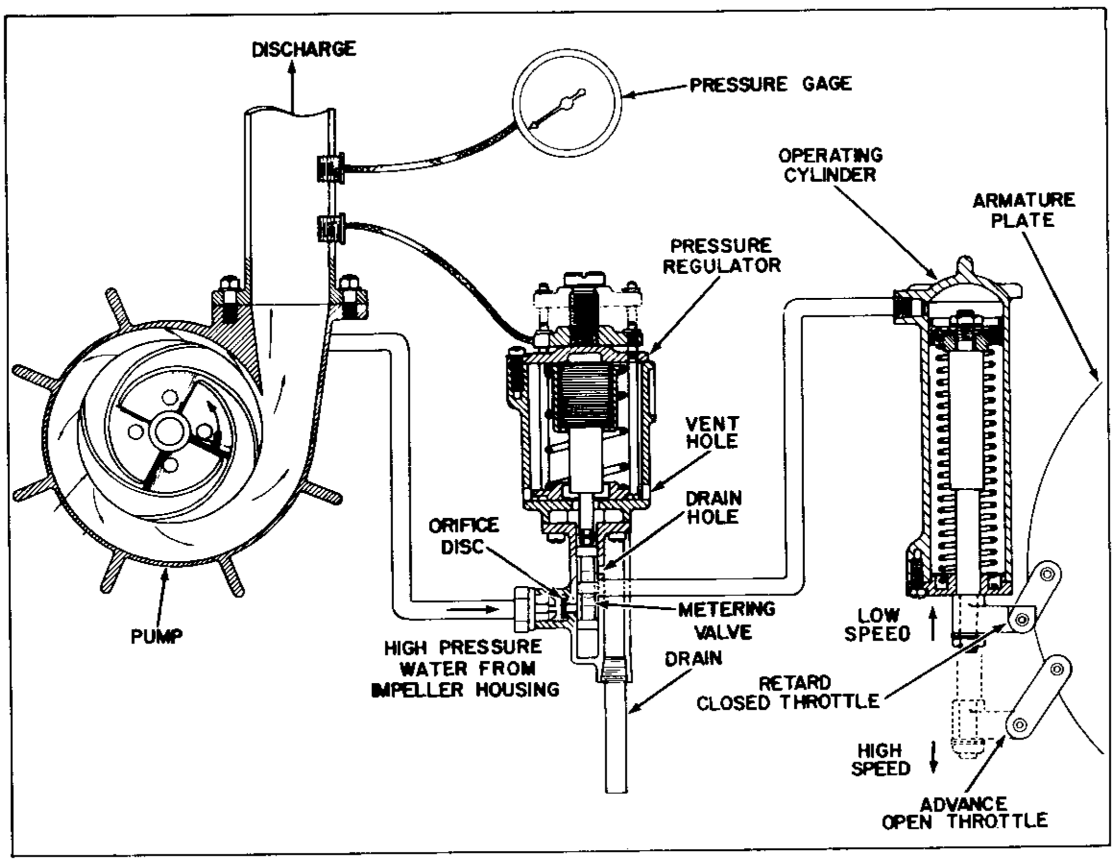


Figure 9930-63. Pressure regulating system–schematic diagram.

exhaust receiver, and its adjusting screw is accessible through a hole in the hood. By means of this adjusting screw, the pressure of the water delivered by the fire pump may be adjusted within a range from 80 pounds per square inch to 120 pounds per square inch, depending on the volume of water being delivered by the pump, which is determined by the size and number of nozzles used.

2. Inside the regulator is a bellows which is connected by tubing to a similar bellows on the pressure side of the pump. The bellows and tube assembly is filled with a non-freezing liquid. The bellows in the regulator operates a small metering valve. There is a water line from the pump to this valve and a pressure line from the regulator to the operating cylinder. The metering valve regulates the water pressure delivered to the operating cylinder.

3. The operating cylinder is, in turn, connected by mechanical linkage to both the throttle valve (carburetor) and the magneto. When the engine is not running, there is no water pressure transmitted to the operating cylinder.

4. The operating cylinder then holds the throttle valve of the carburetor nearly closed, and the ignition spark retarded. This is the proper condition for starting. When the engine is started, the operating cylinder holds engine speed down until the pump is properly primed. In case the pump should lose its prime (as when the foot valve is lifted from the water allowing air to enter) the engine would tend to race to dangerous speeds. However, the loss of pressure to the operating cylinder retards the spark, and partially closes the throttle valve, and therefore keeps the engine speed within safe limits.

5. With the regulator set at a given pressure, and the engine running normally, a constant pressure is maintained on the operating cylinder. The ignition timing and throttle valve settings remain constant, and the unit operates in static conditions. Should the input pressure vary, the operating cylinder will take up a new position and automatically reset throttle valve and ignition timing to maintain the regnlated pressure.

9930.197 FIRE PUMP, WATER OUTLET VALVE, AND MANUAL PRIMER

1. The fire pump impeller is enclosed within the inner and outer impeller housings, and mounted on the crankshaft. It is secured in place by a key and nut. Water is forced into the impeller housing when air is evacuated from the housing and the suction hose by the action of the primer pump. As the water enters, the fire pump impeller throws the water outward, creating pressure within the impeller housing. This pressure shuts off the primer pump by disengaging the primer pump clutch. It is also the pump discharge pressure measured by the pressure gage.

2. The ball-type water outlet valve is located in the discharge opening of the impeller housing. It consists of a ball with a hole through it. Pressing against the ball is a plastic sleeve which helps channel water from the ball to the discharge line when the ball is in the open position. When the ball is in the closed position (turned 90 degrees), the plastic sleeve presses against the ball sealing the discharge passage against the entry of air and preventing discharge of water.

3. This valve should always be closed when starting the pump, to prevent air from entering the impeller housing during priming to permit pressure to build up properly, thus ensuring that the fire pump is completely primed and that the primer pump is disengaged. When pump pressure begins to build up, as indicated on the pressure gage, the valve should be opened slowly and water will be available in the discharge line. Always keep the valve either fully open or fully closed. An intermediate position will allow the water being discharged to erode the sealing surfaces of the valve, resulting in eventual damage. Regulation of water flow should be made at the discharge nozzles. The external handle which positions the water outlet valve locks in either the open or closed positions.

4. The discharge hose is connected to the flange at the outlet valve and the suction hoses to the opening in the intake side of the impeller housing.

5. If one and one-half inch discharge hoses are desired, the three-way gate valve supplied with the pump should be connected to the flange at the pump outlet valve.

6. The manual primer (see figure 9930.64) consists of a lever-arm plug arrangement mounted on the primer bowl in the impeller housing. Its function is to allow water to be poured into the impeller housing to prime the fire pump in the event of failure of the primer pump or if the suction lift is too great for the primer pump to primer the fire pump (lifts greater than 16 to 20 feet). While the pump is operating, the primer lever and plug should always be tightly secured in place with the wing nut provided.

7. To prime the fire pump manually, loosen the wing nut securing the manual priming lever and lift the lever, fill the impeller housing and suction hose with water through the bowl, close and lock the priming lever with the wing nut, and start the pump.

9930.198 PRIMING PUMP AND GEAR HOUSING

1. The priming pump is of the positive displacement type and is mounted on the gear housing beneath the

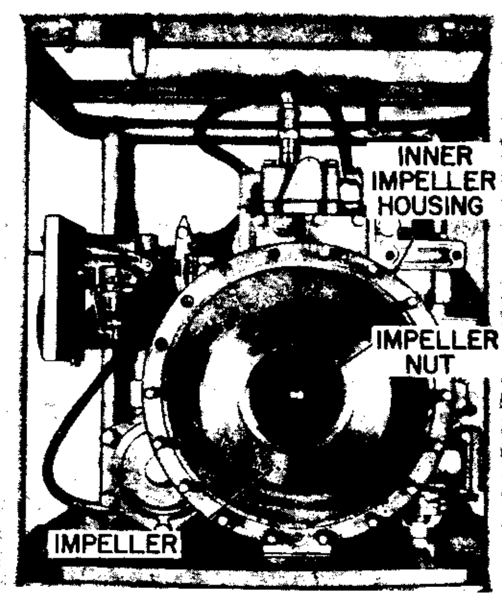


Figure 9930-64. Impeller housing—outer half removed.

carburetor. The gear on the crankshaft drives an idler gear which in turn transmits power to the gear on the primer pump shaft.

2. The intake tube to the primer pump is connected to the intake side of the fire pump. A pressure tube is connected from the impeller housing to the diaphragm side of the primer pump.

3. When the engine is started, the primer pump evacuates the air from the fire pump impeller housing and the suction hose. Because of this suction, atmospheric pressure forces water up through the suction hose and into the impeller housing. As soon as the water enters the center of the rotating impeller, the fire pump begins to build up pressure. This pressure is carried through the pressure tube from the impeller housing to the diaphragm on the outboard end of the primer pump. The diaphragm is in contact with the end of the primer pump drive shaft and, when the pressure builds up, it forces the primer pump drive shaft against the clutch plate which separates the clutch face from the primer pump drive gear, disengaging the primer pump. Therefore, the priming pump is in operation only until the fire pump has been primed.

4. The gear housing and primer pump are lubricated from the oil that accumulates in the bottom of the engine crankcase. There are two spring loaded valves at the bottom of the crankcase which allow the oil to bleed out of the crankcase into rubber lines to the primer pump and gear housing.

9930.199 FUEL TANK

The fuel tank is mounted on the top of the frame and cover assembly. It has a dual hose which connects to the carburetor, one hose for gasoline to the carburetor and the other for compressed vapor from the crankcase to the fuel tank. The vapor maintains pressure within the fuel tank, forcing a supply of fuel back to the carburetor. The pressure cannot escape back to the crankcase during the time the crankcase pressure is low due to a check valve arrangement at the leaf valve.

9930.200 DIAPHRAGM PUMP

A diaphragm pump is built into the top of the fuel tank for the purpose of initially priming the carburetor with fuel. It is necessary to use the pump only when the unit has been standing idle for some time, or when the filler cap has been removed. Removing the filler cap releases pressure within the tank.

9930.201 EDUCTOR

1. The eductor is used when the suction lift for the pump is over 20 feet. This unit is not supplied by the pump manufacturer.

2. When in use, the eductor is attached to the lower end of the suction hose instead of the regular foot valve assembly. The 2½-inch pressure hose from the three-way gate valve (which is attached to the discharge opening of the impeller housing) is connected to the pressure connection of the eductor. The eductor must be fully submerged.

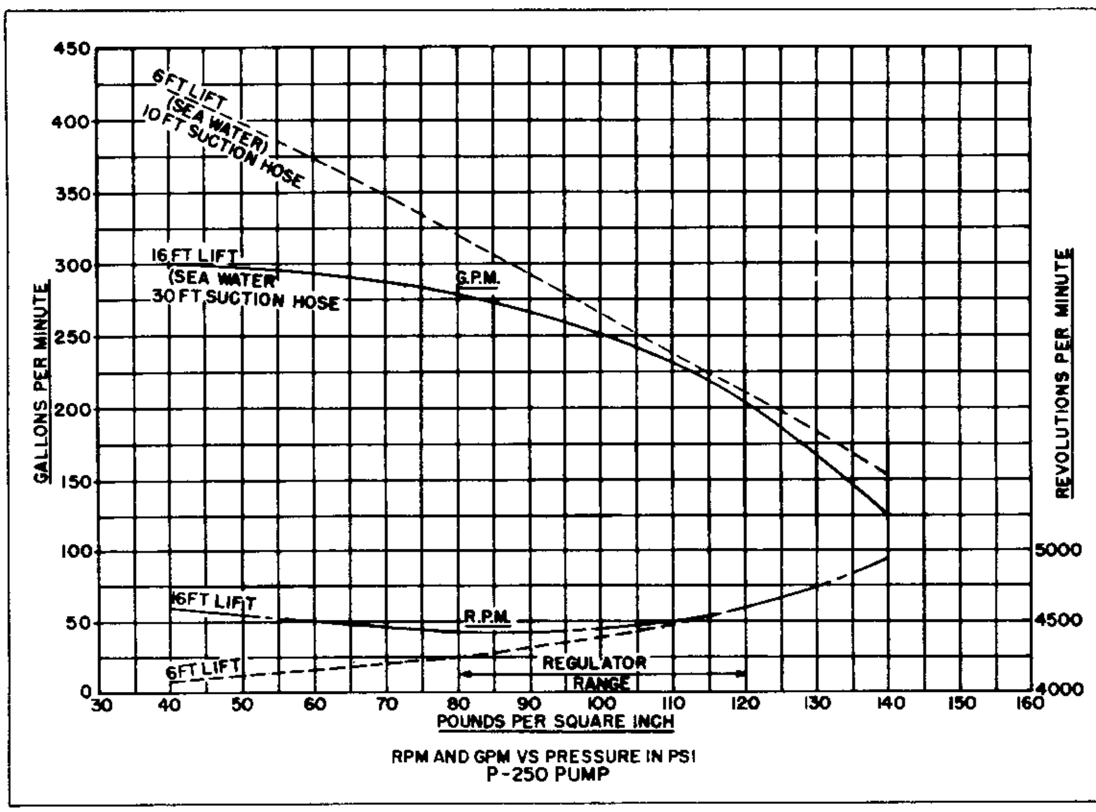


Figure 9930-65. Performance curve chart.

3. The discharge from the pump unit through the eductor raises the water part of the distance to the pump, while the suction of the pump itself raises it the rest of the way. Thus, lifts of more than 20 feet may be accomplished.

4. A built-in foot valve and a strainer are part of the eductor.

NOTE: The fire pump must always be manually primed when the eductor is used.

9930.202 FOOT VALVE

The foot valve (figure 9930-66) is attached to the opposite end of the suction hose. It consists of a heavy mesh strainer, a housing, and a flapper valve which is spring loaded to its closed position. This allows water to enter the suction hose freely but the closure of the valve prevents it from draining back, thus keeping the fire pump properly primed if it should be shut down temporarily. The mesh serves to prevent larger foreign matter which might damage the pump from entering the intake. The foot valve is provided with a valve release for draining the suction hose to reduce weight when recovery hose and foot valve following operation.

9930.203 MODEL P-250 USED AS FIRE PUMP

1. When used as a fire pump, as shown in figure 9930-67, the pressure regulator should be adjusted to maintain a pressure between 100 and 120 psi, which is ample to operate standard fog nozzles or furnish straight fire streams of good quality. Straight suction up to a maximum of 16 feet may be taken either from overboard or from a flooded compartment. A combination suction strainer and foot valve at the lower end of the suction hose prevents foreign matter from entering and permits priming of the suction line and pump (centrifugal pumps must be primed when operating with a suction lift).

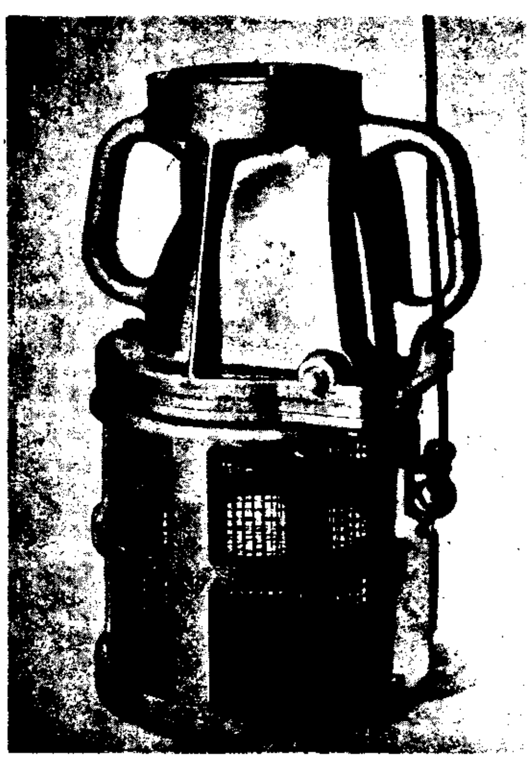


Figure 9930-66. Foot valve assembly.

2. When suction lifts in excess of 16 feet are encountered, as shown in figure 9930-70, an eductor, actuated by a pressure line from the pump can be used to boost suction water into the pump inlet. Since approximately half of the pump output is thus used as a suction booster, the water output of the pump actually available for fire fighting will be reduced.

3. When the unit is used for dewatering compartments, the discharge pressure which the pump is required to develop is generally considerably lower than the pressure required for effective fire fighting. Only enough pressure is needed to move water from the elevation of the pump to the elevation at which the water is discharged (this is known as the static head, 2.31 feet in vertical elevation equaling 1 psi pressure) and to overcome the friction head caused by the frictional resistance of the discharge hose to the flow of water. For this service, involving discharge pressures below 75 psi, the pressure regulator does not control the pressure and its setting is of no importance. Maximum discharge will be obtained by adjusting the discharge pressure to about, but not below 35 psi. If the pressure falls below 35 psi the control system will cause the engine to slow down. At 40 psi discharge pressure the pump will deliver 300 g.p.m. when operating with a 16-foot suction lift. The delivery increases slightly with reduction in suction lift. Maximum discharge can be obtained by any combination of nozzles which produce a discharge pressure of 40 psi. DO NOT ALLOW PRESSURE TO GO BELOW 35 PSI. An arrangement utilizing straight pumping in unwatering operations is shown in figure 9930-67.

4. For dewatering operations involving very low static heads where the difference in level between the liquid surface of the compartment to be dewatered and the point of discharge is 55 feet or less, another method is available which is more efficient than the throttled discharge method described in the preceding paragraph and, therefore, permits a greater discharge capacity. This method utilizes eductors as pumps, the eductors being actuated by the output of the model P-250 pump. The P-250 pump takes suction in the usual way from the flooded compartment, raising the water pressure to 120 psi. (The pressure regulator is adjusted to this value) Instead of discharging this water overboard through the 2½-inch firehose, the hose is led to an eductor located in the flooded compartment. In the eductor, the velocity of the high pressure water jet creates a vacuum which sucks additional water from the flooded compartment into the eductor combining chamber where the high pressure stream picks it up and pushes it overboard through the 4-inch discharge hose. It can readily be seen that the eductor output and, therefore, the total amount of water discharged overboard consists of:

a. The entire capacity of the model P-250 pump, since all the water taken by the pump from the compartment flows through the eductor and then overboard.

b. The water picked up from the compartment by the eductors themselves.

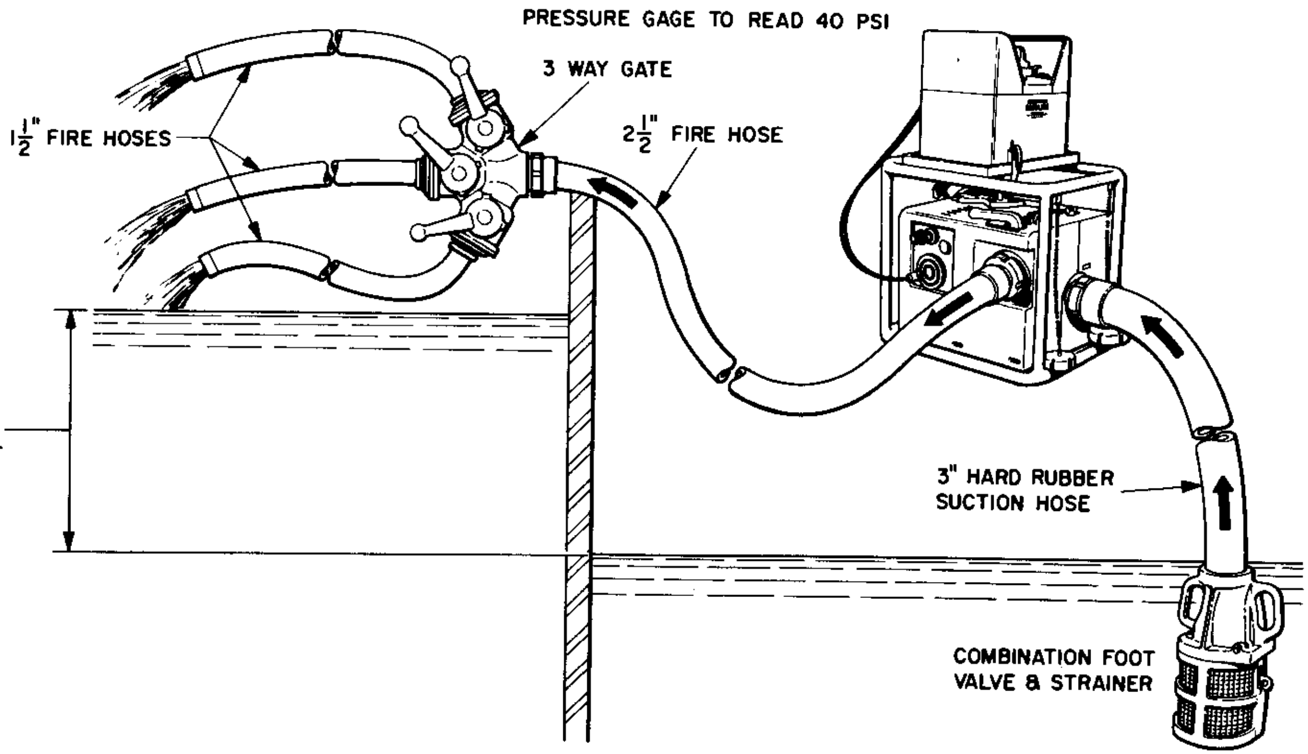


Figure 9930-67.

FOR OFFICIAL USE ONLY

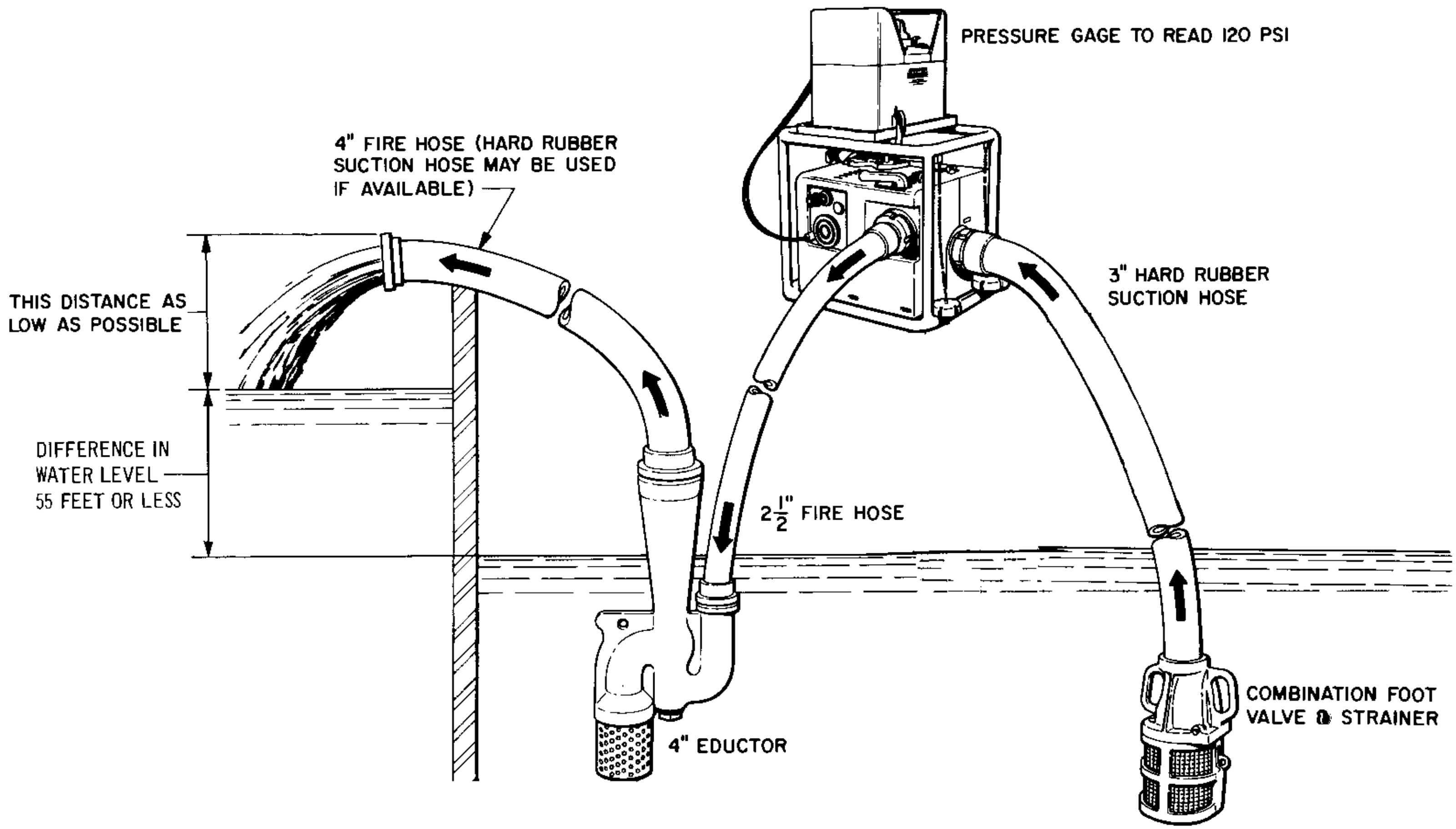


Figure 9930-68.

FOR OFFICIAL USE ONLY

5. While at first glance it appears as if something were obtained for nothing, it actually represents a conversion process in which a high pressure water stream of certain volume contains sufficient energy to move a water stream of larger volume against a lower pressure. While this process is not 100 percent efficient, it results in, when compared with straight pumping, increased dewatering capacities at static discharge heads of 55 feet or less. Figure 9930-68 and 9930-69 show the arrangement with eductors. Inasmuch as the discharge capacity of an eductor increases with a decrease in static head, it is recommended that the discharge outlet be placed at the shortest practicable distance above the discharge level.

6. The model P-250 actuated eductor provides also a ready means of pumping liquids which cannot be moved directly with the pump itself since the cooling of the gasoline engine of the model P-250 pump depends upon circulation of the pumped water through its jacket and injection of water into the exhaust receiver. In pumping liquids, such as special fuel, gasoline, or a mixture of oil and water with an eductor, the model P-250 pump takes water from any available supply and uses the pumped water to actuate eductors as shown in figure 9930-69.

7. A typical case of this type is that of a flooded compartment containing quantities of oil. If an attempt were made to remove this mixture by straight pumping with the model P-250 pump, emulsification of the mixture would prevent proper engine cooling. To dewater a compartment under this condition, the model P-250 pump should be rigged to take suction from overboard with the pump discharge actuating an eductor to handle the contaminated water. In cases of high freeboard of the ship, the overboard suction might exceed the normal pump suction lift of 16 feet. Where this condition is encountered, the overboard pump suction will require an eductor to lift the water into the pump. To accomplish this, a three-way Siamese Hose connection, 2½ x 1½ x 2½ x 1½-inches, should be connected to the discharge outlet of the pump, figure 9930-70. One pressure stream will be avilable for overboard discharge and one for actuation of the eductor. In all cases where the P-250 pump takes suction from overboard, only about one-half of the entire discharge from the eductor represents water which is being removed from the flooded compartment. The other half of the discharge represents water from an outside source and can, therefore, not be counted as water removed from the compartment proper.

9930.204 PORTABLE I. C. E.-DRIVEN PUMP (HANDYBILLY)

The I.C.E.-driven handbilly pump is a positive displacement rotary pump. It is connected by a flexible coupling to a 2-cylinder, 2-cycle gasoline motor, which is mounted on the same base. Ten-foot sections of 2-inch suction hose are used for drawing water from over the side or for connecting to a fireplug. An S-type suction chamber attached to the suction side of the pump is used with a pickup tube for the production of mechanical foam. The unit is commonly called the gasoline handybilly. Weighing 106 pounds, the gasoline handybilly can be carried to the location of a fire when a fire main has been ruptured or when pressure fails. It serves in many situations when it may be necessary to produce mechanical foam by means of the S-type attachment and pickup tube. At the recommended speed of 3,500 rpm the pump will deliver 60 gallons of water a minute with a pressure of 100 psi.

9930.205 BEFORE OPERATING HANDYBILLY

1. Be sure the connections on the suction hose are tight between the water and the pump and that the strainer is well attached and completely submerged in the water. Use gaskets of the proper size where suction is connected to the pump and also in all hose connections. Should the pump fail to draft water, or the discharge at the nozzle show an uneven stream, the most probable cause would be that air is leaking into the suction through a poor connection. Careful attention must be given to the suction hose to see that the screen rests in clear water, not in mud or gravel as grit and small pebbles are likely to be drawn into the pump with damaging results. The gasoline handybilly should not be used for pumping out debris-filled water except in extreme emergency.

2. Be sure to support the suction hose so that the weight of this hose will not be borne entirely by the pump. When the handybilly is used to take water from over side and the freeboard is too great to permit operation from the deck, the practice is to lower the handybilly and a man to operate it in some suitable rigging. As in all conditions when the handybilly takes suction, the suction hose must be supported so that its weight will not strain the connection at the pump; and further, the suction end of the hose must be kept submerged. Do not run the handybilly in confined places. Use exhaust hose only when necessary and then do not elevate it more than 4 feet. Carbon monoxide is given off in the exhaust of the gasoline engine in operation, therefore, it is dangerous to operate the handybilly where an abundance of fresh air is not available. Exhaust gases are expelled through the base with the cooling water from the engine. An exhaust cutout constructed in the exhaust outlet cap blows out automatically if it is not removed while the engine is in operation.

3. **CAUTION:** Do not operate the motor without pumping, since the motor depends on water taken from the pump for cooling. The pump is a high-speed rotary type, and when using for pumping bilges, flooded compartments, and so forth, hold down the engine rpm by coupling a nozzle directly to the pump discharge. A nozzle with an outlet of not more than 5/8-inch should always be attached to discharge or end of discharge hose line. A nozzle of this size will hold the rotative speed of the unit to not over 4,000 rpm, which is proper. Without any nozzle, but in open hose discharge, the speed will reach 7,000 to 8,000 rpm, which will seriously damage the unit. Furthermore, moving the suction hose from one compartment to another will cause the motor to turn at this excessive speed. It must be stopped and not started until the suction hose is again submerged in the water. Before drafting, squirt lubricating oil liberally over the rotors through the discharge port. This will ensure immediate pickup in drafting.

9930.206 TO OPERATE HANDYBILLY

1. Fill fuel tank with a mixture of gasoline and symbol No. 2190 oil in the following proportions: 1 pint oil to 1

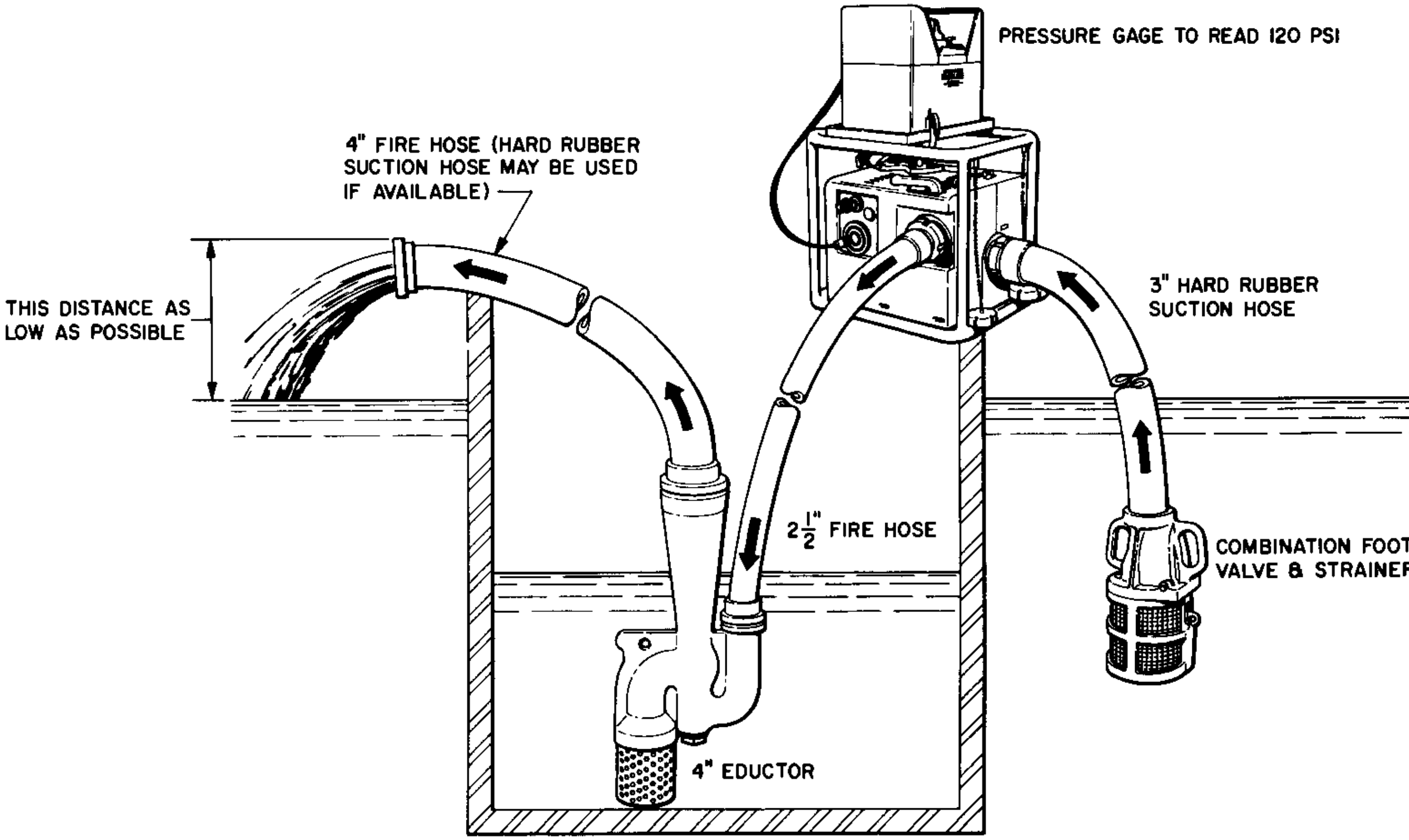


Figure 9930-69.

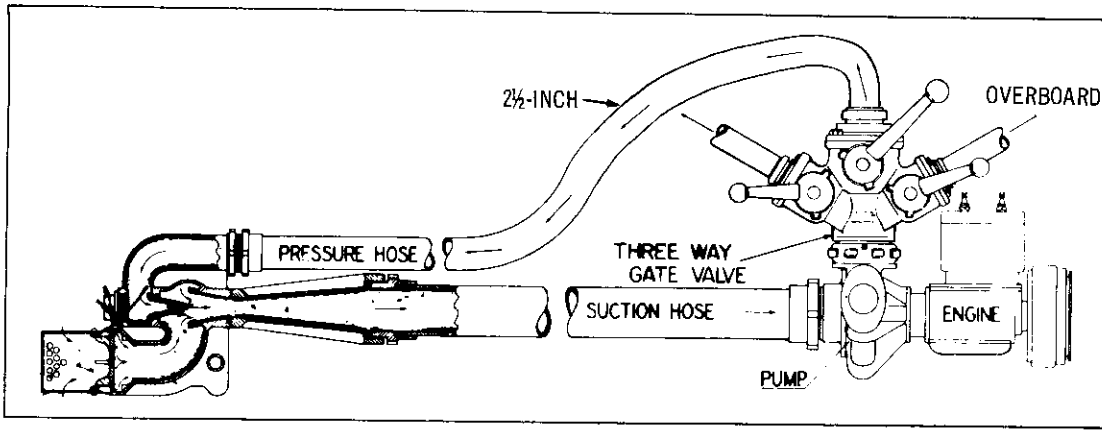


Figure 9930-70.

gallon gasoline. Mix thoroughly in a separate container (other than gas tank) to insure uniform mixture before pouring into the gas tank. (See figure 9930-71.)

2. Open air vent (small knurled cap on top of gas filler cap). Turn left to open.

3. Check to be sure the gas line cock under engine end of gas tank is open, handle down.

4. Check to be sure the three-way fuel cock at the base of the engine is open (handle toward flywheel end of engine). It should be secured in the open position; new models do not have this fuel cock.

5. Open carburetor needle valve two full turns from closed position. Needle valves open in a counterclockwise direction (to the left). (See figure 9930-72.)

SUCTION SIDE OF PUMPER

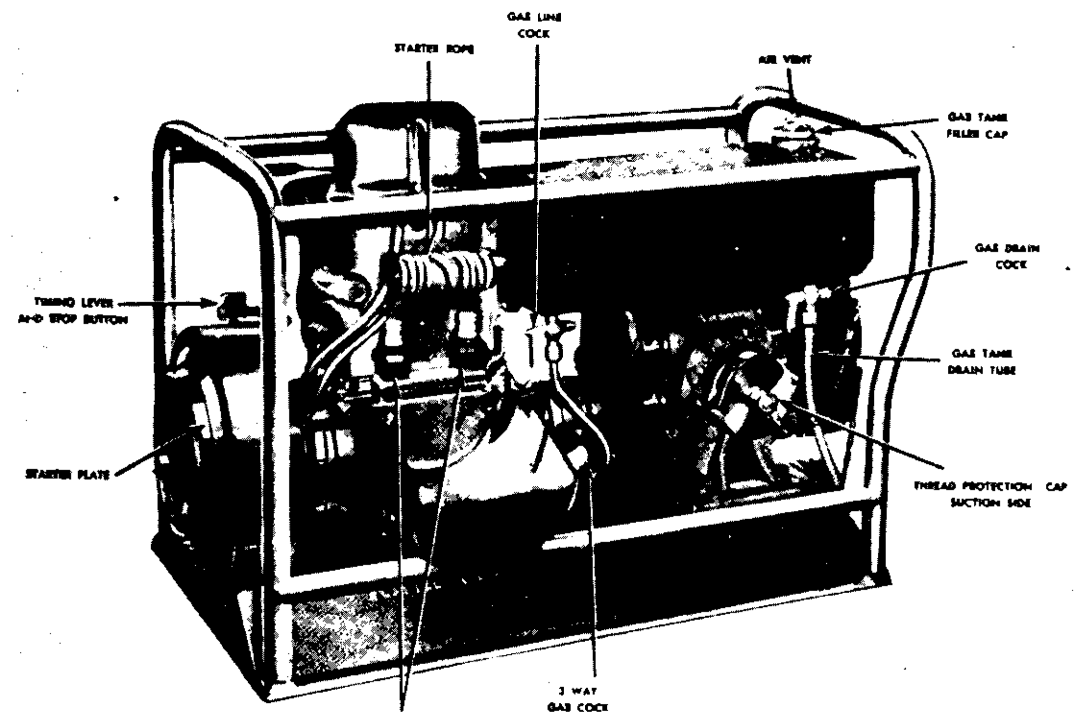


Figure 9930-71.

DISCHARGE SIDE OF PUMPER

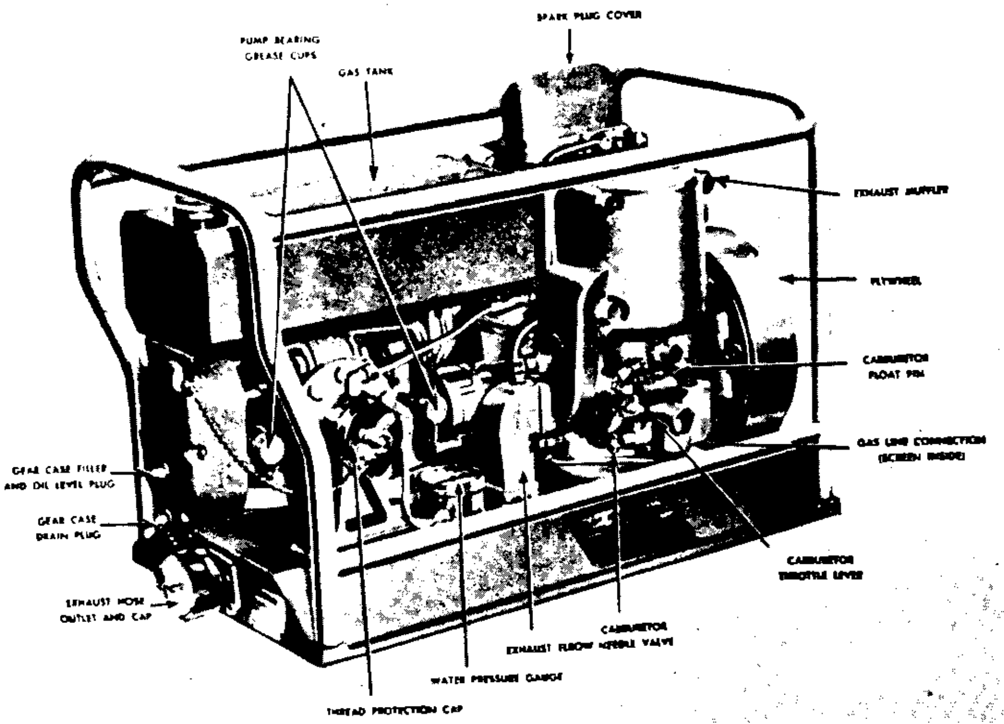


Figure 9930-72.

6. Move carburetor throttle lever down to position marked C (choke) on the carburetor lever quadrant.

7. Flood carburetor by holding down float pin which projects through cover of carburetor float bowl. Hold this pin down until the fuel overflows.

8. Place knotted end of starter cord in notch in starter plate. Wrap cord around starter plate two full turns.

9. To start the motor place foot on rail of pump and pull smartly on starting cord. Motor should start on two or three attempts. If it fails, operations (8) and (9) should be repeated. Failure to start may require further flooding.

10. When motor starts, immediately raise carburetor lever to horizontal position F (fast) marked on carburetor lever quadrant.

11. Adjust carburetor needle valve by closing it approximately one complete turn to the right (clockwise). This will vary in individual motors. Try turning it both to the right and to the left slowly, until the motor runs smoothly. After the motor is thoroughly warmed up, check this adjustment again, balancing if necessary; otherwise leave it alone. (When carburetor needle valve is properly set, the hand on the water pressure gage will stop oscillating and hold a steady position. This is an indicator of the most efficient running speed.)

12. To stop the motor, press down on stop button (the red button on timing lever). Hold the button down until motor stops turning.

13. To start a warm motor, proceed with operations (7), (8), and (9), making no adjustment on needle valve, using choke only if necessary.

14. If a warm motor floods, shut off needle valve on carburetor, and crank the motor four or five times with starting cord. If the motor starts, let it run until it stops, and then open needle valve to running position. This is approximately one turn from a closed position.

9930.207 CARE AND MAINTENANCE

1. After pumping salt water, operate with fresh water for a few minutes, if possible, to flush circulating system of salt water.

2. Wipe complete unit with oily rag, squirt oil liberally over pump impellers, and replace thread protection caps.

3. Remove each spark plug and squirt small quantity of oil into each cylinder. Turn engine several times to lubricate cylinder walls thoroughly.

4. Inspect spark plugs; clean and, if necessary, adjust gap of points. (Correct setting of gap is 0.025 of an inch.)

5. Check breaker points. (Correct setting of gap is 0.025 of an inch.)

6. Be sure flywheel nut is secure. A loose flywheel nut can be the cause of extensive damage if not tightened immediately.

7. Remove and clean screen from gas line nut connection at base of carburetor.

8. Check oil level of pump gear case. Fill it to the proper level. (SAE-30 oil if available. In emergency any lubricating oil will serve.)

9. Pack grease cups on pump with light cup grease and turn down snugly.

10. Make certain that the starter cord is replaced in its holder on the cylinder side cover.
11. Store in a dry place with uniform temperature, to protect electrical parts from condensation.
12. To avoid excessive absorption of moisture by ignition coils, the motor should be run for a short period every week.
13. In general, the operator using the handybilly last knows best what attention it should have before stowing. Proper attention at this time means quick starting and satisfactory operation when the emergency arises.

9930.208 PRACTICAL USES OF HANDYBILLY

1. When used for fire fighting, the handybilly has sufficient capacity to supply one 1½-inch all-purpose nozzle or N.P.U. foam nozzle. It can take straight suction up to a practical maximum of 16 feet. For lifts in excess of this figure, scoops have been reported with such arrangements. Another method (shown in figure 9930-73) of drawing water from a source in excess of 16 feet suction lift is presented by the use of a submersible pump which discharges into the suction inlet of the handybilly. An adapter permits the connection of the 2½-inch submersible pump discharge hose to the 2-inch suction inlet of the handybilly pump.
2. For unwatering purposes, the pump is operated in a similar manner. However, since a low discharge head will cause the pump to overspeed, additional friction head must be introduced. As the discharge of the pump proper is not valved, additional resistance is introduced at the free end of the discharge hose by attaching a restricting orifice in the form of a nozzle.
3. Although the output of the handybilly can be used to actuate on educator for unwatering purposes, the small capacity of the unit does not justify its use with an educator.

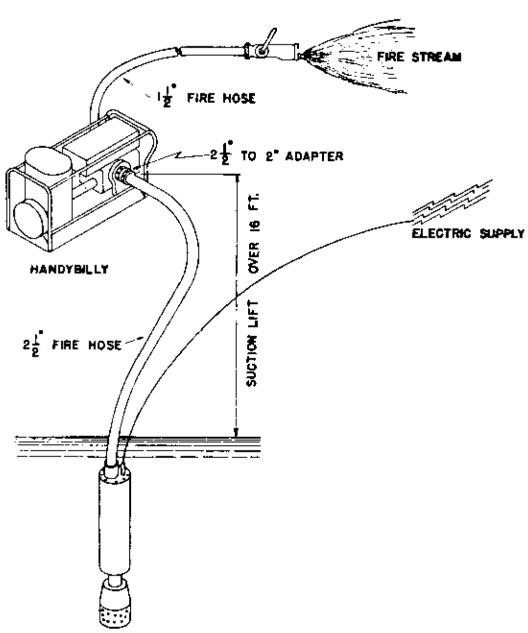


Figure 9930-73.

4. The handybilly cannot be used to pump oil or gasoline directly. Unlike a centrifugal pump, a rotary pump will not handle fluids containing even very small particles of foreign matter.

9930.209 PORTABLE I.C.E.–DRIVEN 500–G.P.M. PUMP (P-500)

The portable I.C.E.-driven 500 g.p.m. model P-500 pump is a single-suction, single-stage centrifugal pump, delivering 500 gallons of water per minute when operating at a discharge pressure of 10 psi with a 16-foot suction lift. It is directly connected to a 4-cylinder, 2-cycle gasoline engine, the extended crankshaft of which also constitutes the pump shaft. The model P-500A, P-500B, and P-500C pumps are identical in operation and construction except for a redesign of minor parts. A number of 10-foot sections of 4-inch suction hose, depending upon the free-board of the ship, are used for drawing water from over the side. The submerged end of the suction hose is equipped with a strainer which prevents debris or other foreign matter from entering and injuring the pump. A foot valve, built into the strainer body, permits the suction hose to be filled with water for priming purposes. Where suction lifts over 16 feet are encountered, an eductor with built-in foot valve and strainer is furnished instead of the ordinary strainer and foot valve. Discharge pressure from the pump, carried to the eductor, will increase the suction lift above the maximum of 16 feet obtained by straight suction alone. The pump discharge terminates in a Y-valve (two 2½-inch ball valves mounted in Y-fitting) permitting two 2½-inch firehose lines to be connected (figure 9930-74). It should be noted here that with the eductor in use a 2½-inch line must be run from one of the 2½-inch valves to the educator, thus leaving only one 2½-inch hose connection and only about one-half of the normally rated pump capacity available for fire-fighting purposes. A water-pressure regulator, adjustable within the range of 75 to 140 psi will automatically maintain the set pressure by governing the throttle and ignition of the driving engine.

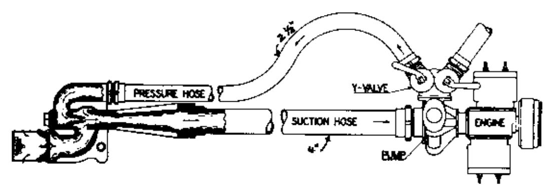


Figure 9930-74.

9930.210 BEFORE OPERATING

Be sure the connections on the suction hose are tight between the water and the pump and that the strainer (or educator when used) is well attached and completely submerged in the water. Use gaskets of the proper size where suction is connected to the pumps and also in all hose connections. Should the pump fail to draft water, or the discharge at the nozzle show an uneven stream, the most probable cause would be that air is leaking into the suction through a poor connection. Careful attention must be given to the suction hose to see that the screen rests in clear water, not in mud or gravel which is likely to be drawn into the pump. Be sure to support the suction hose by a line, so that the weight of the hose will not be borne by the pump casing. Also make sure that the suction hose does not rise above the level of the pump inlet at any point, since this would tend to form an air pocket and interfere with proper priming. Do not run pump in confined spaces unless exhaust hose is connected to carry toxic engine exhaust gases to the weather.

9930.211 CAUTION

Do not operate the engine without pumping, since the engine depends on water taken from the pump for cooling. When using the pump for dewatering purposes, such as pumping of bilges or of flooded compartments, requiring large volumes of water at comparatively low pressure, the discharge pressure of the pump should not be permitted to drop below 35 psi to ensure the proper working of the pressure regulator and the proper cooling of the engine. Like the handybilly, the P-500 pump cannot be used to pump oil or gasoline directly.

9930.212 TO OPERATE

1. Fill each of the two 7½-gallon-capacity fuel tanks with a mixture of gasoline and United States Navy 3065 (SAE No. 30) engine oil in porportion of 1 pint of oil to 1 gallon of gasoline. Vigorous shaking to ensure a thorough mixture is necessary. The mixing operation can be performed in the fuel tank itself if the tank is empty, otherwise in a separate container.
2. Mount filled fuel tanks to unit, securing them with the inboard spring holddown clamps. When mounted in their proper position, the fuel tank vent valve is automatically opened.
3. Connect the two fuel hoses on unit to bottom of tanks.
4. Open fuel tank valves (wing nuts, one on each tank).
5. Turn fuel valve on control panel from closed position to one of the fuel tanks. See that the float valve pin in the carburetor bowl rises, indicating the bowl is full of fuel.
6. Close both Y-valves. (When using the eductor, the Y-valve connected to the pressure hose leading to the eductor should be open and the other Y-valve closed.)
7. Prime the pump completely, using either of the methods outlined below:

   a. **Hand primer.** Operate the hand primer plunger rapidly, full stroke until it suddenly becomes hard to pump, indicating that air is exhausted and water has entered it.

   b. **Bucket method.** Open filler opening cap on the pump housing and fill with water using buckets or hose until it is completely full.

NOTE: When eductor is used, priming consists of filling the suction hose, pump housing, and pressure hose to eductor with water. This cannot be accomplished with the hand primer and the bucket method of priming is necessary.

8. Prime the carburetor on engine (plunger on control panel) four strokes.
9. Place knotted end of starter rope in notch of starting pulley on flywheel and wind around pulley.
10. Pull the starting rope (pull strongly-don't jerk) to the full length of the rope. If the engine fails to start with two pulls, push the carburetor primer plunger once and pull the rope again. If the engine starts, but stops at once, push primer, start again and keep priming as needed until engine warms up.
11. After engine is running, make sure pressure gage located on control panel registers increases in pressure.
12. When pressure on gage registers 75 psi or more, slowly open one of the Y-valves (with eductor in use, the Y-valve connected to the eductor must be open all the time. Hence, only the other Y-valve can be opened after pressure has built up).
13. Readjust carburetor needle valves so the engine operates best. Normal setting of slow speed needle is one full turn open from closed position; the normal setting of the highspeed needle is 13 notches open (unscrewed) from closed position. Note the readjusted setting for future reference.
14. Adjust water pressure to desired valve by operating pressure regulator.
15. Open the second Y-valve, if output is required (not available when eductor is used).
16. During the entire period of operation of the pump, the attendant should:

    a. Watch the pressure gage and the temperature indicator. If the temperature indicator moves into the "dangerous" (red) zone of the dial, the unit should be stopped.

    b. After about one hour of operation at full capacity, the fuel supply in one tank will be almost exhausted and this condition will be indicated by irregular engine operation; therefore, turn the fuel valve (5) from the empty to the full tank. Another indication of diminishing fuel supply is the lowered position of the float pin in the carburetor bowl.
17. To stop unit, push and hold "Stop" button on the control panel unit the engine comes to a full stop.
18. **To restart.** When the unit has been operating and is stopped, it may be hot or warm when it is restarted. If the Y-valves were closed before stopping and if the foot valve and all hoses and hose connections are tight, the pump will hold its prime and pickup when the engine is operated. If it should fail to do this, the hand primer may be operated while the engine is running.

CAUTION: Do not run too long without full prime and pressure, or engine will overheat. Watch temperature indicator.) Otherwise proceed with operations (8) through (16) except that less carburetor priming (operation (8)) will be necessary when the engine is warm. Be careful not to flood carburetor when warm.

9930.213 USE OF P-500 PUMP IN SALVAGE OPERATION

1. While the model P-500 pump was originally and primarily developed for fire fighting, it can be used successfully for salvage operations pumping large volumes at low pressure. In this case 1 or 2 eductors are used as pumps being served by the model P-500 as the activating means, as shown in figure 9930-75. The model P-500 may also

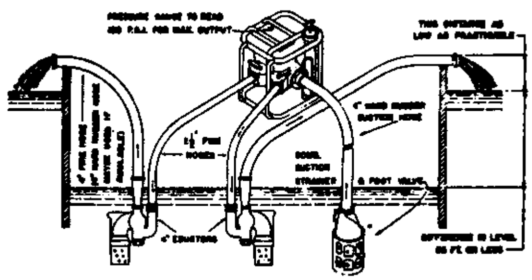


Figure 9930-75.

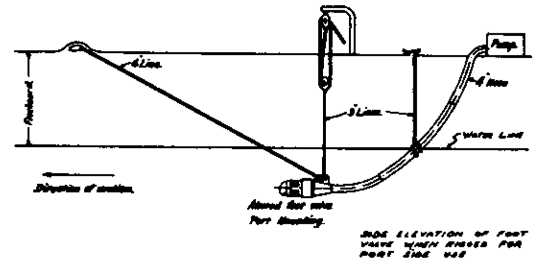


Figure 9930-76.

be used for underwater jetting by connecting 2 pumps in series to deliver water at pressures around 200 psi.

2. Due to abnormal pressures in pump No. 2, the following changes must be made before operation is attempted. Pump No. 1 need not be changed.

a. Disconnect water outlet tubes at the pump. These are the tubes connecting the top of the cylinders to the pump casing. The openings in the pump casings should be plugged. The tubes should be directed downward so as to spill the water between the engine and the pump.

b. Disconnect pressure gage tube at the Y-gate. This is necessary to protect the pressure gage and also to prevent throttling of the engine by the pressure regulator.

c. Remove the tube connecting the hand primer with the pump head, and plug the hole in the pump head. This prevents high pressure water entering the handprimer.

d. The exhaust hose must be sloping continuously downward or completely removed. This is to prevent flooding the engine with exhaust cooling water forced into the receiver by the first pump when the second engine is not operating.

e. The holes in the pump casing and Y-gate and pump head may be effectively plugged by installing a short length of copper tubing of the proper size which has been bent over and tightly crimped at one end.

9930.214 OPERATING PROCEDURE

1. Make necessary alterations of pump No. 2, and connect the pumps together with both 2½-inch discharges from pump No. 1 going into 4- by 2½-inch Y on suction side of pump No. 2.
2. Open Y-gate on pump No. 2 to the jetting nozzle. Be sure this gate is fully open.
3. Prime and start pump No. 1. Open both Y-gates for a short period to fill hoses. Close Y-gates again or water flowing into pump No. 2 will prevent its being started due to advance spark.
4. Start pump No. 2.
5. Open Y-gates on pump No. 1.

9930.215 SUCTION FITTINGS FOR PORTABLE PUMPS

1. A number of different types of suction fittings have been placed in service for taking suction overboard while the ship is underway. So that ships may make up the suction fittings best suited to their operating requirements, 3 types of suction fittings are shown in figures 9930-76 through 9930-78 for information. Figure 9930-79 shows details and assembly for figure 9930-78 which is used with

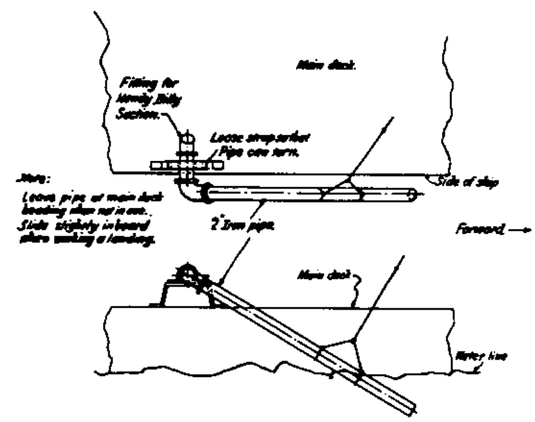


Figure 9930-77.

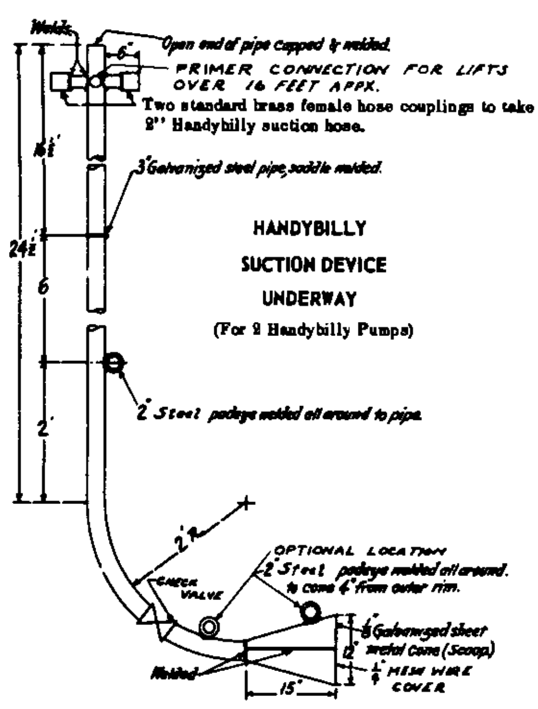


Figure 9930-78.

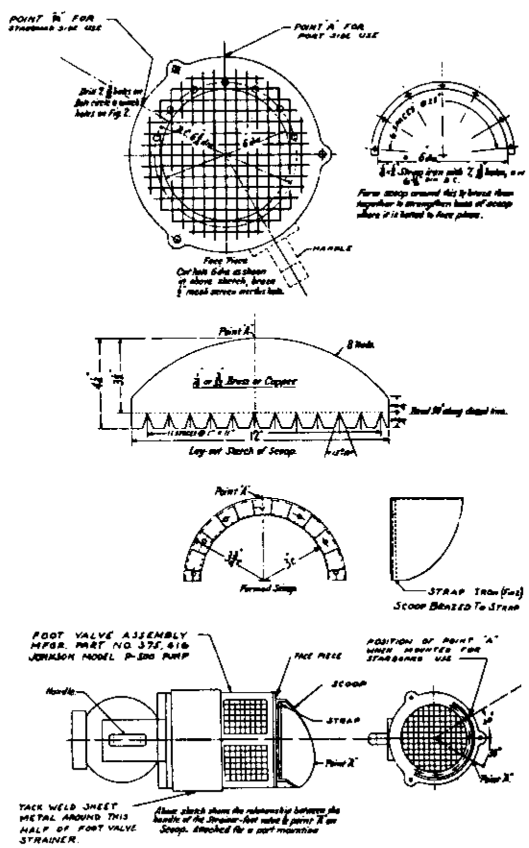


Figure 9930-79.

the P-250. The fittings may be made up by ship forces or may be obtained from tenders or repair ships.

2. Care must be exercised when first rigging these suction fittings for portable emergency pumps while the ship is underway. Figure 9930-76 being a fixed installation that merely requires lowering is the easiest to operate and requires the least care in operation. It will, however, be more vulnerable during dock operations.

9930.216 PORTABLE ELECTRIC SUBMERSIBLE PUMPS

1. Portable electric submersible pumps supplied to ships are of the centrifugal type, driven by a constant speed ac or dc motor and cooled by the pumped water. In the latest design of submersible pumps, the pump is rated to deliver 140 g.p.m. against a maximum head of 70 feet for the ac unit or 60 feet for the dc unit, and the output rises to 200 g.p.m. when the head is reduced to 50 feet for the ac unit or 40 feet for the dc unit.

2. Portable electric submersible pumps are specifically designed for dewatering purposes, their highest efficiency being realized with the head limits given in the preceding paragraph. In dewatering flooded compartments, the pump is dropped into the water and the 2½-inch discharge hose is carried to the nearest point of discharge. Inasmuch as the delivery of the pump increases with decreasing discharge head, speedier dewatering can be accomplished by discharging the water at the lowest practical point and by keeping the discharge hose as short and free from kinks as possible. The low pressures realized with submersible pumps prevent their use as fire pumps to operate fog nozzles or foam-producing equipment. However, they will produce solid streams of fair range, 30 to 50 feet being obtained under favorable conditions.

3. When dewatering against high discharge heads, two submersible pumps can be used in series, the first pump at the lower level lifting water into the suction inlet of the second pump, which is located at a higher level.

4. Submersible pumps are not designed for pumping gasoline or oil. Since the liquid pumped circulates around the motor for cooling purposes, there is a possibility of sufficient gasoline leaking into the motor to form an explosive mixture. When pumping heavy fuel oil, the higher viscosity imposes a greater load on the motor and the oil carries away less heat, therefore, there is a danger of burning out the motor. In an emergency, when conditions warrant the risk of burning out a motor submersible pumps may be used for pumping fuel oil, using two pumps in series.

9930.217 EDUCTORS

1. The operation of eductors has been described in Part 4. While their hydraulic efficiency is low, they perform low head dewatering operations at a greater rate of discharge than can be obtained by straight pumping with the available emergency pumps. Eductors are also used for pumping liquids which portable pumps cannot handle directly and they will pass reasonably small particles of foreign matter. Since the operating medium of an eductor is water under pressure, eductors can be actuated from firemains by connecting a 2½-inch hose from the nearest fireplug to the eductor. Here again, it must be remembered that not all of the eductor discharge comes from the dewatered compartment. As an example—with a firemain pressure of 100 psi at the 4-inch portable eductor, approximately 182 g.p.m. of water is required for the operation of the eductor. The eductor, working against a head of 40 feet, will pick up 151 g.p.m. from the compartment. Thus, while the total eductor discharge is 333 g.p.m. (the sum of the 2 figures) the compartment is dewatered at the rate of 151 g.p.m. A typical connection is shown if figure 9930-70.

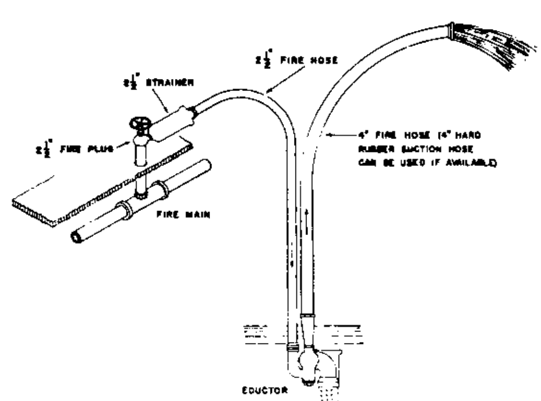


Figure 9930-80. Edutor activated by firemain.

2. When using an eductor for dewatering, the pressure of the operating water must always be substantially higher than the pressure against which the eductor is required to discharge; otherwise the suction effect of the eductor will not be great enough to cause the eductor to take suction. A simple practical rule to follow is that the pressure of the operating water must be at least 3 times the static pressure against which the eductor has to discharge. If a flooded compartment is located so that the static head on the eductor discharge is 50 feet, the pressure necessary to operate the eductor is at least 3 times this amount; (.433 x height in feet = static head). This means that with 50 feet of static head, 65 psi or more must be available at the eductor. The rule of maintaining a minimum ratio of 3:1 between operating and discharge pressure is of particular importance when firemain pressure is used in actuating an eductor. The eductor should be kept in an upright position when in use. Should the eductor come to rest on its side, small pieces of debris could cause the foot valve within the eductor to jam in the open position. This in turn would be a source of back flooding into the compartment if sufficient firemain pressure is not maintained. It is imperative that the eductor discharge hose be kept free of kinks to allow free discharge of water.

3. Two types of 4-inch eductors are available for shipboard use.

a. The single-jet eductor, equipped with foot valve, may be used for dewatering and for supply to the P-250 pump. Discussion elsewhere in this chapter refers to the single-jet type.

b. The perijet eductor is actuated by 6 jets in the periphery of the vacuum chamber, leaving a straight bore of approximately 2½-inches through the eductor base into the discharge section, figure 9930-81. The 2½-inch opening permits passage through the eductor of debris up to that diameter. A 4-inch quick-closing valve is provided at the discharge side for clearing debris by forcing actuating water back through the intake. It can be noted that low firemain pressure will result in introducing additional water into the compartment instead of removing water from it, since the perijet eductor has no foot valve as an integral part of its construction. The absence of the foot valve make the perijet eductor unsuitable for use as a P-250 suction supply. The perijet is about 7 percent more efficient than the single-jet eductor.

9930.218 HULL DISCHARGE OPENINGS

1. Portable pump and eductor discharge are fitted in the hull in all compartments adjacent to the hull above the waterline. These discharges must be located at least 12-inches above the boot-topping, but not below the wave profile of the ship at full speed. They should be located at least 3 feet above the compartment deck.

2. These fittings penetrate the hull, flush to the outside, nippled inside and fitted with a watertight screw cap. A 4-inch to 3-inch reducer is provided and should be stowed adjacent to each opening, and available for setting up on the 4-inch nipple to receive 3-inch discharge hose from portable pumps or eductors operating within the compartments.

3. These hull openings are not fitted with valves.

4. Illustrations within this chapter showing overboard discharge from portable pumps over the gunwales could be interpreted as a substitute for the use of the hull discharge openings.

5. These hull discharge openings may be used to discharge gasoline engine exhaust fumes in emergencies.

9930.219 STRAINERS

1. Battle damage reports reveal instances in which clogging of the suction of emergency pumps has rendered them inoperative at a time when they were most needed. To prevent debris, such as rags, clothing, and waste, usually encountered in flooded compartments, from stopping up the comparatively small orifices of the built-in strainers at the end of the pump suction, the ship's force should manufacture several slip-on basket-type strainers which will be secured over the free end of the suction hose. Two types of such strainers constructed of ¼-inch wire mesh are shown in figure 9930-82. Smaller mesh sizes may be used if available. The cylindrical type is easier to make; however, the box type is preferable because of its larger effective

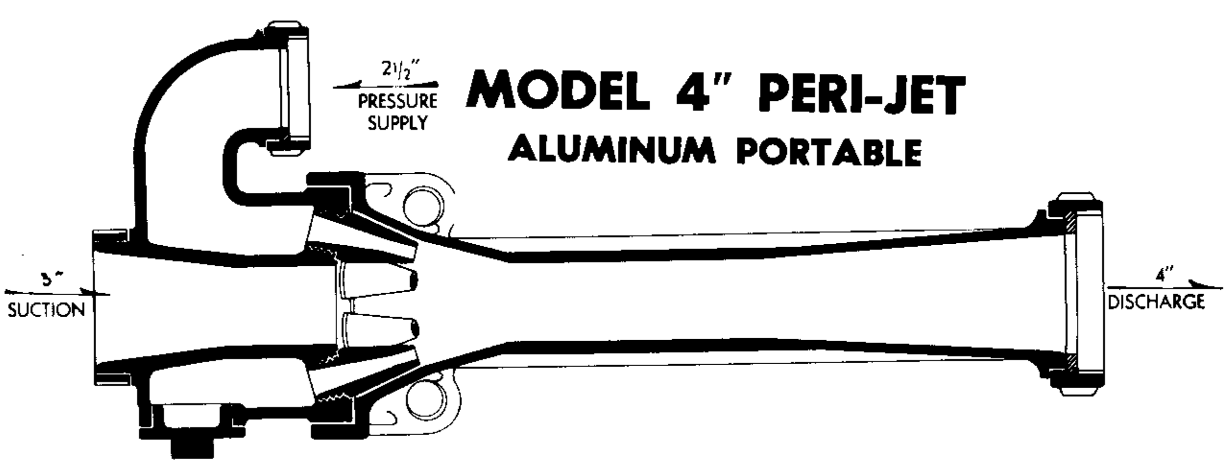


Figure 9930-81.

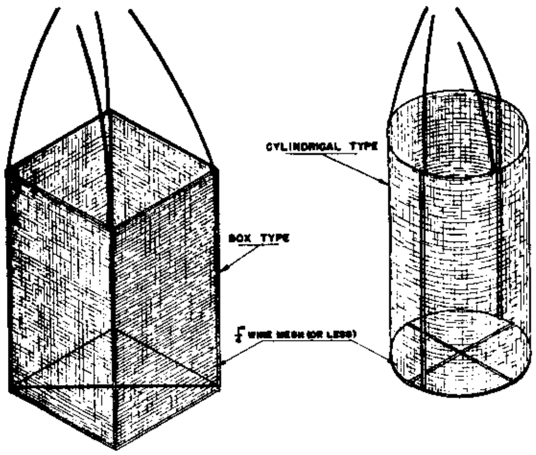


Figure 9930-82.

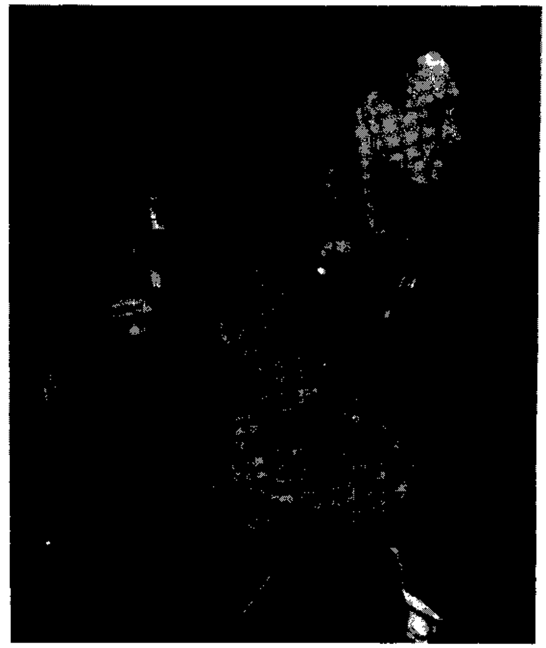


Figure 9930-83.

Figure 9930-84.

straining area. These strainers should always be used when emergency pumping equipment is operated except when taking water underway or in water free from debris. The top rim of the strainer should be positioned above the level of the water.

2. Strainers should be as large as practical commensurate with ease of handling and stowage. The size of access openings, such as escape scuttles or manholes, through which the strainer might have to pass would limit the size of the strainer. Additional smaller strainers should be manufactured and kept on hand for this purpose even though their effective straining capacity is less than that of the larger strainers.

Part 8. Portable Oxyacetylene Cutting Apparatus

9930.231 TYPES AND USES

The oxyacetylene cutting apparatus supplied Naval ships is either the pack type portable oxyacetylene cutting outfit (figure 9930-83, or the emergency type oxyacetylene welding and cutting outfit (figure 9930-84). Except for the fact that the latter may be used for welding, there is no essential difference in the operation of the two. The operator of this apparatus may be called upon to cut holes in decks or bulkheads for the insertion of pipe or applicators equipped with fog heads, or to cut away debris impeding the work of fire fighting or rescue.

9930.232 EQUIPMENT

Complete equipment with each apparatus is contained in a metal carrying case, ready for instant use. The equipment consists of: a cylinder of oxygen, a cylinder pressure gage, a working pressure gage and a regulator, a cylinder of acetylene with similar gages and regulator, a cutting torch, a high-pressure lever-type valve and a cutting tip, and two sections of gas hose. A spark lighter, gloves, and wrench are auxiliary equipment. In addition, the welding and cutting outfit has welding tips.

9930.233 OPERATING PROCEDURE

The procedure for operating the portable oxyacetylene cutting apparatus is the same in principle as it is for the nonportable apparatus. A complete description of both apparatus and method of operation is contained in chapter 9880. Each damage control station should have at least one operator of the cutting equipment with an alternate operator assigned. Operators should be sufficiently trained to cut holes in decks and bulkheads, remove and cut debris, and in other ways assist the fire fighters. This instruction should be given to all selected personnel by attendance at welding schools or by qualified welders on the ship.

SECTION 2. PROTECTIVE EQUIPMENT

(Reserved)

SECTION 3. FIRE FIGHTING AND FIRE HAZARDS

SUB-SECTION A. FIGHTING THE FIRE

Part 1. Organization for Fire Fighting

9930.401 SHIP'S FIRE BILLS

1. For the orderly, efficient, and most expeditious employment of manpower and materials, ships should survey their own conditions regarding the availability of men and materials. They should then assign specific responsibilities, duties and employment, prepare and publish such information in a comprehensive and intelligible form and make it readily available to all personnel involved in such activities.

2. The full implementation of a "Fire Bill" would provide the maximum efficiency in the execution of essential fire fighting actions in times of peril.

3. "Bill" is a sound and recognized nautical word, and application of it within this chapter will be made, as considered necessary.

4. Standard ships' Fire Bills, established by each Type Commander and set forth in Type General Organization Books, are used as a guide by ships concerned. The information which follows is applicable to a typical Ship's Fire Bill.

5. The purpose of the Fire Bill is to establish a fire fighting organization and specify certain responsibilities for its direction to ensure that fires in ships are effectively fought and extinguished. The organization, procedures, and responsibilities set forth in this bill are based on the provisions of the U.S. Navy Regulations, latest NWP and NWIP, and on modifications of the Damage Control Organization as outlined in the Ship's Battle Bill.

6. Fires occurring during combat or while the ship is at general quarters, shall be handled as battle casualties. These fires, which may occur in port or at sea, shall be fought by repair parties and personnel in the vicinity, under the direction of damage control central, (the air officer for fires in aircraft parking areas in carriers. When a fire occurs in port and there is a partial crew on watch the duty fire party will take over.

7. The Engineer Officer is responsible for determining the adequacy of the Fire Bill and for assigning and instructing personnel in accordance with the provisions of the Bill.

8. Repair party personnel, members of the primary shipboard fire fighting units underway, report to their General Quarters station on Fire Call. In some cases, the Ship's Fire Bill may designate the In-Port Fire Party as the primary fire fighting unit. Repair party personnel assigned to the In-port Fire Party proceed to the scene of a fire on the double with assigned equipment.

9. The In-Port Fire Party shall be composed primarily of personnel in the regular damage control repair parties, each duty section having an effective fire fighting force. Heads of departments, division officers, and leading petty officers concerned shall consider training and experience of repair party personnel inmaking assignments in accordance with the Fire Bill. Care must be exercised to avoid assigning personnel of the In-Port Fire Party to additional details in the Rescue and Assistance Party or to other special duties in port which require absence from the ship.

10. Personnel assignments and duties vary from ship to ship.

9930.402 FIRE FIGHTING PARTY EQUIPMENT

The information which follows is typical for an In-Port Fire Party aboard an aircraft carrier:

No. Men	Division	Provide
2	R	OBA and canisters
2	R	OBA tending lines and canisters
1	A	Bag of tools and bag of hose fittings.
1	R	Bag of hose fittings and bag of tools.
1	A	Bolt cutters, fire axe, and crowbar.
1	B	Fire axe, crowbar, and bolt cutters.
1	A	2 NPU nozzles and 2 pickup tubes.
2	M	Two cans of Liquid Foam.
2	V1	Four CO_2 bottles.
2	V1	Hosemen
1	E	Electrical repair kit and rubber gloves.
3	V3	Hosemen
1	E	Rubber boots and sealed beam spotlight.
2	B	Portable blower, electric
1	B	Blower ducts (2 sections)
1	H	First aid kit and 2 blankets
4	V2	Stretchers (2)
1	A	Talker (2JZ circuit) sound powered phone set

1. The leading petty officers in charge of In-Port Fire Parties are normally assigned from the Damage Control Group by the Engineer Officer.

2. When Fire Call is sounded, personnel take stations and perform duties as shown in Table 9930.101.

9930.403 ORGANIZATION OF A FIRE FIGHTING PARTY

1. The organization of a fire fighting (fire) party depends on the number of men available. Figure 9930-151 shows a recommended basic organization of a small fire fighting party, and figure 9930-152 outlines the organization of a large fire fighting party. It may be necessary for individuals to perform more than one duty, and this must be considered when organizing a fire fighting party.

2. One man in the fire fighting party must be designated as the group or scene leader (investigator). His prime duty is to get to the fire quickly, to investigate the situation and determine the nature of the fire, to decide what type of equipment should be used, and to inform damage control central. Later developments may require the use of different or additional equipment, but the scene leader must make the first decision.

3. The number of hosemen assigned to a fire party varies with the number of men available and the size of the firehose. At least 3 men are required for a 1½-inch hose,

Table 9930-101. Stations and duties of in-port fire party personnel.

Personnel	Station	Duties
Command Duty Officer	Command Control	In general charge.
Damage Control Duty Officer (Officer in Charge)	Scene of fire	In direct charge of firefighting operations.
Engineering Department Duty Officer	Engineering Control	Maintain prescribed pressure on firemain. If directed, make preparations for getting ship underway.
Duty Repair Officer (or Petty Officer)	D. C. Central	Maintain communications with fireparty, receive reports on status of fire, coordinate assistance from repair party personnel as required.
Gunnery Department Duty Officer	Scene of Fire	Supervise the activation of magazine sprinkler controls or remove ammunition as directed.
Air Department Duty Officer	Scene of fire on hangar deck	Direct other Air Department personnel as required.
Medical Department Duty Officer (or Petty Officer)	Scene of Fire	Render first aid as necessary.
Supply Department Officer (or Petty Officer)	Scene of Fire	Open storerooms as directed.
Log Room Duty Yeoman	D. C. Central	Provide and man 2JZ phones.
Repair Party Personnel	Respective repair lockers	Repair party personnel, not assigned other duties, stand by to assist as directed and maintain communication with D. C. Central.
Designated Personnel	Divisional Fire fighting equipment	Man fire fighting equipment as assigned on Division Watch, Quarter, and Station Bills.
All other Personnel	General Quarters	Help as needed.

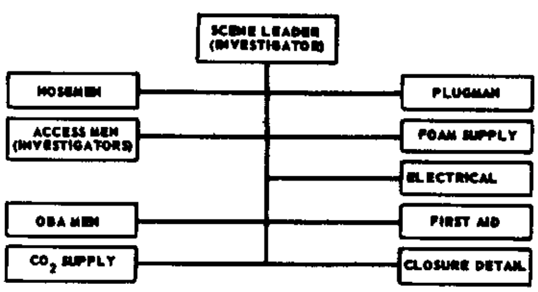


Figure 9930-151. Basic organization of a small firefighting party.

and 4 or 5 men are required for a 2½-inch hose. The hosemen lead out the hose, remove kinks and sharp bends, and stand by the nozzles. Hosemen should wear oxygen breathing apparatus (OBA) while fighting fires.

4. The plugman stands by to operate the fireplug valve when ordered. He rigs and stands by jumper lines, assists on the hose lines and clears the fireplug strainer when necessary.

5. The access men open doors, hatches, scuttles, and other openings and clear routes as necessary to gain access to the fire. These men carry equipment to open jammed fittings and locked doors. Once they have gained access to the fire, they make a detailed investigation of the fire area.

6. The foam supply man prepares the foam equipment for operation and operates it as required. He obtains spare foam cans from racks and prepares them for use.

7. The electricians deenergize all electrical equipment in the fire area, both for the protection of personnel and possible prevention of explosions or flashbacks. They rig power cables as required for portable tools, lights, and blowers.

8. The CO_2 supply men take extinguishers to the fire and operate them as necessary.

9. The OBA men have their gear on and ready for immediate use throughout the fire fighting operation. Fire fighting suits must be available at the scene. OBA tenders are in charge of tending lines when used and keeping spare canisters readily available. The OBA men assist in making the investigation where oxygen breathing apparatus is necessary for entry. These men also work with hoses and perform other duties in compartments containing smoke and toxic gases.

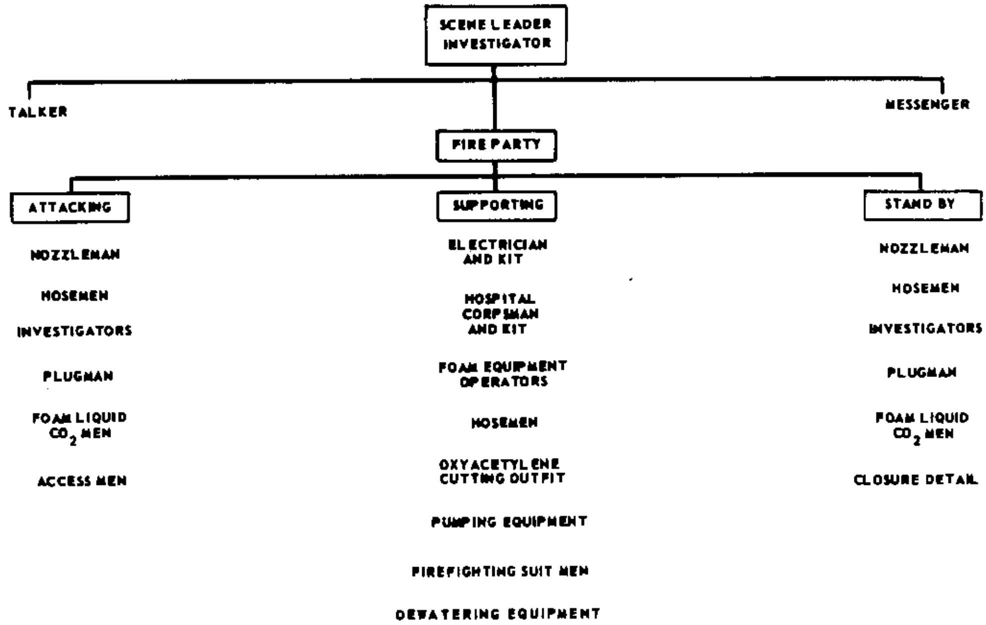


Figure 9930-152. Organization of a large firefighting party.

10. The closure, or ventilation detail secures all doors, hatches, and openings in the boundary of the fire area to isolate the fire. They establish secondary fire boundaries by cooling down areas adjacent to the fire, and assist in fighting the fire as directed.

11. Hospital corpsmen provide first aid to any injured and transport injured to the sick-bay as required. The ventilation detail secures all ventilation closures and fans in the area of smoke and heat. The telephone talkers establish and maintain communications with damage control central, either directly or though the local repair station by connecting phones to the nearest sound powered JZ circuit outlet.

Part 2. Application of Principles

9930.411 GENERAL PROCEDURE

1. With thorough training in the chemistry of fires, how they are caused, and the capabilities of the fire fighting equipment, the Navy fire fighter should be able to combat, control, and extinguish practically any fire which could be encountered in a ship.

2. The problems, situations, and conditions that could be experienced by a ship's fire fighter are unpredictable and it would be impossible to attempt to describe every possibility.

3. The fire fighter should make it a practice to do the following:

a. Make every effort to prevent fires and report hazardous conditions.

b. Anticipate possibilities of fires in the various parts of his ship.

c. Take every advantage and opportunity to increase his knowledge of fire fighting.

d. Learn the proper use and capabilities of the fire fighting equipment available to him.

e. Realize that fire fighting is a serious responsibility and that the proper performance of his duties could be vital to the survival of the ship.

9930.412 CLASSES OF FIRES

1. Class A fires in ordinary combustible materials, such as bedding, mattresses, dunnage, books, cloth, canvas, wood, and wood shavings are dealt with by "cooling" the fire to below its ignition temperatures. All Class A fires leave embers which are likely to rekindle when air finds its way under them. Hence, the entire mass must be cooled thoroughly. The Navy all-purpose nozzle is used on Class A fires in ships. If this were not done and the burning embers below the surface of the combustibles were allowed to remain uncooled, the smoldering fire would raise the temperature of the material to the ignition point and the fire would break out again. "Smothering" with foam or with canvas blankets cannot be considered effective for a Class A fire because this does not lower the temperature of the burning embers below the surface of the fire.

2. Class B fires, which occur in flammable liquids such as gasoline, jet fuels, kerosene, oils (including fuel oil), paint, turpentine, grease, tar, and in other combustible substances which do not leave embers, can be extinguished by a barrier between the fuel and air or oxygen necessary for its combustion. Such a barrier may be produced by the use of foam. This is called a "permanent smothering" agent. Carbon dioxide and dry chemical can also be considered as smothering agents for such fires, but they are only temporary and must be renewed if danger of reignition of the combustibles is possible.

3. Class C fires occur in electrical materials and present the added danger of electrical shock to the fire fighter.

Furthermore, in Class C fires it is desired that the electrical equipment not be damaged by the extinguishing process since extinguishing agents other than gases will contaminate electrical instruments, contacts, and devices. Carbon dioxide is the preferred agent in such fires as it gives both protection against electric shock and less likelihood of injury to equipment. Water fog, and dry chemical although not preferred, can also be used as they do not transmit electricity to the fire fighter except for water fog as described in article 9930-42.

4. Class D fires have been designated by the National Fire Protection Association as those fires involving certain metals such as magnesium, potassium, powdered aluminum zinc, sodium, titanium, zirconium and others which require careful fire attack with special methods - nd extinguishing agents.

5. There has been developed a standard background symbol for each class of fire; Class A is a triangle, Class B a square, Class C a circle and Class D a star. Many major fire extinguisher manufacturers are using this system of symbols on their products.

9930.413 PRIMARY DECISIONS

1. When the investigator has determined which of the four classes, or combinations, are involved in the fire, other factors must also be determined and action taken to control and restrict the spread of the fire. Action must be quickly taken to ascertain the following:

a. What combustibles are in the immediate vicinity, in all surrounding spaces, and in the compartments above and below.

b. What vents and other channels there are and what breaches resulting from battle damage would facilitate the spread of the fire.

c. Whether the fire main is furnishing sufficient pressure. (Damage control would be notified if the pressure were insufficient or if additional pressure were needed to supply the many lines laid on an extensive fire.)

d. What method of extinguishment is indicated.

e. What is the best technique to (1) prevent the spread of the fire, (2) to extinguish the fire and (3) to avoid affecting the stability and buoyancy of the ship which would impair its fighting efficiency.

f. The fire fighter must know three situations before he can take action:

(1) Location of fire
(2) What is burning
(3) What is the extent of the fire; that is, what are its effects on the surrounding area.

2. Information concerning the location of the fire or fires should be immediately supplied to the officer-of-the-deck. The fire fighter should have sufficient knowledge of the construction and compartmentation of his ship to be able to clearly identify the location given to enable him to visualize problems that may be involved.

9930.414 COMPARTMENT IDENTIFICATION SYSTEM

1. The compartment numbering system in ships has a series of letters to identify the use being made of the compartment. From the letter the probable contents of the compartment or tank, and so forth can be determined. The complete compartment number should agree with that indicated on the damage control diagrams in the Ship's Damage Control Book. The compartment numbers must be clearly posted at every access opening to each compartment, trunk, tank or void.

2. The following is a list of those letters used in the system, and indicates the usage of the compartments and others so designated:

A	Stowage areas as: Issue rooms. Refrigerated stores. Storerooms.
AA	Areas such as: cargo holds. compartments.
C	Ship and fire control operating areas which are normally manned such as: CIC. Communication office. Electronic operating spaces. Pilothouse. I.C. rooms. Plotting rooms.
E	Machinery spaces which are normally manned such as: Auxiliary machinery rooms. Evaporator rooms. Main machinery areas. Pump rooms. Refrigerating machinery rooms. Emergency generator rooms. Steering gear rooms.
F	Diesel fuel, lubricating oil, and fog oil tanks.
FF	Cargo diesel oil, fuel, and lubricating oil tanks.
G	Gasoline tanks.
GG	Cargo gasoline tanks.
J	JP-5 Tanks.
JJ	Cargo JP-5 tanks
K	Stowage of chemicals and semisafe and dangerous materials, except gas and gasoline tanks.
L	Living quarters, medical and dental areas, and passageways.
M	Ammunition magazine.
Q	Areas not otherwise covered such as: engineering, electrical, and electronic areas that are not normally manned; galley laundry, offices, pantries, shops and wiring trunks.
T	Vertical access trunks.
V	Void compartments such as: Cofferdam compartments other than gasoline tank cofferdams. Void or ballast wing tanks. Void wing tanks.
W	Compartments storing water, including bilge and sump tanks.

9930.415 INITIAL OPERATIONS

1. Acting upon information as to the location of the fire, the Scene Leader makes a quick survey to ascertain what combustibles are or could be involved, the extent of the fire, and what methods and equipment are necessary for its extinguishment.

2. The Scene leader should make every effort to arrive at the scene of the fire during its early and localized stage; take immediate action to extinguish the fire with equipment at hand if at all practical. For the purpose of this discussion it will be assumed that the scene leader will be confronted with fires that have become quite extensive, and threaten to grow out of control endangering other areas of the ship. Should these conditions exist, the fire fighter must call for additional men and equipment to localize, control, and extinguish such fires. Whatever is required by standard procedures to extinguish fires in the class of materials involved must be applied quickly and in quantity.

3. Once the location, the extent, and the materials involved in the fire have been determined, a fire area is established in which all safety precautions are observed and from which all personnel not involved are evacuated and all combustible materials are removed. Within these boundaries, doors, hatches, manholes, ventilation ducts, and all other openings are closed, as circumstances warrant and as far as it is practical to do so without undue interference with the operation of the ship.

4. Knowing the material condition of readiness set, the Scene Leader will direct the local operations of the firemen as circumstances demand.

5. The Scene Leader will direct the deenergizing of electrical systems in the area or in compartments which could become flooded. It is quite possible that some electrical circuits and equipment would of necessity remain energized during a fire fighting operation with any risk involved considered a necessary hazard. The Damage Control Officer will have to make these decisions.

9930.416 FIRE FIGHTERS EXTINGUISHING METHOD CHART

Combustible Involved	Type Fire	Useful Extinguishing Agents
Woodwork, bedding, clothes, combustible stores	A	1. Fixed water sprinkling 2. High-velocity fog. 3. Solid water stream. 4. Foam. 5. Dry chemical extinguishers. 6. CO_2 extinguishers.
Explosives Propellants	A	1. Magazine sprinkling. 2. Solid water stream or high velocity fog. 3. Foam.
Paints, spirits, flammable liquid stores	B	1. CO_2 (fixed system). 2. Foam. 3. Installed sprinkling system. 4. High velocity fog. 5. P-K-P Dry Chemical. 6. CO_2 portable.
Gasoline	B	1. Foam, handline or sprinkler systems. 2. CO_2 (fixed system). 3. Water sprinkling systems. 4. P-K-P Dry Chemical.
Fuel oil, JP-5, Diesel oil, and kerosene	B	1. Foam, handline or sprinkler system. 2. P-K-P Dry Chemical. 3. Water sprinkling system. 4. High-velocity fog. 5. CO_2 (fixed system).
Electrical and radio apparatus	C	1. (Deenergize affected circuits). 2. Portable CO_2 extinguishers or CO_2 hose reel system. 3. High-velocity fog. 4. Fog-Foam or Dry Chemical (if CO_2 not available).
Magnesium Alloys	D	1. Jettison into the sea. 2. Solid water stream. 3. High-velocity fog.

Extinguishing agents are listed in the order of their preferred use. They act in the following manner: (1) Solid Water Stream—wetting, penetrating and cooling, (2) Water-Fog—wetting, cooling, shielding, (3) Foam—permanent smothering, (4) CO_2—temporary smothering, (5) P-K-P Dry Chemical—temporary smothering.

9930.417 PREVENTING SPREAD OF FIRE

1. In the event that battle damage has breached bulkhead so that an uninterrupted passage is provided for the fire to spread, the fire fighter improvises to close the breach. For this purpose he may use fireproof material, if available; otherwise, combustible material is employed and is kept cool by sprays from a hose line, or a water curtain of fog. This cooling processes applied, if practical, to all surrounding bulkheads, to the overhead in the compartment below, and to the deck of the compartment above. The fire fighter is aware that a fire in a compartment is similar to a fire in a metal box that is sending out heat in all directions. Not only does the heat pass by conduction through the four bulkheads of the compartment on fire, but it passes in the same manner down through the deck and up through the overhead. Cooling must be applied on all sides of the compartment. With the hull boundaries, the sea does the cooling. Cooling the surrounding bulkheads and decks of a compartment on fire is resorted to for two purposes: to prevent the spread of the fire to combustibles in adjacent compartments and also to prevent the heat from weakening and distorting these structures.

2. The fire fighter, whenever practical and necessary, may remove combustibles from the immediate vicinity of a fire. Especially when the combustibles present a great hazard—such as that presented by gasoline and other explosives—the fire fighter may remove them to a safe distance or even jettison them. Since it is not always possible or practical to remove combustibles from the vicinity of a compartment on fire, the fire fighter may fill the compartments containing them with carbon dioxide and

batten down the compartments. For large compartments the approximate carbon dioxide requirement is 1 pound for every 16 cubic feet of space. He may also depend upon cooling and smothering the combustibles with fog spray from all-purpose fog nozzles or through fixed fog installations, or he may flood the compartment with water through a sprinkling system or by a hose line. Fuel may, on occasion, be shifted to other tanks.

3. In deciding upon effective means for preventing spread of a fire, the experienced fire fighter acts with a thorough understanding of the means by which heat is transmitted. He knows all the possibilities in a set of conditions at a fire and, even though he may be unable to confine a fire within bounds, he should not be taken by surprise. He is always prepared to make any rapid adjustment in his extinguishing methods as the changes in the fire boundaries require.

4. When there are combustibles in a compartment adjacent to the one that is on fire, the fire fighter knows that heat from the fire can pass through bulkheads or decks and ignite these combustibles—and he acts accordingly. If the fire is not one of great magnitude or if it is one he can check more or less promptly, he may simply move the combustibles away from the bulkheads that form the vertical boundaries of the compartment that is on fire, or move the combustibles out of range on the deck above or the deck below. But if the fire is intense and not likely to readily be extinguished, the fire fighter must remove the combustibles from the adjacent compartments or take action to prevent them from igniting. Action must be taken promptly, because heat will pass by conduction through the bulkheads or decks and further pass to the combustibles and ignite them, or pass through the space between the bulkhead and the combustibles by radiation and ignite them. It is the radiation and conduction hazard which requires that bulkheads, overheads, and desks be protected by approved types of non-flammable paints and coatings.

5. While the work of preventing the spread of fire is under way, the work of extinguishment is continuing. The two are undertaken simultaneously; and they are equally important. To the experienced fire fighter the confining of a fire within bounds is the more important of the two. He would consider that a fire so confined is definitely under control. His principal problem would be to extinguish the fire, and, until the equipment best suited for the task can be put into operation, he uses whatever equipment there is at hand which can be used effectively. The selection of the method of extinguishment is the most important decision made by the fire fighter, utilizing his knowledge and experience as well as the equipment available to him.

9930.418 FIRE FIGHTING PARTY IN ACTION

1. To ensure the most effective use of the men and of the equipment in the fire party, a rapid analysis of the situation must be made. Since no two fires are exactly alike, the deployment of men and equipment will not always be the same. However, the following general rules will be helpful in most situations:

a. Do not underman the attacking party, which is the first line of defense. The attack group makes the primary investigation and moves in to contain the fire.

b. Do not overman the attacking or supporting forces. (The supporting group brings up auxiliary equipment, assists with foam and CO_2 supply, and fights the fire as needed.) If you have men at the fire who are not actually engaged in fire fighting, send them to the standby party. (This group makes the closures necessary to isolate

Figure 9930-153.

the fire area, cools the surrounding areas, assists with fighting the fire as needed, and supplies foam and CO_2.)

c. See that the fire party is quiet and orderly. There should be only two men talking at a fire: the leader of the fire party and the JZ talker who makes reports to damage control central.

d. Give concise and accurate orders.

e. Make concise and accurate reports to damage control central.

f. Observe all possible safety precautions and insist that the men in the fire party also observe them.

g. Do not overlook the possibility that the fire may spread by radiation, conduction, or convection. Send men to adjoining compartments to check on the possibility of ignition. Have men cool down bulkheads or decks, if necessary.

2. In fighting any kind of fire, the first problem is to get men and equipment to the fire. (See Fig. 9930-153.)

3. It must be understood that fire fighting is **NOT** a "by-the-numbers" evolution and different situations can require additional action(s). After the alarm is sounded, giving the location of the fire–compartment number and name (galley, boatswain's locker), and class of fire, if known–the following procedure is generally used:

a. Isolate the fire–close all doors, hatches, and vents, and secure blowers.

b. Deenergize electrical circuits in the compartment where the fire is located.

c. Bring required equipment to the scene of the fire (CO_2 extinguishers, applicators, fire rake, flame safety lamp, and dewatering equipment).

d. Lead out two hoses, from different plugs, to the area of the fire. Rig one hose with an applicator, and charge both hoses. (If fire is below decks, only 1½-inch hoses should be used.)

e. There must be an OBA man in complete battle dress, with gloves and miner's headlamp, serving as nozzle man for each of the two separate hoses.

f. There should be a tender wearing asbestos gloves for each OBA man.

g. Run out extra hoses in surrounding compartments to cool off decks, overheads, and bulkheads.

h. Rig portable pumps which can be used if firemain pressure is lost.

i. Station men to protect combustibles in the area (at magazine sprinklers or CO_2 releases).

j. Combat the fire from the best position possible to protect personnel. Approach a topside fire from windward, if possible.

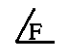
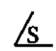
k. Send out investigators to check surrounding areas. Inspection and reporting must continue until the fire is out and danger is over. Then investigators return to the scene leader.

l. Move phone talker as close to the scene as possible.

m. The reports to be made from the scene are as follows:

(1) Location of fire
(2) Class of fire
(3) Action taken in combatting the fire
(4) Fire under control
(5) Fire out
(6) Fire overhauled
(7) Reflash watch set
(8) Compartment tested for explosive gases
(9) Compartment tested for oxygen content
(10) Electrical circuits and ventilation system tested
(11) Amount of damage done.

4. Figure 9930-154 shows some symbols which can be used by investigators and messengers when reporting by written messages the damage incurred and the action being taken.

Symbol	Meaning	Symbol	Meaning
A	Class of Fire A, B, C, D		Flooding Being Pumped Out
	Fire Under Control		Flooding Completely Pumped Out
	Fire Out	S	Smoke in Compartment
	Reflash Watch Set		Smoke Being Removed
	Compartment Tested for Explosive Gases and Oxygen Content		Smoke Cleared
	Fire Overhauled	T 1JV T	Tele. Communications Lost on 1JV
F / 300	Flooding at Rate of 300 Gallons per Minute	T / 1JV	Tele. Communications Restored on 1JV

Each Message Must Contain The Compartment Number To Avoid Confusing Report With Damage In Another Compartment.

Figure 9930-154. Symbols used in reporting damage and action being taken.

9930.419 APPLICATION OF WATER AND WATER FOG

1. As water is the most available extinguishing agent aboard ship, a knowledge of its application is essential. In certain Class A fires where the flame is particularly deepseated; the solid stream can be used to dig down into the material. Much of the technique in fighting a fire with a solid stream of water is a matter of exercising common sense. The fire fighter handling the nozzle of a solid stream should be careful to keep as close to the deck as possible where the heat is less intense, in order to prevent being overcome by heat and fumes.

2. In determining the number of hose lines to be brought into service, the fire fighter should be guided by the extent and intensity of the fire. He must consider that the pumping capacity of his ship is not unlimited and that every gallon of water released in the ship reduces its stability and freeboard until pumped out. The all-purpose nozzle permits the fire fighter to use water

fog for nearly all fire fighting situations where water is indicated and still have a solid stream available when needed. Use of a solid stream from 100 feet of 2½-inch hose equipped with NAP nozzle and with 100 psi at the fireplug will discharge 250 g.p.m. while a high velocity fog pattern under the same conditions will only discharge approximately 117 g.p.m.

3. Water fog utilizes water in its most efficient form. A screen of fog can be used to beat back heat and fumes in a situation where the fire fighter cannot approach the fire without some protection. It forms a barrier between the fire fighter and the fire. Circumstances and the availability of equipment would determine the choice of either high velocity or low velocity fog. High velocity fog is produced with the fog tip set in the all-purpose nozzle; low velocity fog is produced with the 4-, 10-, or 12-foot applicator equipped with low velocity head. The practice has been to use 1 high-velocity line and 1 low-velocity line together as a team.

4. The fire fighter must keep the fog stream between himself and the fire. He should not turn it to the side and thus expose himself to the heat. The protective function of water fog may be used when a fire fighter needs to apply foam to the surface of burning gasoline and requires some protection to approach closely to the burning surface. It may be also used to protect a fire fighter who must close valves or throw a switch in the fire area.

5. Water fog is an efficient cooling agent for protecting surrounding hazards when a compartment is on fire. A high-velocity fog stream directed against bulkheads and decks will remove or greatly reduce the danger of heat passing through them by conduction and igniting combustibles in adjacent compartments. Such cooling would serve another important purpose: the danger from a reflash occurring as a result of heat radiating back from bulkheads and decks in the compartments on fire would also be removed or greatly reduced. In some situations it may be necessary to cut holes in adjacent bulkheads or decks to introduce a short section of pipe equipped with a fog head and connected to a hose line (See figure 9930-155) or an applicator set in an all-purpose nozzle.

6. Water fog is also an excellent extinguishing agent as well as a protective agent. In Class A fires, where small portable extinguishers cannot be used because of the size of the fire, water fog will effectively extinguish the fire with a minimum of damage to materials. Water fog may be used also for Class C fires in electrical equipment as described in article 9930-42. However, the damaging effect of water applied by this method will be greater than that when carbon dioxide is used.

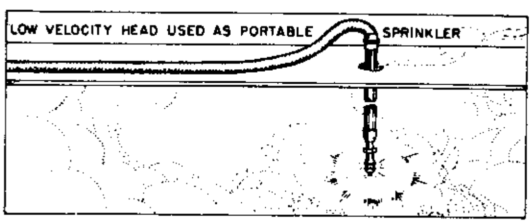


Figure 9930-155.

7. In certain compartments water sprinkler systems are equipped with fog heads and in some ships water fog installations are arranged from permanent piping so that a thick curtain of fog may be sent athwartship, and fore and aft, to form a barrier against the spread of fire. Some of these are activated by connecting the systems to the firemain with a 2½-inch hose line. While others are permanently connected by fixed piping to the firemain.

9930.420 MECHANICAL FOAM

1. Mechanical foam is discharged from the nozzle in the consistency of heavy cream. It is lighter than most flammable liquids and when applied to fires of this type (except alcohols, aldehydes, ethers, ketones, and the more volatile ethers), the fire is smothered by the cohesive foam blanket over the top. Mechanical foam flows easily around obstructions, yet has sufficient adherence qualities to make a tight blanket over liquids through which obstructions protrude.

2. The fog foams as applied by the NAP nozzle, either high or low velocity, do not reach full expansion and are much lighter and fronthier than mechanical foam. Ordinarily they will extinguish Class B fires more quickly than mechanical foam, but the light foam blanket formed is fragile and easily broken up with the consequent danger of reflash.

3. Foam applied by the NAP nozzle solid stream again does not reach full expansion, but forms a thin, tough coat over the liquid. This method should be used only when the fire cannot be reached by a stream from a mechanical foam nozzle. It should be considered a "better-than-none" method of applying mechanical foam.

4. The high capacity foam systems are installed primarily for flight, well, vehicle, and hangar-deck protection. Foam may be discharged from fixed monitors of fixed sprinkler systems.

9930.421 APPLICATION OF FOAM

1. The method of foam application to a fire is extremely important. In most cases, a stream of foam should be deflected from a bulkhead in such a way as to avoid undue agitation of burning oil or gasoline. The fire fighter must remember that foam is only efficient when it covers the top of the surface of burning combustibles. Therefore, he must hold the foam stream sufficiently above the deck to break its force before it flows over the fire. Since the rate of application is important he places several such streams in operation as quickly as possible. He continues this operation until the burning area is completely covered with a foam blanket thick enough to smother the fire. After the fire is extinguished the fire fighter should continue to pile up a foam blanket to a depth of 6 to 8 inches. Such a blanket will normally last 6 to 8 hours. Foam generating equipment should be kept at the scene to repair any break in the foam surface such as may be caused by motion of the ship.

2. He may also flow the foam on, and thus extinguish a pool of burning gasoline on a deck surface.

3. Another important method of foam application is that of foam sprinkler heads where foam descends in the form of a fluid cone onto the buring surface.

4. **Fire in the Hangars.**

a. In aircraft carriers, foam service outlets are installed fore and aft immediately outside the hangar. A study of fires which have occurred in aircraft carriers reveals that the majority take place at or near the midship section, leaving the fore and aft ends of the deck relatively safe for the launching of fire fighting operations. Spare fire hose and nozzles should be stowed behind bulkheads inin sheltered areas close to these fore and aft foam service outlets. Satisfactory progress can be made in hangar deck fire fighting where fire parties advance from the fore and aft ends simultaneously converging on the fire with high capacity foam gear. As progress is made toward the fire, supplementary foam lines can be operated from other foam service outlets made accessible in the course of the advance. Operations of the monitor nozzle foam streams and lines out of range as a result of the advance should be secured by the fire parties as soon as possible to prevent too great a drain on the system.

b. The hangar water sprinkling system should not be operated while using the foam system. The sprinkler system can be used effectively to control the intensity of a hangar conflagration should events prevent immediate application of fog foam. It should be secured immediately when the fog foam system is started. The capacity of the ship's pumps is not sufficient to supply both the hangar sprinkler system and the fog foam system simultaneously at pressures required for efficient operation. Judicious use can be made of the hangar sprinkler system for cooling down the structure after the fire has been extinguished. Extreme care must be exercised while doing this to prevent the foam blanket from being broken up to the extent that reflashes may occur.

c. Test fires have been extinguished by using the sprinkler system and applying foam simultaneously. The tests, however, were conducted in simulated hangar structures, free of obstructions, which permitted an uninterrupted flow of foam over the entire area. Continued operation of the sprinkler system after stopping the application of foam caused a rapid reduction in the thickness of the foam blanket. A 2-inch blanket was reduced to 1-inch within 1 minute.

d. When general, fire, or flight quarters are sounded, all foam injection stations should be manned and foam proportioner pumps should be primed and placed in operating condition. If fire develops on the hangar deck, water curtains at both extremities of the area involved should be placed in operation. Hangar doors, if installed, should be closed to form a boundary for the fire. Foam monitor nozzles covering the involved area should be turned on, thereby reducing the temperatures within the area and furnishing a foam blanket. If fire or other damage makes foam monitor nozzles within the involved area inoperative, the foam lines located forward and after should be advanced into the involved area to extinguish the fires. When the fire is beyond the reach of the hose lines at the fore and aft ends of the hangar, the nearest operable hose outlets outside the involved area should be used. The use of the stream shapers on the portable lines will be dependent upon the severity and extent of the heat wave created by the fire. They should not be used at close range since the foam is delivered with such force to a localized area that it tends to break up the foam blanket. Monitor nozzles should be shut down when mopping up with the 2½-inch lines has been started; the water curtains should be cut off as soon as all fire has been extinguished and the involved area sufficiently cooled to be certain that no flash back will occur.

e. Hangar deck monitors should be preset both in elevation and train to give the best total coverage and stream shapers should be removed. Once the setting has been determined, these positions should be marked so hangar deck crews can see at a glance whether monitors are in proper position.

f. On later ship installations where foam sprinkler systems have been installed in the hangar overhead, they should be used as the first line of attack. Personnel in the appropriate **CONFLAG** station will select the sprinkler group/groups to be activated. All other fire fighting procedures are identical with those on ships not fitted with foam sprinkler systems. Personnel likely to become involved in a hangar fire should become familar the foam sprinkler system. Also, older ship installations are equipped with a water sprinkler system and should not be confused with the foam sprinkler system.

g. While the above has dealt only with hangar deck fires, similar procedures can be followed for well, tank, and vehicle decks equipped with foam producing equipment.

5. **Fire on flight deck.**

a. Fire should be approached from the windward side whenever possible preferably with foam lines in pairs, one with stream shaper and one without. The stream shaper line can be shut down momentarily and the shaper removed as the fire party closes in on the involved area. The stream shaper can be discarded without shutting down the line but, when done in this manner, it usually goes over the side or is damaged and is lost for further use.

b. In the event fire is caused by a plane crashing on the flight deck and the rescue of personnel enters the problem, the fire party should concentrate on the fire surrounding the plane, using foam lines. The operating personnel should be protected from the heat by means of a water fog applicator operated from one of the ship's regular service fire plugs. After rescue has been accomplished, the remaining fire should then be attacked with the foam lines.

c. Crash fires and other fires may involve munitions inside of, attached to, or nearby the aircraft for aircraft arming. Personnel in charge of fire fighting operations must know the locations of the munitions in or on the aircraft. If munitions are carried inside, such personnel must have knowledge of the most suitable places to penetrate the aircraft skin for the insertion of the 2½-inch applicator water-fog nozzles. Foam and water-fog lines should move in practically simultaneously, with the foam lines cutting a path through the fuel fire and driving the fire away from the munitions. Water fog, high or low velocity—whichever technique is best suited, must be applied immediately to cool the weapon and prevent detonation. Munitions, depending on the chemical composition of the explosive and the type of casing, will vary in the time required to react to the heat input from the fire. Regardless of the type of munitions, fire fighting and cooling must be started immediately, certainly within 30 to 60 seconds. The water-fog application must be continued until after the fire has been extinguished and there is no chance that the temperature of the munitions will rise when the application of water fog is stopped.

9930.422 APPLICATION OF STEAM

1. Steam as an extinguishing agent in Naval ships is applied through installed piping systems. Generally, steam is not effective on Class A fires; the combustibles leave embers that cannot be extinguished by a blanket of steam on the top of the fire and the steam does not penetrate sufficiently. In the absence of other extinguishing mediums, however, steam can be used to retard the propogation of flame. For Class A fires, a penetrating cooling medium, such as water, should be applied and with pressure to break down the masses of embers for quicker extinguishment.

2. On Class B fires, steam acts in a manner similar to that of fog, but with very much less cooling effect. Fog cools the oil as it absorbs heat and is converted to steam, and the steam then acts as a smothering agent. This effect is achieved because steam displaces the air that is required for combustion.

3. Steam should not be used if foam or fog is available because of the quantity required and because it renders a compartment untenable. A fire fighter cannot enter a compartment flooded with steam because of the heat.

4. Steam is available for fires which could occur in boiler casings.

9930.423 APPLICATION OF CARBON DIOXIDE

1. A compartment is dangerous to enter when it is filled with carbon dioxide. A fire fighter can enter a compartment so filled if he wears an oxygen breathing apparatus; but the operation of machinery by personnel so encumbered would be impracticable and, furthermore, machinery requiring oxygen for combustion would be rendered inoperative. The decision to fill machinery spaces with carbon dioxide is not likely to be left to the individual fire fighter; nevertheless, he should be aware of the possible consequences.

2. Compartments, such as those for gasoline and paint stowage, can be filled with carbon dioxide without interfering with the fighting efficiency of the ship, since these compartments are not manned. The individual fire fighter may not be required to decide when carbon dioxide is to be released for protecting gasoline or paint in stowage or for extinguishing them; he should, however, know how it is done.

3. In the use of the 15-pound portable carbon dioxide extinguishers, the fire fighter does not have to consider the possibility of harm to personnel; the quantity of gas released from one or several of these cylinders is not usually sufficient to reduce the total oxygen content of the air in a compartment below a dangerous minimum. He has only to consider the speed with which he can apply carbon dioxide to an incipient fire. The time allowance is a matter of seconds and within this he must get the extinguisher to the fire, pull out the stop pin, and open the valve. The gas will rush from the horn nozzle in a swift stream, made up partly of carbon dioxide "snow." It will travel 5 or 6 feet without entraining and mixing with air that would impair its efficiency as a smothering agent.

4. If carbon dioxide is put over a fire in time, the fire will go out immediately. It should be applied to the base of the fire first. The squeeze-grip type extinguisher may be turned off while in use, but it will hold the carbon dioxide without leakage indefinitely. In continuous operation the 15-pound cylinder will expend its contents in about 40 seconds. Carbon dioxide cylinders should be recharged to capacity as soon after use as practical. A discharged cylinder must not be returned to its place of stowage.

5. While carbon-dioxide extinguishers are designed for hand application, they can be used in a small compartment as a means of providing partial flooding. Two or three portable carbon-dioxide extinguishers can be opened and tossed into such a compartment and the doors closed. The carbon dioxide, being heavier than air, will settle and form a blanket ove the lower portion of the compartment and, if the compartment is not too large for the amount of CO_2 released, extinguish the fire. It may be estimated that one 15-pound cylinder of carbon dioxide will cover the bottom of a compartment 11 by 12 feet in dimension to a depth of 1 foot.

9930.424 DRY CHEMICAL AGENT

Purple-K-Powder dry chemical agent is extremely useful for all types of Class B flammable duel fires, above and below decks aboard ship. The extinguisher is carried to the fire scene and the activation plunger pushed. The dry chemical is then pressurized and by squeezing the hose nozzle, a dense cloud of fire killing powder will be discharged. Apply this discharge at the base of the flame, "cutting off" the fuel from its flame and "wig-wagging" the discharge across the burning surface. The flames will immediately subside and the fire fighter can advance his discharge to the farther edge of the fire and up into the flaming cloud to fully extinguish the area. The powder is not toxic, nor is it asphyxiating like CO_2. However, in a closed compartment, the dense white discharge induces coughing when ingested into the lungs.

9930.425 RIGGING JUMPERS

1. In fighting fires in ships it is frequently necessary to rig a temporary jumper to bypass a damaged section of firemain. Figure 9930-87 shows a simple jumper rigged from fireplug to fireplug to restore service in the mains and risers forward of a rupture in the firemain. The procedure for rigging this jumper is as follows.

a. Send men to secure the stop valves at either end of the rupture.

b. Send two men to remove the wye-gates from the required fireplugs, then attach 2½-inch hose to each fireplug, and connect the two lengths of hose, using a 2½-inch double female coupling.

c. Order the valves opened on the fireplugs.

2. If fireplugs are not conveniently located for rigging jumpers, you can restore firemain service by rigging jumpers from flange to flange. In this case, the procedure is as follows:

a. Send men to secure the stop valve at frame 22, just below the second deck, and the stop valve at frame 19 on the second deck.

b. Have two men remove the ruptured section of firemain at the flanged joints. Then bolt on adapters at the flanges, one male and one female, and connect a length of 2½-inch hose.

c. Have the men who secured the stop valves open the valves and charge the line.

3. The situation shown in figures 9930-156 and 9930-157 illustrate the use of a jumper on a firemain riser. In

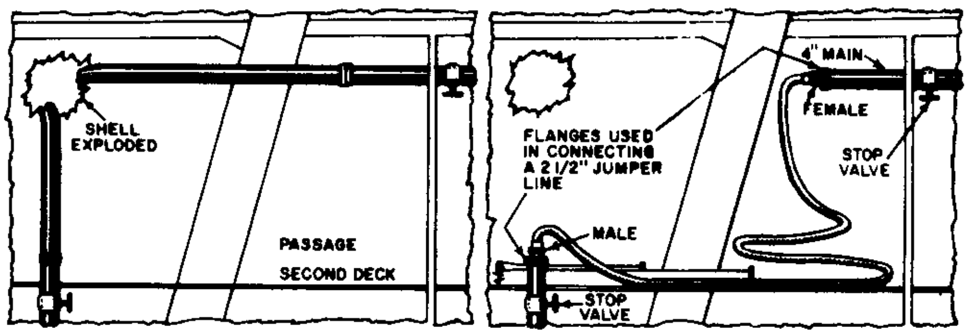


Figure 9930-156.

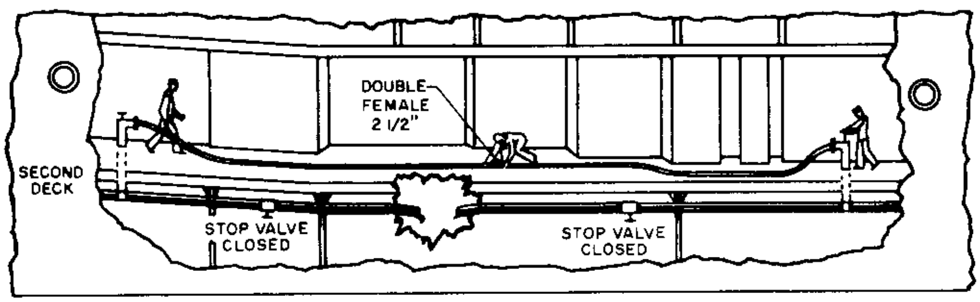


Figure 9930-157.

the case illustrated, it is necessary to rig a jumper because the firemain is ruptured at frame 106 on the first platform deck, and the only available fireplugs are on this ruptured riser. When a Class A fire occurs in boats on the boat deck, the procedure is as follows:

a. Send a man to close the valve at frame 105 on the second platform and another man to close the valve at frame 109 on the first platform.

b. Have two men remove the wye-gates from the fireplugs at frames 104 and 112. Connect the female end of a length of 2½-inch hose to the fireplug at frame 104 on the second platform, in the trunk, and lead the line up to the second deck; connect the female end of another length of 2½-inch hose to the fireplug at frame 112 on the second deck. Use a double female connection to connect the two lengths of hose and you have a complete jumper.

c. Order the attacking party to connect a length of 2½-inch hose, while the jumper is being rigged, with all-purpose nozzle attached, to the fireplug at frame 107 on the boat deck.

d. Order the men who secured the stop valves to open the valves and charge the line.

e. Fight the fire with a solid stream of water and with high velocity fog as conditions require.

9930.426 COLD WEATHER OPERATIONS

1. The necessity for thorough preparation for cold-weather operations must be emphasized. Careful attention to all details, complete familiarity with the ship and her equipment, and painstaking inspection to ensure proper material condition prior to departure are essential. In the operating area, exposed fire fighting equipment should be inspected daily, and more frequently under severe icing conditions. Care must be taken to avoid damage to the equipment when removing ice. Prior to operation, an inspection should be made to ensure that there is no ice that may foul moving parts, clearances, or orifices.

2. Special precautions to be taken in connection with the firemain system in below-freezing temperatures will depend upon its arrangement and its relative complexity or simplicity in the particulr ship involved. The precautions thus taken should be studied and the modified procedures thereby required for the emergency use of the system should be rehearsed in fire fighting drills. In general, sections of the firemain which are exposed to the weather or run through unheated compartments should be completely drained and maintained in a dry condition when the temperatures are below freezing. For ships in which the arrangements permit, secure firemain cutout valves on firemain risers to weather decks and drain plugs at lowest point between riser and plug; leave weather deck fireplugs in the open position when their risers have been drained and secured below decks.

3. For ships having a more complex system, such as aircraft carriers, the extent to which the above or other suitable precautions can be taken will depend upon the arrangements in any particular case. Fire hose and the locations in which they can be taken and nozzles should be stowed on racks and fittings provided and should be completely dry prior to such stowage. Nozzles should be stowed with shutoff gates in the open position. Cans of foam, proportioners, and P-250 pumps should be stowed

in heated compartments with access as close as practical to weather-deck locations of probable use. Oxygen breathing apparatus, together with spare canisters, should be stowed in heated compartments.

4. Fire hoses and nozzles will perform satisfactorily at freezing temperatures and below, provided the water is kept flowing and a good pressure is maintained. If the pressure is reduced or the hose is secured, the nozzle and plug may become frozen if a long lead of hose is to be secured at temperatures below 10°F.; stop flow only for the time necessary to disconnect each length of hose. After securing, hoses and nozzles should be taken below decks and completely dried before returning to topside stowage. Foam, P-250 pumps, oxygen breathing apparatus, and spare canisters should be returned to below decks stowage as soon as they are no longer needed.

5. Portable gasoline-engine-driven fire pumps should be lubricated with cold-weather lubricants and should be given test runs of approximately one-half hour's duration at least twice weekly. When operating in below freezing temperatures, a tarpaulin should cover the pump to retain sufficient engine heat to prevent freezing of water in pressure gages and control piping.

6. Pressure in compressed gas cylinders, such as CO_2 fire extinguishers, subjected to cold will drop considerably and may be insufficient for practical use. If such is the case the cylinder may have to be warmed or kept in heated compartments but extreme caution is necessary if heat is applied. Care must also be observed in using steam or other heat for deicing to ensure that cylinders stowed on deck are not overheated.

SUB-SECTION B HAZARDS

Part 1. Four Classes of Combustible Materials

9930.431 CLASS A COMBUSTIBLES

1. **Class A combustibles** are those that leave embers, such as wood, paper, cotton and wool fabrics, etc. Although Naval ships are constructed of steel, the equipment necessary for their operation includes a great deal of Class A combustibles. These may be ignited directly, or they may be ignited as the result of heat transmitted from other fires. The chief characteristic of Class A combustibles, the fact that they leave embers, determines the method of extinguishment. Inasmuch as surface extinguishment is not sufficient (although it is sufficient for Class B fires), Class A fires, except in the incipient stage, are not extinguished by smothering. They must be cooled throughout the entire mass. Water is the indicated extinguishing agent.

2. Fires involving ammunition (Class A fires) are extinguished with water; sprinkler systems are installed in powder magazines, including those for fixed ammunition, small arms, warheads, mine charges, aerial bombs, shell rooms, and locations, including turrets, where powder is handled or passed in bags. Immersion tanks are also provided in areas where powder in exposed bags is handled, including turrets but not including magazines nor at guns. Additional protection is provided by installation of fireplugs in ammunition-handling rooms, turret-handling rooms, and ammunition passages.

3. In certain ships, cork is employed for winterizing purposes, and in refrigerated supply ships (reefers) cork is used for insulation. Glass-fibre board is more widely used in ships for insulation. Cork applied to surfaces with an adhesive is not covered with metal sheathing. If it takes fire, the procedure is the same as for a fire in surface paint, except that it is more than ordinarily difficult to extinguish.

9930.432 CLASS B COMBUSTIBLES

1. **Class B combustibles,** such as oils, grease, and gasoline are also widely distributed in Naval ships and in some locations, there are heavy concentrations of supplies. The greatest hazard would result from fires in machinery and fire rooms and in oil and gasoline tanks. These fires and fires in paint lockers, in stores of fats of various kinds, and in certain other combustibles constitute Class B fires.

2. Class B fires are principally extinguished by smothering because when Class B combustibles are ignited, vapor is given off at the surface and burns. The fire is on the surface and when the supply of oxygen is cut off over the surface, the fire goes nut. It may be that while fire is burning over the surface, only a shallow layer of oil is heated to its ignition temperature. The rate of heat penetration in fuel and lubricating oils is low. Fuel oil burning for 10 to 15 minutes, may have only an inch-deep layer of oil heated to its ignition temperature. Extinguishing such a fire is less difficult in its early stages.

3. Foam applied to Class B fires forms a stout, smothering blanket, the thickness of which is to be determined by the character and the temperature of the mass of oil beneath it. Oil burning for some time may become heated throughout and, when this occurs, the foam has a greater tendency to break down; a larger quantity of foam must then be applied. When fog is used on Class B fires, extinguishment is accomplished because the finely diffused fog particles present a very large area for the absorption of heat. As the cooling takes place some of the fog particles turn to steam. The fire is extinguished by the cooling action of the fog and the smothering action of the steam. Steam applied in the first instance would smother the fire. It does not, however, have an appreciable cooling effect and it renders compartments untenable.

4. A solid stream of water would be ineffectual for extinguishment of Class B fires but might be used on a weather-deck spill fire to wash combustibles over the side.

5. Another advantage of fog as compared to steam on Class B fires is that fog causes an emulsification, or frothing, on the surface of viscous oils such as fuel and lubricating oils. (It does not have this effect on gasoline or lighter oils.) Froth produced by the action of fog has to some degree the blanketing quality of foam which contributes to the extinguishment of fire. Steam causes only slight emulsification.

9930.433 CLASS C COMBUSTIBLES

Class C combustibles (electrical equipment) are widely distributed in Naval ships. This electrical and electronic equipment may ignite by short circuits or friction (static electricity) or Class A or B fires might extend to cause ignition. When equipment so involved cannot be deenergized, the danger of electrical shock must be guarded against. Sea water is a good conductor of electricity and it must not be used as a solid stream of water to extinguish Class C fires. This hazard is greatly reduced, but not entirely removed, when the water applied is finely divided, as it is in fog produced with the high-velocity fog tip and, especially with the low-velocity fog head. Carbon dioxide does not conduct electricity and is the preferred extinguishing agent for Class C fires. Dry chemical would be a second choice. Water or foam would cause damage to electrical equipment and require a most thorough clean-up.

9930.434 CLASS D COMBUSTIBLES

Class D combustibles include certain metals such as magnesium, sodium, titanium, zinc, zirconium, and potassium. These metals are used in the manufacture of certain parts of aircraft, missiles, engines, electronic equipment, etc. With some of these metals no flame is necessary for their ignition; heat from radiation, conduction or convection, would be sufficient.

9930.435 STOWAGE OF COMBUSTIBLE MATERIALS

Combustible materials such as canvas, textiles (blankets and clothing), wood, certain plastics, packaged liquids or semi-liquids, munitions, pyrotechnics, etc., should not be stowed directly upon or against a compartment boundary. Such materials should be stowed in such a manner as to provide an insulating space between boundary and materials.

9930.436 EXAMPLE 1 – A BOATSWAIN STORES FIRE (CLASS A)

1. A fire has been burning 3 or 4 minutes in the boatswain stores located on the third deck well forward. Access is to be made through a hatch from the windlass room above. The combustibles are Class A materials, chiefly rope. There is no sprinkler system. The procedure for protecting the surrounding hazards is the same as that for Class B and Class C fires; but the procedure for extinguishing the fire is different in certain respects.

2. The hazards surrounding this boatswain stores fire are as follows: Forward, stores of canvas (Class A); aft, warrant officers' stateroom (Class A); above electric-hydraulic machinery in the windlass room (Class C). The contents of the chain locker below present a negligible hazard. The first three of these hazards must be protected, or if the fire has not gained much headway and can apparently be bought under control before it becomes serious, they must be watched and preparations made for instant action.

3. In the warrant officers' staterooms, combustibles that can be moved are, if necessary, cleared out of the compartments, or at least moved away from the bulkhead between these compartments and the boatswain stores compartment. If cooling the bulkhead is necessary, a low-velocity fog is applied through an applicator attached to an all-purpose nozzle. In the compartment forward of the boatswain stores compartment the canvas and other combustibles are moved away from the bulkhead between these compartments, if necessary, or they are moved out. The bulkhead is cooled with low-velocity fog, should this cooling be necessary. If the contents of the compartment have reached a dangerously high temperature, they are wet down with fog or a solid stream of water.

4. The windlass room above the boatswain stores compartment presents a different problem than the compartments forward and aft. In this space the electric-hydraulic machinery presents a Class C hazard. The machinery would, if necessary, be deenergized, and low-velocity fog would be played carefully on the deck. Filling this compartment with carbon dioxide is out of the question, since the only access to the compartment on fire is through the windlass room.

5. For the extinguishment of this boatswain stores fire the combustibles must be cooled throughout their mass by the use of fog to beat down the surface fire and a solid stream for deep-seated fires. No foam is used. Hose lines equipped with all-purpose nozzles are led into the windlass room through the door and down through the hatch to the boatswain stores compartment. Unless the entire compartment is ablaze, the nozzle men go down the ladder leading into it. They should wear oxygen breathing apparatus. The use of a lifeline depends on the number of men entering the compartment. (See chapter 9880.) If used, the lifeline is manned from the windlass room.

6. If the entire compartment is ablaze, the nozzle men would fight if from the hatch, using high-velocity fog to protect themselves from the heat and fumes, as in fighting a Class B fire. In the compartment the nozzle men, approaching behind a fog screen, take position at a safe distance from the flames. The fog beats back the heat and covers a large surface area of the fire quickly. In a matter of seconds the surface fire will subside; then the all-purpose nozzle is shifted to the solid position. This stream has the force needed to break down the mass and thereby facilitate penetration. The nozzle valve is moved back to fog position when smoldering fire is exposed. When there is no longer any surface evidence of fire, though there is still a possibility that fire is burning deep in the mass of combustibles, the solid stream is continued until the fire is extinguished.

7. When the fire is extinguished, it must be "overhauled." This means that unburned material and embers must be pulled apart and examined carefully. Small portions, a few sparks, may have survived the wetting. Such persistence must be expected in Class A materials; indeed, it is because of it that these materials are set apart as a class.

8. One charged hose remains at the scene and a "reflash" watch is set. After the compartment has been tested with the combustible gas indicator, the flame safety lamp is lighted and allowed to burn for 5 minutes; then the compartment again is tested for oxygen content. As soon as it is determined that the compartment air is safe to personnel, clean-up operations are started, electrical and ventilation services are restored, and repair and restoration actions are taken. Each action is reported when and as appropriate.

9930.437 EXAMPLE 2 – AN ENGINE ROOM FIRE (CLASS B)

1. Assume that a Class B fire has been burning in the engine room for 2 or 3 minutes that all personnel have been evacuated through the excape hatch, and that this is the only entrance to the engineroom. Since the fire is in the engineroom the fire fighter assumes that oil is very likely burning over the deck area. Subsequent inspection disclosed that

a. the burning oil was flowing from ruptured supply lines,

b. fuel oil may have flowed into the engineroom through a breach in adjoining fuel tanks, and/or

c. oil had accumulated in the bilges.

2. The following actions must be taken promptly:

a. Secure ventilation supply and exhaust fans.

b. Remove combustible materials (oils, grease) and place in safe place.

c. Smother the fire.

3. The fire fighter must be familiar with the general methods for safeguarding compartments against fire—as well as he knows the character and extent of hazards—and the compartmentation plan of his ship. A survey of the hazards in the vicinity of the engineroom fire shows that there are possibilities of the fire spreading to the fuel oil tanks, electrical equipment, and to combustibles in the crew's mess. (All three classes of fire may result.) There is fuel oil in the bottom tanks and in the wing tanks, in the engineroom and in the compartment aft, and the crew's mess is overhead.

The procedure for extinguishing this engineroom fire is based on the fact that it is a Class B fire and must be smothered. In addition, the extinguishment of the fire must be accomplished from a hatch about 20 feet above the surface of the burning oil. Both fog and foam are used on this fire. Fog is used to shield the fire fighter against heat and fumes and foam smothers the fire. The fog is applied with an applicator equipped with a low velocity fog head; it is set in an all-purpose nozzle. The shield of fog enables the nozzle men manning the foam line to stand at the hatch and apply foam over the fire. They aim the foam stream against one bulkhead of the compartment from which the foam will spread across the surface. If a second foam line is used, it is aimed against the opposite bulkhead. The nozzle men should avoid splashing the foam directly into the fire; this breaks down some of the foam. Above all, these men must get a complete cover over the fire quickly. High velocity fog applied in quantity from the same locations will extinguish the fire, but there will be a danger of reflash.

4. **Ventilation ducts** are plainly marked, either **supply** or **exhaust**, and symbols are added to show what compartments they serve. Close both supply and exhaust ventilation. The fire fighter secures both supply and exhaust ventilation when he abandons the space. The supply fan would otherwise supply the fire with air, increase the draft, and force additional smoke and fumes out through the hatch. If the exhaust fan were not turned off, it would increase the draft over the fire although it would vent some of the smoke and fumes. If possible prior to reentry, the exhaust fan may be restarted.

5. Stop the flow of lubricating oil. All piping is marked by stenciling the name on the pipe or its covering. (The supply would not be shut off, however, if the fire were more or less incipient, and the engineroom personnel were able to remain at their stations.)

6. One action to be taken for the protection of combustibles in the vicinity of the fire is to cool the surrounding structures, reducing the danger of heat transmission by conduction through these structures. It is not always possible to cool all surrounding structures. Whether the cooling is done or not, any combustibles that can be readily moved are transferred to a safe distance. If the fire is intense and not likely to be extinguished in a short time, even combustibles that cannot be moved conveniently (such as fuel oil, and gasoline in bulk) are transferred to a safe distance. In emergencies they may be jettisoned.

7. Action undertaken to protect combustibles in compartments adjacent to one on fire are sometimes extended to flooding with water. This action would only be taken when no other procedure would be effectual. If compartments have sprinkling systems, these would be turned on. On occasion, a compartment in the fire area may be filled with carbon dioxide and sealed to safeguard its contents.

8. For the engineroom fire under consideration, cooling surrounding structures is possible in the compartment aft (containing electrical equipment), in the engineroom forward, and in the crew's mess above. If the fire proved to be stubborn, the wing tanks to port and starboard, and the bottom tanks below the engineroom would have to be pumped out. Fog is used to cool the bulkheads fore and aft of the engineroom and the deck in the crew's mess above it. As long as fog is applied to these structures, heat radiated through them will be cooled down. The fire fighter, nevertheless, knows that any or all of the compartments in which this cooling is done may be rendered untenable by battle damage; or the service of water to any or all of the fog nozzles may be interrupted. Therefore, he does not neglect to move combustibles from the danger zone if they are likely to ignite.

9. As this is a Class B fire, the procedure for extinguishing this engineroom fire is smothering and the extinguishment must be accomplished from a hatch about 20 feet above the surface of the burning oil. Both fog and foam are used on this fire, the fog to put a shield over the heat and fumes, and the foam to do the actual work of smothering. The fog is applied with an applicator equipped with a low-velocity fog head. It is set in an all-purpose nozzle. The "shield" of fog over the heat and fumes makes it possible for the nozzle men manning the foam line to stand at the hatch and apply foam over the fire. They aim the foam stream against one bulkhead of the compartment from which the foam will spread across the surface. If a second foam line is used, it is aimed against the opposite bulkhead. As far as it is possible to do so, the nozzle men manning the foam line avoid splashing the foam directly into the fire since this would break down some of the foam. They must get a complete cover over the fire quickly. High-velocity fog applied in quantity from the same locations will extinguish the fire, but there will be danger of re-flash.

9930.438 EXAMPLE 3 – OIL SPRAY FIRES IN A MACHINERY SPACE (CLASS B)

A rupture in a pressurized fuel line sprays fuel over the surrounding area and saturates the air. The fuel is then ignited by a hot surface and develops into a large-scale fire. Immediate action is required before heat and smoke force personnel to abandon the space.

Effective control of oil spray fires requires that two measures be taken immediately:

1. Attack the fire with a dry-chemical extinguisher and a foam hoseline (Twinned-Agent Techniques).

2. Secure the source of oil.

DELAY IN THE EXECUTION OF EITHER OF THESE FUNCTIONS WILL RESULT IN THE FIRE REACHING UNMANAGEABLE PROPORTIONS, USUALLY RESULTING IN RENDERING THE COMPARTMENT UNTENABLE.

Dry Chemical. Dry chemical is a flame inhibiting or "flame knockdown" agent. It snuffs out spray fires and bilge fires very fast **but it will not permanently extinguish the fire.** Re-ignition of the oil spray fire and bilge fire will occur unless foam is simultaneously applied.

Foam. Foam is employed to cool down surrounding hot metal surfaces and other sources of re-ignition and to permanently extinguish spill fires on the deck or in the bilge. It is essential that foam be discharged through a mechanical foam nozzle. Foam alone will generally be ineffective on oil spray fires.

In general, machinery-space ventilation systems should remain in operation during the following procedures. If personnel are forced to evacuate the compartment, all ventilation should be shut down and hatches closed.

Two courses of action in attacking the fire can be pursued, depending upon the type of foam system installed in the machinery space. Both will be given in the following paragraphs:

1. Remotely Operated Foam System

This system has foam hose outlets installed within the machinery space as well as outside the space at the foam proportioner. The system is activated by hydraulic control cocks located at each outlet. Portable dry chemical extinguishers are also located in the vicinity of these outlets.

A minimum of four men normally is required for this procedure. A foam hose nozzleman and a foam hoseline handler lead out the foam hose from the nearest foam outlet. Another man picks up and actuates a dry-chemical fire extinguisher and then follows closely behind the foam nozzleman. The fourth man turns the hydraulic foam control cock to the open position, opens the foam hose outlet, and then mans the foam proportioner to replenish the foam supply tanks.

The foam hose nozzleman advances toward the fire and clears a path through the deck or bilge fire obstructing access to the oil-spray fire. If heat is too intense, the dry-chemical man may fire a **VERY SHORT** burst of dry chemical (one second or less) in front of the nozzleman. This action will provide a temporary heat shield for the nozzleman.

When the foam has cut a path within 20 feet of the spray fire, the dry-chemical man directs the powder towards the source of the fuel spray. When the spray fire is extinguished the dry-chemical operator discharges the agent in short bursts (two seconds ON and four seconds OFF) or as necessary to prevent re-ignition of the spray.

DISCHARGE OF DRY CHEMICAL IN EXCESS OF THAT NEEDED TO PREVENT REIGNITION MUST BE AVOIDED. EXCESSIVE DISCHARGE WILL RENDER BREATHING EXTREMELY DIFFICULT, REDUCE VISIBILITY, AND WASTE THE AGENT.

The foam-hoseline nozzleman directs foam on the residual fire on the deck, in the bilge, and over the surrounding area until the fire is extinguished.

Concurrent with the fire-fighting operations, the oil flow must be secured as soon as possible. In some instances, the oil flow may be secured by a fire fighter (foam-hoseline handler) provided that he can reach the oil cut-out valve or system shut-down control without being doused by the oil spray. Should the fire party be unable to secure the flow of oil, they should continue operations until the oil system can be secured at a distant point by other personnel.

2. Locally Operated Foam System

This system has all foam-hose outlets installed outside the machinery space. The system is activated locally at the proportioner. Portable dry-chemical extinguishers should be located in the space near accesses.

Four men also are normally required for this procedure. The foam-hose nozzleman, foam-hose handler, and foam-plug operator assemble at the foam-hose outlets located outside the access to the machinery space. The nozzleman and the hoseline handler lead the foam hose into the space. The foam-plug operator manually opens the proportioner inlet valve, the foam liquid valve, and the foam-hose outlet. He then mans the proportioner and replenishes the foam supply tank. The dry-chemical man picks up a dry-chemical extinguisher and follows the nozzleman.

From this point the fire is fought in the same manner as that described in 1 above.

9930.439 EXAMPLE 4 – AN ELECTRONICS ROOM FIRE (CLASS C)

1. A fire in a compartment containing electrical and/or electronic equipment requires that procedures to extinguish Class C fires be employed. Other combustibles in such an area could be Class A materials. The extinguishing procedure for Class C fires is required by the hazard of electric shock, short-circuiting with possible destruction of vital equipment, and probable subsequent failure of equipment through corrosion should water in any form or foam be employed to extinguish or blanket the fire. To extinguish such fires carbon dioxide is the recommended agent.

2. Assuming that the fire in the electronics room has not become too threatening, it may only be necessary to station details of men with fog nozzles to stand by in adjacent areas. These fog nozzles are not employed unless decks, bulkheads, or overhead areas radiate heat to a serious degree. If necessary, however, equipment likely to damaged by water would be moved away, in the event that it is possible to do so, and low-velocity fog would be used for cooling. The bulkhead separating the coding room and communications office from the radio room is cooled with fog if the fire has reached a dangerous degree of heat radiation. The other bulkheads have no compartments beyond them and need no cooling to protect surrounding hazards. Fog played on them has the effect of reducing the temperature in the radio room.

3. Carbon dioxide is applied with 15-pound portable extinugishers. In the event that all efforts with carbon dioxide fail, fog is used. Because of the fine diffusion of its particles, fog reduces but does not entirely remove the danger of electric shock. The condensation of the fog on the electrical equipment would, however, cause more or

less serious damage. Regardless of this disadvantage, fog is used on Class C fires whenever the circumstances warrant. When fog is used on these fires, the electrical equipment must be deenergized.

9930.440 EXAMPLE 5 – DEEP FAT FRYER FIRE

Fires in deep fat fryers generally result from overheating of cooking oils and fats, and subsequent auto-ignition of the fat. Most fires have occurred while the fryers were operating unattended, contrary to previous instructions, either through failure of personnel to remain at the units when operating or through failure to properly secure the units after use. Factors contributing to the intensity and spread of the fires include: delayed discovery of fire, grease laden ducts and hoods, splashing and overflow of burning fat by solid stream hose line or portable extinguishers discharged directly onto the fat liquid surface.

Each galley should be provided with (20) pound dry chemical extinguishers and at least one 4 foot, low velocity water fog applicator for use with the nearest 1½-inch hose line. Extinguishers should be in accordance with MIL-E-24091 except that those for use on Minecraft must have non-magnetic shells.

In the event of a fire in a deep fat fryer, 3 men may be required as follows:

1. One man to shut down electrical power to the fryer and to operate the dry chemical extinguishers. There should be no delay in getting the dry chemical extinguisher into play.
2. One man to shut down electrical power to the galley and sound the alarms. After accomplishing these, if only 3 men are present, this man will assist in handling the 1½-inch hose line.
3. One man to operate the low velocity water fog applicator.

Additional personnel on the scene will be assigned to check duct work and adjacent spaces and initiate fire fighting these areas if necessary.

At first sign of overheating (white smoke), shut-off fryer and place cover securely on the fryer.

If the oil has ignited:

1. First man shuts off power to fryer and mans dry chemical extinguishers.
2. Apply dry chemical in short burst of approximately 3 seconds to extinguish flames. Repeat if oil reignites.
3. Second man shuts down power to galley and sounds the alarm.
4. Third man plays out 1½-inch hose line with LOW VELOCITY FOG applicator. Second man assists as soon as possible.
5. Apply low velocity water fog to fire for approximately 3 seconds simultaneously with dry chemical discharge.
6. If the oil reignites, again apply dry chemical and water fog for approximately 3 seconds. THE POWER TO THE FRYER MUST BE OFF TO ALLOW COOLING AND PREVENT REIGNITION.
7. The man who assisted with the hose line or additional personnel check duct work and adjacent compartments and initiate fire fighting in these areas if necessary.

Part 2. Hazards and Precautions

9930.451 RESPONSIBILITY

1. The matter of fire hazards in Naval ships and the proper precautions for meeting them is an all hands responsibility. The responsibility is both individual and collective.

2. To the individual, some of the circumstances in which he is called upon to observe his responsibility may seem unimportant but there are no unimportant circumstances involving fire hazards in ships of the Navy. A carelessly tossed match or cigarette butt may start a fire as damaging as one started by an enemy shell. A fire that would jeopardize the fighting efficiency of a Naval ship might be caused by such throughtless acts as the throwing of a switch in an atmosphere containing explosive vapor or the unguarded use of sparking tools in such an atmosphere. A wiping rag, saturated with oil or grease, that is left to generate heat might set dangerous combustibles on fire. These and many other avoidable hazards are the responsibility of the individual.

3. The collective responsibility of a Naval ship's personnel embraces a strict adherence to the directed and voluntary practices that are described even aboard Naval ships as "good housekeeping." These practices include such things as maintaining vents and galley hoods free of oil and grease, keeping containers of volatile liquids tightly closed and properly stowed, preventing the accumulation of oil and grease in the bilges, keeping quarters and workships free of waste materials, putting oil, tallow, and wiping rags into metal containers and storing them as far from the hazards as possible, stowing below in safe places all but indispensable minimum amounts of dangerous combustibles, and being especially careful with open lights and electrical equipment wherever and explosive vapor hazard exists.

4. The miscellaneous items in the foregoing lists require some organized presentation if they are to serve as a basis for anything more than a broad reminder to ships personnel, one that would be too generalized to be effective. These hazards and others may be classified in accordance with characteristics they hold in common. They may be examined, therefore, as contributing to the explosive vapor hazard, the static-electricity hazard, or the spontaneous ignition hazard in Naval ships. (The hazards from matches, cigarette butts and so forth, are, of course, too varied for subdivision into groups.) Chapter 9300 should be consulted for further information regarding the classification and stowage in ships of safe, semi-safe, and dangerous materials.

9930.452 EXPLOSIVE VAPOR HAZARD

1. The vapors presenting the chief explosive vapor hazard in Naval ships are gasoline vapor, heavy fuel oil vapor, JP-5 and carbon monoxide. The quantities of alcohol, ether, and kerosene carried are not large enough to constitute an extensive explosive vapor hazard but they are, of course, definitely hazardous. Gasoline gives off vapor at ordinary temperatures, since its flash point is minus 45°F. Heavy fuel oil gives off vapor in dangerous amounts when it is heated to 150° to 250°F., and JP-5 to 140°F. (its flash point). Carbon monoxide is produced when fire in a compartment is not supplied with sufficient

oxygen for the complete combustion of the carbon in the combustible materials involved. If the oxygen were so supplied, then carbon dioxide (CO_2) instead of carbon monoxide (CO) would be produced. Carbon monoxide is also present in the exhaust gases from internal combustion engines.

2. The vapor pressure of the highly volatile gasoline is strong enough to overcome the pressure of the air above it at temperatures as low as −45°F. (Air pressure is 14.7 psi at sea level.) Gasoline vapor expands and will overflow any open container that is not too deep or flow out of any opening above the level of the gasoline and, since it is heavier than air, it will flow downward to the lowest possible level. It may be carried laterally by air currents and it may be carried upward by convection (heat) currents.

3. There is always the danger that free-moving gasoline vapor will flow down and along a deck until it comes in contact with an open flame, an electric spark, a friction spark, or a lighted cigarette butt. If the mixture of the gasoline vapor and air is not "too lean" (not below 1.4 percent by volume) or not "too rich" (not above 6 percent by volume) it will explode. The chances are that the mixture of free-moving gasoline vapor and air will fall within this explosive range. It is a wise precaution to assume that it will do so and take measures to prevent the escape of vapor from the surface of gasoline. This is accomplished by keeping gasoline in closed containers. When for any reason, gasoline is exposed to the air, all sources of ignition within the probable range of travel must be removed or protected from contact. This precaution includes the grounding of all objects that might cause a spark from accumulated static electricity.

4. Full tanks of gasoline do not present the explosive hazard that is presented by tanks that are partly filled; and empty tanks (containing no liquid) may present a still greater hazard, especially when air is admitted. In full tanks there is no free surface for the release of vapor; consequently the gasoline will not explode. In tanks that are partly filled, the vapor mixture is likely to be "too rich" to explode although it is advisable to assume that the mixture is within the explosive range. A tank that has been emptied of its gasoline content will retain vapor and air in an explosive mixture. Only a spark is needed to touch off an explosion. On Naval ships when gasoline is pumped from a tank, it is replaced with water so that there is no open space left for the forming of gases.

5. Fuel oil at ordinary temperatures is not explosive, and it is not capable of spontaneous ignition. In fact, it is difficult to ignite, but the vapor, which is given off at temperatures above 150°F., is explosive when mixed with air. Like the vapor of gasoline, this vapor is heavier than air and, in consequence, tends to accumulate at low levels such as in bilges and at the bottom of tanks where it may remain undiscovered until it is ignited by a flame or a spark. Some heavy fuel oil vapor is always present in partly filled tanks or in impty tanks that have not been vented. Furthermore, a leak anywhere in an oil-burning system may cause the vapor to accumulate. The precautions indicated are, in general, the same as those for gasoline and carbon monoxide; grounding must be resorted to in order to prevent sparking from static electricity, leaks must be remedied promptly, and access to open flames must be prevented.

6. In addition to the explosive hazard presented by gasoline vapor, heavy fuel oil vapor and JP-5, one from another source may be encountered in ships—the explosive and toxic hazards presented by carbon monoxide which must be guarded against. Carbon monoxide is produced as an exhaust gas from internal combustion engines and by any fire for which there is not sufficient ventilation to provide oxygen for the complete combustion of carbon, such as might be the case in a closed compartment. The product of this incomplete combustion is carbon monoxide instead of carbon dioxide. In compartments that have been painted with drying oil paint and sealed, carbon monoxide may be generated. Whatever the source, carbon monoxide forms an explosive mixture if its concentration in air is from 12.5 to 74 percent by volume—a very wide explosive range. An open flame or a spark will explode any mixture of carbon monoxide and air within these limits. A test for explosive gases should be made after a Class A, B, C fire has been extinguished in a compartment.

7. The toxic hazard presented by a carbon monoxide is treacherous one as this gas is odorless and colorless. In a concentration of ½ to 1 percent by volume it is lethal if it is breathed for more than a few minutes. In the event that a fire fighter must enter a compartment containing or believed to contain carbon monoxide, he wears an oxygen breathing apparatus. A life line manned by another fire fighter is attached to the harness of the apparatus.

8. Whatever the explosive vapor hazard may be, ignition from flame or spark must be prevented. The general precautions have been described and their observance is a responsibility of ship's personnel. Repair work involving the use of blowtorches or oxyacetylene welding equipment must not be done in a tank that has contained a flammable liquid unless all precautions listed in chapter 9220 have been observed. Oil drums near a fire may explode. If they contain gasoline, their contents will expand three-quarters of 1 percent of volume for every 10° increase in temperature. Oil drums, which cannot be removed should be cooled with fog or water stream.

Further information on this subject may be found in chapter 9880.

9930.453 STATIC ELECTRICITY HAZARDS

1. The possibilities for more or less serious consequences from the static electricity hazard in ships are many and varied. Although the generation of static electricity cannot be prevented, it is possible to prevent its accumulation and thus prevent the occurrence of static sparks when, in particular, an explosive vapor is present or within probable range for contact.

2. Static electricity is a stationary charge of electricity that is generated by friction between two solid substances, a solid substance and a liquid (such as friction resulting from the passage of a liquid through a hose), by solid substances coming together and separating, by radio antenna, or by various sorts of motion of a person or a material. It accumulates on surface, but if the surface is moist, the static charge is discharged. For this reason persons whose skin is habitually dry readily accumulate static electricity on the surface of their bodies and should exercise extreme precaution in dry air containing explosive vapor when operating machinery or using sparking tools. When a sufficient charge of electricity has accumulated on a surface,

and the object (or person) so charged comes close to one that is not grounded or one that is not equally charged, the two charges neutralize by jumping the gap. The spark produced across this gap will ignite any explosive vapor in the vicinity.

3. Accumulation of static electricity can be prevented by grounding machinery. The fire fighter is not called upon to perform this task, but he should understand the principle involved especially since he may have occasion to use equipment when a static electricity hazard is present. The fire fighter may be called upon to set up an electric blower to vent a compartment of explosive vapors; the blower should be grounded.

4. If he has occasion to put water into an empty gasoline tank, he must ground the nozzle. This is necessary because of the high probability that the tank contains gasoline vapor. For the same reason, gasoline pipes and their outlets must be grounded. The friction of the moving gasoline is a possible source of static electricity. Filtering materials of chamois or leather would contribute to the static electricity hazard and, consequently, they are not used for filtering gasoline unless this hazard is guarded against. Chamois, for instance, may be used for filtering gasoline if it is used with a 40-mesh wire gauze and with the hose nozzle grounded. Wire gauze alone may be used with safety for filtering gasoline and, if it is so used, the hose nozzle would also be grounded.

5. Another method preventing the accumulation of static electricity is to maintain a relative humidity of 40 to 50 percent in enclosures containing flammable liquids. This amount of moisture provides a means for the static charge to leak away. A third method is to use so-called static neutralizers which produce ionization in the air and thus make it a conductor of electricity to carry off the static charge. In Naval ships, however, the standard practice is to resort to grounding.

9930.454 SPONTANEOUS IGNITION HAZARD

1. Wiping rags impregnated with substances that are subject to spontaneous ignition which are permitted to remain anywhere in a ship, and expecially in hazardous locations, endanger the safety of the ship. Spontaneous ignition (also called spontaneous combustion) may occur, under certain conditions, in materials contaminated with turpentine, linseed oil, olive oil, peanut oil, or other oils that are not petroleum products, or in materials impregnated with animal fats. Oxygen is necessary for spontaneous ignition, but sufficient ventilation would carry off heat before it could accumulate. A 3- to 5-percent saturation with substances subject to spontaneous ignition may be enough to cause fibrous materials to ignite.

2. Some substances ignite spontaneously if they are dampened to a critical degree. A more or less low initial heat is sometimes required to actuate the process of spontaneous ignition. The sun's rays may provide this initial heat.

3. Stacked foods are sometimes subject to spontaneous ignition. As a precautionary measure against this hazard such foods are usually stocked in tiers. A further precaution would be to put food stores, whether sacked or in packages, on skids on inch or two above the deck. An additional space for ventilation would thereby be provided and, in the event of a fire in a compartment below, water could be flushed through this space to keep the deck cool. Wood that has been heated for a long time, even well below its ignition temperature (about 500°F.), becomes charred and it may then ignite spontaneously. Heat from steam pipes has been known to cause fire in this way.

9930.455 OTHER HAZARDS

1. **Alchols.** Ordinary foam is not effective due to alcohol mixing with water in the foam and the foam settling to the bottom. A fairly satisfactory "alcohol foam" is available commercially, but shipboard need for it is not sufficient to warrant carrying on board. Recommended extinguishing agents are carbon dioxide or dilution by water until flash point is elevated to a range where extinguishment can be accomplished.

2. **Ether.** Foam and alcohol foams have about the same effect on this combustion as on alcohol. The recommended agent is carbon dioxide. Water fog may be used for cooling the container and for preventing spread to other combustibles.

3. **Jellied gasoline.** This combustible should be treated the same as gasoline, although it does not give vapors so readily. Jellied gasoline makes an intense, close to the surface, fire. Foam is the recommended extinguishing agent. Water fog causes a light surface crusting of the napalm jelling agent and the crust will usually smother the fire.

4. **Magnesium.** Magnesium dust is an explosion hazard, and magnesium shavings can be ignited with a match. Magnesium sheets, shapes, and castings are flammable, igniting at temperatures in the neighborhood of 1,200°F. But unless subjected to high temperatures for prolonged periods, magnesium is not readily ignitible due to the high heat conductivity of the metal carrying heat away from the ignition source. Magnesium burns with an intense white flame. Water in quantity, as high velocity fog, is the recommended extinguishing agent. Water is effective only as an agent to cool the material to a point below the ignition temperature. Since, when water is applied to burning magnesium, there may be many small explosions, the fire fighter should apply water fog from a safe distance or from behind shelter. When carbon dioxide is applied to magnesium fires, the magnesium combines with oxygen in the extinguishing agent and continues to burn. Magnesium breaks down other chemical extinguishing -gents. If they occur, magnesium fires in aircraft crashed should be considered as incidental hazards and allowed to burn under control until other fires are extinguished. Ordinarily an efficient firefighting team will extinguish a cr-sh fire before magnesium parts are sufficiently heated to ignite.

5. **Liquid oxygen.** Liquid oxygen is not combustible, but supports and accelerates combustion of all flammable materials. Its boil off vapors create an oxygen-enriched atmosphere in the vicinity thereby creating an additional hazard to flammable materials if ignition occurs from some heat, flame, or spark source. Fire fighting is accomplished with water using solid stream or fog. Use copious quantities of water to flush away the liquid oxygen.

6. **Hydrogen peroxide.**

a. Hudrogen peroxide itself is nonflammable and does not have a flash point. However, it is a strong oxidizer and will support combustion. The vapors given off by any hydrogen peroxide decomposition contain oxygen and will support combustion. Large quantities of water shall be used to flood any fire involving hydrogen peroxide, since the water cools the fire and also dilutes the hydrogen peroxide, rendering it inactive. Fire fighting involving hydrogen peroxide is accomplished with water, using solid stream or fog. Use oxygen-breathing apparatus in fighting fires involving hydrogen peroxide to prevent inhalation of the toxic vapors or aerosols.

b. **Behavior in fire.** When hydrogen peroxide is heated, the rate of decomposition is accelerated. This decomposition produces gaseous oxygen and steam. Under some circumstances, this decomposition at about 300°F. approaches an explosive rate. A secondary effect is to accelerate the rate of burning of any combustible material because of the oxygen liberated in decomposition, making this type of fire very intense and difficult to combat. Caution must be used in fighting H_2O_2 involved fires which are always violent in burning and accompanied by fequent explosive reactions in the fuel and flame area.

c. **Toxicity and effects.** Hydrogen peroxide is toxic in contact with the skin and the eyes and produces vapors which are irritating to the eyes, nose and throat. There is no absorption through the skin, but if swallowed serious evidences of poisoning occur. Skin splashing causes blanching of the area contaminated and results in a sensation of stinging or burning. If the skin contact is brief, the above described effects are dissipated rapidly. The eyes may be affected either by splashing, or by contact with the vapors. The vapor effect produces excess tears, redness, and a stinging sensation. The vapors and splashes also produce nose and throat irritation, with burning, coughing, and excess nasal and throat secretions.

d. **Personnel protection.** Whenever and wherever hydrogen peroxide is being handled or repairs and inspections are being made to handling and storage systems and compartments, personnel shall wear goggles or face masks, and fire resistant clothing, including boots. Clothing constructed of cotton, wool, or other combustible materials is likely to ignite spontaneously and result in serious burns. Clothing should be maintained clean, free of grease, oil, paint, dust, etc., and should not be used for other purposes. Safety fresh water showers in some form are essential near storage and handling areas as the most rapid countermeasure for individual gross contamination.

e. **Housekeeping.** The highest degree of cleanliness is required in all operations with hydrogen peroxide, because hydrogen peroxide is sensitive to contamination and presents fire and explosion hazards in combination with combustible and other organic material. The entire installation shall be maintained clean of oil, grease, or any materials containing oil or grease. Hydrocarbon oils, greases, or similar lubricating materials not approved for the purpose shall not be used on any parts of the valves, pumps, or fittings of the system. Parts of the system shall not be handled with oily gloves or hands. Should oil or grease be found on fittings, valve stems, or similar parts, such parts shall not be used until they are properly cleaned and passivated. Kerosene, benzene, gasoline, or similar organic cleaners shall not be used. The hydrogen peroxide storage compartment, and all areas in which hydrogen peroxide operations are proceeding, shall be kept clear of combustible materials insofar as possible. All hydrogen peroxide spills shall be immediately flushed away with water.

7. **Nitric acids.** Nitric acid does not burn but is a strong oxidizing material which, in contact with organic materials, may cause fire. At elevated temperatures all types of nitric acid will give off toxic gaseous oxides of nitrogen and, when subjected to fire, nitric acid will evolve these toxic fumes which will actively support combustion. Water, foam, and other standard shipboard fire-fighting material and equipment may be used for extinguishing fires involving nitric acid. Always equip fire fighters with oxygen-breathing apparatus.

8. **Mixed amine fuels.** Shipboard extinguishing equipment using carbon dioxide, mechanical foam, water fog, and straight water streams readily extinguish MAF fires. When diluted with more than 30 percent of the fire fighting water, MAF fuel is rendered non-combustible. The combination of nitric acid oxidizer with ignited or unignited MAF in spill fire situations results in violent burning for a short period of time followed by ordinary burning to self-extinction or dilution by fire fighting water to the extinguishing point. Nitric acid in combinations of JP-5, AVGAS, and MAF, such as in crash fires, can be readily extinguished by all the available shipboard fire extinguishing agents. Water is the preferred agent on acid and MAF mixture fires because both are completely soluble in water. When nitric acid is added to unignited mixtures of fuels, self-ignition will occur only when MAF is a part of the fuel mixture. In summary, fire extinguishing equipment using water and foam currently available in ships can be employed to cope with MAF and nitric acid, separately or in combination, for fire prevention and for fire extinguishment. NAVSHIPS 378-0319 should be consulted for further information on control of IRFNA-MAF type fires. The presence of JP-5 or AVGAS in a casualty involving MAF and/or nitric acid will require the use of mechanical foam to effect control and extinguishment. There are many other hazards, particularly in chemicals, which require special firefighting techniques; but they are beyond the scope of this chapter. The Handbook of Fire Protection, published by the National Fire Protection Association, contains a wealth of material on this subject as well as on many other fire-fighting and fire-protection subjects.

9930.456 CARBON DIOXIDE REQUIREMENTS

When carbon dioxide flooding is resorted to for extinguishing combustible materials subject to quick flash fire (Class B) and little or no combustible materials subject to smoldering (Class A) are involved, the following quantities would be effective:

Volume of space (cu. ft. net[1])	Carbon dioxide (pounds)
100	7.5
140	10
220	15
300	20
375	25
500	35
800	50
1,100	70
1,600	100

[1]Allowance is made for impermeable structures and contents of compartments. For spaces larger than 1,600 cubic feet,

Footnote continued on following page.

the requirements are as follows:[2]

18 cubic feet per pound of gas up to 4,500 cubic feet space.
20 dubic feet per pound of gas up to 50,000 cubic feet space.
22 cubic feet per pound of gas up to 50,000 cubic feet space.

[2] It will be noted that relatively larger quantities of carbon dioxide are required for small spaces than for large ones.

9930.457 FLASH POINTS AND IGNITION TEMPERATURES

	Flash point	Ignition temperature
	°F.	°F.
Alcohol (grain)	55	700
Ether	–49	366
Fuel oil (heavy)	150	765
Gasoline	–45	440
Kerosene	100	440
Linseed oil (boiled)	432	650
Linseed oil (raw)	403	650
Lubricating oil	315	440
Magnesium	–	1204
Turpentine	95	464
AvGas	–45	800

9930.458 SUMMARY OF TESTS AND INSPECTIONS

Weekly:

Applicator:
Fogheads for clogged openings.
Bayonet locks to ensure studs are in workable order.
Butt-end of applicator to ensure it is not out of round.
Fit into nozzle.

CO_2 systems:
Refer to article 9930-175.

Firemains: Flushing should be done weekly with maximum number of hose lines practical and with all segregation valves open. Pressures of at least 60 psi are required for effective flushing. Mains should be flushed with fresh water whenever possible.

Foam Systems:
Refer to article 9930.131.
For valves see chapter 9480.

Nozzles:
Threads clean.
Hose gaskets in place.
Shut-off gate in good working order.
Fog tip in nozzle with retaining chain attached.
Fog tip free of foreign material or verdigris.

Proportioners, Portable Water-Motor:
Refer to article 9930.123.

Pumps, P-250
Pumps should be run long enough to bring them up to operating temperature. Fresh water should be used for drafting from and discharging into a steel drum.
Refer to articles 9930.193, 9930.194 and 9930.195.

Monthly:

Breathing Apparatus, Oxygen: Refer to chapter 9880, Section II, Part 7.

Fixed Fog Systems:
Inspect fog heads for clogged openings.
Inspect intake caps for ease of removing.
See also chapter 9480.

Strainers, Fireplug:
Handle in good operating condition.
Flush after each use.

Miscellaneous:

Canisters, Oxygen Breathing Apparatus:
Refer to chapter 9880, Section II, Part 7.
All canisters shall be inspected to ensure that none of the old type are in ships. All new shipments shall be checked for old canisters.

Cold Weather Operations:
Refer to BUSHIPS Cold Weather Handbook (NAVSHIPS 250-533-7) and Naval Arctic Operations Handbook (CNO).

Hose, Fire: Refer to articles 9930.76 and 9930.78.
Masks Air-Line (Hose): Refer to chapter 9980, Section II, Part 7.
Sprinkler, Hangar and Magazine: See chapter 9480.
Valves, Firemain: See chapter 9480.

9930.459 FIRE PREVENTION REFERENCES

For fire prevention, fire fighting, and hazards information on specific areas or equipment, check the chapters of the Naval Ships Technical Manual listed below for the indicated area of interest:

Acid Handling Precautions, 9622, 9623
Acid Storing Precautions, 9622, 9623
Acids, Stowage of, 9300
Air Compressor Explosions, 9490
Air, Depletion of Oxygen in, 9380
Ammo; Fire Preventive Stowage of, 9780
Availability Work List Items, 9080
Battery Charging Ventilation, 9622, 9623
Battery Fires, Procedure, 9622, 9623
Battery Safety Precautions, 9622, 9623
Bilge Oil Fires, 9510
Boiler Casing Fires, 9510
Boiler Compound Fire Hazards, 9510
Brush Sparking Fire Hazard, 9413
Calcium Hypochlorite Fire Hazard, 9350
Carbon Dioxide Indicator, 9920
Carbon Monoxide, 9380
Carbon Monoxide Indicators, 9920
Carbon Tetracholoride, 9600
Carboxide Gas Hazards and Protection, 9360
Chemicals, Stowage of, 9880

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U.S. GOVERNMENT PRINTING OFFICE: 1968--343648/A-2