CHAPTER 7

DAMAGE CONTROL

LEARNING OBJECTIVES

Upon completion of this chapter, you should be able to do the following:

1. Describe the objectives of damage control.
2. Describe the damage control responsibilities of the commanding officer, executive officer, officer of the deck, division officer, damage control petty officer, and work center damage control petty officer.
3. Describe the damage control central organization.
4. Describe the assignments, responsibilities, and dress requirements of repair parties and teams.
5. Describe the duties and responsibilities of the on-scene leader.
6. Describe the duties of the at-sea fire party.
7. Describe the procedures used for investigating flooding, structural damage, and fires.
8. Identify the classes of fire and extinguishing agents used in damage control.
9. Describe the methods used to prevent the spread of fires.
10. Describe the method used to control flooding.
11. Describe the two types of flooding.
12. Identify the types of damage control communications.
13. Describe the purpose of and rules observed while administering first aid.
14. Describe the hazards involved in a nuclear weapons mishap incident.
15. Identify the sources of damage control information.
16. Describe the hazards and non-nuclear effects of a nuclear attack.
17. Describe the effects and types of radiation produced by a nuclear attack.
18. Describe how biological warfare agents are disseminated, detected, and identified.
19. Describe the characteristics and classifications of chemical warfare agents.
20. Describe the effects of and treatment for chemical warfare agents.
21. Describe the objectives and phases of disaster control ashore.

Naval history is filled with instances that illustrate the important role damage control has played in naval operations. Ships have been damaged where their survival seemed impossible. Yet, through gallant damage control efforts, these ships have recovered to fight again. For example, the USS *Belknap* (CG-26) survived a terrible collision at sea (fig. 7-1) and recovered to serve again. On too many other occasions, however, ships that should have been saved have been lost because of needless failures in damage control preparations and operations. It has been said that if a ship survives the initial impact of damage, it has a good chance of being saved. Along with

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Figure 7-1.—USS Belknap (CG-26).

confidence in the integrity of their ships, all repair party personnel should have confidence in their ability to control all but the most devastating damage.

OBJECTIVES OF DAMAGE CONTROL

The three basic objectives of shipboard damage control are PREVENTION, MINIMIZATION, and RESTORATION.

Prevention means to take all practical preliminary measures, such as maintaining watertight and fumetight integrity, providing reserve buoyancy and stability, removing fire hazards, and maintaining and distributing emergency equipment before damage occurs.

Minimization is to minimize and localize damage by taking measures to control flooding, preserve stability and buoyancy, combat fire, and provide first-aid treatment to injured personnel.

Restoration is to accomplish, as quickly as possible, emergency repairs or restorations after the occurrence of damage. Restoration requires measures such as supplying casualty power, regaining a safe margin of stability and buoyancy, replacing essential structures, and manning essential equipment.

All members of the ship's company should realize the importance of their responsibilities. You should think of damage control as an offensive as well as a defensive action upon which your ship's ability to inflict damage on the enemy may depend. Damage control not only is concerned with battle damage but also nonbattle damage. This includes damage from fire, collision, grounding, weather, and explosion. Damage control action may be necessary in port as well as at sea and may involve the use of personnel and facilities from an undamaged ship.

Damage control requires a detailed knowledge of the ship's construction, characteristics, compartmentation, and stability, and of apparatus placed on board to prevent or control damage. Basically, control of damage depends upon the ability and the initiative of personnel to take prompt corrective action, using readily available material. Having a thorough knowledge of the ship will enable personnel to take the necessary corrective action.

RESPONSIBILITIES

All members of the ship's company should know their damage control responsibilities and realize the importance of damage control. The importance of efficient damage control cannot be overemphasized. Damage control readiness can only be achieved by a firm program stimulated by effective and dynamic leadership. This program should be executed by enthusiastic, well-trained, and determined officers and crew from all departments on board. While no area can be fully covered, the basic responsibilities of key individuals in the damage control organization are stated in the following paragraphs.

Commanding Officer

Chapter 8, *U.S. Navy Regulations,* delineates the various broad responsibilities of the commanding officer (CO). For example, he or she must "maintain his or her command in a state of maximum effectiveness for war or other service . . . . Immediately after a battle or action, repair damages so far as possible, [and] exert every effort to prepare the command for further service . . . ."

To carry out this charge, the commanding officer ensures the command is well trained and continually exercised in all aspects of damage control. The commanding officer should be fully aware of all of the ship's weaknesses, including the adequacy and operability of all damage control equipment.

Executive Officer

The executive officer (XO) keeps the command advised of the status of the ship's damage control readiness. The executive officer carries out the requirements of command damage control training, including the ship's readiness to combat all casualties and damage caused by hostile acts or other occurrences.

Officer of the Deck

The officer of the deck (OOD) is the senior member of the underway watch team and is the primary assistant to the commanding officer on the bridge. The OOD should be intimately familiar with the ship, its material condition, and established procedures for emergencies. The OOD should know and understand the correct course of action, or options, for various damage control situations. The OOD should be able to analyze a situation quickly and take prompt, positive, and correct counteraction. The OOD's ability to react properly and promptly will be directly proportional to his or her knowledge of the ship, damage control procedures, equipment available, and training received.

Division Officer

The division officer is responsible for taking all practical preliminary measures before damage occurs, such as maintenance of watertight and airtight integrity, removal of fire hazards, and upkeep of emergency equipment. Division officers ensure that all equipment, closures, and markings under their cognizance are kept in the best possible condition. This is done by periodic inspections, adherence to planned maintenance system (PMS) checks by division damage control petty officers (DDCPOs), and training of personnel within the division.

Damage Control Petty Officer

A qualified senior petty officer in each division is designated as damage control petty officer (DCPO). Section leaders of each section are designated as duty DCPOs outside of normal working hours in port; they also perform the duties of the DCPO at some time during their tour of duty. Division officers notify the fire marshal and the damage control assistant (DCA) of DCPO and duty DCPO assignments and of any changes to these assignments. DCPOs should have received formal training and be qualified before assignment.

DCPOs normally serve for a period of 6 months. They check in and out with the fire marshal and DCA upon being assigned to or released from such duties.

Duties and Responsibilities of the DCPO

The DCPO and duty DCPOs (duty section leaders) have the following duties and responsibilities:

Being acquainted with all phases of the ship's damage control, fire-fighting, and defense procedures

Assisting in the instruction of division personnel in damage control, fire-fighting, and chemical, biological, and radiological (CBR) defense procedures

Ensuring the preparation and maintenance of damage control checkoff lists for all spaces assigned

Supervising the setting of specified damage control material conditions within division spaces and making required reports

Weighing portable C02 bottles, inspecting and testing damage control and fire-fighting equip-ment, and preparing required reports for approval of the division officer in following the current ship's instruction

Ensuring all battle lanterns, dog wrenches, spanners, and other damage control equipment are in place and in a usable condition in all division spaces

Ensuring all compartments, piping, cables, and damage control and fire-fighting equipment are properly stenciled or identified by color codes

Posting safety precautions and operating instructions in required division spaces

Assisting the division officer in inspecting division spaces for cleanliness and preservation and assisting in the preparation of required reports

Conducting daily inspections of division spaces for the elimination of fire hazards

Performing such other duties with reference to damage control and maintenance of division spaces as may be directed by the division leading petty officer, division officer, fire marshal, and DCA

WORK CENTER DAMAGE CONTROL PETTY OFFICER

Each work center will have a designated work center damage control petty officer (WCDCPO). WCDCPOs are supervisors responsible for matters concerning damage control within their work centers. They have basically the same duties and responsibilities as the DCPO but apply them to their respective work centers.

DAMAGE CONTROL ORGANIZATION

The damage control administrative organiza-tion is an integral part of the engineering department. However, each department has major administrative and preventive maintenance responsibilities to fulfill.

DAMAGE CONTROL BATTLE ORGANIZATION

The damage control battle organization includes damage control central (DCC); repair parties for hull, propulsion, electronics, weapons, and air; and battle dressing stations. Each person within the organization must be highly trained in all phases of damage control. Ships should be self-sufficient, and ship's personnel should be able to take positive action to control any damage likely to occur. Provisions should be made for relief of personnel engaged in arduous tasks, for battle messing, and for transition from one condition of readiness to another. Positive,

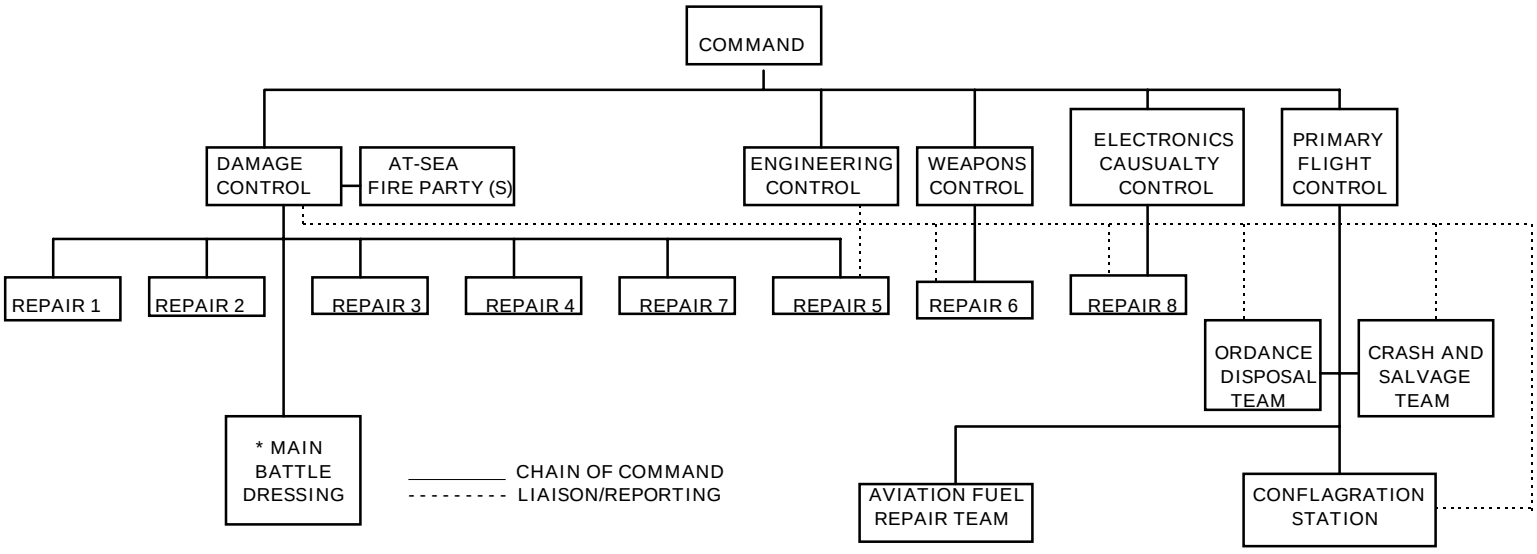

Figure 7-2.—Damage control battle organization chart.

accurate, and rapid communications should take place between all damage control parties, fire-fighting parties, or similar groups so that overall coordination of effort and direction can be accomplished. The primary damage control battle organization repair parties and teams are shown in figure 7-2.

The primary duty of the damage control organization is to control damage in order to keep the ship fighting. Damage control objectives are attained by taking the necessary action to do the following:

1. Preserve stability
2. Preserve watertight integrity (buoyancy)
3. Control list and trim
4. Maintain effective segregation of vital systems
5. Prevent, isolate, combat, extinguish, and remove the effects of fire
6. Detect, confine, and remove the effects of nuclear, biological, and/or chemical attack
7. Assist in the care of injured personnel
8. Make rapid repairs to structures and equipment

Ships designate one of the repair parties to act as SECONDARY DCC. The repair party designated as secondary DCC maintains status boards and communications logs identical to those maintained by DCC; it also directs control of damage in the event DCC is unable to perform its function.

FUNCTIONS OF DAMAGE CONTROL CENTRAL

Damage control central (DCC) is the hub of the ship's damage control efforts. It is organized to coordinate control of all damage the ship may suffer in battle, and it keeps the commanding officer advised of the capabilities of the ship after each casualty. It trains repair parties to operate and control damage as independent units.

DCC personnel check all damage reports and the corrective action being taken. DCC issues directions when repairs are not progressing satisfactorily, damage is beyond the capabilities of the personnel involved, advice is requested, or corrective action in progress is incorrect.

DCC maintains status boards showing struc-tural damage, location of flooding boundaries, condition of propulsion, condition of electrical and casualty power circuits, and corrective actions taken.

REPAIR PARTIES AND TEAMS

Each ship will have at least one repair party. Some ships have as many as eight repair parties. In addition, larger ships may have an ordnance disposal team, a crash and salvage team, or an aviation fuel repair team. Each repair party will have an officer or a senior petty officer in charge. Composition of repair parties depends on the number of personnel available, type of ship, and area of responsibility. A repair party organization chart is shown in figure 7-3. All repair parties should have the following capabilities:

- Making repairs to electrical and sound-powered telephone circuits.

NO.	GO CLO		EVALUATION AND COMM					FIRE FIGHTING A			FIRE FIGHTING B		FIRE FIGHTING C		FLOOD AND SMOKE CONTROL							DAMAGE CONTROL REPAIR					NBC DEFENSE									MISC ASSIG				REMARKS
NAME	CIRCLE WILLIAM	ZEBRA	REPAIR LEADER	IN CHARGE AT SCENE	INVESTIGATOR & OBA	LINE TENDER	PHONE TALKER	NOZZLEMAN & OBA	2ND HOSEMAN	PLUGMAN	NOZZLEMAN & OBA	PROVIDE FOAM	PROVIDE CO2	ELECTRICIAN	SECURE VENTILATION	PORTABLE BLOWERS	FIRE MAIN ISOLATION	REMOTE CONTROLS	SUBMERSIBLE PUMPS	P-250 TEAM	EXPLOSIVE TEST	PROVIDE PLUGS, WEG	PROVIDE TOOLS	PROVIDE SHORING	ROPE-OFF AREA	SOUNDINGS	MONITOR	RELIEF MONITOR	RECORDER	B.W. SAMPLER	C.W. IDENTIFICATION	MATERIAL DECON	PERS DECON	DECON EXIT MONITOI	TRAFFIC CONTROL	CASUALTY POWER	SCUTTLE SHIP STATIC	STRETCHER BEARER	DR & D.C. READ COND. 2	

Figure 7-3.—Repair party organization chart.

- Giving first aid and transporting injured personnel to battle dressing stations without seriously reducing the damage control capabilities of the repair party.

- Detecting, identifying, and measuring dose and dose-rate intensities from radiation. Parties should also be capable of surveying and decontaminating personnel and contaminated areas. The only exception is when parties are specifically assigned to departments with special requirements, as in the case of nuclear weapons accidents and/or incidents.

- Sampling and/or identifying biological or chemical agents. Parties should also be capable of decontaminating areas and personnel affected as a result of biological or chemical attack. The only exception is when the medical department is responsible.

- Controlling and extinguishing all types of fires.

- Evaluating and reporting correctly the extent of damage in-its area. This includes maintaining the following graphic records:

  —Graphic display boards showing damage and action taken to correct disrupted or damaged systems

  —Deck plans showing locations of CBR contamination and the location and safe routes to battle dressing and personnel cleansing stations

  —A casualty board for visual display of structural damage

Repair Party Assignments

Division officers are responsible for assigning personnel to repair parties. Each repair party will have a nucleus of experienced and mature personnel. Repair party personnel obtain this experience through the completion of special training programs and personnel qualification standards (PQS). The DCA maintains a list of all personnel assigned to repair parties. The DCA also ensures that replacement personnel are properly trained and that they attain PQS qualifications. Avoid mass repair party personnel reassignments, and replace key repair party personnel on a contact relief basis.

Dress Requirements for Repair Parties

While none of the available uniform fabrics currently in use is considered protective clothing, it is a documented fact that parts of the body not covered by some form of clothing suffer more severe burns. A complete working uniform, to include a round neck tee shirt, should be worn by all personnel engaged in repair party activities. Roll down and button shirt sleeves, button shirt collars, and tuck trousers into socks. Uniforms of polyester double knit and 100-percent polyester should not be worn by personnel engaged in repair party activities. Additional items of protective equipment should be worn as follows:

- Life jackets of the inflatable type should be issued and worn in the pouch. Kapok life jackets should be readily available at or near the repair locker for those repair parties not issued inflatable life jackets. Personnel assigned oxygen breathing apparatus (OBA) duty may omit wearing a life jacket while wearing the OBA.

- Issue protective headgear (battle helmet with liner) to repair parties.

- Protective masks, preadjusted for immediate use, in the carrying case. Personnel assigned OBA duty may omit carrying a protective mask while wearing the OBA.

Setting Material Condition Zebra

Material condition Zebra is used for maximum protection in battle. During general quarters, personnel in manned spaces are responsible for setting condition Zebra in those spaces, including all accesses to those spaces. Repair parties are responsible for all other Zebra fittings. DCC coordinates the setting of condition Zebra for X-ray and yoke fittings that previously were logged open in the damage control closure log. Condition Zebra is first set on the fire main, drainage, freshwater, and ventilation systems. Access fittings should be closed starting with the lower decks and proceeding to those on higher decks. Condition Zebra is not fully set until all X-ray and yoke fittings are checked out.

Each unit leader will report "manned and ready" to the repair locker officer when sufficient personnel are in the area to carry out their duties. It is not necessary to have all personnel present to report manned and ready. When condition

Zebra has been set in assigned areas, each unit will report "Zebra set" to the repair locker leader. Each repair locker officer will compile "manned and ready" and Zebra reports and report attainment status to damage control central. In an actual casualty immediate damage control action may be necessary. In this case unit leaders should report manned and ready as soon as possible.

REPAIR PARTY ORGANIZATION FOR FIRE FIGHTING

Repair parties provide the only personnel immediately available to fight fires during action. Therefore, deciding upon a plan of action for repair parties, before action, is essential.

All repair parties must be thoroughly indoctrinated and properly trained to carry out such plans of action. Valuable time would be lost if the method of fire fighting was not decided until the fire was actually underway. No matter how well your people are trained in the use of equipment, if they are not trained to act as a team following definite plans, confusion will result. This confusion may be short lived, but it will interfere with fire-fighting efforts.

Divide large repair parties into fire-fighting groups. Where possible, organize at least two groups or teams from each repair party. Train these groups so any member can quickly undertake any of the detailed duties as circumstances warrant. Each team member should know the correct starting position in the event of a fire, flooding, or a major casualty as assigned by the watch, quarter, and station (WQS) bill. Maximum use of PQS will assist in training your teams to be competent, flexible repair parties. Table 7-1 shows the minimum acceptable duty damage control party assignments for fire and collision/flooding duties.

BATTLE DRESSING STATIONS

Most ships have a minimum of two battle dressing stations equipped for emergency handling of battle casualties. These stations should be well separated from each other and accessible to stretcher bearers from repair parties in the vicinity. These stations will be manned with medical department personnel. The medical department should also provide first-aid boxes for personnel in battle stations.

Table 7-1.—Minimum Acceptable Duty Damage Control Party

	Fire Duties	Collision/Flooding Duties
(1)	On-scene leader	On-scene leader
(2)	Accessman/ compt. tester	Pump detail (1)
(3)	First aid	First aid
(4)	CO_2	Pump detail (2)
(5)	Sprinkleman	Pump detail (3)
(6)	Boundary setter	Boundary setter
(7)	Boundary setter	Boundary setter
(8)	Foam Man	Pump detail (4)
(9)	DCC phones	DCC phone
(10)	On-scene phones	On-scene phones
(11)	#2 plugman	Shoring detail (1)
(12)	#1 hoseman	Shoring detail (2)
(13)	#1 plugman	Shoring detail (3)
(14)	#2 hoseman	Pump detail (5)
(15)	Electrician	Electrician
(16)	#1 nozzleman	Investigator
(17)	#2 nozzleman	Assistant investigator
(18)	DCC supervisor	DCC supervisor

ON-SCENE LEADER

The on-scene leader takes charge of the repair of damage at the immediate scene and is directly in charge of the fire-fighting party. The first duty of the on-scene leader is to get to the fire or damage quickly to investigate and evaluate the situation. When the nature of the fire or damage has been determined, the on-scene leader informs the repair party leader, who informs DCC. The on-scene leader is responsible for directing efforts to control the fire or damage at the scene. Later developments may require the use of different or additional equipment, but the on-scene leader must decide what equipment to use first. The on-scene leader must ensure that personnel observe all safety precautions and standard procedures in the performance of all phases of damage control. The on-scene leader is the assistant repair party leader and is in charge of the repair locker in the absence of the repair party leader. To be an on-scene leader, you should be qualified in investigation, fire fighting, and damage control repair.

Table 7-2.—At-Sea Fire Party

No. of Men	Function/Provide
1	Scene Leader
2	Investigator—OBA
2	Nozzleman—OBA
2	OBA Tender—Kit
2	Hoseman—2 cans foam/AFFF
2	Plugmen—CO_2
1	2JZ S/P Talker
1	Messenger/2 PKP
1	Electrician—Kit/OBA
1	Corpsman—Kirst-aid kit

AT-SEA FIRE PARTY

Commanding officers may organize an at- sea fire party either as a standing organization or as part of a special detail. As an on-scene leader you may be placed in charge of the at-sea fire party. The at-sea fire party may be formed intact as a repair party or unit or may be composed of members of the various repair parties. A standing at-sea fire party will respond to all fires occurring at sea except when the ship is already at general quarters. If the at-sea fire party is at the scene of a fire when general quarters is sounded, it will remain at the scene until relieved. The purpose of the at-sea fire party is to

- respond immediately to fire alarms when repair parties are not manned,
- extinguish small fires effectively without disrupting other ships' operations, and
- control fire until ongoing sensitive critical evolutions can be terminated and general quarters stations can be manned and ready.

At-sea fire parties will normally consist of the personnel shown in table 7-2. Variations are authorized if required by the needs of a particular ship. The DCA is responsible for the organization and training of the at-sea fire party.

When the fire alarm is sounded, the at-sea fire party will proceed from the closest repair locker to the scene of the fire. Scene leaders will wear a steel helmet painted red and marked front and back with l-inch black lettering identifying the repair party (II, III, etc.). The lower circumference of the helmet will have three 1-inch horizontal stripes of reflective tape in white, red, white. No other member of a repair, damage control, or rescue and assistance party will wear a similarly marked helmet or one that could be mistaken for a scene leader.

INVESTIGATING DAMAGE

As an on-scene leader you should be qualified as an investigator. Four principles of investigation should be considered in your investigation of damage:

1. An investigation must be thorough.
2. It must be conducted with caution.
3. Results must be reported clearly and quickly.
4. Investigations must be repeated.

Ships have been lost and others have suffered unnecessary damage because investigating personnel have neglected one or more of these four principles.

Investigation Teams

Each repair locker and unit has at least four investigators, with OBA tenders organized into two-man teams and assigned specific areas for investigation. If an area has extensive damage, form additional teams. Equip each investigator with an OBA. An investigator's kit containing a sounding tape and deck drain wrench is provided by the OBA tender. If an investigator must enter a space alone, the OBA tender must man a tendering line secured to the D ring on the back of the investigator's OBA.

Initial/Rapid Survey

Initial indications should be recognized and evaluated quickly to give DCC an accurate estimate of the extent of damage. Investigate symptoms of dangerous conditions, such as a minor loss of power, a wisp of smoke, dropping pressure, or excessive warmth of a bulkhead, and take prompt corrective action. You should also provide details on casualties that interfere with repairing or limiting damage, such as absence of light or ventilation and the presence of smoke, flammable liquids, wreckage, or loose stores.

Repeat/Detailed Investigation

Although a compartment has been inspected and is free of fire and flooding, you should not assume it is secure; it must be reinspected. A fire can break out from undetected damage to an electrical circuit or from a hot splinter buried in combustible materials. Flooding may be caused by open or partly open valves, especially if intervening watertight boundaries fail. The initial/rapid investigation is a preliminary inspection. A detailed investigation is made as soon as possible and in greater detail. This investigation should be thorough; otherwise, the extent of secondary or minor damage could go undetected. Sound all compartments, tanks, and voids adjacent to the original point of damage to determine penetration and flooding. Make detailed investigations of every compartment after every hit, particularly any compartment which lies within 50 feet of the point of impact. (Fifty feet is the nominal distance from the point of impact that damage should spread if the underwater protective system is initially intact.) If any compartment on the perimeter of this 50-foot arc shows the presence of water, extend the investigation beyond the originally estimated levels until an intact watertight boundary is determined.

Investigation for Flooding

As a general rule, complete flooding of a compartment or flooding to sea level indicates that a compartment is open to the sea. Flooding to a lesser height may indicate that the puncture is relatively small or that progressive flooding is occurring. Although progressive flooding can be verified by subsequent soundings, the general rule does not always hold true. In more than one case, an unisolated saltwater line leading through a secured compartment has been ruptured and has caused the space to become completely flooded without direct access to the sea. Such a condition is even more dangerous than a penetration of the hull because, in time, the pressure within the compartment could reach 100 pounds or more and cause previously undamaged bulkheads to collapse.

Investigation for Structural Damage

Investigation for structural damage should cover a considerable area surrounding the immediate scene of damage not only on the same level as the principal casualty but also one level above and below it. You should look for such items as splinter holes, ruptured pipelines, warped or fractured frames or stanchions, cracks, open seams, leaky stuffing tubes, bent shafts, improperly closed fittings, and severed electrical cables. You should note and quickly report any damaged bulkheads that require shoring. Circuit breakers and electrical measuring instruments mounted on switchboards may give information on structural damage. When a circuit breaker trips in battle, it may be an indication of physical shock or of an overload caused by damaged cables or equipment. Hot bearings on motors and hot electrical cables may also be indications of structural damage. Identify and report the circuits or equipment quickly.

Investigation for Fires

An investigation for fires should not only detect fires but imminent causes of fires. You should look for items such as smoke; warm bulkheads, hatches, or decks; peeling paint and tile; arcing wires; hot/jammed watertight doors and hatches; and loss of lighting. These symptoms normally indicate that a fire is present. In addition you should inspect for spilled or ruptured fuel or flammable liquid tanks and containers; wreckage; loose stores; and broken or damaged electrical controllers, power panels, and switches. These items are potential causes for secondary fires.

Reporting Information

You should use message blanks to report your findings to the repair party leader. Then the repair party leader will correlate and evaluate the information and pass it to the parent repair party and DCC. Local leaders should evaluate the information and take immediate steps to isolate damaged systems, to attack casualties in the most logical manner, and to provide the correct equipment to meet the emergency. DCC will pass essential information to the commanding officer concerning casualties, their extent, their effects on the ship's remaining buoyancy and stability, and their probable effects.

After a casualty occurs, the repair party may *appear* to spend the first hour investigating damage and too little time localizing the damage or effecting repairs. This is not true; much of the damage is obvious within a few minutes. With a well-indoctrinated damage control organization, only a small number of people are required to

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Figure 7-4.—Flight deck fire, USS Enterprise (CVN-65).

devote their entire time to investigative work. The remaining people in the repair party are able to start remedial action immediately.

Benefits of Investigation

The first two steps in handling a casualty are to put out fires and control flooding. However, without adequate investigation, no one knows what types and quantities of material must be provided at the scene, which electric circuits or pipelines must be isolated, and which partially flooded compartments can be made watertight and pumped dry. For example, as the result of a proper investigation, a repair locker or unit could stop progressive flooding in six compartments containing holes that could be plugged in several minutes. Without an investigation, the unit might waste the same amount of time attempting an impossible repair on one leak.

FIRE FIGHTING

Whether a battle casualty is caused by a bomb, torpedo, or projectile hit, fire is a common result (fig. 7-4). Unless the fire is quickly extinguished, more serious damage than that caused by the initial explosion may develop. The process of fire is a three-component chemical reaction requiring fuel, heat, and oxygen. You control and extinguish fires by eliminating one of these components. Fires are classified by type of fuel, as shown in table 7-3. Methods of extinguishing a fire are shown in table 7-4.

Table 7-3.—Classification of Fires

Class A—Fires in ordinary combustible materials such as mattresses, dunnage, wood, canvas, and paper.
Class B—Fires in substances such as gasoline, fuel oil, lubricating oil, diesel oil, and paints.
Class C—Fires in electrical equipment.
Class D—Fires in metals such as magnesium, potassium, sodium, titanium, zirconium, powdered aluminum, zinc, and others which require careful fire attack with special methods and extinguishing agents.

Table 7-4.—Fire-fighting Methods.

COMBUSTIBLE INVOLVED	TYPE FIRE	USEFUL EXTINGUISHING AGENTS
Woodwork, bedding, clothing, combustible stores	A	1. Fixed water sprinkling 2. High-velocity fog 3. Solid water stream 4. Foam/AFFF 5. Dry Chemical 6. CO_2 Extinguisher
Explosive Propellants	A	1. Magazine sprinkling 2. Solid water stream or high-velocity fog 3. Foam/AFFF
Paint, spirits Flammable liquid stores	B	1. CO_2 (Fixed System) 2. Foam/AFFF 3. Installed sprinklers 4. High-velocity fog 5. P-K-P Dry Chemical 6. CO_2 Portable
Gasoline	B	1. Foam/AFFF, handline or sprinkler systems 2. CO_2 (Fixed System) 3. Water sprinkling system 4. P-K-P Dry Chemical
Fuel oil, JP-5	B	1. Foam/AFFF, handline or sprinkler systems 2. P-K-P Dry Chemical 3. Water sprinkling system 4. High-velocity fog 5. CO_2 (Fixed System)
Electrical and radio	C	1. (De-energize affected circuits) 2. Portable CO_2 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. High-velocity fog—cool 3. Dry Sand—Talc—Smother
Grenades, Napalm	D	1. Dry sodium Chloride 2. Stow in kerosene or similar Hydrocarbon

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

Initial Fire-Fighting Operations

In fire-fighting operations, you must first determine the location and type of fire and then determine the method of extinguishing the fire, as shown in table 7-4. For complicated or simultaneous fires, fog will serve in nearly every situation. In case of a class C fire, first de-energize all circuits where possible. Next, establish fire boundaries by closing all doors, hatches, manholes, ventilation ducts, and other vents in the area as practical and de-energize power as necessary.

CO_2 Safety Precautions

You must be aware that the very qualities that make carbon dioxide (CO_2) a valuable extinguishing agent also make it dangerous to life. When CO_2 replaces oxygen in the air where combustion cannot be sustained, there is no respiration. Prolonged exposure to carbon dioxide causes suffocation, very much as immersion in water does when a person drowns. CO_2 cannot be seen or smelled. It gives no evidence of its presence that can be recognized by the senses. Since CO_2 is heavier than air, it remains close to the surface of the space in a deep or shallow pool, depending on the amount of area covered and the amount of CO_2 used. When a portable carbon dioxide extinguisher is used, there is practically no breathing danger in the average compartment because its 135 cubic feet of CO_2 lies in a shallow pool well below the usual breathing level.

When entering a compartment that contains carbon dioxide (or any other harmful gas) in a dangerous concentration, you must wear an OBA.

Except in an emergency, you should not open a CO_2 flooded compartment for at least 15 minutes after it has been flooded. This delay is a precautionary measure to give all the burning substances time to cool down below their ignition temperature; this prevents reignition upon contact with air.

Warn anyone who uses a carbon dioxide extinguisher that the "snow" will blister the skin and cause painful burns if it is allowed to remain on the skin.

Discharge of CO_2 leads to a buildup of a static electrical charge. You should keep the cylinder in contact (grounded) with the metal structure of the ship when discharging CO_2.

Halon 1301 Hazards

The mechanism by which Halon 1301 extinguishes a fire is not thoroughly understood. The phenomenon appears to be a physical/chemical action that inhibits combustion. Halon 1301 has the ability to extinguish both the flammable liquid spill and spray types of fire. Halon 1301 decomposes upon contact with flames or hot surfaces above 900°F (482°C). While this decomposition allows the Halon 1301 to function effectively, it also results in the formation of several decomposition products, primarily hydrogen fluoride and hydrogen bromide.

Fuel decomposition products, carbon monoxide, oxygen depletion, heat, and smoke create personnel hazards. Personnel should not remain in a space where Halon 1301 has been released to extinguish a fire unless OBAs are worn. Although personnel can be exposed to concentrations of 5 to 7 percent of Halon 1301 for up to 10 minutes without danger to health, spaces should still be evacuated upon accidental discharge.

If Halon 1301 is discharged where no fire exists, several hazards may arise. For example, noise from the discharge can be startling; turbulence may be sufficient to move light objects; direct contact with the vaporizing liquid may have a strong chilling effect and can cause frostbite and burns to the skin; and obscured vision may result because of condensation of water vapor in the air. If you are in a space where Halon 1301 is discharged and vision is obscured, do not move about until vision improves. Moving blindly could result in injuries.

Preventing Spreading of Fires

In fighting a fire, you should secure any breaches in bulkheads adjacent to the fire. Also, be sure to cool adjacent bulkheads. Remove any combustibles from nearby compartments or render the compartments safe by one or more of the following methods:

- Cool or smother compartments with fog.
- Fill compartments with CO_2.
- Flood compartments as practical.

Postfire Action

Start postfire action while fire fighting is still in progress. As the on-scene leader you should

have all necessary postfire equipment at the scene by the time the fire is out. This equipment should include axes, rakes, cutting torches, an oxygen analyzer, an explosimeter. You should

- set the reflash watch with a charged hose manned and ready to extinguish any flare-up of the fire;
- test the compartment for explosive gases and oxygen content, in that order;
- overhaul the fire, breaking up any areas where danger of smoldering embers exists;
- retest the compartment for explosive gases; and then
- desmoke and retest again.

FLOODING CONTROL

One of the most important damage control measures is to control flooding. Drainage by fixed systems or portable pumps is ineffective in handling flooding caused by damage until the rate of flooding has been controlled. The entire pumping capacity of the drainage systems is sufficient to care for flooding only when the leaks are small. A hole in the hull, with an area of only 1 square foot, 15 feet below the surface, will admit water at 13,900 gallons per minute (gpm). The total pumping capacity of the fixed drainage systems in a large combatant ship, for example, is only 12,200 gpm.

All pumping facilities cannot be used on any single flooded compartment. Therefore, it is essential that you isolate compartments flooded by underwater damage by watertight subdivisions before dewatering efforts can be successful.

Basically, two methods can be used in the control of flooding: (1) restrict or entirely stop the flow of water entering the hull and (2) confine and remove water that has entered or is still entering the ship.

Preparatory Measures to Resist Flooding Before Damage

It has been wisely said that 90 percent of the work of damage control—the important part-is accomplished before damage and only about 10 percent after the ship has been hit. Most preparatory work consists of measures taken to toughen the ship to resist flooding.

An important first step is for all personnel concerned with damage control to learn what features have been designed into their ship to enable it to resist flooding. The most significant of these features is the extent and type of vessel subdivision. The subdivision of the vessel will determine the extent and type of flooding that can occur and the type of corrective measures needed after damage. The DCA, repair party officers, and repair party leaders should also know the extent to which bulkheads adjacent to damage can be submerged before uncontrolled flooding arises.

To combat flooding successfully, you need speed and accuracy. To be effective in applying corrective measures, damage control personnel should be familiar with the equipment provided to control list and trim and to improve stability.

All hands should learn the general effects of a torpedo hit or other underwater damage to their ship. Since a single hit may wipe out entire repair parties or possibly carry away the damage control central station, ships may have to depend on other than repair parties to confine the flooding, to fight fire, and so forth. More important, vessels have been lost because personnel escaping from damaged areas left doors and hatches open behind them, thus permitting rapid spread of loose water. All hands should be trained to confine flooding by securing doors and hatches, lest stability efforts be too little or too late.

Certain material preparations are vital in toughening the ship to resist flooding. They include

- maintaining watertight integrity of the ship's subdivision,
- properly classifying closures and fittings,
- properly setting material conditions of closure, and
- providing adequate and well-distributed operable damage control equipment.

Types of Flooding

There are two major types of flooding: solid and partial.

SOLID. — If your ship has received severe underwater damage, compartments will be badly ruptured and completely flooded. Little or nothing can be done to correct this damage. Isolate the compartments to permit concentration

on compartments that can be repaired to prevent progressive flooding. *Solid flooding* refers to a compartment that is completely filled from deck to overhead. To be able to flood solidly, a compartment must be vented. Venting can take place through an air escape, an open scuttle or a ventilation fitting, or fragment holes in the overhead. Solid flooding has no other effect than to add weight at the center of gravity of the ship.

PARTIAL. —Compartments that are only partially flooded because their outboard bulkheads contain small holes, cracks, loose rivets, broken seams, or splinter holes allow progressive flooding to take place. If nothing is done about these holes, the ship will take on more and more water. The ship will lose buoyancy and list or trim stability. *Partial flooding* refers to a condition in which an intact compartment is not completely flooded. An "intact compartment" means that the deck on which the water rests and the bulkheads that surround it remain watertight. If the boundaries remain intact, water will neither run into nor out of the flooded compartment as the ship rolls. The final result of partial flooding is usually a decided loss in overall stability.

Establishing Flooding Boundaries

Flooding boundaries are the bulkheads and decks restricting the partially flooded area from the flooding boundary. If partially flooded compartments become completely flooded, the flooding boundaries may not hold. There may be hidden cracks or leaky stuffing tubes or the bulkheads may not be able to withstand the pressure put on them. In other words, just because a flooding boundary seems safe one minute is no sign that it will be safe the next. Therefore, repair party personnel should keep on reinspecting and should make sure the boundary holds (even so far as to add shoring if bulkhead or overhead strength is in question).

Holding What You Have

Many ships have been sunk during battle action, but very few of them have gone down as a direct result of initial damage. Most of them have gone down hours later as a result of progressive flooding, fire, collapsing bulkheads, increased free surface, and human errors. Had flooding and fire boundaries been established when and where it was possible to do so and the damage confined to its original area, even though the area was large, many of those ships would still be afloat and fit to fight. The moral is HOLD WHAT YOU HAVE; DO EVERYTHING POSSIBLE TO PREVENT PROGRESSIVE FLOODING AND BURNING. It is natural to attack the *obvious* damage while completely ignoring *hidden* damage that may sink the ship. Hours are often wasted trying to patch large or multiple holes in compartments that are already flooded. Smaller holes through interior bulkheads (holes which are causing progressive flooding) are overlooked. In many cases, plugging those interior holes first would be far better in order to HOLD WHAT YOU HAVE.

Holes in Underwater Hull

Large holes in the underwater hull, such as those caused by torpedoes, contact mines, or near-miss bombs, cannot be repaired by a ship in battle. A dry dock is required for such repairs. Large sections of hull plating are destroyed, flooding is complete and extensive, and the amount of wreckage is tremendous.

As you investigate the damage, you may come to a bulkhead that has only small holes in it, such as cracked plates or seams, warped hatches, leaky stuffing tubes, or holes made by blast or by flying debris. Such leaks should be treated as small holes in the underwater hull. By plugging those holes, you can localize flooding and preserve buoyancy. If you remove the water from the compartments you made watertight, you can begin to minimize the damage. For example, plugging leaks in bulkheads of a boiler room and clearing the space of water would help minimize damage. Small holes in the underwater hull often result from near-miss bombs or from violent explosions in some other part of the ship. For example, a torpedo explosion forward may damage shell plating on the quarters and cause cracks. Cracks may also result from stresses produced by steaming at high speeds in heavy seas.

Two factors that make repairing underwater holes rather difficult are water pressure and accessibility.

Rate of Flooding

It makes no difference whether the hole is made by a shell, a torpedo, a bomb splinter, a defective gasket, or an unpacked stuffing tube; if one side of the hole is submerged, water will flow through it. The amount of water that comes into a ship through the hole or flows from one compartment to the next varies directly with the area of the hole and the square root of its depth. Table 7-5 is a chart for determining the flow of water through holes in gallons per minute.

Table 7-5.—Chart for Determining Flow of Water Through Holes in Gallons Per Minute

HOLE DIA. IN INCHES	HEAD OF WATER IN FEET												
	2	4	6	8	10	12	14	16	18	20	24	28	32
1	28	40	49	56	63	69	74	79	84	89	97	105	112
2	111	157	192	222	248	272	294	314	333	351	384	415	444
3	250	354	433	500	559	612	661	707	750	790	866	935	1000
4	445	629	770	889	994	1089	1176	1257	1333	1405	1540	1663	1778
5	695	982	1203	1389	1553	1701	1837	1964	2083	2196	2406	2598	2778
6	1000	1414	1732	2000	2236	2449	2646	2828	3000	3162	3464	3741	4000
7	1361	1925	2357	2722	3043	3333	3601	3849	4083	4303	4714	5092	5444
8	1777	2514	3078	3555	3974	4354	4702	5027	5332	5620	6157	6650	7109
9	2249	3181	3896	4499	5030	5510	5951	6362	6748	7113	7792	8416	8997
10	2777	3927	4809	5553	6209	6802	7347	7854	8330	8781	9619	10390	11107
11	3360	4752	5820	6720	7514	8231	8890	9504	10080	10626	11640	12573	13441
12	4000	5655	6926	7997	8941	9795	10579	11310	11996	12645	13852	14961	15995
13	4693	6637	8129	9386	10494	11496	12417	13274	14079	14841	16257	17560	18772
14	5443	7697	9426	10885	12170	13331	14400	15394	16327	17210	18853	20364	21770
15	6246	8834	10820	12494	13969	15302	16528	17667	18740	19754	21640	23374	24988
16	7106	10051	12310	14214	15892	17409	18804	20102	21322	22475	24620	26593	28429
17	8024	11347	13897	16047	17942	19654	21229	22694	24071	25373	27795	30022	32095
18	8996	12722	15582	17992	20116	22035	23802	25445	26988	28448	31164	33660	35985
19	10024	14177	17363	20049	22416	24555	26523	28354	30073	31700	34726	37408	40098
20	11110	15710	19241	22218	24840	27211	29392	31421	33326	35129	38483	41566	44436
21	12244	17316	21208	24488	27379	29992	32396	34632	36732	38719	42416	45814	48977
22	13439	19008	23280	26881	30054	32923	35561	38016	40322	42503	46560	50290	53763
23	14688	20772	25441	29376	32844	35978	38861	41544	44064	46447	50881	54958	58753
24	15995	22622	27707	31993	35769	39183	42323	45245	47989	50585	55414	59853	63986
25	17356	24545	30061	34711	38809	42513	45920	49090	52067	54883	60122	64939	69424
26	18770	26546	32513	37542	41974	45980	49664	53093	56313	59359	65025	70235	75085
27	20242	28627	35061	40485	45264	49584	53557	57254	60727	64012	70122	75740	80971
28	21770	30787	37707	43539	48679	53325	57598	61574	65309	68842	75413	81455	87080
29	23353	33026	40449	46706	52220	57203	61787	66053	70059	73849	80898	87380	93414
30	24992	35345	43289	49985	55885	61219	66125	70690	74977	79033	86577	93514	99971
31	26683	37735	46216	53365	59665	65359	70597	75470	80048	84378	92432	99838	106732
32	28434	40212	49250	56868	63581	69649	75231	80424	85302	89916	98499	106391	113738

You can control flooding by jettisoning equipment, using submersible pumps, and forming a bucket brigade (if other methods fail).

Methods Used to Control Flooding

Several readily available methods that do not call for elaborate tools or training can be used to plug or patch holes to control flooding. These repairs are temporary and will not be watertight. If the inflow of water can be reduced by as little as 50 percent, flooding may be controllable with portable pumps.

The simplest method of repairing a fairly small hole is to insert some kind of plug. Each repair locker has a large assortment of conical, square-ended, and wedge-shaped wooden plugs. Never paint these plugs because unpainted wood absorbs water and grips better than painted wood. If possible, wrap plugs with lightweight cloth to help them grip better. Roll up pillows and mattresses and shove them into holes but this action should be backed up with some type of patch or shoring. Plate patches are commonly used types of patches. They are made from tables; doors; deck plates; or any relatively strong, flat material. Ordinary galvanized buckets can be used in a variety of ways to stop leaks; for example, you can push them into a hole to form a metal plug and held in place by shores.

We have mentioned just a few of the things you can use to control flooding. When all thumb rules and experience have been exhausted, your task is to use your own ingenuity to find something that works.

Holes in Hull Above the Waterline

Holes in the hull at or just above the waterline may not appear to be very dangerous, but they are. They destroy reserve buoyancy; and if your ship rolls in a heavy sea or loses buoyancy, those holes become submerged and admit water at a very dangerous level—above the center of gravity. That reduces stability; and because the water almost invariably presents a large, free surface (it shifts with ship movement), it becomes doubly dangerous. Therefore, plug those holes at once. Give high priority to holes near the waterline. Above-water holes present another hazard: they permit light to leak out at night. This light may disclose your position to the enemy.

Sources of Damage Control Information

Much information of utmost importance to the effective operation of a damage control organization exists in other publications and is, of necessity, omitted from this chapter. These publications are of particular interest to those in charge of the damage control efforts and are available for study on board each ship. In addition to studying the publications listed in table 7-6, key members of the damage control organization should attend damage control schools. These schools teach both theoretical and practical aspects of damage control problems. The DCA should maintain a damage control library containing, as a minimum, the publications listed in table 7-6. It should be available to all divisions.

DAMAGE CONTROL COMMUNICATIONS

Communications are a vital part of the damage control system. Without proper communications between the various repair parties and DCC, the entire damage control system could break down and cause the loss of the ship. As a scene leader, you are responsible for ensuring that personnel are able to follow correct procedures for using damage control circuits. Phone talkers must be knowledgeable about the stations with which they communicate. Inexperienced personnel should not use the phones. Repair party phone talkers and messengers should complete the applicable section of Repair Party PQS for phone talkers.

The normal means of communications aboard ship are as follows:

- Battle telephone circuits (sound powered)
- Interstation two-way systems (intercoms)
- Ship's loud speaker system (general announcing)
- Ship's service telephones
- Voice tubes (where installed)
- Messengers

Sound-powered telephones are the primary means of communications during battle or while combating damage. The 2JZ circuit is the main

Table 7-6.—Sources of Damage Control Information

1. OPNAVINST 3120.32B, *Standard Organization and Regulations Manual U.S. Navy*
2. NWP-65, *Tactical Manual for Individual Type Class Surface Ship*
3. *Surface Ship Survivability*, NWP 62-1 (REV-C)
4. *Ships Organization and Regulations Manual*
5. Engineering department organization manual
6. Battle organization manual
7. *Repair Party Manual* (COMNAVSURFLANTINST 3541.1C/COMNAVSURFPACINST 3541.4B)
8. Ship's and Department Instructions
9. Damage control books
10. Master compartment checkoff lists
11. Booklet of general plans
12. Engineering casualty control manuals or EOCC
13. Naval Ships' Technical Manual NSTM,
    079, Section I—"*Stability and Buoyancy*"
    079, Section II—"*Practical Damage Control*"
    079, Section III—"*Engineering Casualty Control*"
    555, "*Fire Fighting—Ship*"
14. List of authorized alterations
15. Tables of tank capacities
16. Special liquid loading instructions, including ballasting instructions
17. Schedule of watertight test and inspections
18. *Coordinated Shipboard Allowance List* (COSAL) for damage control equipment
19. Docking plan
20. Manufacturer's instruction books for damage control equipment
21. *Damage Control Training Requirements,* OPNAVINST 3541.1C
22. *Shipboard Damage Control Training Program* (COMNAVSURFLANT ships), CINCLANTFLTINST 3541.1E
23. *Damage Controlman 3 & 2*, NAVEDTRA 10572
24. *Hull Maintenance Tech 3 & 2*, NAVEDTRA 10571-1
25. *Hull Maintenance Tech 1 & C*, NAVEDTRA 10574
26. Personnel Qualification Standard (PQS) for Damage Control
    Basic Damage Control Qualification Standard, NAVEDTRA 43119-2E
    Advanced Damage Control Emergency Parties Qualification Standard, NAVEDTRA 43119-3E
    Damage Control Watches Qualification Standard, NAVEDTRA 43119-4C
    Division Damage Control Petty Officer (DCPO), NAVEDTRA 43119-5
    Conflagration Station Operator Qualification Standard, NAVEDTRA 43119-6A
    Standard Answerbook for Basic Damage Control Qualification Standard, NAVEDTRA 43119-2E/SAB
    Standard Answerbook for Advanced Damage Control Emergency Parties Qualification Standard, NAVEDTRA 43119-3E/SAB

damage control circuit and is common to the damage control station and all repair parties. It connects DCC with repair parties II, III, and V. The 3, 4, 5, 6, and even 7JZ circuits are individual repair party circuits connecting each repair party station with its auxiliary station and patrol area.

The following are some of the other typical sound-powered circuits:

- JA (Captain's battle circuit) Connects conn, pilot house, interior communications (IC) room, combat information center (CIC), and damage control central (DCC)

- JV (Maneuvering circuit) Connects pilot house, bridge wings, main engine control, forecastle, fantail, steering gear room, IC room, and DCC

- 2JV (Engineer's circuit) Connects all machinery spaces, engineer log room, IC room, emergency diesel generator space, main distribution switchboards, smoke watch, fueling station, and DCC

- X-40J (Casualty communication circuit) Provides a means of rigging communication lines between vital stations during an emergency condition

The 4MC circuit is the damage control intercom system. It provides two-way communications between DCC and the repair stations. It also provides communications from repair lockers to their respective unit patrol areas by means of remote units powered through the call switches on the repair lockers' intercom unit.

Ship's service telephones are available for use where they are installed near repair stations. Do not place too much reliance on them, as they may go out of commission early in the action.

The ship's general announcing system is a means of communications, but so many stations are affected that it should only be used when all other methods fail.

When all other means of communications have failed, you can use messengers. Train messengers to relay oral orders information without error, even though written messages are more reliable. See *Military Requirements for Petty Officer Third Class,* NAVEDTRA 12044, for a discussion on messengers.

For more in-depth information on sound-powered telephone procedures and the correct terminology, refer to *Naval Ships' Technical Manual,* chapter 470; *Basic Military Requirements,* NAVEDTRA 12043, chapter 21; and *Sound-Powered Phone Talkers Manual,* NAVPERS 14005-A.

PERSONNEL CASUALTY CONTROL

First aid is the emergency treatment of the sick or injured before regular medical or surgical attention can be obtained. In this section we will only give you basic rules. For more detailed information on treatment, refer to *Basic Military Requirements,* NAVEDTRA 12043. First aid does not take the place of proper medical attention. It only provides assistance to the injured until proper medical care can be obtained. The purpose of first aid is to

1. save life,
2. prevent further injury, and
3. preserve resistance and vitality.

When providing first aid to injured personnel, be sure to follow these rules:

1. Keep the patient lying down, head level, until the injuries have been determined.

2. Examine the patient for cessation of breathing, hemorrhage, and evidence of shock. These conditions take precedence in this order over everything else and demand immediate treatment.

3. Remove clothing to determine the extent of the injury. Rip or cut the clothing along the seams, Removing clothing in the normal manner may compound the injury, especially in fractures. Do not remove too much clothing; exposure to cold may bring on the condition of shock.

4. Remain calm. Act quickly but efficiently. Determine which of the patient's injuries needs attention first, and then determine the proposed course of action.

5. Keep the patient comfortable. This can be done while the patient's injuries are being treated. A blanket may do the patient as much good as the dressing applied to his wounds. Keep the injured person warm enough to maintain normal body temperature.

6. Do not allow the patient to see the injury. Assure the patient that the injuries are understood and that good care will be given. Such things are important in keeping a patient calm and preventing shock.

7. Keep open wounds and burns as clean as possible. Avoid touching open wounds and burns with your hands or unsterile objects unless no sterile dressings are available.

8. Do not try to give liquids to an unconscious person.

9. Never give morphine to an unconscious person.

10. Do not move a patient until the extent of the injuries has been determined.

NUCLEAR WEAPONS ACCIDENT/INCIDENT

Nuclear weapons systems have built-in safety features and are governed by safety rules during all operational phases. As a senior petty officer, you must recognize, however, that hazards do exist. You must know what to do in the event of a nuclear weapon accident/incident.

In the United States, nuclear weapons maybe transported by aircraft, trucks, trains, or naval ships. In each case, weapons and components are installed in special containers that are securely fastened to the transport vehicle by carefully designed tie-downs and mountings. Because principal methods and procedures related to nuclear weapons accident/incidents are classified, only basic information will be covered here. More detailed information can be found in the *Repair Party Manual* (COMNAVSURFLANTINST 3541.IC/COMNAVSURFPACINST 3541.4B).

Even though nuclear weapons are designed to prevent a nuclear yield in the event of accidental detonation, a possible hazard is still associated with conventional weapons and material. The two components of a nuclear weapon that constitute the most probable hazard in the case of an accident are high explosives and plutonium.

HIGH EXPLOSIVES

Most nuclear weapons contain high explosives in varying amounts of up to 200 pounds. These high explosives present a major hazard. Treat accidents or fires involving nuclear weapons the same as those involving conventional high explosives. If a nuclear weapon is involved in a fire, the high explosives could detonate. Detonation may be very small or of considerable magnitude. If a nuclear weapon accident occurs, only personnel trained in high-explosive disposal should attempt to clean up, recover, or dispose of the high explosives.

PLUTONIUM

Plutonium may become dispersed as small particles as the result of impact, detonation of the high explosives, or by smoke if a fire occurs. Plutonium is a hazard only if it enters the body. When small particles of plutonium are suspended in the air, the particles can be inhaled into the lungs or swallowed. Plutonium particles may also enter the body through cuts in the skin.

RESPONSE TO A NUCLEAR WEAPON ACCIDENT/INCIDENT

Execute a shipboard nuclear accident/incident in the same manner as any shipboard general emergency. In port, if less than the entire crew is aboard and if the situation warrants, sound general quarters. Sound general quarters at sea and the appropriate repair locker/damage control team takes charge. If you are the first person on the scene, pass the alarm; then rig any available fire hose and start cooling the warhead with high velocity water fog. Do not use foam on warheads, as it acts as an insulator and causes heat retention rather than cooling.

If you are caught in the area of a fire or an explosion, obtain some type of respiratory protection, even if it is a handkerchief placed over the nose and mouth. An explosion may result in scattered, burned, or melted explosives in the area. High explosives in this form are especially susceptible to shock or movement. They may be recognized by their tan or buff color in their original form, a pink color when fused, or a white powdery appearance when burned. Remember, stay away from high explosives.

CBR DEFENSE

CBR defense is defined as all damage control and personnel protective measures used to combat/minimize the effects of chemical, biological, or radiological attack. CBR defense measures may be invoked to counter a direct enemy attack or to counter the effects of the use of CBR weapons by friendly forces in defending themselves.

In studying CBR defense, remember that new approaches are constantly being tested—new weapons are being developed and new protective and defense measures are being established. Keeping up to date with new developments is therefore particularly important in the field of CBR defense.

RADIOLOGICAL DEFENSE

The detonation of a nuclear weapon creates a nuclear warfare environment. A nuclear weapon burst produces characteristic effects that damage both ship and equipment, injure personnel, and adversely affect the performance of electronic, electrical, and communications equipment. Nuclear and thermal radiation are hazards of a nuclear warfare environment that are added to those ordinarily met in conventional warfare. The air blast and underwater shock effects of a nuclear weapon burst pose defensive problems of a greater magnitude than those posed in an encounter using high explosives. The air blast and released heat energy of high-explosive detonation cause localized damage; in a nuclear weapons detonation, these effects may envelop the entire ship.

NUCLEAR WEAPONS HAZARDS

Nuclear radiation is a hazard to personnel at distances well beyond the range of lethal damage from other effects. A ship's continued performance depends upon the effectiveness of nuclear warfare defense actions that are undertaken during and after a nuclear weapons burst. Personnel injuries may result from the nuclear weapons effects of air blast, underwater shock, thermal radiation, and nuclear radiation.

DAMAGE-SURVIVAL ZONE

The damaging effects of a nuclear weapons attack generally decrease in severity as distance from the burst increases. As shown in figure 7-5, a *kill zone* surrounds *surface zero;* ships in the kill zone will be sunk, immobilized, or severely damaged. Outside of this zone is a much larger *damage-survival* zone in which ships will receive severe topside damage, operational damage, moderate damage, or light damage. The size of each of these zones depends primarily on weapons yield. The damage-survival zone is not only much larger than the kill zone, it is also much more important from the standpoint of modern naval formations. This is because most of the damaged ships in a modern naval formation probably will be located within the damage-survival zone.

NON-NUCLEAR EFFECTS

A brief discussion of damage by non-nuclear effects is given below. Table 7-7 summarizes the possible types of damage that can result from air blast, underwater shock, or water waves.

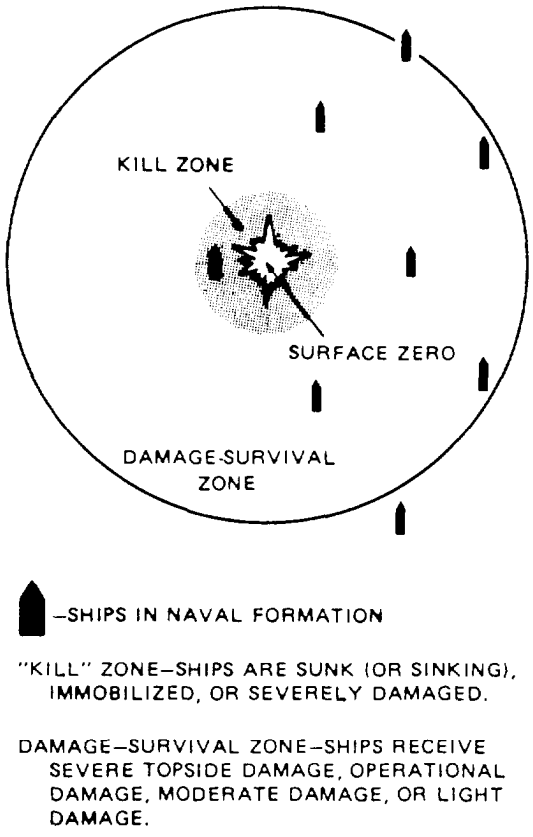


Figure 7-5.—Damage-survival zone.

Damage by Air Blast

An *air blast* is the name given to the pressure pulse created in the air by explosion. Air blast from a nuclear detonation can cause general damage up to 10 miles from the burst. The time required for the damaging effects to reach a ship may range from seconds to about 1 minute. Air-blast damage primarily will be inflicted on the superstructure and the hull above the waterline. Surfaces that are nearly parallel to the air blast will be damaged less than those that are nearly perpendicular to it.

Damage by Underwater Shock

Underwater shock is the name given to the pressure pulse created in water as a result of an explosion on or below the water surface. Shock from a nuclear burst is similar to that resulting from a depth charge. It can inflict severe damage

Table 7-7.—Possible Damage from Air Blast, Underwater Shock, or Water Waves

BLAST	UNDERWATER SHOCK	WATER WAVES
1. Warping, buckling of flight deck; distortion of main deck.	1. Foundation damage to heavy machinery; serious misalignment of shafting.	1. Distortion of topside structure.
2. Distortion of airplane elevators.	2. Rupture of feedwater and steam lines.	2. Flooding above waterline.
3. Distortion of hull girder.	3. Damage to boiler brickwork, especially floors.	3. Damage to guns.
4. Dishing of shell plating above waterline.	4. Displacement of and damage to heavy gun mounts.	4. Short circuiting of electrical and electronic systems.
5. Cracking of seams above waterline, possibly extending below waterline.	5. Distortion of hull and hull fittings; buckling of longitudinals and transverse framing.	5. Displacement and distortion of deck machinery, weather doors, gun shields.
6. Rupturing of boiler casings and associated boiler air systems.	6. Dishing and rupturing of shell plating below waterline, resulting in flooding.	6. Rupturing of topside piping systems.
7. Distortion of and damage to deck machinery, stacks, fittings, masts, weather doors, radar antennas, etc.	7. Damage to electronic systems components and disruption of system performance.	
8. Rupturing of fuel system at hangar-deck and flight-deck levels.		

to ships at a distance of several miles. Underwater shock travels much faster than an air blast; it can arrive in from less than 1 second up to 10 seconds. Hull damage will occur in the form of dished and ruptured plating and damaged supporting structures. Light equipment may be tossed about, causing damage to other equipment and injury to personnel. Engineering piping systems, shafting, and boiler brickwork are especially sensitive to underwater shock.

Damage by Water Waves

Water waves from a surface or underwater burst of a nuclear weapon maybe over a hundred feet in height. In deep water, waves may be a contributing source of damage at ranges of over 1 mile from a nominal nuclear weapon and possibly over 10 miles from a megaton-weapon burst. Arrival time of the waves is from one-half minute to several minutes, depending on the distance from the burst. Only in isolated instances will water waves be the primary source of ship damage. Flooding may occur through weather doors-that have been damaged by an air blast.

PROTECTION AGAINST AIR BLAST, HEAT, AND UNDERWATER SHOCK

An air blast produces injuries among topside personnel primarily by bodily displacement (picking them up and throwing them about) and among below-deck personnel by displacement of personnel and loose gear. The severity of injuries can be reduced if personnel hold on to solid ship structures and loose gear is secured.

Heat (also called thermal radiation) produces injuries (skin burns and eye damage) among topside personnel and can ignite clothing or other combustibles. The severity of potential thermal injury may be reduced if personnel quickly cover exposed skin surfaces while dropping out of sight of the fireball or curling up on the deck to present a minimum target to the fireball.

Table 7-8.—Recommended Personnel Action Against Nuclear Detonations

Burst Type	Warning		No Warning
	Topside Personnel	Below-deck Personnel	Topside Personnel
Air	A	B	C
Surface	A	B	C
Under-water	A	B	--

A—Lie prone and hold on to solid ship structure.

B—Stand with knees flexed and hold on to solid ship structure.

C—Hands-to-face evasion.

Table 7-8 summarizes actions personnel should take to reduce injuries from air, surface, and underwater detonations for "warning" and "no warning" attack situations.

The maneuvers to reduce the vulnerability of topside personnel to both thermal radiation and air blast effects of air and surface bursts are explained in the following paragraphs.

Personnel in Open Topside Areas

When you see the flash or see the sky light up, close your eyes and immediately raise your hands to cover your face. Personnel hands-to-face evasion is practical only for topside personnel who are alerted by the flash. The hands-to-face evasion is designed to provide protection against air blast and thermal radiation.

Meanwhile, drop to the deck as rapidly as possible. Do not use your hands to break your fall; use your shoulder. Keep your hands over your face, and curl up to present a minimum target. You may feel the heat from the detonation. Two to five seconds after the flash (depending on the weapon yield) or after the heat sensation is over, remove your hands from your face. Then immediately grab hold of a solid ship structure firmly to prevent the air blast winds from blowing you overboard or against the ship's structure. You may suffer flash blindness for up to 30 minutes.

Personnel in Congested Topside Areas

You may be in a position in which you cannot quickly drop to the deck (as those on a gun mount). In such a case, when you see the flash or see the sky light up, close your eyes and immediately raise your hands to cover your face as rapidly as possible, while crouching and bending your head down. You may feel the heat from the weapon. At this point, grab hold of a solid ship structure to keep from being blown overboard or against the ship's structure by the air-blast winds.

Underwater shock produces injuries among topside and below-deck personnel by the mechanical transmission of the water shock force throughout the ship structure. The shock force results in rapid upward acceleration of the deck. The deck hits personnel and throws them off balance, propelling them into the overhead or into bulkheads. Personnel can reduce the severity of potential injuries if they hold on to solid ship structures, flex their knees, and rest on the balls of their feet. If personnel expect underwater shock, they should not lie prone on the deck because this position subjects more body area to the forces transmitted through the deck.

Self-Aid and First Aid

If you or your shipmates should sustain injuries or become contaminated with radiological, biological, or chemical agents during an attack, you can increase your chances of survival by immediately administering certain self-aid and first-aid measures, *Self-aid* consists of those measures that individuals can apply to help themselves. *First aid is* the assistance given by nonmedical personnel to a casualty until medical help arrives.

Treat the blast and heat injuries from a nuclear explosion in the same manner as those resulting from high-explosive bombs, incendiary weapons, and mechanical accidents. Follow standard self-aid and first-aid measures in treating fractures, concussions, lacerations, contusions, hemorrhages, burns, shock, and exposure.

Immediate treatment is not needed for nuclear radiation sickness. Remember, you could receive a dose of radiation even though you are NOT contaminated with radioactive particles. If the possibility exists that you have been exposed to nuclear radiation, you will be checked by medical personnel and given appropriate treatment.

If directed, proceed to a personnel decontamination station, where you will discard your clothing and equipment and take a shower. In washing, use plenty of soap and warm water; pay

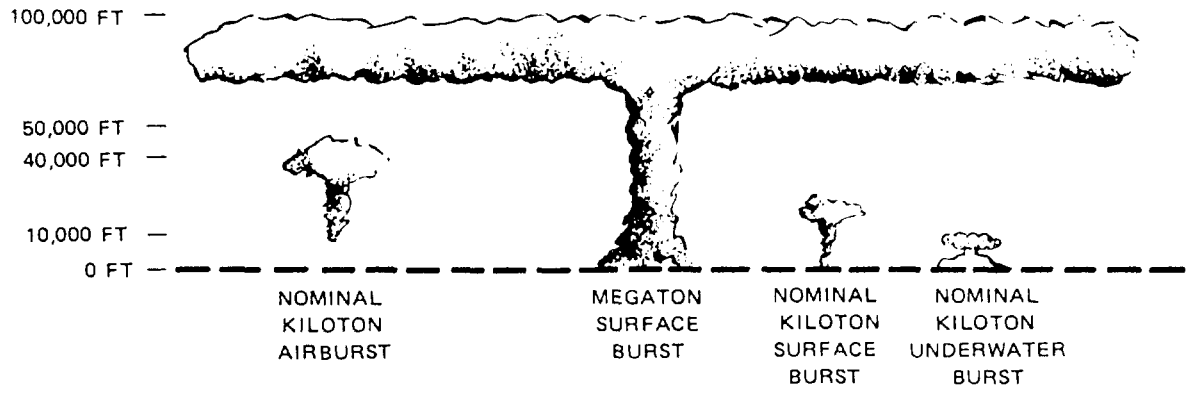


Figure 7-6.—Relative sizes and altitudes of radioactive fallout clouds.

close attention to the hairy parts of your body, body creases, and fingernails, where dirt tends to gather.

NUCLEAR RADIATION

Nuclear radiation presents a threat to our naval forces. The effects of this threat can be controlled if the basic facts of nuclear radiation are understood. The following paragraphs describe the phenomena of *initial radiation, radioactive fallout,* and *types of radiation emitted by contamination.*

Initial Radiation

Initial nuclear radiation consists of gamma rays and neutrons and is emitted at the time of a nuclear detonation. This radiation is emitted in the first minute after burst; however, most of it is emitted in the first few seconds. This radiation causes no damage to material, but it can be very injurious to ship's personnel and produce many casualties. The casualty range of initial radiation of a normal kiloton burst is over 1 mile. Initial radiation can readily penetrate the surface layers of targets. However, dense material, such as steel, can appreciably reduce radiation.

Radioactive Fallout

Radioactive fallout is a delayed phenomenon of a nuclear detonation. Most of the fallout occurs minutes to hours after the burst. Surface and subsurface (underwater and underground) nuclear bursts deposit large amounts of fallout in localized areas. An airbursr in which the fireball does not contact the surface usually does not result in fallout of military significance. This is because there is less radioactive material, and it is dispersed over a great area before reaching the surface.

Within a few seconds after the burst, the radioactive products primarily are in the atomic cloud (fig. 7-6) along with a much larger amount of nonradioactive material, such as seawater or surface material. Radioactive elements mixed with nonradioactive material form the total contaminant produced by the burst. This radioactive mixture falls back to the earth's surface as radioactive fallout.

Heavier particles in the cloud fall out around surface zero soon after the burst. The prevailing winds carry finer and lighter particles over a large area many miles from surface zero. A megaton burst carries significant amounts of fallout several hundred miles and disperses it over thousands of square miles. The time when fallout reaches a given location may be from a fraction of a minute to as much as 24 hours.

Types of Radiation Emitted by Contamination

Radioactive contamination can emit three types of ionizing nuclear radiation: *alpha, beta,* and *gamma.* A single particle of contaminant may be the source of one or more of these types. These radiations are not detectable by the human senses; however, electronic instruments (radiacs) can detect the presence of radiation, differentiate among the three types, and measure their respective amounts and intensities. The following paragraphs discuss the three types of radiation.

ALPHA. —You can stop alpha radiation by almost any barrier, including 1 to 2 inches of air.

Alpha radiation becomes a hazard only if alpha-emitting contaminants are taken into the body by breathing, eating, drinking, or by absorption into the bloodstream through broken skin. Major alpha contamination in a nuclear attack is not likely; however, it will present a hazard in the event of a nuclear weapons handling accident.

BETA. —Beta radiation has a range in the air of only a few feet and has limited penetrating power. Generally, you cannot stop beta radiation with light-porous material, such as ordinary clothing, particularly since the contaminant tends to impregnate the material. However, you can stop beta radiation with dense material, such as heavy-duty gloves and foul-weather clothing. Beta contamination is primarily a skin-contact hazard.

GAMMA. —Gamma radiation is similar to X radiation (X rays). It has an effective range in the air of many hundreds of feet and is highly penetrating. It cannot be completely stopped by a barrier. A sufficient thickness of material can reduce the intensity of gamma radiation to an insignificant level. Because of the penetrating power of gamma radiation and the large amount of gamma rays emitted by fallout contaminants, it is the most significant radiation hazard in most contaminated ship situations.

CHEMICAL AND BIOLOGICAL DEFENSE

The threat of attack with chemical or biological warfare agents is more likely on land. However, their uses are still a definite threat in naval engagements and amphibious operations.

BIOLOGICAL WARFARE (BW)

Large-scale use of biological warfare (BW) agents has not occurred in modern times. Therefore, there is little experience with the military potential of BW agents except by noting that naturally occurring diseases have affected the outcome of some past wars. Any nation with a modern scientific program can produce effective biological agents.

Biological warfare is the intentional use of living infectious microorganisms (germs) to reduce or destroy the military effectiveness of personnel. The exception to this is the recent use in Southeast Asia and Afghanistan of toxins classified as BW agents but are *not* living organisms. BW agents are living microorganisms (except toxins) that cause disease in personnel, plants, and animals. BW agents differ greatly from chemical agents in that a living microorganism can grow and multiply in a susceptible host. Once infected, an incubation period is required before the infection produces a casualty. This incubation period varies greatly among infectious microorganisms. For this reason, use of BW agents are unlikely to be used in situations where results are needed in less than 48 to 72 hours.

Detection and Identification

Because of the incubation period, there is a lapse of time before victims realize they are infected. Detection before the first symptoms are noticed is difficult, and identification of a particular agent may take considerable time. It is possible to detect excessive organic life in the atmosphere, but identification of the particular agent is still in the development stage. Once a biological infection is started, it may spread by normal contagious processes without further agent deployment. BW agents will infect an individual if they enter the lungs, stomach, or bloodstream.

Dissemination

BW agents are likely to be dispersed as aerosols of solid or liquid particles and are invisible except near the source of dissemination. These particles, when inhaled, can penetrate the lungs where they can start an infection. Aerosols of BW agents can penetrate buildings and ships. The microorganisms required to infect an individual are so small that it is possible for a single delivery vehicle to spread a casualty-producing aerosol over many hundreds of square miles. When biological agents infect biting flies, mosquitoes, fleas, and ticks and are released into an area, they, in turn, bite and infect people. BW agents may also be spread by saboteurs, who may contaminate food and water supplies, food processing plants, and air-conditioning systems. Shells, rockets, and mortar bombs are not suitable for dissemination of these agents because of the adverse effect of heat and shock in an explosion.

Self-Aid

If you suspect that BW contamination has taken place, put on your protective mask and observe the basic principles of preventive

medicine, which include individual hygiene, sanitation, and physical checkups. Report any illness to medical authorities immediately.

If there is a possibility of contamination by BW agents, carefully remove your clothes to avoid spreading any contamination. Take a thorough soap and water shower as soon as possible. Pay careful attention to your face and hands. Use a fingernail brush to remove dirt under your nails. Frequently brush your teeth and gums, the roof of your mouth, and your tongue. Dispose of your contaminated clothing as directed.

The speed with which the deadly effects of some biological agents take place will require you to take immediate self-aid and first-aid measures.

CHEMICAL WARFARE

Chemical warfare (CW) agents are those intended for use in military operations to kill, injure seriously, or incapacitate people through physiological effects. Chemical agents used as weapons of war are almost as old as recorded history and can be dated from the fifth century B.C. CW operations in the modern sense were first used during World War I when the German army released chlorine gas from large cylinders into a favorable wind. Although large stocks of chemical agents were produced and stockpiled during World War II, none were used. Since the end of World War II, much effort has been directed into research and development of chemical agents. The introduction of nuclear weapons and the fact that CW agents were not used in World War II does not exclude the possibility of their use in future wars. Detection, protection, and decontamination are the most important concerns of CW defense.

Characteristics of Chemical Warfare

Chemical warfare has unique characteristics, and it is not thought of in terms of conventional warfare. Since chemical warfare is directed primarily against man, it has obvious tactical advantages. It does not damage equipment or other war materials but rather makes them dirty and renders them unusable. Chemical warfare is a weapon of surprise. It is capable of traveling over and around structures as well as penetrating compartments. Chemical warfare is economical and is capable of affecting large areas for relatively small material expenditures. In addition to its lethal or incapacitating effects, the use of chemical warfare causes morale and psychological problems, and its impact on medical and logistic facilities can be enormous. It also reduces performance because of defensive measures needed to combat it.

CW agents can attack the body through the eyes, nose, mouth, or skin. CW agents produce almost instantaneous casualties when they enter the eyes, are breathed through the nose or mouth, or are ingested. Penetration through the skin is likely to produce casualties more slowly, although the presence of open wounds can hasten the process. Almost any weapons system can be used to deliver CW agents.

Classification of Chemical Agents

CW agents maybe classified according to their physical state, tactical use, or physiological action. They exist as solids, liquids, or gases. You can also group CW agents according to their tactical use.

CASUALTY CW AGENTS. —Casualty CW agents are capable of producing serious injury or death. They include nerve agents, blister agents, blood agents, and choking agents. The most important are the nerve agents. They interfere with the transfer of nerve impulses, thereby disrupting essential bodily functions, such as breathing, muscular control, and vision. The nerve, blood, and choking agents are primarily killers. The blister agents normally result only in incapacitation; however, they may cause blindness and even death through secondary infection.

INCAPACITATING AGENTS. —These agents produce temporary physiological or mental effects that render individuals incapable of performing their assigned duties.

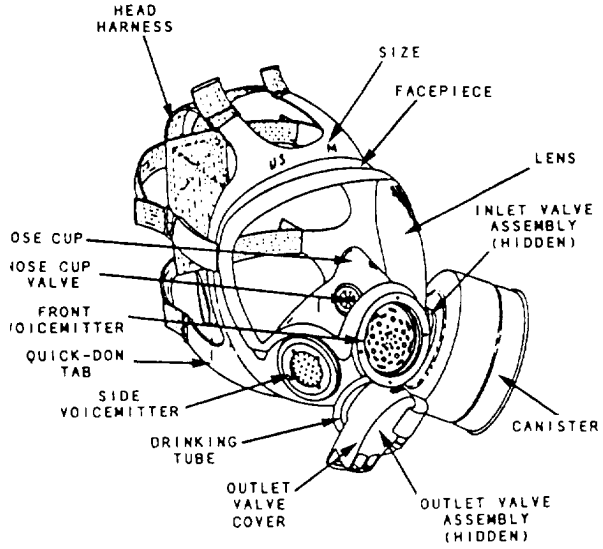
RIOT CONTROL AGENTS. —These agents, such as tear gas, produce only temporary irritating or incapacitating effects when in contact with the eyes or when inhaled.

Effects of Chemical Warfare Agents

Victims of casualty agents (nerve, blister, blood, and choking agents) require hospitalization. Inhalation of high concentrations of vapor from these agents or contact with liquid agents, without prompt medical treatment, will produce death.

EFFECTS OF NERVE AGENTS. —You should consider nerve agents to be the most dangerous because of their ability, even in small amounts, to cause casualties. Their detection by the senses is unlikely since they are colorless, tasteless, and virtually odorless, They cause no irritation on initial contact or on entry into the body. Nerve agents can cause casualties almost immediately when vapor is inhaled, when liquid is absorbed by the eyes or wounds, or when you consume contaminanted food and water. Speed, both in donning your mask and in removing of contamination from exposed skin, is imperative. You can inhale a lethal dose in 5 to 10 seconds. Symptoms will occur in about 1 minute, incapacitation in 1 1/2 minutes, and death in about 6 minutes.

At the first sign of a NERVE AGENT in the atmosphere, stop breathing and put on your protective mask immediately. If possible, hold your breath until the mask is on and properly adjusted. Wear the mask constantly until you are sure no nerve agent is present in the air and the all-clear signal is given.



MCU-2/P protective mask.

NOTE: The MCU-2/P gas mask is replacing the Mk5. This new mask provides an improved field of vision, better voice communications, lower breathing resistance, and is more comfortable to wear than the Mk5 gas mask.

If a liquid nerve or blister agent gets on the skin, you should remove it at once using the M-258A1 decontamination kit. Information on how to use the M-258A1 kit can be found in *Basic Military Requirements,* NAVEDTRA 12043. After decontaminating the affected area, continue with your combat duties. You should examine the contaminated area occasionally for local sweating and muscular twitching. If none develops in the next half hour and you have no tightness in your chest, your self-aid was successful and you can forget it. However, if these symptoms do occur, inject one atropine injection and one 2-PAM chloride injection in the outer thigh at once. Wait 10 minutes; if symptoms persist, administer another atropine injection and another 2-PAM chloride injection. Wait 10 minutes; if symptoms persist, administer another atropine injection only. You cannot give more than three injections unless under the direct supervision of medical personnel. However, under realistic conditions this may not be possible, so the senior person on the scene must make a decision.

If a drop or splash of liquid nerve agent should get into your eyes, instant action is necessary to avoid serious injury.

WARNING

Do not use the M-258A1 kit to decontaminate the eyes, wounds, or mouth as the decontaminating agent is poisonous and a caustic hazard.

Quickly open a container of uncontaminated water, tilt your head back so the eyes look straight upward, and slowly pour the water into the eyes so the irrigation will last not less than 30 seconds. This irrigation must be done in spite of the presence of nerve agent vapor. Hold your breath as much as possible during this procedure. If you cannot hold your breath long enough to complete rinsing the eyes with water for 30 seconds, rinse as long as possible and put on your mask before breathing. After taking several breathes with the mask on, remove the mask and complete the decontamination, As soon as the irrigation is completed, put on the protective mask at once. Watch the pupil of the contaminated eye during the next minute, using a mirror if one is available; or else have someone nearby watch it for you. If the pupil rapidly gets smaller, inject one atropine and one 2-PAM chloride injection at once into the outer thigh. If the pupil does not get smaller, there is no nerve agent contamination. Do not use the antidote until you are sure the symptoms are those of nerve agent poisoning.

Exposure to high concentrations of nerve agents may bring on a lack of coordination, mental confusion, and physical collapse so fast that a person may not be able to perform self-aid measures. If this happens, the necessary procedures will have to be done for the casualty (as first aid) by the nearest person who is able to do so.

Severe nerve agent exposure may rapidly cause unconsciousness, muscular paralysis, and stoppage of breathing. When this occurs, atropine and 2-PAM chloride injections alone will not save a life. Start artificial ventilation, as a first-aid measure, immediately and continue until you can restore natural breathing or until medical personnel can take over. Atropine and 2-PAM injections increase the effectiveness of artificial ventilation and should be administered to the casualty as soon as possible.

EFFECTS OF BLISTER AGENTS. —Blister agents would probably be used in conjunction with nerve agents. They cause incapacitating rather than lethal effects detectable by the senses. They smell of garlic, fish, or geraniums and may appear as colorless to dark brown oily liquid or droplets. They attack through all body entry points, particularly the eyes and those parts of the body that are warm and moist. A droplet the size of a pinhead can cause a blister the size of a quarter. Blister agents react almost immediately on any part of the body they touch. You must wash the liquid from the eyes in seconds to avoid an injury. Treatment after 2 minutes is of little use. On the skin, depending on the dose received, effects appear from 1 hour to days following exposure. The first signs are a reddening of the skin, like a severe sunburn, followed by an itching or a burning sensation. Blisters appear in a day or less after reddening. Recovery time varies from about 6 days to as long as 8 weeks.

Because phosgene oxime (blister agent) reacts rapidly with tissue, decontamination will not be entirely effective after pain has begun. Nevertheless, flush the contaminated area as rapidly as possible with large amounts of water to remove any phosgene oxime that has not yet reacted with tissue.

Whenever liquid or vaporized blister agents are known, be sure to wear the protective mask. You must deal with liquid blister agents in your eyes or on your skin immediately.

You can decontaminate a liquid blister agent in your eye that does not cause immediate pain by rinsing the eye with water for at least 30 seconds. Try to regulate the flow of water so that flushing lasts not less than 30 seconds and not more than 2 minutes. Decontamination with water effectively removes mustard gas and is now the standard procedure for all blister agents.

The risk of leaving blister agents in the eye is greater than the risk of exposure to blister agent vapors. The decontamination procedure MUST be performed in spite of the presence of vapor.

EFFECTS OF CHOKING AGENTS. —Choking agents are less effective than nerve agents; the use is for quick, incapacitating effects. Death may occur within 3 hours. Choking agents are colorless but you can detect them by odor, which smells like new-mown hay or grass. They enter the body when inhaled through the nose or mouth. In low concentrations, there is a delay of 3 hours or more in their effect; in high concentrations, the effect is immediate including the possibility of death within minutes.

Irritation of the eyes or a change in the taste of a cigarette might indicate the presence of the choking agent phosgene. Smoking may become tasteless or offensive in taste. If any signs of choking agents occur, hold your breath and put on the protective mask at once. Unless you experience nausea, vomiting, difficulty in breathing, or more than the usual shortness of breath caused by exertion, continue your normal combat duties. If any of these symptoms occur, you should rest quietly until you are evacuated by medical personnel.

EFFECTS OF BLOOD AGENTS. —Blood agents were not very effective in World War I because the high concentrations necessary to cause death could not be achieved. Modern methods of delivery make their use possible; and because they are less persistent than other agents, they can be immediately used for quick casualty effects. Blood agents are colorless but may have a slight odor of bitter almonds. They attack the body when inhaled or ingested through the nose or mouth. A few breaths can cause incapacitation or death. Incapacitation can occur almost immediately; a lethal dose of vapor can result in death within 15 minutes.

In the case of blood agents, speed in self-aid and first-aid measures is essential. Stop breathing and put your mask on at once if you notice any stimulation of breathing; an odor of bitter almonds; or any irritation of the eyes, nose, or throat. The effects of blood agents act so rapidly that within a few seconds you will be unable to

put on the mask by yourself. If at all possible, try to hold your breath until the mask is on; this may be very difficult since blood agents strongly stimulate respiration. If a person's breathing has stopped, administer artificial ventilation.

EFFECTS OF VOMITING AGENTS. — Vomiting agents are used for harassment but may be dispersed along with lethal chemical agents. Vomiting agents alone cause temporary incapacitation only. Vomiting effects last from about 30 minutes up to several hours, depending on the concentration. Vomiting agents are invisible and odorless. They attack the body through the nose and mouth and irritate the eyes.

EFFECTS OF TEAR AGENTS. —Tear agents are used for their harassing effect. They have been used extensively as riot control and chemical defense training agents. Tear agents attack the eyes and irritate or burn moist areas of the skin. Effects are instantaneous but normally persist for only a few minutes.

Table 7-9 shows the properties of blister, blood, nerve, and choking chemical agents.

PERSONNEL DECONTAMINATION STATIONS

Personnel decontamination stations differ somewhat from ship to ship, but the basic requirements of the stations are the same. Each decontamination station is divided into two parts: (1) a contaminated or unclean section containing a washing area and (2) a clean section. This prevents recontamination of personnel and ship locations. If possible, the unclean and clean sections have separate access routes or entrances. The decontamination station provides showers with warm water (if possible); cleansing agents, such as ear syringes and eye bath cups; hair and nail clippers; scissors; surgeon's hand soap; towels; and brushes. Radiation instruments for monitoring personnel and clothing and supplies of clean clothing are also on hand at each station.

A decontamination (decon) station should be about 8 feet by 9 feet. It should have an entrance from the outside and an exit into an uncontaminated area near the showers. If exposed to contamination, you should use proper decontamination procedures. Do not remove your mask until a monitor tells you it is safe to do so. In general, personnel decontamination does not take priority over urgent battle requirements, but it should be accomplished as soon as possible. The following is a list of decontamination procedures:

1. Remove rain gear and battle dress just outside the decon station. Place it in the trash cans, bags, or other storage provided. Now you will be monitored for contamination. If there is no contamination, go to an uncontaminated space through another route. If there is contamination, go through the process described in paragraph 2 through 5 below.

2. Enter the first part of the decon station in pairs. Use the buddy system to do gross decon of masks and gloves with the M258A1 personnel decon kits. Decon boots by immersing them in the 2- by 2- by 6-inch pans filled with a 9 percent high test hypochlorite (HTH) and water solution.

3. Move to the second part of the decon station where attendants will cut away your smock and help remove your trousers and boots. Place the contaminated clothing in trash bags for disposal.

4. Move to the showers, soap and wash your entire body thoroughly, and rinse well. Pay special attention to fingernails, hairy parts of the body, and hidden parts where contamination tends to concentrate.

5. You are now ready to enter the clean part of the ship where you will put on new clothing. Before you enter the clean part, a monitor with a long-range radiac will check to ensure that you no longer carry contamination. Turn over your DT-60 dosimeter to this monitor. The monitor will take the readings and enter them in the log.You will be told if you can remove your gas mask.

MISSION-ORIENTED PROTECTIVE POSTURE

Mission-oriented protective posture (MOPP) establishes levels of readiness. The MOPP is a flexible system of protection against chemical agents used in chemical warfare defense. MOPP prescribes various types of protective clothing and equipment for wear, depending on the tactical mission, work-rate demand, and heat stress conditions (actual or possible). There are four

Table 7-9.—Properties of Chemical Agents

AGENTS	CHEMICAL AGENT SYMBOL	STATE AT 20°C	ODOR	RATE OF ACTION	PHYSIO-LOGICAL ACTION	PROTECTION REQUIRED	DECON-TAMINATION	MEANS OF DETECTION	USE	PERSISTENCY
CHOKING AGENTS	Phosgene CG	Colorless gas	New-mown hay; green corn	Immediate to 3 hours, depending upon concentration	Damages lungs	Protection mask	None needed; aeration in closed spaces	M18A2	Delayed action casualty agent	Short; vapor may persist for some time in low places under calm or light winds and stable atmospheric conditions (Inversion).
	Diphosgene DP	Colorless liquid	New-mown hay; green corn	Immediate to 3 hours, depending upon concentration	Damages lungs	Protective mask	None needed; aeration in closed spaces	M18A2	Delayed action casualty agent	
	Chlorine CL	Yellow gas	Chlorine	Immediate	Damages lungs	Protective mask	M258A1. Soap abd water	M18A2	Quick-action casualty agent	
NERVE AGENTS	Tabun GA	Colorless to brown liquid	Faintly fruity; none when pure	Very rapid	Cessation of breath and death may follow	Protective mask and clothing	M258A1. Bleach slurry, steam in confined area	M18A2 and M256 Kits, CWDD	Quick-action casualty agent	Depends upon munitions used and weather. Heavily splashed liquid persists 1 to 2 days under average weather conditions.
	Sarin GB	Colorless liquid	Almost none when pure	Very rapid	Cessation of breath and death may follow	Protective mask and clothing	M258A1. In confined area steam; hot soapy water	M18A2 and M256 Kits, CWDD	Quick-action casualty agent	Evaporates at about the same rate as water. Depends upon munitions used and the weather.
	Soman GD	Colorless liquid	Fruity; camphor odor when pure	Very rapid	Cessation of breath and death may follow	Protective mask and clothing	M258A1. Hot soapy water	M18A2 and M256 Kits, CWDD	Quick-action casualty agent	Depends upon the munitions used and the weather. Heavily splashed liquid persists 1 to 2 days under average weather conditions.
	VX	Colorless liquid	Odorless	Rapid	Produces casualties when inhaled or absorbed	Protective mask and clothing	M258A1. Hot soapy water	M18A2 and M256 Kits, CWDD	Quick-action casualty agent	
BLOOD AGENTS	Cyanogen chloride CK	Colorless gas	Somewhat like AC	Rapid	Interferes with use of oxygen by body tissues	Protective mask	None needed	M18A2 and M256 Kits	Quick-action casualty agent	Short; vapor may persist in jungle or forest for some time under suitable weather conditions.
	Hydrogen cyanide AC	Colorless gas or liquid	Bitter almonds	Very rapid	Interferes with use of oxygen by body tissues	Protective mask	None needed	M18A2 and M256 Kits	Quick-action casualty agent	Short; the agent is highly volatile and in the gaseous state it dissipates quickly in the air.

Table 7-9.—Properties of Chemical Agents—Continued

AGENTS	CHEMICAL AGENT SYMBOL	STATE AT 20°C	ODOR	RATE OF ACTION	PHYSIO-LOGICAL ACTION	PROTECTION REQUIRED	DECON-TAMINATION	MEANS OF DETECTION	USE	PERSISTENCY
BLISTER AGENTS	Distilled mustard HD	Colorless to pale yellow liquid	Garlic	Delayed; hours to days	Blisters; destroys tissues; injuries blood vessels	Protective mask and clothing	Bleach	M18A2 and M256 Kits	Delayed-action casaulty agent	Depends upon munition used and the weather. Heavily splashed liquid persists 1 to 2 days in concentrations to provide casualties of military significance under average weather conditions, and a week to months under very cold conditions.
	Nitrogen mustard HN-1	Dark liquid	Fishy or musty	Skin effects delayed 12 hours on longer	Blisters; affects respiratory tract; destroys tissues; injures blood vessels	Protective mask and clothing	Bleach	M18A2 and M256 Kits	Delayed-action casualty agent	Depends on munitions used and the weather. Somewhat shorter than duration of effectiveness for HD.
	Nitrogen mustard HN-2	Dark liquid	Soapy in low concentrations, fruity in high concentrations	Serious effects same for HD; minor effects sooner	Similar to HD. Broncho-pneumonia may occur after 24 hours	Protective mask and clothing	Bleach	M182A and M256 Kits	Delayed-action casualty agent	
	Nitrogen mustard HN-3	Dark liquid	None if pure	Immediate effects on contact	Similar to HN-2	Protective mask and clothing	Bleach	M182A and M256 Kits	Delayed-action casualty agent	Considerably longer than for HD.
	Phosgene oxime dichloro-foroxime CX	Colorless solid or liquid	Sharp; pene-trating	Rapid	Violently irritates mucous membrane of eyes and nose; forms welts rapidly	Protective mask and clothing	None entirely effective	M18A2 and M256 Kits		Somewhat shorter than for HD. Very short duration under humid conditions.
	Lewisite L	Dark oily liquid	Variable; may resemble geraniums	Prompt eye stinging; delayed blistering	Similar to HD plus may cause systemic poisoning	Protective mask and clothing	Bleach	M18A2 and M256 Kits	Moderately delayed casualty agent	
	Mustard-lewisite mixture HL	Dark oily liquid	Garlic like	Immediate eye effect; skin effects 1/2 to 1 hour	Similar to HD plus may cause systemic poisoning	Protective mask and clothing	Bleach	M18A1 Kits, M256	Delayed-action casualty agent	Depends on munitions used and the weather. Somewhat shorter than that of HD.

levels of MOPP, as shown in table 7-10. The accomplishment of the mission still has priority. However, there is concern for factors like heat exhaustion, fatigue, senses, and personal needs.

The MOPP does not require that individuals wear complete protective equipment at all times. Duty requirements, body heat buildup, and basic human needs prevent the use of full-protective equipment for an indefinite period. The MOPP does, however, give the commanding officer a wide range of choices of protection from no protection at all to full-protective clothing and equipment. The ideal solution is to balance the requirement for protection with the work rate imposed by the mission. The balance will minimize both chemical and heat casualties. The physical location of personnel, such as topside or

Table 7-10.—Employment for MOPP Levels for Individual Protection

MOPP LEVEL-1

1. Protective equipment issued to shipboard personnel.
2. Mask fitted for immediate use.
3. Protective suit, boots, gloves, and mask (new canisters in can) are located at battle station.

MOPP LEVEL-2

1. Protective suit is donned (without hood up).
2. Mask (with unopened canisters), boots, and gloves are carried or located at battle station.

MOPP LEVEL-3

1. Suit and boots are worn.
2. Mask is fitted with filter canisters.
3. Mask and gloves are carried (without hood up).

MOPP LEVEL-4

1. All protective equipment to be worn (hood up and secured).
2. Exposed topside personnel will don rain gear over protective suits.

NOTE 1: The setting of each level may be recommended to the Commanding Officer by the Chief Engineer or DCA based on tactical mission, work rate demand, and heat stress probabilities/actuals experienced by the various battle station areas (i.e., engine room, CIC, etc.).

NOTE 2: Atropine auto injectors (3) and pralidoxime chloride auto injectors (2 PAM-CL) (2) are issued by medical personnel and carried by ships force in mask carrier.

NOTE 3: The commanding officer may designate "mask only" in certain portions of the ship according to the probable threat.

within the ship, and their relative ability to enter and don full-protective clothing while continuing to perform assigned duties must also be considered.

A great number of heat casualties is acceptable since heat casualties are more likely to recover and ordinarily do not require the intensive medical care necessary in treating chemical casualties. Personnel fully trained in the use of protective clothing and accustomed to its use will suffer fewer and less severe heat casualties.

DISASTER CONTROL ASHORE

"Disaster preparedness" means implementing actions to promote survival of personnel, preservation of resources, and restoration of mission-essential operations following any type of disaster. All naval activities must plan for self-recovery and provide an effective system of mutual assistance when required. In planning for disaster response, units should first consider those requirements necessary for their own survival. Each unit will have a civil disaster bill based on OPNAVINST 3120.32B.

As a senior petty officer, you maybe assigned as a member of, or to lead, a civil disaster detail. When providing civil disaster relief, you may expect to deal with demoralized, hysterical, or apathetic survivors. They may be incapable, temporarily at least, of intelligent action in their own behalf. Mass destruction of homes and other buildings, widespread fires, and complete absence of all forms of public utilities should be anticipated. Disaster relief operations are normally conducted in five phases (I-V).

Phase I (Planning)

Immediately following the order to provide disaster relief to an area, the planning phase (I) begins and extends until the detail arrives at the disaster area. During this period, determine the need for every aid. Assemble all available maps and/or charts of the area, and make suitable reproductions to ensure adequate maps for rescue operations. The geographic reference (GEOREF) grid system should be used.

The operations department prepares portable communications equipment and establishes a communications plan. It also establishes disaster assistance teams. These teams should be self-sustaining and have adequate supplies of food and water. Each team should also have crowbars, picks, fire axes, shovels, two blankets, and a stretcher. If fires are anticipated, fire-fighting teams should break out available fire-fighting gear. The supply department provides food and supplies and prepares to establish field kitchens and serve meals to survivors. The medical department should be prepared to set up a field hospital and have medical teams organized, equipped, and ready to render assistance as necessary.

Phase II (Investigation of Extent of Disaster)

Phase II is the investigation of the extent of the disaster. Following a large-scale disaster, many confusing and inaccurate reports are likely to be received from survivors. A survey team is dispatched to the disaster area. It should make contact with local authorities and determine the extent of immediate assistance needed and relay this information to the senior officer present. If available, helicopters can be used to survey outlying areas to determine the extent of the disaster.

Phase III (Initial Disaster Relief)

Phase III is the initial disaster relief phase. The general objectives of this phase are to

- rescue persons requiring immediate attention,
- fight and extinguish fires,
- render medical aid, and
- aid in any way within the capabilities of personnel and materials to ease the situation.

A command center is set up in the disaster area to direct and establish liaison with other rescue personnel to avoid duplication of effort. There will be no armed personnel in the disaster area unless specifically authorized by the commanding officer.

Phase IV (Routine Aid and Assistance)

Phase IV consists of routine aid and assistance. The general objectives of this phase are to

- continue medical and rescue work;
- provide food and supplies as required and directed;
- commence repair of utilities, such as communications, water, and electrical supply insofar as practical; and
- provide temporary shelter.

Phase V (Withdrawal)

Phase V is the withdrawal phase. When the situation is under control, the unit will withdraw from the disaster area. Phase V is only emergency relief, not rehabilitation. Its primary purpose is to assist in a disaster area. All equipment and supplies not authorized to be left behind will be recovered and returned to the command.

SUMMARY

There can be no substitute for training and preparation in situations requiring damage control action. Damage resulting from battle, fire, collision, and CBR attack must be brought under control as soon as possible to ensure the survival of ship and crew. Successful damage control requires a detailed knowledge of the ship's construction, characteristics, compartmentation, and stability. It also includes knowledge of those design features and equipments used to prevent or control damage should the ship be endangered. The control of damage depends on the ability and the initiative of personnel to take prompt corrective action using materials that are readily available.

As a senior petty officer, you will often be placed in a position of responsibility for training or leading damage control repair parties. This is not to say that you must know everything there is to know about damage control. But, you should be aware of the types of information and training that are available. Take advantage of the ship's damage control library for conducting training on board. Your personnel should be cross-trained in damage control procedures to build more effective and versatile teams.

In the event of a CBR attack, fast action on the part of all personnel can minimize injury and prolonged incapacity. Knowing what actions to take and when to take them can mean the difference between survival and death and winning and losing a battle. Properly applied self-aid, first aid, and personnel decontamination can increase your chances of recovery from CBR exposure.

Natural disasters can occur at any time or any place in many forms, such as flooding, earthquakes, and hurricanes. As a senior petty officer, you may be required to lead a civil disaster detail ashore. Knowing what your duties are and what to expect following a disaster can save lives and property.

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DEVIL TO PAY

Today the expression "devil to pay" is used primarily as a means of conveying an unpleasant and impending happening. Originally, this expression denoted the specific task aboard ship of caulking the ship's longest seam.

The "devil" was the longest seam on the wooden ship, and cauling was done with "pay" or pitch. This grueling task of paying the devil was despised by every seaman, and the expression came to denote any unpleasant task.