NONRESIDENT
TRAINING
COURSE

Boatswain's Mate

NAVEDTRA 14343

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PREFACE

About this course:

This is a self-study course. By studying this course, you can improve your professional/military knowledge, as well as prepare for the Navywide advancement-in-rate examination. It contains subject matter about day-to-day occupational knowledge and skill requirements and includes text, tables, and illustrations to help you understand the information. An additional important feature of this course is its references to useful information to be found in other publications. The well-prepared Sailor will take the time to look up the additional information.

History of the course:

- *Aug 1996: Original edition released.*
- *May 2003: Administrative update released. Entered administrative updates and errata. Technical content was not reviewed or revised.*

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CHAPTER 1

BOATSWAIN'S MATE DUTIES

So you want to be a Boatswain's Mate. Fine! You have chosen one of the most interesting and one of the most difficult ratings in the Navy. We will not deceive you by telling you that a Boatswain's Mate's life is easy. As a Seaman, you should have a good idea of what life in the deck force is. You found the life is hard, frequently dangerous, and seemingly thankless. Undoubtedly, you have spent many long hours performing tiring and dangerous tasks, such as handling stores while replenishing at sea. You may have run your boat far into the night while you were cold and wet. At times, duty has kept you from sitting down to eat while the food was still hot. Often you were anchoring or mooring the ship while other shipmates were cleaning up and changing clothes to go ashore. Surely, you've been razzed by shipmates with less demanding jobs. Such things are aggravating, and you may even have wanted to find an easier job that would permit you to eat and knock off on schedule.

Then again, maybe you like hard work with an element of danger. Perhaps you like the responsibility of running and caring for your own boat. Maybe you have detected a note of admiration in your shipmate's good-natured needling.

Whatever your reasons, you are about to begin studying for one of the most varied and interesting ratings in the Navy. It is varied, because the rating includes elements of so many other ratings. It is this wide variety of tasks that also makes it more interesting.

This chapter describes the Boatswain's Mate as a leader, and some of the standard shipboard procedures you will need to know. We will discuss the duties you will have as Boatswain's Mate of the watch and will cover the use of the Boatswain's pipe in detail. You will receive some helpful hints on assigning personnel, how to plan work, and how to supervise once the job starts, A few of the important records and reports you need will be explained in this chapter; other records will be described in the following chapters and in other manuals available to you. Also in this chapter you will learn a little bit about ceremonial functions onboard a naval vessel and also ashore.

THE BOATSWAIN'S MATE AS A LEADER

LEARNING OBJECTIVES: Describe the Boatswain's Mate's role in the indoctrination of new personnel and in the maintenance of the following records: muster roll, bunk and locker assignments, equipage issued, watch and duty list, and inspections.

Boatswain's Mates hold a particularly sensitive position. Hundreds of young sailors get their first taste of shipboard life under the watchful eye and guidance of the BMs. If these young sailors are impressed with the type of leadership displayed by their BMs, they may be influenced to work hard while in the Navy and to reenlist when their time is up. Even if they leave, they probably will speak well of their life in the Navy, thereby inspiring others to enlist. An early example of poor leadership, on the other hand, could drive many out of the Navy and cause them to criticize the Navy for the rest of their lives.

When you attain the grade of third class in most Navy ratings, your duties do not change significantly, nor are your responsibilities greatly increased. You stand the same watches; you continue with the same job with only minor added responsibilities. When you are advanced to Boatswain's Mate third class (BM), on the other hand, you experience a distinct change. You literally step out of the ranks of the workers and join those of the bosses. You may have to take charge of fairly large groups of personnel engaged in rather dangerous work. You become responsible not only for completing the task assigned but also for the safety and welfare of the personnel working for you.

To function properly in such a capacity—particularly when involved in dangerous seamanship evolutions—the BM must step back, observe, and direct. If the BM tries to do all the work, two or three of the less experienced personnel, not knowing what to do, may cease working, thus reducing the effectiveness of the crew. Additionally, the BM may not notice a dangerous situation developing, and as a result, someone may be hurt.

We do not mean to imply that as a BM you must never do physical labor— far from it. There are times when you must grasp the line and heave with the rest. There are other times, such as when instructing personnel, that you may work harder than they. The point we emphasize here is that, as a person advanced to BM, you must begin to regard yourself as a leader, not a worker. You are now responsible for the overall job, not just one small segment. More important, you are responsible for the output, safety, and well-being of the crew working for you. Sooner or later you will be given the task of section leader, wherein you must make watch as well as duty assignments. In this role and in the role of boatswain's mate of watch (BMOW), you begin to function as an assistant to the officer of the deck (OOD) as well as being an assistant to your division officer. You must learn to operate efficiently for several different officers and anticipate their needs. Thus the BM's role is a greatly expanded one, and to be most effective, you must regard yourself as a leader and supervisor and learn to use personnel and other resources as efficiently as possible.

INDOCTRINATION

Many of the personnel coming aboard are stepping onto a ship's deck for the first time in their lives.

Deck petty officers, especially section leaders, are responsible for the indoctrination of new crew members. Not only must they explain all of their duties in detail, but they must act as guides, showing new personnel their stations in every watch, and telling them when and how they are supposed to get to their station, They must also point out the location of their berths and lockers and where to go for meals and quarters. In other words, everything must be explained in detail to the new crew members. To show these sailors a watch bill and just read off all their stations and then criticize them when they don't show up at their stations is poor leadership.

A sailor fresh from a training station who is assigned the duty of bringing a grapnel to rescue and assistance drill may not even know what a grapnel is, let alone where to find it or what to do with it when it is brought to the scene. You must be sure that all the personnel know where to pick up and how to operate or use any equipment they are required to provide in any of the ship's emergency bills.

New personnel must be instructed in the proper performance of their duties in all the watches and drills, and all the personnel must be thoroughly briefed about where they fit into each phase of shipboard routine. As a deck PO, you can indoctrinate these sailors in the shortest possible time. Don't be impatient and become angry when you have to tell someone the same thing several times before it is understood. Look back on the days when you were inexperienced, and remember that new crew members have a great deal to learn.

SECTION RECORDS

As a section leader, you must maintain certain records. Some of these records are described in the remainder of this topic. Use your own initiative, however, in keeping other records and reports that are useful to you.

Muster Roll

Section leaders maintain accurate muster rolls for their sections. Primarily, this is to account for all the personnel assigned to their section. Mustering a section at quarters is a good example of one use of a muster roll. Division leading POs have a muster list of the entire division by sections.

Bunk and Locker Assignments

Information about bunk and locker assignments is entered in the watch, quarter, and station bill. The section leader should duplicate this information in a notebook. The notes serve a useful purpose during daily inspections. The identity of a sailor responsible for an unmade bunk or improperly stowed locker is readily apparent.

Equipage

Section leaders maintain an account of all the equipage, such as life jackets, foul weather clothing, and the like, issued to personnel in their sections. This account is both for purposes of inventory (accountability) and for determining the serviceability of all the items and their need for replacement.

Watch and Duty List

Each PO maintains a list of personnel assigned to his or her watch (at sea, in port, lifeboat crew, security, etc.). This list is used for mustering personnel and quickly designating a substitute for any person not available for a watch because of leave, sickness, and so on.

Inspections

Dates and results of all the inspections (personnel, material, lower deck, locker, seabag) are entered in the section leader's notebook. This information is valuable in enabling section leaders to eliminate defects noted in their organizations.

SUPERVISING THE WORK OF OTHERS

LEARNING OBJECTIVES: Describe nine skills the Boatswain's Mate should possess to be a successful section supervisor. Describe three considerations for planning work on an unfamiliar job. Explain why a Boatswain's Mate, appointed to a responsible position, should feel confident. Discuss the importance of critiquing a fouled-up evolution immediately after an operation. Explain the difference between a command and an order.

As a Boatswain's Mate, you are required by the very nature of your work to be a supervisor, not merely a skilled worker. You must learn to analyze a job, assign personnel to perform the various tasks included, and then show them how to do the work, if necessary. You have to advise them on working safely, observe them at work, inspect their work, and then make oral and written progress and final reports. You must also learn how to obtain and care for the tools and supplies you need.

PLANNING THE WORK

Ordinarily, as a new BM, you are assigned jobs that you and your personnel know well; you merely have to see that the jobs are completed satisfactorily and report that fact to your division PO or CPO. Your planning responsibilities require little more than finding out which jobs are to be done and assigning personnel to do them. As you gain experience, however, the work assigned will become more complex and less familiar, and you will be required to exercise more initiative to accomplish it.

In the absence of detailed instructions on an unfamiliar job, the first thing you must do is to analyze the job. To do this, determine your objective; that is, find out exactly what you are to do. With your objective clearly in mind, consider the step-by-step procedure for completing the job. Once the job is broken down into components, consider whether you have the personnel with the required skills, the tools, and the supplies necessary. If not, take steps to obtain them. Your division PO and division officer may have to advise you on this and other steps. When you are assured that you have or will have the personnel and equipment, concentrate on planning the actual work.

In the planning phase, you must, as supervisor, keep the objective firmly in mind while considering all the aspects of the job—which tasks must be done first, which tasks can be done at the same time, which tasks must be completed before another is started, when key personnel and certain tools and materials must be available, and how scheduled operations will interfere with the work. Write down each task and every item pertaining to it, and consider each task in the context of the whole job. As part of the planning, select the personnel for the various tasks. Once the planning is completed, notify the personnel of their assignments and provide instructions. Then the work can start.

TAKING CHARGE

When you are given responsibility, it is because your superiors feel that you are capable of doing the job. At first you may not share their confidence, and you may dislike having to give orders to personnel with whom you have worked. For these reasons you may hesitate to take charge. Quit worrying about how the personnel feel about you. Your friends should be happy that you have advanced to the rank of petty officer and wish you well. Those who do not wish you well probably are few, and you can probably gain their respect if you conduct yourself with dignity and treat them fairly. Your self-confidence will grow with your knowledge and experience.

Remember that you will be given credit or blame for the outcome of any job assigned to you. If you want credit, rather than blame, trust yourself, take charge, and carry through. You will make mistakes, but you should learn from them—not worry about them. Additionally, do not be afraid to make a decision for fear of making a mistake. Take into account everything related to the question, make your decision, and then act on it.

You should not hover over your personnel but should check them at irregular intervals while the work is progressing. Also, keep yourself available in case you are needed.

Progress reports are required on some jobs. Such reports may be made daily, at some given interval, or upon the completion of the tasks. Before reporting a job as finished, you must check every item of the task to make certain that the work was satisfactorily completed.

This is not intended to be a section on leadership, but the following paragraphs contain a few tips on supervising seamanship work.

Before commencing a seamanship evolution, such as towing or fueling, review tech manuals and pubs on the evolution. Instruct your personnel and make certain that each knows what is to be done and how to do it. Nothing can foul up an operation quicker than a person who does not know his or her job. Review all the safety precautions pertaining to the evolution, and make sure they are understood. Using a checkoff list and such plans and diagrams as are available, see that all the gear is on hand and properly rigged, and a safety brief is given. Report to the proper authority when you are ready to begin. While waiting to commence operations, do not excuse any personnel without permission.

During an evolution, you must be on the spot, alert, and fully aware of what is going on. At such times, only one person should give orders, lest contradictory orders ensue and confusion and danger result. Everyone should be permitted to warn of immediate danger, but developing danger should be brought to the attention of the supervisor giving orders.

Do not let anyone clown around, skylark, or otherwise distract personnel from their jobs. During a dangerous operation is no time for comedians to go into action; save the humor for breaking the tension at the end of the job.

If something goes wrong during an evolution, a critique (cri-teek') should be held immediately after the operation, while the events are vivid in everyone's mind. That is, the evolution should be reviewed to determine the cause of the foul-up. If a piece of equipment failed, was it in poor condition or of the wrong design or too weak for the job? In the past, had the equipment been repeatedly subjected to strains beyond its safe working load? If it was personnel who failed, did they do so because they did not understand what they were to do? If they did not understand, had they been properly instructed? Were they goofing off or sleeping on the job? Were they physically incapable of doing the job?

Once the cause of the foul-up is determined, steps must be taken to prevent its recurrence. If a piece of equipment fails, steps should be taken to repair the faulty item, to replace it with one of similar capability, or to replace it with a stronger one. Never replace any item with a stronger or weaker one without proper authorization, however, because the rig design may call for that particular piece to fail, rather than a more expensive or more vital part, when the rig is overtaxed. If a person failed, you may decide that proper instruction will take care of the fault or you may find it necessary to replace the person. In some cases, you may determine that the task requires two or more persons. If your personnel fail repeatedly despite the fact that they are trying to do as they are told, it may be that you are at fault. Perhaps you do not know how to give an order properly.

GIVING ORDERS

A command has two parts—a preparatory command and a command of execution. An order has as many as five parts—who, what, when, how, and why. Although all the parts are not required at all times, mentally review the five parts every time you give an order to make certain that you do not leave out a vital part. *Who* may be left out if there can be no doubt as to whom the order is addressed. *What* is essential, and it must be in every order. *How* can be omitted if you know that the person can do the job. *When* can be overlooked if the time to do the job is unimportant or if the time is implied in the order; for example, "Swab the deck in deck berthing." Although the word *now* is not in the order, the intent clearly is there, and there should be no doubt as to when the task must be done. When there is time to explain, *why* should be included if the person may not understand the importance of the job or the reason it must be done in a particular way. If personnel know why, they are more likely to give the task the attention it deserves. Then, too, if *why* usually is included, a person is more willing to respond without hesitation when there is no time to explain.

Regardless of the circumstances, give an order in a calm, clear, matter-of-fact voice, loud enough to be heard but not loud enough to be irritating. Make sure that the person receiving the order clearly understands each part. If you doubt that the person understands, ask the person to repeat or explain any or all the parts.

SAFETY

LEARNING OBJECTIVES: Describe safety precautions that should be taken when crew members are working aloft or over the side, both in port and under way.

Responsibility and safety is everyone's job. You, as a PO, not only have the responsibility of your own safety, but you have to always be on the alert for dangers that may affect your work details. The safety precautions are located in OPNAVINST 5100 (SERIES).

WORKING ALOFT AND OVER THE SIDE

Among the dangerous work that Seamen are required to do is working aloft and over the side, and sooner or later every BM will have to supervise Seamen engaged in such work. In the past, personnel have been injured while working aloft or over the side; therefore, the OOD must be satisfied that all reasonable precautions for personnel safety have been taken before anyone is permitted to leave the deck. The OOD directs the communication watch officer to secure the proper radio transmitters, the radar supervisor to secure the radar antennas in the vicinity of the work, and the engineer watch officer to take precautions to prevent boiler safety valves from lifting. The OOD also requires that the person in charge of the work ensures that all the personnel are properly instructed and that they are wearing the necessary safety equipment.

SAFETY EQUIPMENT

Personnel working outside the lifelines in port must wear inherently buoyant vest type of life jackets and safety harnesses, DYNA-BRAKE and lines. Personnel working aloft must wear safety harnesses with dynabrake assemblies.

Two types of safety lines are used. One is a 6-foot-11/2-inch nylon line with a steel snap hook at either end. The other is a 50-foot-1 1/2-inch nylon line. Before personnel begin to work, their safety lines must be secured above them to a solid part of the ship, or it may lead up over a solid object and be secured below. A safety line should never be secured to the boatswain's chair, gantline, stage, or stage line; nor should it be secured to the rungs of a ladder or a lifeline. Never lower or hoist a safety line and gantline (stage line) at the same time. Keep one secured while moving the other.

Personnel working outside the lifelines at sea must wear inherently buoyant vest type of life jackets and safety harnesses and lines. The safety lines must be properly tended on deck. Ordinarily a safety line is not secured, but a round turn should be taken with it around a solid object, such as a bitt, chock, or cleat, and the free end held by a responsible person. Do NOT secure safety lines to the lifelines. Under way you must have the commanding officer's permission to go aloft and to work over the side at anytime.

NEVER LEAVE PERSONNEL UNATTENDED WHILE THEY ARE WORKING ALOFT OR OVER THE SIDE.

Burning, welding, and blowtorch operations are not permitted on a stage or boatswain's chair unless the bridles, stage lines, and gantlines are of steel wire.

BOATSWAIN'S PIPE

LEARNING OBJECTIVES: Match various pipe calls with their scores. Identify phraseology used for passing the word over the general announcing system.

The boatswain's pipe (originally termed a *call*) dates back to the days of sail. It had definite practical uses in those days, many of which have now ceased to exist. Men high on the royal and top gallant yards could hear the pipe under weather conditions that would cause the human voice to be inaudible or unintelligible. Although the days of sail are gone, the boatswain's pipe is still very much a part of the Navy.

Since the pipe or call is a device distinctive to the sea and particularly to the Boatswain's Mate rating, all the Boatswain's Mates should take special pride in knowing how to use it correctly and effectively. The use of the call implies the right to pass and to issue orders, and thus it continues a symbol of authority.

In learning to use the boatswain's pipe, you should have the benefit of instruction by an experienced BM. The following paragraphs contain specific information on the use of the pipe, but you will be able to understand and follow the information more quickly with the help of an instructor.

USING THE BOATSWAIN'S PIPE

One of your first military duties as a BM will be BMOW. Your watch duties are explained later in this chapter, but before you can carry them out properly, you must know the various calls on the boatswain's pipe and the standard Navy phraseology.

Tuning

Figure 1-1 shows the boatswain's pipe and the name of its parts. Whether you use a Navy-issue or a commercial pipe, the first thing you have to do is tune it. Pipes are stamped out when manufactured; therefore, both the hole and the pee are often misshapen. Most pipes are too open at the pee and have to be flattened and soldered at the sides of the pee to fill the space between the pee and the bowl; otherwise, a hissing sound of escaping air will interfere with the clearness of the call.

Some pipes are improved by filing the wind edge, which is the edge of the bowl farthest from the pee. The hole should be filed down until the blast of air from the pee is split exactly by the sharp edge of the bowl. A test of this can be made by pushing a broom straw through the reed. The edge of the hole should split the straw. At times it is necessary to flatten the part of the reed projecting over the bowl to accomplish this. Once tuned, the pipe should sound when held with its mouth to a gentle breeze.

Hand Positions

The four correct positions of the hand for using the boatswain's pipe are open, curved, closed, and clinched. They are shown in figure 1-2. The lung force or blowing pressure varies with each position. As a rule the open hand requires the least pressure for a clear note, and the clinched position demands the greatest pressure in making the note shrill and clear. Low notes are made with the open hand position; high notes, with the clinched position.

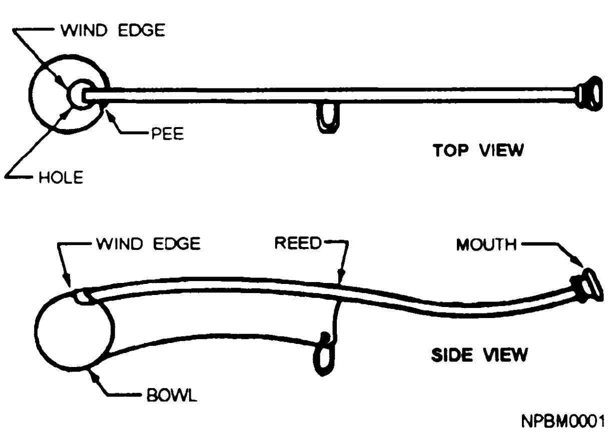


Figure 1-1.—Boatswain's pipe and its parts.

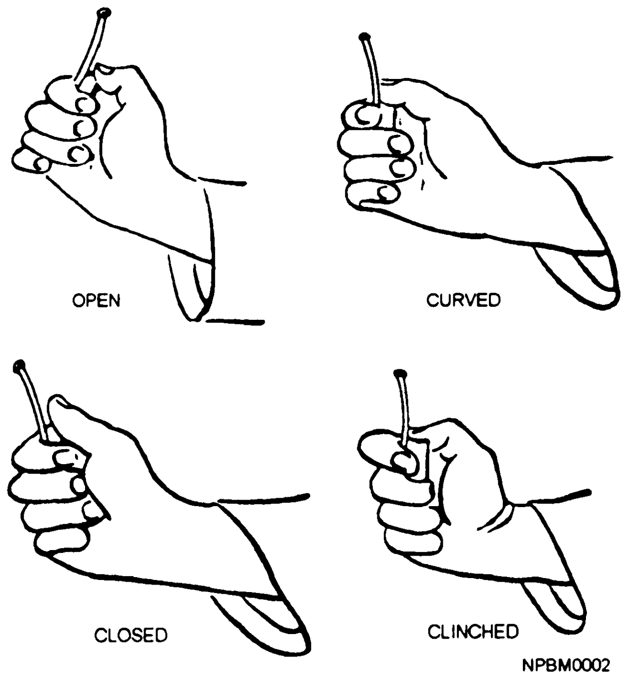


Figure 1-2.—Hand positions.

Scores

The various calls are written out somewhat like musical scores, with the four hand positions indicated in the four horizontal spaces. An explanation of the score follows:

1. A straight line indicates a SMOOTH note.
2. A dotted line means a RATTLED note.
3. A broken line stands for an UNDULATING note.
4. Full arrowheads along a line indicate FULL-BREATH PULSATION.
5. Half arrowheads along a line denote GENTLE-BREATH PULSATION.
6. An arrow on the end of a line signifies that you END SHARP.
7. No arrow on the end of the line means that you allow the note to DIE AWAY.

Intervals, or rests, are marked with a vertical line and the number of seconds noted above the line.

The number of seconds each pipe should be given under normal conditions is marked above the bar, but circumstances sometimes require that a signal be shortened.

Smooth notes are made as an ordinary whistle is blown and are raised or lowered by the lung force exerted.

Rattled notes are sounded by ballarding the tip of the tongue against the roof of the mouth, imitating a whistle rattled by a pee.

Undulating notes are made by a combination of the tongue slowly vibrating while the throat pulsates the lung pressure, causing the sound to undulate smoothly at equal intervals.

Calls

Calls are derived from using individual scores or combinations of scores. To be efficient with the pipe, a person needs to practice the scores, using the hand positions and various combinations of scores.

CALL MATES.—Before the days of public address (PA) systems aboard ships, every word passed was by word of mouth. The word was given to the Boatswain or BMOW, who sounded "Call mates" to assemble his mates. As they drew near from different parts of the ship, they answered repeatedly with the same call. After receiving the word, they dispersed to pass the word at every hatch.

The call is shown in figure 1-3. Start the call in a clinched position and sound as "peep-peep-peep," short and shrill, with a pause of less than 1 second after the first two peeps.

WORDS TO BE PASSED.—This call usually is the prelude to any word passed aboard ship. Its purpose is to command the attention of all hands to the announcement about to be made.

Commence the call in a closed position and clinch within 1 second. Impulse the shrill call about three times and end sharp. See figure 1-4.

ALL HANDS.—All hands is piped as a general call to any event in which all hands are to participate (battle stations, for example).

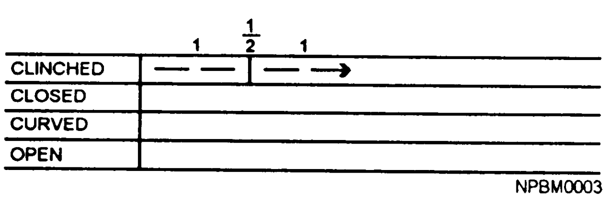


Figure 1-3.—Call mates.

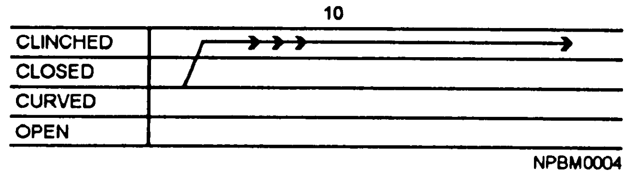


Figure 1-4.—Passing the word.

Close to the clinched position and impulse softly about three times, holding the shrill for 10 seconds, ending sharp; again close to the clinched (softly) and hold the second shrill for 10 seconds and allow it to fall softly to a finish in 3 seconds. This call is seen in figure 1-5.

BOAT CALL.—Boat call is piped to call away a boat and also to pipe a division to quarters. The entire call is lengthened in proportion to the seniority of the boat called. In other words, the call is longer for the gig than for the motor whaleboat. After you pipe the call, pass the word "Away the gig (barge). Away!" For other boats, omit the last "Away!" When piping a division to quarters, after the call, pass the word "All the (number) division to quarters!" See figure 1-6.

Start the call in the open position, close to the clinched, hold the shrill for 5 seconds; then open and close again to the clinch and hold the second shrill for another 5 seconds; then open again and let the signal end softly, allowing about 3 seconds for the fall to silence.

HEAVE AROUND.—This call piped twice means "Heave around on the capstan or winch." Piped once, it means Mess Gear. The overall duration is the same for both. (It also is part of the pipe for Mess Call.)

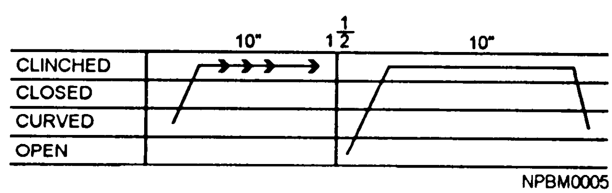


Figure 1-5.—All hands.

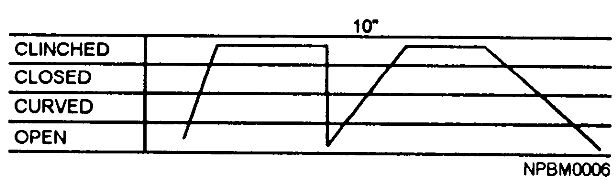


Figure 1-6.—Boat call.

Call in the curved position and blow very softly with an undulating sound by pulsating the breath with the throat, allowing the tongue to undulate slowly. Shift to the clinched position, increasing the rapidity of the undulations; then allow the sound to fall back to the soft, low tones of the start. See figure 1-7.

SWEEPERS.—This call, as shown in figure 1-8, pipes all sweepers to man their brooms and clean out all butt kits.

Commence as in "Heave around" and close sharply to a short shrill. Repeat this three times and finish with four or five sharp peeps from the closed position to the clinched in rapid succession. Repeat the call from its commencement; however, instead of finishing with sharp peeps, make the sound more like an impulsed shrill, as though slurring the peeps.

VEER.—This call is piped to "Ease away," "Walk back," or "Slack away." A slurred veer calls side boys to '"Tend the side": one veer, two side boys; two veers, four side boys; three veers, six side boys; four veers, eight side boys.

Call in the curved position and blow to imitate the sound of a whistle rattled by a pee. This rattling sound is produced by ballarding the tip of the tongue against the roof of the mouth. The rapidity of the ballarding is in proportion to the pitch of the sound, rising to the maximum in the shrill rattle.

For walking back the falls, this pipe is sounded continuously during the walk back or the lowering from a belay. The speed of the lowering is in proportion to the undulations of the pipe or the rapidity of its rising and falling in sound caused by changing from curved or open to clinched. Sometimes this is accentuated by impulsing with the throat; short peeps mean to lower handsomely for a short distance. The call is shown in figure 1-9.

STAND BY.—This call is piped for "Stand by" and "Set taut."

Commence the call with the hand in the curved position and instantly change to the clinch, causing a rising peep, and follow it with a slurred peep—short and ending sharp. This is shown in figure 1-10.

HOIST AWAY.—Hoist away is piped after "Set taut" to start a power hoist or a "Walk away" with boat falls or tackles.

The pipe is the same as "Passing the word" except that the shrill is not impulsed, and it is softened by changing the position from clinched to curved; also, the lung pressure is lessened so as to finish low and soft instead of sharp. The length of this pipe is about 10 seconds for a signal to make a long walk away in hoisting. See figure 1-11.

HAUL.—Haul is the pipe equivalent of "Ho! heave! ho! heave!" by voice when the gang is heaving together on a line instead of walking away with it. The low note means "Get another purchase," and the high note means "Heave!"

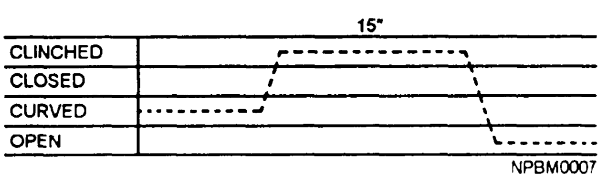


Figure 1-7.—Heave around.

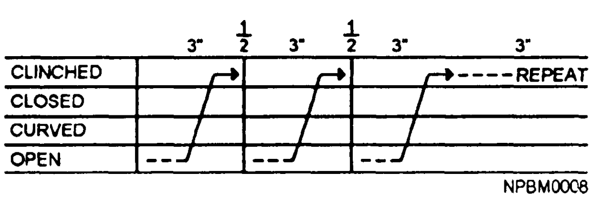


Figure 1-8.—Sweepers.

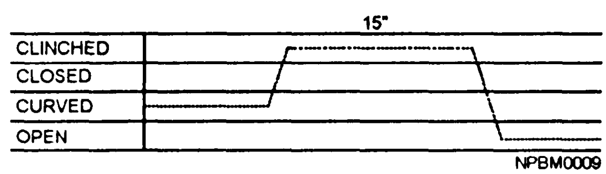


Figure 1-9.—Veer.

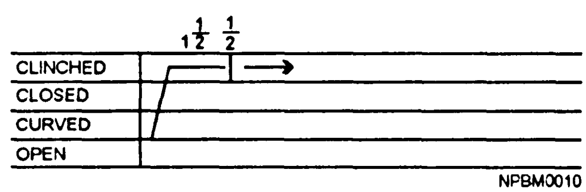


Figure 1-10.—Stand by.

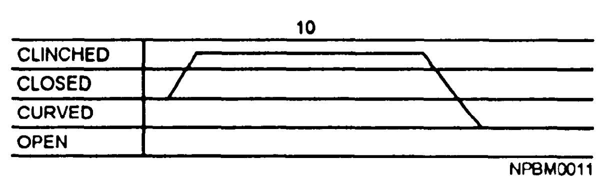


Figure 1-11.—Hoist away.

Commence with the hand in the closed position and change to the clinched; sound about an equal length of time in each position and finish with a sharp shrill. Normal time is about 3 seconds, as shown in figure 1-12.

BELAY.—This call is piped to avast hauling and make fast and to annul an order just piped. See figure 1-13.

Call open, then close sharply to the clinched position and impulse with the tongue to the roof of the mouth about six times while holding the first shrill about 5 seconds, then change to the curved and impulse softly with the breath and tongue to cause a smooth, undulating sound for about the same interval as the impulsed shrill, then clinch sharply and finish with three shrill, slurred peeps in rapid succession.

PIPE DOWN.—The call "Pipe down" consists of "Passing the word" and a long (10-second) "Veer," ending in a short, sharp peep in the clinched position. It is piped as "Secure" from any all-hands function. Also, it is piped immediately after the bugle call "Tattoo," just before word is passed to "Turn in. Keep silence about the decks."

MESS CALL.—Mess call is the longest of the calls; it should cover no less than 1 minute. It consists of "All hands," a long "Heave around," and a long 'Pipe down," in that order.

PIPING THE SIDE.—This is the aristocrat of all the calls on the boatswain's pipe. It consists of the call shown on the score in figure 1-14 piped twice. The call for "Alongside" is sounded so as to finish just as the visitor's boat or vehicle makes the gangway. During this pipe the side boys and BM stand at attention, but do not salute.

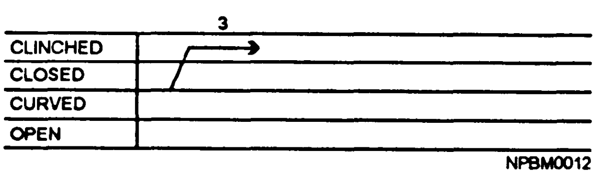


Figure 1-12.—Haul.

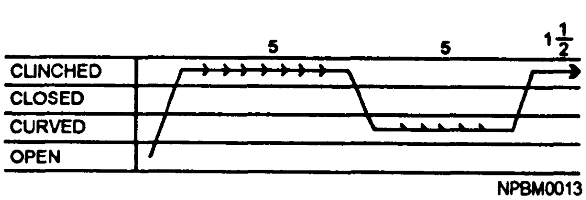


Figure 1-13.—Belay.

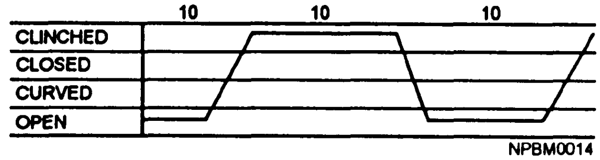


Figure 1-14.—Piping the side.

The call for "Over the side" starts just as the visitor's head appears at quarterdeck level. The side boys and BM salute on the first note and drop from salute on the last one. See figure 1-15.

Fill the lungs, commence with the lowest smooth note and rise to the shrill, then fall to the low note again and finish with a low, soft shrill. Rising to the shrill should be about equal to the time of holding the shrill; the time of falling from the shrill should be about one-third less than that of rising.

Saluting procedure is reversed when a visitor is leaving. "Over the side" is piped as the visitor passes the BM on the way to the gangway, and the side boys and BM salute on the first note. They drop from salute on the last note and remain at attention while "Alongside" is sounded. The last call begins as the visitor's boat or vehicle departs.

Inhale deeply before you start piping the side, because etiquette requires that it be drawn out as long

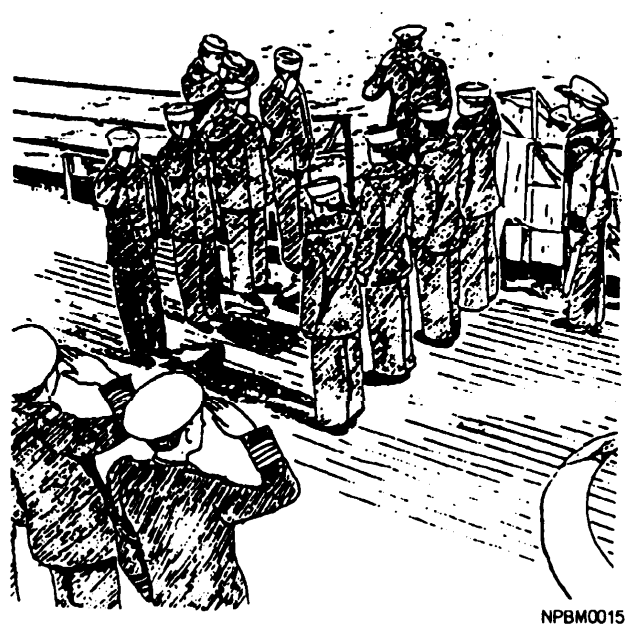


Figure 1-15.—Over the side.

as possible. The more side boys the visitor rates, the longer the notes should be sustained.

STANDARD PHRASEOLOGY

You must use the customary phraseology of the service when passing the word as BMOW through the ship's general announcing system. Pages from the shipboard standard organization and regulations listing the watch routine are generally available somewhere near the watch station. Any word listed that is enclosed in quotation marks must be passed exactly as written. Here are some examples selected from a typical list:

EVENT	WORD TO BE PASSED
AIR BEDDING	"ALL DIVISIONS AIR BEDDING."
ARRIVALS AND DEPARTURES	Title of officer, preceded by proper number of boat gongs.
BOATS	"AWAY THE MOTOR WHALEBOAT (GIG) (BARGE), AWAY!"
"CHURCH CALL"	"DIVINE SERVICES ARE NOW BEING HELD (LOCATION). MAINTAIN QUIET ABOUT THE DECKS DURING DIVINE SERVICES."
COLLISION	"COLLISION. COLLISION, PORT SIDE, FRAME TWENTY" (or other location).
EIGHT O'CLOCK REPORTS	(In port) "ON DECK ALL EIGHT O'CLOCK REPORTS" (never the twenty hundred reports). (At sea) "LAY BEFORE THE MAST ALL EIGHT O'CLOCK REPORTS."
EXTRA DUTY PERSONNEL	"LAY BELOW TO THE MASTER-AT-ARMS OFFICE (or other designated area) ALL EXTRA DUTY PERSONNEL." This word is also used for restricted personnel.
FIRE	"FIRE, FIRE, FIRE, THERE IS A CLASS A (B, C, D) FIRE IN COMPARTMENT 2-205-7A (GIVE NOUN NAME OF SPACE IF KNOWN). AWAY THE NUCLEUS FIRE PARTY (OR IN-PORT FIRE PARTY)."
FLIGHT QUARTERS	"FLIGHT QUARTERS. FLIGHT QUARTERS, MAN ALL FLIGHT QUARTERS STATIONS TO LAUNCH (RECOVER) AIRCRAFT (HELICOPTERS)."
GENERAL QUARTERS	"GENERAL QUARTERS. GENERAL QUARTERS, ALL HANDS MAN BATTLE STATIONS."

EVENT	WORD TO BE PASSED
HOIST IN BOATS	"FIRST DIVISION, STAND BY TO HOIST IN (OUT) NUMBER ____ MOTOR LAUNCH (GIG)."
INSPECTION (material)	"STAND BY ALL LOWER DECK AND TOPSIDES SPACES FOR INSPECTION."
INSPECTION (personnel)	"ALL HANDS TO QUARTERS FOR CAPTAIN'S PERSONNEL INSPECTION."
KNOCK OFF WORK	"KNOCK OFF SHIP'S WORK." (First, pipe "ALL HANDS.")
LATE BUNKS	"UP ALL LATE BUNKS."
LIBERTY	"LIBERTY COMMENCES FOR SECTIONS ONE AND THREE, TO EXPIRE ON BOARD AT (HOUR, DATE, MONTH, YEAR)."
MAIL	"MAIL CALL"
MEALS	"BREAKFAST (DINNER OR SUPPER) FOR THE CREW."
MESS GEAR	"MESS GEAR. CLEAR THE MESS DECKS TILL PIPE DOWN." EARLY (BREAKFAST, DINNER, OR SUPPER) FOR MESSMEN, COOKS, AND WATCH RELIEFS.
MISTAKE OR ERROR	"BELAY MY LAST."
MUSTER ON STATIONS	"ALL DIVISIONS MUSTER ON STATIONS." (Indicate fair or foul weather parade.)
PAY	"PAY DAY WILL BE HELD IN ACCORDANCE WITH THE PLAN OF THE DAY."
PREPARATIONS FOR GETTING UNDER WAY	"MAKE ALL PREPARATIONS FOR GETTING UNDER WAY."
QUARTERS FOR MUSTER	"ALL HANDS TO QUARTERS FOR MUSTER, INSPECTION, AND INSTRUCTION."
REVEILLE	"REVEILLE, REVEILLE, ALL HANDS HEAVE OUT AND TRICE UP. THE SMOKING LAMP IS LIGHTED (IN ALL AUTHORIZED SPACES) (OUT IN SPECIFIC AREAS)."
SMOKING LAMP	"THE SMOKING LAMP IS OUT THROUGHOUT THE SHIP (OR BETWEEN CERTAIN FRAMES) WHILE TAKING ON FUEL (HANDLING AMMUNITION)." "THE SMOKING LAMP IS LIGHTED IN ALL AUTHORIZED SPACES."

EVENT	WORD TO BE PASSED
SWEEPERS	"SWEEPERS MAN YOUR BROOMS. MAKE A CLEAN SWEEP DOWN FORE AND AFT. SWEEP DOWN ALL DECKS, LADDERS, AND PASSAGEWAYS. THROW ALL SINKABLE TRASH CLEAR OF THE FANTAIL (OR DEPOSIT ALL TRASH AND GARBAGE IN THE RECEPTACLES PROVIDED FOR ON THE PIER)."

One thing to remember in terminology is that a person *lays to* a place and *musters with* a person. For instance, the names of enlisted personnel should be passed as rate, initials, last name: "Seaman J.A. Doe, lay up to the boatswain's locker" or "Seaman J.A. Doe, muster with the duty master-at-arms on the quarterdeck." In passing the word for officers, follow the procedures used in your ship. Some ships discourage passing the word for officers except when they cannot be located by other means.

If you have any doubt about how an announcement should be worded, ask the OOD. Pass any special word exactly as received. Any long announcement should be written down and read off; otherwise, you may forget part of the text.

BOATSWAIN'S MATE OF THE WATCH

LEARNING OBJECTIVES: Describe a Boatswain's Mate of the watch duties at sea and in port. Detail the similarities and differences in each watch station.

The BMOW is the petty officer (PO) in charge of the watch—the most important enlisted assistant to the OOD. The status of the BMOW in this respect is the same whether the ship is in condition of readiness I, II, or III or whether the regular sea watch or the in-port watch has been set.

AT SEA

The normal peace time deck sea watch for which the BMOW is responsible consists of the helmsman, lee helmsman, OOD messenger, lookouts, lifebuoy watch, and lifeboat crew of the watch. Besides being the principal enlisted assistant and executive arm of the OOD, the BMOW must ensure that all deck watch stations are manned and that all personnel in the previous watch are relieved. The BMOW makes a report to the OOD when the deck watch has been relieved.

The *Ship's Organization and Regulations Manual* shows the sea watch stations that must be manned and the divisions required to man them. From this information, the BMOW knows which division section leader must be contacted if any person fails to report at his or her watch station.

The BMOW must know where all personnel in the deck watch sleep, so as to be able to call them anytime, day or night.

On some ships, lookouts and helmsmen stand 2-hour watches and must be relieved in the middle of the watch. The BMOW must either personally call reliefs for these individuals or direct the messenger to call them, making sure that the wheel and lookouts are relieved at the proper time.

On ships that do not have a duty master-at-arms (MA), the BMOW often assumes the duties of the MA, such as mustering restricted personnel and assigning extra military duties.

While it is the duty of the section leader and the division PO to instruct the personnel they send on watch, the BMOW must never assume that every person standing watch has been properly instructed and trained. The BMOW must also ask the OOD for any special instructions for the watch and pass them along to the proper personnel.

A BM is required to be a qualified helmsman and should make use of every opportunity to train personnel to stand watches as helmsmen.

The BMOW should make it a habit to observe all details about the ship within view. The BMOW should correct all unseamanlike practices, such as Irish pennants, without reference to the OOD. The BMOW never leaves the station without the permission of the OOD.

Piping the Routine

The ship's typical daily routine is posted somewhere near the watch station, and from it, the BM learns what calls should be piped and when to pipe them. The routine may be modified by orders in the Plan of the Day or by standing or special orders. Since such orders may not have been entered into the printed daily routine, the BMOW must check with the OOD to make sure the standing orders are up-to-date.

Frequently, the OOD is preoccupied with the ship to the point where orders for carrying out various phases of the ship's routine may not be given. It is up to the

BMOW to remind the OOD of announcements to be made.

Always obtain permission from the OOD before passing any word. The OOD may grant you blanket permission at the start of each watch to pass all words relating to the ship's routine, but never presume this to be true.

Some ships require that you use "Now hear this" or "Now" as a preface to the word to be passed over the PA system. This preface prepares the listeners for an announcement but is not essential if you pipe "Passing the word" to command attention. The standard procedure for your ship should be followed.

A word of caution about using the PA system: When you pass the word, keep your pipe about 12 inches away from the microphone to avoid damaging the circuit. Make sure only the desired circuits are cut in. There is no need, for instance, to pipe "Sweepers" over the officers' circuit. Make it a habit to check your circuits to eliminate unnecessary noise and annoyance.

Coxswain of the Lifeboat

Another of your duties at sea may be as coxswain of the lifeboat, and a few words now may save you some trouble later.

Before you relieve the watch, muster your crew, check the falls to make sure they are free for running, inspect the boat to ensure that all the necessary equipment is in the boat, and have the engineer test the engine. If everything is to your satisfaction, you may relieve the watch and report to the BMOW that the lifeboat crew has been mustered and the lifeboat is ready. The *Ship's Organization and Regulations Manual* has detailed instructions for the lifeboat crew, and you should be thoroughly familiar with these instructions.

Occasionally, an inexperienced person might be detailed as a member of your lifeboat crew. If this happens to you, report the incident to the BMOW immediately so that the person may be replaced.

Inspections

The BMOW under way conducts certain inspections during the watch. These inspections are made at irregular intervals as directed by the OOD. Their purpose is to ensure that personnel of the watch are stationed properly and that they are alert and cognizant of their duties.

Stations and personnel inspected normally include the lifeboat, lifeboat crew, lifebuoy watch, lookouts, brig, and brig sentry (if applicable). If any discrepancies are noted, the BMOW corrects them immediately. The BMOW makes a report to the OOD upon completion of the inspection and informs the OOD of any corrective action.

IN PORT

When the ship comes to anchor or moor or goes alongside a pier or another ship, the OOD shifts the watch from the bridge to the quarterdeck. Naturally, the BMOW goes with the OOD and takes charge of stationing the in-port watch.

The watch normally includes the BMOW, messenger, side boys, sentries, duty boatcrew, and from about 2100 to turn-to, the anchor watch (as applicable). The duties of the BMOW with regard to mustering the watch and calling reliefs are the same as they are at sea. The BMOW also pipes the daily routine in port according to the same method as at sea (as applicable).

The OOD may direct the BMOW to take charge of jobs about the decks that are necessary for carrying out the ship's routine and cannot be assigned to other BMs. However, it is desirable that supervision of tasks away from the quarterdeck be turned over to other POs.

Another duty is to organize working parties. When the word is passed for personnel to muster with a working party, the BM should follow up the order, muster the party, and report to the OOD when the party is ready. If the party is not ready, the reason for any delay should also be reported. The BM should make sure that personnel are sent to unload the ship's boats if they have returned with small freight.

The BMOW sees that the quarterdeck is kept neat, that personnel not at work do not congregate on the quarterdeck, and that boats coming alongside receive boat lines. The BMOW should inspect the side frequently to ensure that the side is clear of hanging lines. In general, the BMOW assists the OOD in every way possible and never leaves the quarterdeck without the OOD's permission.

Boats

The BMOW in port is in general charge of the crews of any of the ship's boats in the water. Frequently, the BMOW should inspect the moorings of all the boats alongside and at the booms, see that boat keepers are sent to the boats if bad weather makes it necessary, and ensure that the boats are provided with proper chafing gear. The BMOW should see that boat keepers in boats at the booms keep themselves alert and that all personnel in boats observe proper boat etiquette. If a boat is called away but fails to make the gangway within a reasonable time, the BMOW must investigate and correct the cause of the delay.

Side Boys

The BMOW in port is responsible for the side boys. The BMOW inspects them for personal appearance and proper uniform, instructs them in their duties, drills them repeatedly until they can tend the side smartly, and sees to it that they remain clear of, but adjacent to, the quarterdeck when not rendering side honors.

Messenger, Sentries

The BMOW also inspects the messenger and sentries before they go on watch and ascertains that they are clean, neat, and military in appearance. It is the duty of the BMOW to see that the messenger keeps the quarterdeck clean and the brightwork shined. Side boys lend a hand here if necessary.

OTHER DUTIES

Duties that you will be required to perform from time to time are master-at-arms, police petty officer, petty officer of the watch, section leader, and shore patrolman. The duties of a boat coxswain are described in chapter 6, respectively, of this manual.

RECORDS AND REPORTS

LEARNING OBJECTIVE: Explain how to fill out the ship's deck log sheet and other reports. State procedures for making changes to logs and reports.

No attempt will be made to describe all of the records and reports that need to be kept or made. A few of the important ones will be explained in this topic.

SHIP'S DECK LOG

The ship's deck log contains a complete chronological record of the ship's history, from the time of commissioning to the day the commission pennant comes down and the ship's active career terminates. It presents a complete, accurate narrative of noteworthy incidents in the life of the ship and of events affecting the officers, crew, and passengers.

Besides its historical importance, the log has legal standing: It may be required as evidence in naval, admiralty, or civil courts. When, as frequently happens, witnesses to an incident involving a ship, its crew, or passengers are dead or widely dispersed, the log may be the only available evidence upon which important legal decisions may be rendered. For this reason entries must be clear, concise, and accurate.

Responsibility and Description

Standard forms for keeping the log are provided by the Naval Military Personnel Command. The following forms are now in use:

1. Ship's Deck Log—Title Page, OPNAV 3100/98 (Rev. 7-84)

2. Ship's Deck Log Sheet, OPNAV 3100/99 (Rev. 7-84)

The ship's deck log provides a cover and a temporary storage for the ship's deck log sheets. All the ships must prepare an original copy of the log. The log is submitted to the Chief of Naval Operations monthly for permanent retention, and the copy is retained on board the ship for a period of 1 year, after which time it may be destroyed. All the entries in the ship's deck log must be made with a ball-point pen with black ink. The quartermaster of the watch, or other designated watch personnel, should write the log of the watch legibly, with each event being recorded at the time it happens or as directed by the OOD.

The OOD supervises the keeping of the ship's deck log, ensuring that all operational and navigational data and all other information relative to each event throughout the watch, including exact times, are entered accurately and chronologically as they occur. The remarks in the log are recorded daily by watches except when specifically directed otherwise by the Chief of Naval Operations.

Making Changes to the Deck Log

When a correction is deemed necessary, you should draw a single line through the original entry so that the entry remains legible, then enter the corrected entry in such a manner as to ensure clarity and legibility. Corrections, additions, or changes must be made only by the person required to sign the record for the watch and must be initialed by that person in the margin of the page. When the commanding officer directs a change or

OPNAV 3100/99 (Rev. 7-84)
S/N8107-LF-031-0498

SHIP'S DECK LOG SHEET

IF CLASSIFIED STAMP SECURITY MARKING HERE

USE BLACK INK TO FILL IN THIS LOG

		SHIP TYPE	HULL NUMBER	YEAR	MONTH	ZONE	DAY	
D	A	DDGN	1170	3	07	Q	01	E
1	2	3-4	5-7	12	13-14	15	16-17	22

JAN 12 1974

USS UNDERWOOD

AT/PASSAGE FROM NORFOLK, VA.

TO VA CAPES OP AREA

CLASS: μ HANDL:
78 79

POSITION ZONE TIME	POSITION ZONE TIME	POSITION ZONE TIME
0800	1200	2000
L ________ BY ____	L ________ BY ____	L ________ BY ____
λ ________ BY ____	λ ________ BY ____	λ ________ BY ____

LEGEND
1- CELESTIAL
2- ELECTRONIC
3- VISUAL
4- D.R.

TIME	ORDER	CSE	SPD	DEPTH	RECORD OF ALL EVENTS OF THE DAY
18-21	23-29	30-32	33-36	37-40	41 … 77
					00-04
2342					Assumed the watch. Moored portside to
					USS ROYAL (DD-000) at Pier 3, Birth 32,
					Naval Operating Base, Norfolk, Virginia with
					standard mooring lines doubled and spring lay
					out fore and aft. Receiving miscellaneous
					services from the pier. Cold iron and
					security watches have been posted. Material
					condition YOKE has been set throughout the
					ship. Ships present include various units
					of the U.S. Atlantic Fleet. SOPA is Com Burlant
					embarked in USS REMINGTON (AD-00).
2351					
0059					Security watch reports all conditions normal.
0156					Security watch reports all conditions normal.
0259					Security watch reports all conditions normal.
					R. C. Fox
					R C FOX, BTC, USN
					04-08
0345					Assumed the watch. Moored as before.
0358					Security watch reports all conditions normal.
0506					Security watch reports all conditions normal.
					W. J. Tiger
					W. J. TIGER, LTJG, USN
					08-12
0725					Assumed the watch. Moored as before.
0830					Captain arrived on board.
0910					Received fuel, water and draft report. Draft
					fwd. 13', aft 14'0", mean 13'9".
0930					Stationed the special sea detail.
					N. A. Trout
					N. A. TROUT, LT, USN
					08-12 (Continued)
0950					Captain and Navigator are on the bridge.
0952					Steering shifted to bridge.
0955					Completed all preparations for getting underway.

REPORT SYMBOL
OPNAV 3100-10

IF CLASSIFIED STAMP REVIEW/DECLASSIFICATION DATE HERE

IF CLASSIFIED STAMP SECURITY MARKING HERE

NPBM0016

Figure 1-16.—Ship's Deck Log Sheet.

addition to a log entry, the person concerned should comply unless that person believes the proposed change or addition to be incorrect, in which event the commanding officer must enter such remarks in the record and sign them.

The deck log sheets must be used as follows:

1. A Ship's Deck Log—Title Page, OPNAV 3100/98, must be appropriately completed and appended to each original and duplicate monthly log.

2. The original log entries must be recorded on the Ship's Deck Log Sheet, OPNAV 3100/99, as shown in figure 1-16. The front and reverse of each original sheet must be used either for continuation of entries for a day or for starting the entries for a new day, as appropriate.

You have two excellent guides in making out the ship's deck *log—Instructions for Keeping Ship's Deck Log,* OPNAVINST 3100.7, and the *Watch Officer's Guide.*

ANCHOR LOG

One of the most important records that you, as a Boatswain's Mate, are responsible for is the anchor log. This is a permanent record of your ground tackle and its use. It includes the following basic information: serial numbers, weights, and types of all the anchors; serial numbers of the shots of chain and their position within the ground tackle; the length and diameter of each cable, in fathoms; serial numbers of each detachable link, both those in use and spares. For example:

<u>Port Anchor</u>

LWT type	serial #____lb___	
Outboard swivel shot	length _____fathoms	
1st detachable link	serial # ______	
2d detachable link	serial # ______	

<u>Anchor chain cable</u> ______ <u>fathoms</u>.

1st shot	serial # ____	detachable link # ____
2d shot	serial # ____	detachable link # ____
3d shot	serial # ____	detachable link # ____
4th shot	serial # ____	detachable link # ____
5th shot	serial # ____	detachable link # ____

<u>Spare detachable links</u>

1 _____ serial # ______

2 _____ serial # ______

3 _____ serial # ______

The anchor log also records the use of your ground tackle, as shown in figure 1-17.

PORT ANCHOR

DATE	DROP TIME	DEPTH OF WATER (FEET)	CHAIN OUT (FATHOMS)	TYPE OF BOTTOM	LOCATION PORT	LOCATION BERTH	ANCHOR DATE	AWEIGH TIME	CONDITION OF ANCHOR	REMARKS
5/8/64	1600	50	60 WE	Sand	San Diego, Calif.	61	5/7/64	0732	Clear	None
5/9/84	1430		15 OD		Coronado Roads. Calif.	47				Broke chain inboard of swivel shot for mooring
5/10/84	—	—	45	—	At Sea	—	—	—	—	Broke chain inboard of swivel shot - veered 45 fathoms for being towed
5/10/84	—	—	—	—	At sea	—	—	—	Moderate Strain	Heaved in and reconnected chain to port anchor

NPBM0017

Figure 1-17.—Anchor Log—Port Anchor.

HULL REPORTS

A weekly inspection is made of all the spaces and compartments except those carrying fuel oil, water, or other liquids and those designated as voids, cofferdams, ballast tanks, or double bottoms. The purpose of this inspection is to ascertain the material condition of each compartment. Results of the inspection are recorded on a hull report, which is turned in to the engineer officer or the damage control assistant.

All the reports noted from the hull inspection are entered into the work center work list/job sequence number log (WCWL/JSN log). This form is covered in the *Ship's Maintenance and Material Management (3-M) Manual,* OPNAVINST 4790.4 (SERIES).

For necessary repairs to be made, a Maintenance Data Form, OPNAV Form 4790-2K, should be made out for each discrepancy noted. This form is covered in the *Ship's Maintenance and Material Management (3-M) Manual,* OPNAVINST 4790.4 (SERIES).

WORK RECORD

A work record is neither official nor required. But if you maintain one, you will find it of great assistance in planning work for your section and integrating the work load of your section with that of the division. Enter the data for your work record in a notebook that fits conveniently in your pocket. When you receive a work assignment, make an entry in your notebook listing the type of work, compartment or other location, time estimate, number of personnel required, and the tools and other material needed. Note daily the progress on each job entry and any remarks pertinent to the job. For example: "Suspended work painting forecastle—rain." When a job is completed, cross off that entry in your notebook but leave the entry legible for reference purposes.

SHIPS' 3-M SYSTEMS

Maintaining operational readiness is sometimes difficult because of the age of many ships and their equipment. It is also difficult because of the complexity of weapons, communications, and engineering systems.

To overcome these problems, the Navy has developed a preventive maintenance program. This program consists of a schedule of inspections, tests, adjustments, and routine maintenance procedures. It also consists of a system of checkoff lists to ensure that the schedule is carried out. The administration of such a program aboard ship requires that the preventive maintenance needs of every piece of equipment be recognized. It also requires that these needs be planned for, accomplished, and so recorded.

The 3-M System is covered in the OPNAVINST 4790.4 (SERIES), the ship's 3-M Manual. Therefore, it will not be repeated here.

SHIP CEREMONIES

LEARNING OBJECTIVES: Describe the ceremonial procedures for the following events: keel-laying, christening, commissioning, and decommissioning.

Since the days when the United States emerged as an independent nation, tradition has played an important role in the ceremonial functions of our Navy. At first, most of the honors and ceremonies rendered by our Navy were carried over from the British Navy. As the years went by, however, the United States Navy began changing these carry-over honors and ceremonies to conform to its own concept of ceremonial functions. As a result, the United States Navy now has a rigid set of rules that cover all ceremonies.

All the types and phases of ceremonial functions rendered by and on board naval vessels are presented in this chapter. Boatswain's Mates are the keepers of tradition and must know what is required and also when, how, why, where, and by whom the honors and ceremonies are given. For more detailed information on honors and ceremonies, you should consult SECNAVINST 5060.22 *(Drill and Ceremonies),* OPNAVINST 1710.7 *(Social Usage and Protocol Handbook), United States Navy Regulations 1990, and Naval Ceremonies, Customs and Traditions.*

Tradition dictates that each ship constructed for the service be honored on four historic ceremonial occasions: keel-laying, christening (or launching), commissioning, and decommissioning. Periodically various directives pertaining to these events are issued, and you should check with the District Commander's office for guidance.

You, as a senior Boatswain's Mate, may be asked questions concerning the proper agenda for the ceremony. Fortunately, existing regulations do not predetermine the precise sequence of activities or establish inflexible protocol stipulations. Your command should be given a comfortable latitude to produce a ceremony rich in Navy heritage and significance, yet singular in its specific circumstances. The information in this chapter is intended not to represent a rigid standard but to present a concept of what has been done in the past in order to provide a guide to what is traditional and appropriate for the situation.

KEEL-LAYING CEREMONY

The first milestone in the history of a ship is the generally simple ceremony that marks the laying of the keel. The invitation is issued by the shipyard officials, and the ceremony is conducted by them. The builder may be the commander of a naval shipyard or the president of a private company.

LAUNCHING/CHRISTENING CEREMONY

In the second significant ceremony, the recently constructed ship is solemnly dedicated, named, and committed to the sea. You may have many variations in launching programs, even as to whether it is known as a launching or a christening or both. The desires of the shipbuilder and the Navy, as well as existing circumstances, will determine its final form. You should also note that the designation U.S. Ship (USS) is not used with the ship's name at this point, for she has not yet been accepted into naval service.

COMMISSIONING CEREMONY

The third and most important ceremony in the history of a ship is her admittance into the U.S. Navy. The essence of the ceremony is her acceptance by the Navy, for this will entitle her to fly the commission pennant and to be designated a U.S. Ship.

There are two major steps in the commissioning process. First, the builder turns the ship over to the commander of the district. Second, the commander receives the ship and commissions her, then turns the ship over to the prospective commanding officer, who accepts her, assumes command, and proceeds to act as host for the remainder of the ceremony.

DECOMMISSIONING CEREMONY

The fourth ceremony for the ship is generally a most somber occasion and far less elaborate than any of the others we have discussed. This is the ceremony that terminates the active naval service of ships other than those lost at sea.

BURIAL AT SEA

LEARNING OBJECTIVES: Describe the roles of religious and military components for burial at sea ceremonies. Compare burial procedures of casketed remains to burial procedures for cremated remains.

In earlier naval history, burials at sea were a necessity when death occurred on board a ship. Under modern conditions this is seldom a necessity. Burials at sea do not take place except when specific arrangements have been made at the request of the deceased's next of kin.

ELIGIBILITY FOR BURIAL AT SEA

The regulations for at-sea disposition of remains casketed in a metal casket and inurned cremated remains (cremains) from a naval vessel or inumed cremains from a naval aircraft are set forth by the Bureau of Medicine and Surgery.

Civilian personnel will not be authorized to attend services aboard naval ships, aircraft, and auxiliary craft. Services aboard a ship, while it is in port, are permitted on an "as not-to-interfere" basis.

PREPARATION FOR THE BURIAL AT SEA CEREMONY

There are two component parts of the ceremony of burial at sea: the religious and the military. The reading of the scripture and prayers, the committal, and the benediction constitute the religious part and may be performed by the chaplain/commanding officer or an officer designated by the commanding officer. All other aspects of the ceremony are performed by other personnel.

Casketed Remains from a Naval Ship

For burial at sea, the casketed remains are covered with the national ensign, with the union placed at the

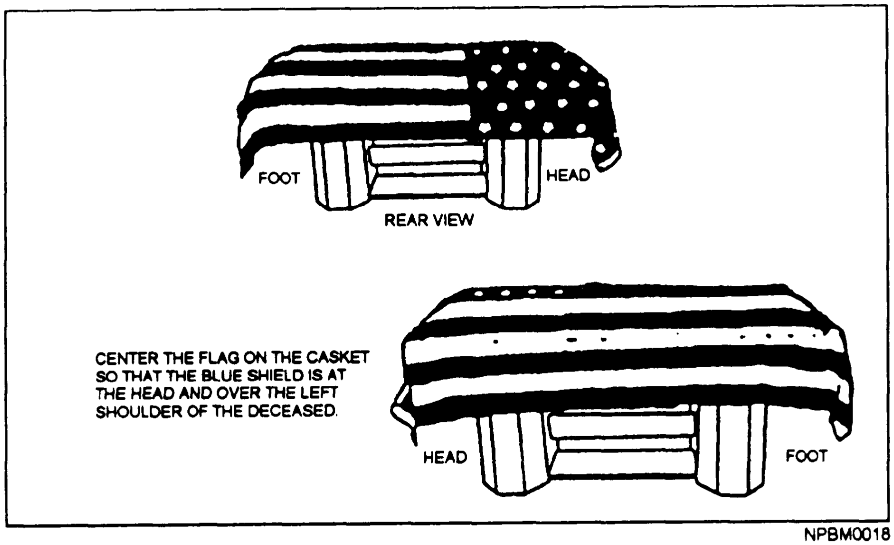


Figure 1-18.—Correct method of displaying the flag with the casket.

head and over the left shoulder, as shown in figure 1-18. When the casket is draped with the national ensign, the cap and sword of the deceased are not displayed.

Six pallbearers are aligned according to height on both sides of the casket. They carry the casket feet first. Pallbearers will uncover when they are belowdecks and not carrying the casket. They remain covered at all other times.

The selected place for committal (weather deck, which has a reasonably unobstructed area in which to form the detail—usually in the aft part of the ship) is clear and rigged. When the casketed remains are brought on deck, the casket is placed securely on a stand, if necessary, with feet outboard at right angles to and extending over the side of launching.

Attention is sounded on the bugle or passed by word of mouth as the pallbearers, preceded by an officer or a chief, execute the hand salute as the cortege passes to the place selected for the committal. When the remains have been so placed, the hand salute is terminated by those in sight, and a sentry is posted unless the burial service is to follow immediately.

An officer or a chief petty officer, as assigned, is designated to take charge of the firing squad of six persons. Another officer or chief directs the pallbearers during the service until the flag is encased and delivered to the commanding officer.

Disposition of Cremains from a Naval Ship

In cases where the remains have been cremated and the receptacle containing the ashes has been received on board for burial at sea, the following procedures will govern:

If the receptacle is to be opened and the ashes scattered at the time of committal, a small table or stand should be securely rigged beforehand at the selected place for the committal. The receptacle will be placed on this table or stand during the reading of the service. The folded flag will be placed on the stand beside the cremains. The executive officer or another officer appointed by the commanding officer will assume responsibility for opening the receptacle and scattering the ashes at the appropriate time (keeping in mind the wind factor) during the committal ceremony.

If the receptacle is to be committed together with the ashes, a small platform should be constructed and rigged so that during the service the receptacle may rest thereon and be launched at the time of committal by tilting up the inboard end of the platform, thus permitting the receptacle and ashes to slide overboard into the sea.

For all phases of the funeral where the cremains are carried by hand, one enlisted member will be detailed to carry the receptacle containing the ashes.

Four enlisted members are detailed as flag bearers and serve instead of the six pallbearers otherwise required. The flag bearers follow the bearer of the receptacle as it is brought on deck and carried to the place of committal. The prefolded flag is carried by the leading flag bearer on the right. The flag is then placed on the stand beside the cremains. The flag will be picked up and held folded by the flag bearers during the committal of the ashes to the sea.

THE CEREMONY FOR BURIAL AT SEA

Assemble all participating personnel, as shown in figure 1-19.

When the honor platoon has been assembled in massed formation and has been brought to parade rest, the burial service begins. The ceremony is read through to the prayers. During prayers the assemblage remains covered with bowed heads. After the conclusion of the prayers, if the name of the deceased was not included in the service, it is fitting that it be mentioned. Upon conclusion of the prayers, the pallbearers hold the casket and national ensign in place by hand as may be necessary before the reading of the committal.

When these preparations have been completed and all is in readiness, "Attention" is sounded. The command "FIRING SQUAD, PRESENT ARMS" (honor platoon hand salutes) is given and the reading of the committal begins. When the indicated word of the committal is read, the pallbearers tilt the board until the casket slides along it, under the national ensign, overboard into the sea. As it slides overboard, the pallbearers retain the board and the national ensign and stand fast.

The commands "FIRING SQUAD, ORDER ARMS, and PARADE REST" are given and all hands bow their heads. The benediction is pronounced. Then follow the commands "FIRING SQUAD, ATTENTION; FIRE THREE VOLLEYS." (Honor platoon hand salutes and remains so until the last note of taps.) "READY, AIM, FIRE; AIM, FIRE; AIM, FIRE." After the last volley, the firing squad remains at the READY position, pieces locked, until the conclusion of taps, and salutes.

Upon completion of taps, the firing squad is brought to "ORDER ARMS." The pallbearers encase the national ensign by folding it, as shown in figure 1-20. It is then presented by the chief master-at-arms to the commanding officer.

After the commanding officer has received the flag and has departed, the command "PARADE REST" is

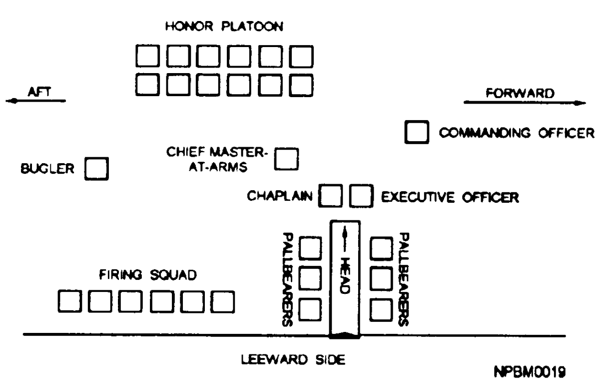


Figure 1-19.—Deck plan for burial at sea.

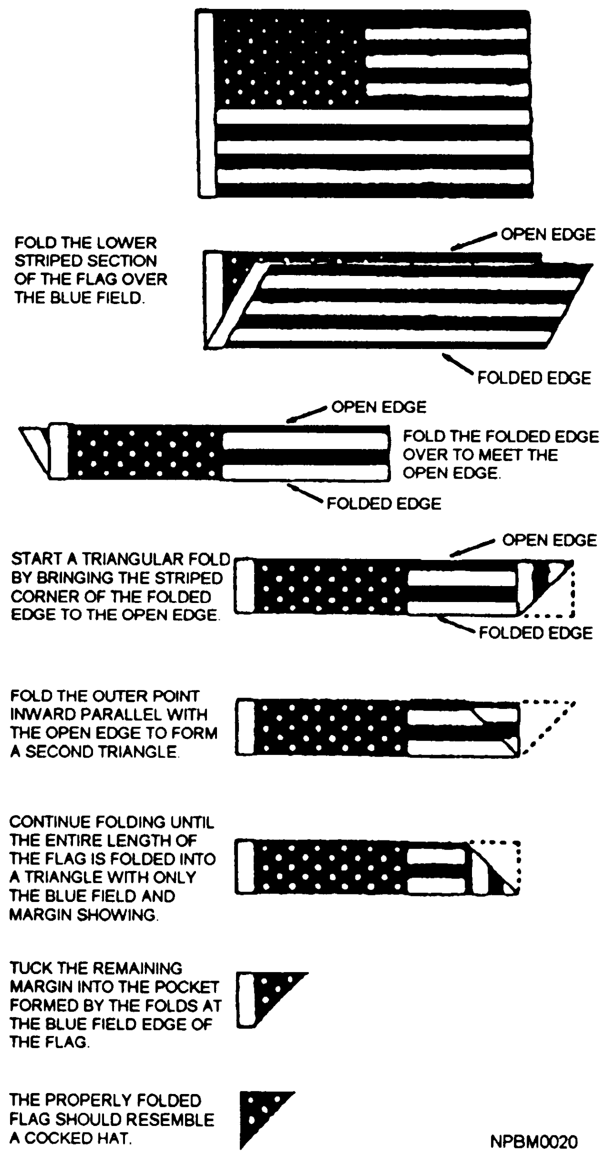


Figure 1-20.—Correct method of folding the U.S. flag.

given; and when all have assumed it, the details (firing squad and pallbearers) are brought to attention, formed, and marched away. When they are clear, the honor platoon is brought to attention, retreat is sounded, and the ceremony is over.

Navy Military Funerals, NAVPERS 15555 (SERIES), contains detailed information concerning burial at sea.

PASSING HONORS

LEARNING OBJECTIVES: Describe the procedures for passing honors onboard a U.S. naval ship and all small boats.

Passing honors are those honors, except gun salutes, rendered by ships and boats when ships, embarked officials, or officers pass (or are passed) close aboard. "Close aboard" means passing within 600 yards for ships and within 400 yards for boats. To ensure that appropriate honors are given, you should interpret these distance limitations liberally.

Passing honors consist of sounding the command "ATTENTION," followed by a hand salute by all persons in view on deck and not in ranks. Passing honors are exchanged between ships of the U.S. Navy and between ships of the Navy and the Coast Guard, passing close aboard.

Table 1-1 prescribes the honors for a ship of the Navy when passing close aboard a ship or naval station displaying the flag of the officials indicated, and for naval stations (insofar as practical) when a ship displaying such flag passes close aboard. These honors are acknowledged by returning the same honors.

Table 1-2 lists the honors to be rendered by a Navy ship being passed close aboard by a boat displaying the flag or pennant of a civil official or a naval officer.

FOREIGN DIGNITARIES AND WARSHIPS

The honors prescribed for the President of the United States are given by a Navy ship being passed close aboard by a ship or boat displaying the flag or standard of a foreign president, a sovereign, or a member of a reigning family. The foreign national anthem is played instead of the national anthem of the United States.

Passing honors are exchanged when foreign warships pass close aboard. The honors consist of parading the guard of the day, sounding "ATTENTION," rendering the hand salute by all

Table 1-1—Passing Honors Rendered by a Ship or a Naval Station]

Official	Uniform	Ruffles and flourishes	Music	Guard	Remarks
President ____________	As prescribed by senior officer present.	4	National Anthem	Full_____	Man rail, unless otherwise directed by senior officer present.
Secretary of State when special foreign representative of the President	_____do._____	4	___do.___	___do.___	Crew at quarters.
Vice President	Of the day _____	_______	Hail Columbia	___do.___	Do.
Secretary of Defense, Deputy Secretary of Defense, or Secretary of the Navy, Director of Defense Research and Engineering	_____do._____	_______	National Anthem	___do.___	Do.
An Assistant Secretary of Defense, Under Secretary or an Assistant Secretary of the Navy.	_____do._____	_______	___do.___	___do.___	Do.

Table 1-2.—Passing Honors Rendered by a Ship Being Passed by a Boat

Official	Ruffles and flourishes	Music	Guard	Remarks
President	4	National Anthem	Full	"Attention" sounded, and salute by all persons in view on deck. If directed by the senior officer present, man rail.
Secretary of State when special foreign representative of the President.	4	do.	do.	"Attention" sounded, and salute by all persons in view on deck.
Vice President	4	Hail Columbia		Do.
Secretary of Defense, Deputy Secretary of Defense, Secretary of the Navy, Director of Defense Research and Engineering, an Assistant Secretary of Defense, Under Secretary or an Assistant Secretary of the Navy.	4	Admiral's March	do.	Do.
Other Civil official entitled to honors on official visit.				Do.
Officer of an armed service				Do.

persons in view on deck, and playing the foreign national anthem.

RENDERING PASSING HONORS

The command "ATTENTION" is sounded by the junior when the bow of one ship passes the bow or stern of the other vessel. If a senior is embarked in a boat, "ATTENTION" is sounded before the boat is abreast or nearly abreast of the quarterdeck.

The guard, when required, must "PRESENT ARMS," and all persons in view on deck will salute. Music is played when required. The order "CARRY ON" is sounded when the prescribed honors are rendered and acknowledged.

Passing honors are not rendered after sunset or before 0800 except when international courtesy requires. Passing honors are not exchanged between ships of the Navy when they are engaged in tactical evolutions outside port. The senior officer present may direct that passing honors be dispensed with in whole or in part.

Precedence of Shipboard Means of Announcing

There are a number of ways to call attention to ceremonies, events, departures, and arrivals aboard a Navy ship. The preferred order of use is as follows:

1. Bugle
2. Whistle
3. Passing the word

No more than one means should be used for a given event, and the same means should be used throughout that event; for example, "ATTENTION TO PORT" should not be announced by a whistle and followed by the same order given orally over the ship's loudspeaker. "CARRY ON" should not be announced using a different device than that used to announce "ATTENTION."

Bugle and Whistle Signals

The following are prescribed to standardize bugle and whistle signals when they are used for passing/side honors.

One blast	ATTENTION TO STARBOARD
Two blasts	ATTENTION TO PORT
One blast	RENDER SALUTE
Two blasts	TERMINATE SALUTE, REMAIN AT ATTENTION
Three blasts	CARRY ON

HONORS FOR OFFICERS

LEARNING OBJECTIVES: Describe the honors for officers, official visits, change of command, official inspections, civil officials of the United States, foreign officials, and officers. State the occasions for and the proper use of passing the word, boat gongs, boat hails, and side honors.

The honors due officers of the armed forces are set forth in table 1-3. These honors are rendered by ships and stations on the occasion of an official visit. Ashore, the single gun salute (when prescribed) is given on arrival instead of on departure.

An officer departing for or returning from an official visit is rendered, by the flagship or command, the honors established for such a formal visit. Aboard the flagship, however, the uniform of the day normally is worn, and gun salutes are not fired.

NOTE: The term *official visit* means a formal visit of courtesy requiring special honors and ceremonies. An informal visit of courtesy requiring no special ceremonies is a "call."

PROCEDURE FOR OFFICIAL VISIT

The honors specified for an official visit are rendered on the visitor's arrival as follows:

Table 1-3.—Honors Required for Officers of the Armed Forces

Officer	Uniform	Gun Salute		Ruffles and flourishes	Music	Guard	Side Boys
		Arrival	Departure				
Chairman, Joint Chiefs of Staff	Full Dress	19	19	4	General's or Admiral's March	Full	8
Chief of Staff, U.S. Army	do.	19	19	4	General's March	do.	8
Chief of Naval Operations	do.	19	19	4	Admiral's March	do.	8
Chief of Staff, U.S. Air Force	do.	19	19	4	General's March	do.	8
Commandant of the Marine Corps	do.	19	19	4	Admiral's March	do.	8
General of the Army	do.	19	19	4	General's March	do.	8
Fleet Admiral	do.	19	19	4	Admiral's March	do.	8
General of the Air Force	do.	19	19	4	General's March	do.	8
Generals	do.	17	17	4	do.	do.	8
Admirals	do.	17	17	4	Admiral's March	do.	8
Naval or other Military Governor, commissioned as such by the President, within the area of his jurisdiction.	do.		17	4	General's or Admiral's March	do.	8
Vice Admiral or Lieutenant General	do.		15	3	do.	do.	8
Rear Admiral or Major General	do.		13	2	do.	do.	6
Commodore or Brigadier General	do.		11	1	do.	do.	6
Captain, Commander, Colonel, or Lieutenant Colonel	Of the day.					Of the day.	4
Other Commissioned Officers	do.					do.	2

1. When the rail is manned, men are spaced uniformly at the rail on each weather deck, facing outboard.

2. The command "ATTENTION" is sounded as the visitor's boat or vehicle approaches the ship.

3. If a gun salute is prescribed on arrival, it is fired as the visitor approaches and is still clear of the side. The proper flag or pennant is broken on the first gun and hauled down on the last gun except when it is to be flown for the duration of the visit. Other ships firing a concurrent salute also haul down the flag or pennant displayed in honor of the visitor on the last gun.

NOTE: If the ship visited is moored to the pier in such a position that it is impractical to render the gun salute before arrival on board, the salute is rendered—provided local regulations do not forbid gun salutes—after the official arrives on board and the commanding officer assures himself or herself that the dignitary and party are moved to a position in the ship that is well clear of the saluting battery.

4. The boat or vehicle is piped as it comes alongside.

5. The visitor is piped over the side, and all persons on the quarterdeck salute and the guard presents arms until the termination of the pipe, flourishes, music, or gun salute, depending on which is rendered last.

6. If the gun salute is not prescribed on arrival and a flag or pennant is to be displayed during the visit, it is broken at the start of the pipe.

7. The piping of the side, the ruffles and flourishes, and the music are executed in the order named. In the absence of a band, "To the Colors," instead of the national anthem when required, is sounded on the bugle.

8. The visitor, if entitled to 11 guns or more, is invited to inspect the guard upon completion of the gun salute or such other honors as may be accorded.

On departure, the honors prescribed for an official visit are as follows:

1. The rail is manned, if required.

2. The command "ATTENTION" is sounded as the visitor arrives on the quarterdeck.

3. When the visitor is ready to leave the ship, the guard presents arms; all persons on the quarterdeck salute; and ruffles and flourishes, followed by music, are sounded. The visitor then is piped over the side. The salute and present arms terminate with the call. If no salute is fired, the flag or pennant displayed in honor of the visitor is hauled down.

4. The boat or vehicle is piped away from the side.

5. If a gun salute is directed upon departure, it is tired when the visitor is clear of the side. If a flag or pennant is displayed in honor of the visitor, it is hauled down with the last gun of the salute.

When possible, the same honors and ceremonies are rendered on the occasion of an official visit to a naval station.

PASSING THE WORD AND USE OF BOAT GONGS

Passing the word and the use of boat gongs to announce the arrival and departure of senior officers are not means of rendering honors, nor are they intended to be. Passing the word and boat gongs are used to indicate the arrival and departure of commanders, chiefs of staff, chief staff officers, and commanding officers for interested personnel. Arrivals and departures are to be announced only during the hours between reveille and taps. Commanding officers should be familiar with local SOPA regulations concerning the use of topside speakers for passing arrivals and departures and other shipboard announcements.

Arrivals and departures are announced as follows:

Sound the boat gong, special gong, or gas alarm (as specified locally) in groups of two corresponding to the number of side boys to which the officer announced is entitled.

Announce the officer's title using the same format as the coxswain's replies, as shown in table 1-4. For commanding officers of units of the operating forces where commands are not listed in the coxswain's replies, the authorized short title must be used; for example, (FAIRWING No., ATKRON No.). For commanding officers of shore stations or shore activities, the title of the command, without the geographical location, must be used; for example, Naval Supply Center, Fleet Training Center.

The word *arriving* or *departing* is used after the officer's title or the authorized short title.

It is common practice for units to announce the crossing of certain officers over the 1MC of the quarterdeck to units outboard or inboard, as the case may be. This is a perfectly acceptable procedure, since boat gongs and passing the word are not forms of honors

Table 1-4.—Boat Hails

OFFICER OR OFFICIAL ABOARD BOAT	COXSWAIN'S REPLY
President or Vice President of the United States	United States
Secretary, Deputy or an Assistant Secretary of Defense	Defense
Secretary, Under Secretary or an Assistant Secretary of the Navy	Navy
Chairman of the Joint Chiefs of Staff	Joint Chiefs of Staff
Chief of Naval Operations or the Vice Chief of Naval Operations	Naval Operations
Fleet, Force or Type Commander	______Fleet or abbreviation of administrative title, i.e., PACFLT
A Flag Officer	Flag Officer
A Chief of Staff/Chief Staff Officer	Staff
A Flotilla/Group Commander	*______ Flot/Gru ______ (type) (number)
A Squadron Commander	*______ Ron ______ (type) (number)
A Division Commander	*______ Ron ______ (type) (number)
A Marine Officer Commanding a Brigade	Brigade Commander
A Commanding Officer of a Ship or Station	______________(Name of Ship or Station).
A Marine Officer Commanding a Regiment	Regimental Commander
Any Other Commissioned Officer	Aye, Aye.
Warrant Officer	No, No.
Enlisted	Hello
A boat not intending to go alongside, regardless of rank of passenger	Passing

*The type abbreviation used, for example, is CRUDESGRU FIVE, SERVGRU ONE, PHIBRON SIX and MINEDIV TWO TWO.

but information signals to those personnel who may have a need to know.

The arrival of a visiting Navy captain or commander (or an officer of equivalent grade in the other services) who is not a type/operational commander, chief of staff, chief staff officer, or commanding officer or whose command identity is not known to the officer of the deck is announced by his or her rank and service; for example, Captain, U.S. Navy; Colonel, U.S. Army.

If a party consisting of more than one officer or official entitled to an announcement either arrives or departs, only the senior member need be announced.

SIDE HONORS

On the arrival and departure of civil officials, foreign officers, and United States officers, when directed by the senior officer present, the side is piped and the appropriate number of side boys paraded.

Side boys are not paraded on Sunday or between sunset and 0800 on other days. They are not paraded during meal hours of the crew, general drills and evolutions, or periods of regular overhaul. As an exception to the foregoing rules, side boys may be paraded at any time during daylight hours in honor of civil officials or foreign officers.

Except for official visits and other formal occasions, side boys are not paraded in honor of officers of the armed services of the United States unless the senior officer present directs otherwise.

The side is piped when side boys are paraded but not at other times. When side boys are not ordered, the guard and band are not paraded in honor of the arrival or departure of an individual.

FLAG OFFICER OR UNIT COMMANDER ASSUMING OR RELIEVING COMMAND

When a flag officer or unit commander relieves a command or departs after being relieved, the same honors are rendered as for an official visit, subject to the regulations pertaining to gun salutes.

When assuming a command, an officer reads his or her orders to the assembled officers and crew. Immediately after reading the orders, the officer's personal flag or command pennant is broken. Thereupon, the gun salute is fired if required by Navy regulations.

If the flag officer or unit commander is relieving another officer in command, the officer being relieved reads his or her orders to the assembled officers and crew. On completion of the reading or after the gun salute (if fired), the officer's flag or command pennant is hauled down. The officer succeeding to command then reads his or her orders, after which the flag or command pennant is broken. The commission pennant is not displayed aboard ship if a personal flag or pennant is flying.

OFFICIAL INSPECTIONS

When a flag officer or a unit commander boards a ship of the Navy to make an official inspection, honors are rendered as for an official visit except that the uniform is prescribed by the inspecting officer. The flag or command pennant of the officer is broken upon his or her arrival and is hauled down on departure. When the officer's flag is on board the vessel being inspected, the personal flag is hauled down on board his or her flagship. If the vessel being inspected is his or her flagship, the flag remains flying. Insofar as practical and appropriate, the same provisions apply when a flag officer in command ashore makes an official inspection of a unit of his or her command.

HONORS FOR CIVIL OFFICIALS AND FOREIGN DIGNITARIES

A ship or station must render honors to civil officials of the United States, as shown in table 1-5. Foreign dignitaries are honored, as shown in table 1-6. As with honors for officers of the armed forces, ashore the single gun salute (when prescribed) is given on arrival instead of on departure.

When a civil official of the United States takes passage officially in a ship of the Navy, he or she is rendered the same honors on embarking and disembarking as prescribed for an official visit, Additionally, if he or she is entitled to a gun salute, it is fired when he or she disembarks in a port of the foreign nation to which he or she is accredited.

SUMMARY

In this chapter you have learned all about shipboard duties, under way, and in port watches. You learned about the boatswain's pipe and how to use it in everyday life onboard a ship. Also, you have learned how to arrange and take charge of a burial at sea onboard a ship. You have studied about the many honors and ceremonies you will participate in during your naval career. Now it is time for you to go out and take all you have learned from this chapter and try to use this in your shipboard life. GOOD LUCK!

Table 1-5.—Honors for Civil Officials of the United States

HONORS AND CEREMONIES[5]												
		Gun Salute								Flag		
Official	Uniform	Arrival	Departure	Ruffles and flourishes	Music	Guard	Sideboys[4]	Crew[4]	Within what limits	What	Where	During
The President	Full Dress	21	21	4	National[1] Anthem	Full	8	Main rail		President's	Main-Truck	Visit
Former Presidents	do.		21	4	Admiral's March	do.	8	Quarters		National	do.	Salute
Vice President	do.		19	4	Hail Columbia	do.	8	Quarters		Vice President's	do.	Visit
Governor of a State	do.		19	4	Admiral's March	do.	8		Area under his jurisdiction	National	Fore-Truck	Salute
Speaker of the House of Representatives	do.		19	4	do.	do.	8			do.	do.	Do.
The Chief Justice of the United States	do.		19	4	do.	do.	8			do.	do.	Do.
Ambassador, High Commissioner, or special diplomatic representative whose credentials give him authority equal to or greater than that of an Ambassador.	do.		19	4	National Anthem	do	8		Nation or nations to which accredited	do.	do.	Do.
Secretary of State	do.		19	4	do.	do.	8			do.	do.	Do.
U.S. Representative to the U.N.	do.		19	4	Admiral's March	do.	8			do.	do.	Do.
Associate Justices of the Supreme Court	do.		19	4	do.	do.	8			do.	do.	Do.
Secretary of Defense	do.	19	19	4	Honor's March	do.	8	Quarters		Secretary's	Main-Truck	Visit
Cabinet Officers (other than[2] Secretaries of State and Defense)	Full Dress		19	4	Admiral's March	Full	8			National	Fore-Truck	Salute
President Pro Tempore of Senate	do.		19	4	do.	do.	8			do.	do.	Do.
United States Senators	do.		19	4	do.	do.	8			do.	do.	Do.
Governor of a State of the United States	do.		19	4	do.	do.	8		Out of jurisdiction	do.	do.	Do.
Members of the House of Representatives	do.		19	4	do.	do.	8			do.	do.	Do.
Deputy Secretary of Defense	do.	19	19	4	Honor's[3] March	do.	8.	Quarters		Deputy Secretary's	Main-Truck	Visit

Table 1-5.—Honors for Civil Officials of the United States—Continued

	HONORS AND CEREMONIES[5]											
		Gun Salute								Flag		
Official	Uniform	Arrival	Departure	Ruffles and flourishes	Music	Guard	Sideboys[4]	Crew[4]	Within what limits	What	Where	During
Secretary of the Army	Full Dress	19	19	4	Honor's[3] March	Full	8			National	Fore-Truck	Salute
Secretary of the Navy	do.	19	19	4	do.	do.	8	Quarters		Secretary's	Main-Truck	Visit
Secretary of the Air Force	do.	19	19	4	do.	do.	8			National	Fore-Truck	Salute
Director of Defense Research and Engineering	do.	19	19	4	do.	do.	8	Quarters		Director's	Main-Truck	Visit
Assistant Secretaries of Defense and General Counsel of DOD	do.	17	17	4	do.	do.	8	Quarters		Assistant Secretary's	do.	Do.
Under Secretary of the Army	do.	17	17	4	do.	do.	8			National	Fore-Truck	Salute
Under Secretary of the Navy	do.	17	17	4	do.	do.	8	Quarters		Under Secretary's	Main-Truck	Visit
Under Secretary of the Air Force	do.	17	17	4	do.	Full	8			National	Fore-Truck	Salute
Assistant Secretaries of the Army	do.	17	17	4	do.	do.	8			do.	do.	Do.
Assistant Secretaries of the Navy	do.	17	17	4	do.	Full	8	Quarters		Assistant Secretary's	Main-Truck	Visit
Assistant Secretaries of the Air Force	do.	17	17	4	do.	do.	8			National	Fore-Truck	Salute
Governor General or Governor of a Commonwealth or Possession of the United States, or area under United States jurisdiction	do.		17	4	Admiral's March	do.	8		Area under his jurisdiction	do.	do.	Do.
Other Under Secretaries of Cabinet, the Deputy Attorney General	do.		17	4	do.	do.	8			do.	do	Do.
Envoy Extraordinary and Minister Phenipotentiary	do.		15	3	do.	do.	8		Nation to which accredited	do.	do.	Do.
Minister Resident	Full Dress		13	2	Admiral's March	Full	6		Nation to which accredited	National	Fore-Truck	Salute
Charge d'Affaires	do.		11	1	do.	do.	6		do.	do.	do.	do.
Career Minister, or Counselor of Embassy or Legion	do.			1		do.	do.	6		do.		

Table 1-5.—Honors for Civil Officials of the United States—Continued

		HONORS AND CEREMONIES[5]										
		Gun Salute								Flag		
Official	Uniform	Arrival	Departure	Ruffles and flourishes	Music	Guard	Sideboys[4]	Crew[4]	Within what limits	What	Where	During
Consul General; or Consul or Vice Consul or Deputy Consul General when in charge of a Consulate General	Full Dress		11	1	Admiral's March	Full	6		District to which assigned	National	Fore-Truck	Salute
First Secretary of Embassy or Legation	Of the day					Of the day	4		Nation to which accredited			
Consul; or Vice Consul when in charge of a Consulate	do.		7			do.	4		District to which assigned	do.	do.	Do.
Mayor of an incorporated city	do.					do.	4		Within limits of mayoralty			
Second or Third Secretary of Embassy or Legation	do.						2		Nation to which accredited			
Vice Consul when only representative of United States, and not in charge of a Consulate General or Consulate	Of the day		5			Of the day	2		District to which assigned	National	Fore-Truck	Salute
Consular agent when only representative of the United States	do.						2	do.				

[1] See Article regarding honors to President

[2] In the order of precedence as follows
- Secretary of State
- Secretary of the Treasury
- Secretary of Defense
- Attorney General
- Secretary of the Interior
- Secretary of Agricultrue
- Secretary of Commerce
- Secretary of Labor
- Secretary of Health, Education, and Welfare
- Secretary of Housing and Urban Development
- Secretary of Transportation

[3] 32-bar melody in the trio of "Stars and Strips Forever"

[4] Not appropriate on shore installations

[5] Not to be construed as a precedence list

Table 1-6.—Honors for Foreign Officials and Officers

Official or Officer	Uniform	Gun Salute		Ruffles and flourishes	Music	Guard	Sideboys[1]	Crew[1]	Flag		
		Arrival	Departure						What	Where	During
President or Sovereign	Full dress	21	21	4	Foreign National Anthem	Full	8	Man Rail	Foreign ensign	Main-Truck	Visit
Member of reigning royal family	do.	21	21	4	do.	do.	8	do.	do.	do.	Salute
Prime Minister or other cabinet officer.	do.		19	4	Admiral's March	do.	8		do.	Fore-Truck	Do.
Officer of armed forces, diplomatic or consular representative in country to which accredited, or other distinguished official.	Civil Officials: Honors for official of the United States of comparable position. For example, foreign civil officials, occupying positions comparable to U.S. Department of Defense civil officials, shall receive equivalent honors. Officers of Armed Forces: Honors as for officer of the United States of the same grade, except, that equivalent honors shall be rendered to foreign officers who occupy a position comparable to Chairman JCS, CNO, Chief of Staff Army, Chief of Staff Air Force, or CMC. Honors as prescribed by the senior officer present; such honors normally shall be those accorded the foreign official when visiting officially a ship of his own nation, but a gun salute, if prescribed, shall not exceed 19 guns.										

[1] Not appropriate on shore installations.

CHAPTER 2

MARLINESPIKE SEAMANSHIP

This chapter deals with the art of knotting and splicing. This is an age-old craft that all mariners, especially the Boatswain's Mate, must be proficient at. Rope is manufactured from wire, fiber, and combinations of the two. After completion of this chapter, you should be able to explain the construction of line and wire rope and understand their use and care. You will gain knowledge in supervising line-handling details along with the terminology and safety factors to be observed. You will also learn how to tie many useful and ornamental knots and how to splice line.

FIBER ROPE

LEARNING OBJECTIVES: Identify the components and describe the characteristics of fiber and synthetic line.

Fiber rope—or line, as it is commonly called—is fashioned from natural or synthetic (man-made) fibers. Lines made from a variety of natural fibers (cotton, agave, jute, hemp, and abaca) have seen service in the Navy in the past, and some still are used. For example, tarred hemp is known as marline and ratline. Manila (made from the fibers of the abaca plant) formerly was authorized for use only where great strength was required. Now, manila is authorized for general purposes and serves as lashings, frapping lines, steadying lines, and riding lines on fueling rigs. Synthetic lines made of nylon, armaid (kevlar), polyester (Dacron), and polypropylene have been substituted for manila in most applications.

CONSTRUCTION OF LINE

LEARNING OBJECTIVES: Describe the different types of line that the Navy uses. Describe how line is constructed and formed to make different types of line.

Line currently used in the Navy may be three-strand, four-strand, braided, or plaited. In three-strand line, the fibers are first twisted to the right to form yarns. Next, the yarns are twisted to the left to form strands. Then, the strands are twisted to the right to form line.

The procedure just described is standard and used in making right-laid line. Figure 2-1 shows how three-strand right-laid line is made. The system is reversed when left-laid line is made. In either instance, the principle of opposite twists must be observed. The reason for this is to keep the line tight or stable and to prevent the parts from inlaying when a load is suspended on it. All the Navy line 1 3/4 inches in circumference or larger is required to be right laid. This requirement is important because if a left-laid line and a right-laid line were bent together, they would unlay each other under strain.

Braided lines have certain advantages over twisted lines. They will not kink or cockle (explained later), nor will they flex open to admit dirt or abrasives. The construction of some braids, however, makes it impossible to inspect the inner yarns for damage. The more common braided lines are hollow-braided, stuffer-braided, solid-braided, and double-braided.

Hollow-braided lines usually consist of an even number of parallel, tapelike groups of small yarns braided into a hollow, tubelike cord. This type of construction formerly in cotton was used for signal halyards—a purpose now served largely by plaited polyester. Other uses are parachute shroud lines and shot lines for line-throwing guns.

Stuffer-braided lines are manufactured in a similar manner except the braid is formed around a highly twisted yarn core, which rounds out and hardens the line. This type of construction in cotton is used for sash cord (heaving lines).

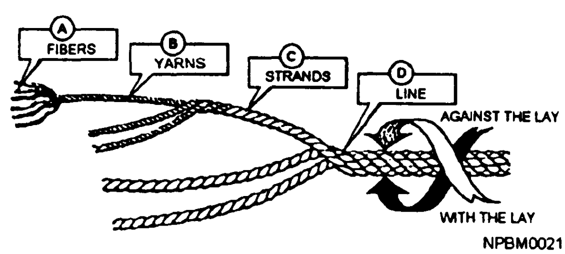


Figure 2-1.—Fiber groupings in a three-strand line.

Solid-braided lines are fashioned in various ways. One familiar construction is that used for lead lines, taffrail log lines, and the like. This braid is of large yarns, either single or plied, tightly braided to form a hard, relatively stiff line that will not kink, snag, or swell in water.

Double-braided line is, essentially, two hollow-braided ropes, one inside the other. The core is made of large single yarns in a slack, limp braid. The cover also is made of large single yarns but in a tight braid that compresses and holds the core. This line is manufactured only from synthetics, and 50 percent of the strength is in the core. Double-braided line is used for mooring lines, towlines, and many other purposes.

Plaited line is made of eight strands—four right-twisted and four left-twisted. These strands are paired and worked like a four-strand braid (fig. 2-2). Thus there are two pairs of right-laid strands and two pairs of left-laid strands formed into a line, which is more or less square. Plaited line is used for towlines, ship mooring lines, messengers, dressing lines, and many other applications. Plaited line is available in nylon, polyester, and polypropylene.

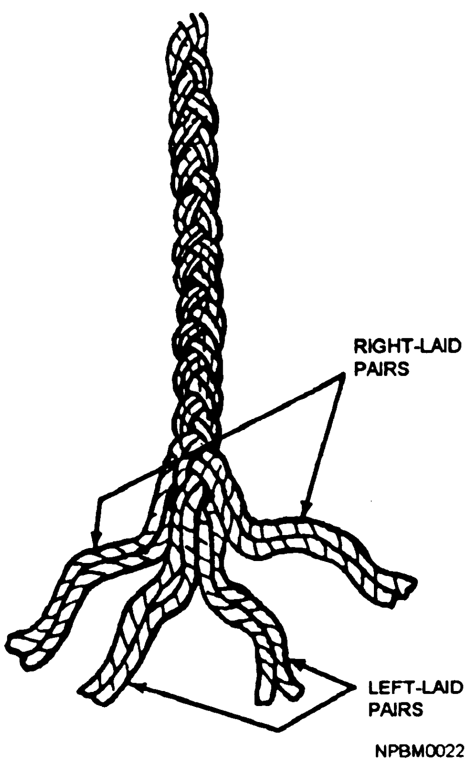


Figure 2-2.—Plaited line.

SIZE DESIGNATION

LEARNING OBJECTIVES: Identify the difference between regular line and small stuff.

Line 1 3/4 inches or less in circumference is called small stuff and is designated as to size by the number of threads (or yarns) that make up each strand. You may find anywhere from 6 to 24 thread, but the most commonly used sizes are from 9 to 21 thread. See figure 2-3. Some small stuff is designated by name. One type is marline—a left-laid, two-strand, tarred hemp. Marline is mainly used for seizings. When you need something stronger than marline, you will use houseline, which is a left-laid, three-strand, tarred hemp. Rope yarns can be used for temporary whippings, seizings, and lashings. The yarns are pulled from strands of old line that has outlived its usefulness. Pull the yarn from the middle, away from the ends, or it will get fouled.

Line larger than 1 3/4 inches is designated by its circumference, in inches. A 5-inch line, for instance, would be constructed of natural or synthetic fibers and measure 5 inches in circumference. Line is available in sizes up to 21 inches.

CARE AND HANDLING OF LINE

LEARNING OBJECTIVES: Describe the care and handling of natural and synthetic lines. Identify how to work out kinks and twists in line. Describe all the areas involved in snap back on synthetic line. Explain the difference between double-braided, three-strand, plaited, and aramid lines.

It is not news to experienced Seamen that misuse and abuse of their gear shortens its life. Yet, because of carelessness and lack of knowledge, line is the one item

	* CIRCUMFERENCE		THREAD
	INCHES	MILLIMETERS	
	3/4	19.05	6
	1	25.40	9
	11/8	28.58	12
	11/4	31.76	15
	11/2	38.10	21
	13/4	44.45	24

NPBM0023

Figure 2-3.—Small stuff.

that receives more abuse than any other equipment the Seaman uses. Also, line in a doubtful condition puts more lives in jeopardy than any other gear. Therefore, as a Boatswain's Mate, you should learn and exercise the proper care and methods of handling line. Teach these procedures to your personnel, and demand that they be constantly used.

NATURAL-FIBER LINES

Small coils of line may be loaded into a cargo net and hoisted aboard. Large hawser coils may be hoisted in a sling placed around the ends of a piece of pipe or a crowbar shoved through the center tunnel of the coil. They may be rolled forward along the deck, hoop fashion, and jiggered into place by the same rig.

Coils of line should always be stowed on shelves or platforms clear of the deck. They should never be allowed to become covered with an accumulation of junk that may prevent the evaporation of moisture. Remember that line composed of vegetable (natural) fiber is susceptible to mildew and rotting.

Coils of small stuff should be arranged along a shelf in order of size, and each coil should be set up in the way in which it opens properly; that is, with the inside end at the bottom of the center tunnel. The burlap wrapper should be left on each coil. The stops, which secure the coil, are inside the wrapper. These should be cut and drawn up the inside end so that the line is started properly. It is a common custom, and a good idea, to set up a narrow, flat strip of wood horizontally over the shelf containing the small stuff with a hole bored in the strip over each coil. The starting end of the line is drawn up through the hole and is prevented from dropping back by an overhand knot. This ensures that anyone coming down for a piece of small stuff need not grope around inside the tunnel for the end, with the resulting possibility of getting hold of the wrong one when the coil is almost depleted.

A lot of trouble can be avoided if the first lieutenant has several reels mounted in the boatswain's locker, The most commonly used sizes of small stuff can be put on these reels to eliminate the possibility of somebody fouling up a partially used coil.

Bights of tightly wound coils of marline have a tendency to work off the ends of a coil and become hopelessly snarled once the stoppers of the coil have been cut. To prevent this, transfer the marline to a reel. Take a short length of pipe and shove it through the center of the coil. Block it up so that the coil is free to turn. In this case, take the outside end of the marline, secure it to the reel, and start laying it up. You will need help on this job because the coil must be tended carefully to prevent bights from slipping off the ends of the coil.

You should make up several skeins of marline for general use on deck. This is done in the same way you made up kite string as a small child. A stick 14 or 16 inches long, or even a rolled piece of cardboard, makes an acceptable core.

Coils of large line should be stowed with their proper side up for opening. Line from 2 to 4 inches, which will be needed in various lengths on deck, should be opened, and a few feet of the end led out. Mooring lines should not be opened until needed.

When a new coil of line is to be opened, give it your personal attention. Five minutes of your time here may save hours later trying to work kinks out of an improperly opened coil.

See to it yourself that every coil to be opened is set up with the inside end at the bottom of the center tunnel and that the coil is started by drawing that end up through.

Whenever possible, line that has become wet in use should be dried thoroughly before stowing. Sometimes this is impossible, as with mooring lines, which must be stowed before clearing port. If line must be stowed wet, it should be laid up on grating in long fakes or suspended in some other way so that it can dry as quickly as possible. It should never be covered until it is dry.

Distortions, Kinks, and Twists

If a line does not lead fairly to a winch drum (gypsy head), it will be badly distorted when it is heaved in.

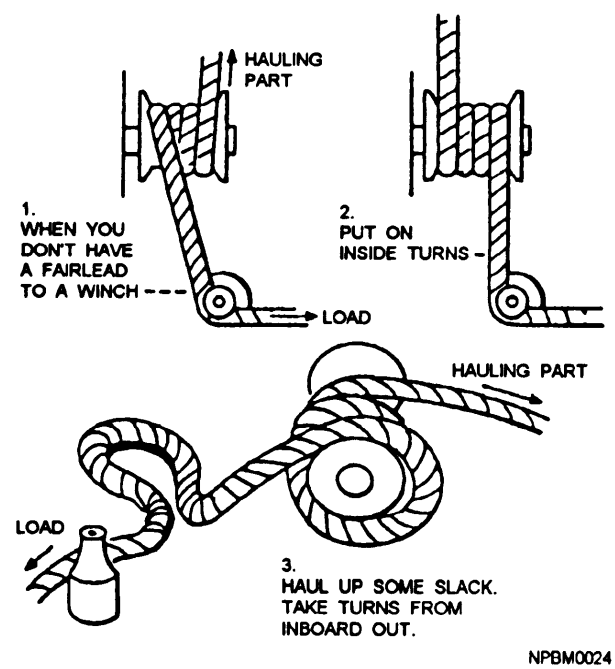


Figure 2-4.—Putting on inside turns to get a fairlead.

Frequently, it is necessary to put on inside turns (fig. 2-4) to obtain a fairlead. Because the outside end is attached to the load and unavailable, enough slack must be hauled up in the hauling part to make the necessary number of turns. The turns should be started inboard, as shown in the illustration.

Whenever possible, a right-laid line should be put on a winch drum or capstan right-handed or in clockwise turns. Heaving on a right-laid line with left-handed turns will eventually kink the line. About the only time left-handed turns cannot be avoided is when a winch is heaving on two lines at once, one on each drum.

A line with a kink in it or a tackle that is twisted from having a dip in it should never be heaved hard while that condition exists. A strong strain on a kinked or twisted line will put a permanent distortion in the line. Figure 2-5 shows what frequently happens when a line with a kink in it is heaved on. The kink, which could have been worked out, is now permanent, and the line is ruined.

A condition similar to a kink is the cockle (or hockle), which actually is a kink in an inner yarn that forces the yarn to the surface. When a strain is applied to a twisted rope with the bitter end (load) free to rotate, the lay of the rope lengthens as the "turn runs out of the rope." Actually, what happens is that the turn is transferred to the strands. When the twist in the strand builds up to a point where it can take no more, the inside yarns pop through the outer ones. Cockles also can be formed in a line wound on a capstan or gypsy head in the direction that tends to unlay the line. Cockles can be corrected by stretching the line and twisting the free end to restore the original lay.

Securing lines improperly can cause drastic reduction in strength. The strength of a line can be reduced by as much as 50 percent for knots and bends and 40 percent for hitches. Figure-eight bends on cleats and "H" bitts have the same effect. See figure 2-6 for the correct way to secure a line on "H" bitts. When lines are properly secured with round turns on "H" bitts, the line will retain 90 percent of its strength. When lines are used

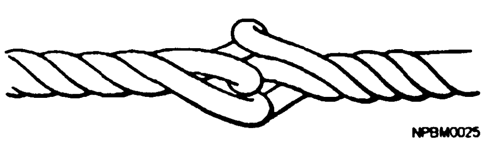


Figure 2-5.—Result of a strong strain on a line with a kink in it.

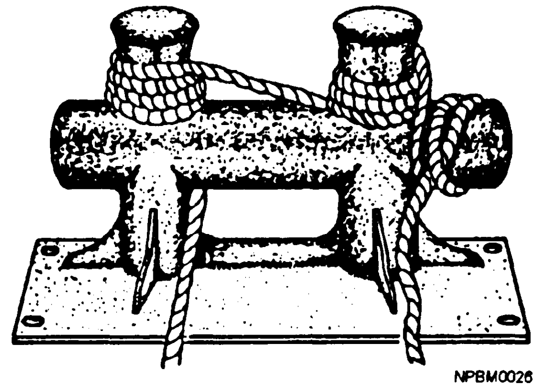


Figure 2-6.—Securing lines to "H" bitts.

on double bitts, figure eights reduce the rope strength by only 25 percent.

Another type of distortion is stretch. Synthetic fiber rope that has not exceeded its safe working load can withstand repeated stretching with no serious effect. When your rope is under a load, it decreases in diameter (elastic elongation) but recovers to its normal size when unloaded. To insure against overloading, attach a tattle-tale to each mooring line.

Stretch and, usually, elongation occur when natural-fiber line under tension is wet down. The line shrinks, adding more strain; and when dry, the line does not recover. Thus length is increased and diameter and strengthdecreased. New line, which still contains a large amount of its original waterproofing oil, does not shrink as much as old line, from which much of the oil has dissipated through exposure. Nevertheless, whatever the condition, taut lines, such as boat falls, must be slacked when it begins to rain or spray begins to wet the line.

Deterioration

Over and above the mechanical damaging factors that occur in service is the effect of aging under storage conditions. The natural-fiber lines basically consist of cellulose and have the same aging properties as paper. That is, they turn yellow or brown and become brittle with time, even under the best storage conditions. The color change indicates that the line has lost breaking strength (BS). The loss usually amounts to 1 to 2 percent per year of storage.

However, BS is not a true index of the utility of the line. More important is the loss of bending strength, indicated by the fibers' becoming brittle and stiff. Bending strength decreases five times as rapidly as BS.

Deterioration of bending strength causes the fibers to rupture easily when bent over sheaves or other holding devices, and the line breaks down with each successive bend, even under light loading conditions. Because of this, it is important that the age of unused lines be determined from the manufacturer's identification marker tape within the line strand. The marker tape will tell you who made the line, the date the line was made, and the fiber type.

WARNING

If natural-fiber line exceeds 5 years or more, do not use the rope for critical operations or those involving the lives of personnel. Natural-fiber ropes more than 5 years old (even though unused) shall only be used for lashing, fenders, or matting.

It is a good idea to maintain a rigging log to aid in identifying when natural-fiber lines should be removed from service and replaced. Unless a log is maintained, you may have to cut a line open to determine its age.

The following are some pointers on the use and care of natural-fiber and synthetic line. Remember them.

- Coil right-laid line right-handed or clockwise.
- Keep line from touching stays, guys, or other standing rigging.
- When surging line around bitts or capstans, take off enough turns so that the line will not jerk, but will surge smoothly.
- If line becomes chafed or damaged, cut and splice. A good splice is safer than a damaged section.
- Do not lubricate line.
- Whip all line ends.
- Inspect line frequently for deterioration. Open the lay and inspect the fibers. White powdery residue indicates internal wear.
- Do not drag a line over sharp or rough objects; doing so can cut or break the outer fibers, When line is dragged on the ground, dirt and other particles are picked up and eventually work into the line, cutting the inner strands.
- The strength of line exposed to the atmosphere deteriorates about 30 percent in 2 years from weathering alone.
- Line loaded in excess of 75 percent of its breaking strength will be damaged permanently. Inspect the inside threads to see if all or a portion of the fibers in the threads are broken.
- Keep bitts, chocks, and cleats in smooth condition to minimize abrasion.
- Use chafing gear on rough, hard surfaces and sharp metal edges.
- Apply loads slowly and carefully.

SYNTHETIC-FIBER LINES

The synthetic fibers currently in use for making line are nylon, aramid, polyester (Dacron), polypropylene, and polyethylene, in descending order of strength.

The characteristics of synthetic line differ from those of manila line. When using synthetic-fiber line, you must observe safety precautions more exacting than those for manila line. A complete list of precautions is located in chapter 613 of the *Naval Ships' Technical Manual (NSTM),* but the more important precautions to be observed are as follows:

- Because of the lower coefficient of friction of synthetic-fiber line, exercise extreme care when a line is being payed out or eased from securing devices (bitts, capstans, cleats, gypsy heads, etc.). For control in easing out, take no more than two round turns on cleats or bitts. For checking a line under strain, take two round turns followed by no more than two figure-eight bends. Any more than this will present a danger to personnel and cause difficulty in handling the line.
- To minimize the hazard of pulling a line handler into a securing device when a line suddenly surges, have safety observers ensure that all the line handlers stand as far as possible with a minimum distance of at least 6 feet from the securing device being tended or worked. Note that this is particularly critical in mooring operations.
- Since a snap-back action inevitably occurs when a line parts under tension, never allow personnel

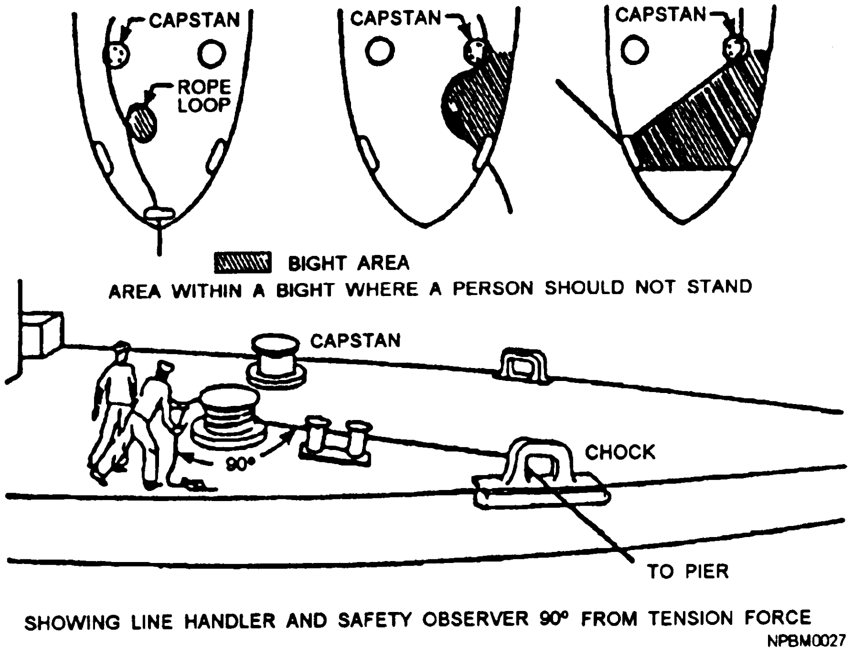


Figure 2-7.—Safe working area.

to stand in the direct-line-of-pull of the line when it is being pulled or when it is under tension. A synthetic line parting under tension will snap back at near the speed of sound, and reaction time to clear the area will not be available. Where possible, position line handlers a minimum of 90° from the direction of the tension force (fig. 2-7).

- Synthetic lines have higher breaking strengths than equal sizes of manila line. Failures of blocks, pad eyes, shackles, and line couplings can be caused by improper substitutions. Many fittings in common use in the fleet are designed for natural-fiber line. For this reason, personnel should determine the identification and capacity of all the gear and fittings used with synthetic-fiber line to ensure that their strength exceeds the minimum breaking strength of the rope. Where the substitution of synthetic-fiber line for manila line is authorized, NSTM, chapter 613, provides the appropriate guidance for the substitution.

- Synthetic line has poor knot-holding characteristics. Some knots that offer good characteristics for securing manila line, such as the square knot, are not adequate for belaying or securing synthetic line. The bowline is one knot known to offer reasonable security when you are bending together or securing synthetic line.

The three following safety rules must be heeded in line handling regardless of the line fiber material:

- Never stand in the bight of a line or in the direct-line-of-pull when the line is being pulled or under tension. See figure 2-7 for examples of danger areas.

- Never continue to increase the load on a line after the rigs have been two-blocked or tightened. Many injuries and fatalities have occurred when operators have not observed this rule.

- Remember that a safety observer is imperative in every case where lines are being worked.

Line Characteristics

Lines are classified by both their construction and their material. The most common line constructions currently used in the Navy are three-strand, double-braided, aramid, and plaited.

Determination of the appropriate line should be based on both the construction of the line and its material. The most common properties of the three constructions are shown in table 2-1. The most common properties of the three materials are shown in table 2-2.

Table 2-1—Synthetic-fiber-line Constructions and Characteristics

Rope Construction	Breaking Strength	Abrasion Resistance	Stretch	Cost	Rotation Under Load
Three Strand	Medium	Good	Highest	Low	Yes
Double Braided	High	Good	Low	High	No
Plaited	Medium	Good	High	Medium	No

Table 2-2.—Synthetic-fiber-line Materials and Characteristics

Rope Material	Breaking Strength	Abrasion Resistance	Stretch	Cost	Resistance to Sunlight
Nylon	High	Good	High	High	Good
Polyproplene	Low	Fair	Medium	Low	Medium
Polyester (Dacron)	Medium	Best	Least	High	Good

The information found in these tables can be used to determine the construction and material needed for a particular application.

If, for example, a line must be able to withstand abrasion (abrasion being the condition a line is subjected to in a chock or around a capstan head), tables 2-1 and 2-2 indicate that the best choice should be a three-strand nylon line. One of the characteristics listed in tables 2-1 and 2-2 for the three-strand nylon line is that the stretch is high. Stretch is a misunderstood characteristic in synthetic line. In some applications of line, excessive stretch is a disadvantage. In other applications, stretch is an advantage. When a line is subjected to impact loading, as it is in towing, the more stretch the line has, the better it can absorb impact.

Normally, synthetic-fiber line is furnished on reels and is unreeled in the same fashion as wire rope. (Wire rope is discussed in detail later in this chapter.) If you receive a synthetic line made up in a coil, however, do not open the coil and pull the end up through the tunnel as with natural-fiber lines. Set the coil on a turntable and pull on the outside end while somebody rotates the turntable. Should a coil collapse and the line kink and tangle, do not try to untangle it by pulling on the line. Secure one end, and drop the remainder of the coil into the sea. In the water, the line will relax and gradually uncoil without forming permanent kinks or cockles. **(DO NOT TRY THIS WHILE THE SHIP IS UNDER WAY.)** This water treatment also removes bulges in new, soft-laid line and hardens the line structure.

Before new three-strand synthetic-fiber line is used, it should be faked down on deck and allowed to relax for 24 hours. The shorter the line, the less time the relaxing process takes; for example, a length of less than 50 feet will relax in 1 hour.

When wet, synthetic line shrinks slightly and minimal swelling may occur. When the line is tensioned, the water squeezes out; and under working loads, it appears as vapor. Because line under tension develops friction, and thus heat, the water has a beneficial cooling effect. Nylon loses 15 percent of its strength from water being absorbed by nylon molecules.

Nylon, aramid, and polyester lines exhibit almost no decrease in strength due to sunlight, but polypropylene does. Polypropylene line may lose as much as 40 percent of its strength in 3 months when exposed to tropical sunlight if the line is made without ultraviolet inhibitors. Ultraviolet inhibitors can be added to the line at the time of manufacture to reduce the effects of sunlight. White polypropylene line has almost no inhibitors added, while black polypropylene has the most inhibitors added. However, just because a polypropylene is black does not mean that it has had ultraviolet inhibitors added. If a polypropylene line has had ultraviolet inhibitors added, it should meet military specification MIL-R-24049. If the line is obtained

Table 2-3.—CID-A-A-50435 Aramid Rope Procurement Characteristics

CIRCUMFERENCE (INCHES)	BREAKING STRENGTH (POUNDS)	NATIONAL STOCK NUMBER	ALLOWANCE EQUIPMENT LIST
3 3/8	50,000	4020-01-338-7005	2-260024067
3 1/2	60,000	4020-01-338-7499	2-260024070
3 3/4	70,000	4020-01-338-7006	2-260024069
4 1/8	96,000	4020-01-339-1571	2-260024068
4 3/4	135,000	4020-01-338-7003	2-260024076
5 3/8	180,000	4020-01-338-7007	2-260024071
5 7/8	225,000	4020-01-339-5150	2-260024072
6 1/4	280,000	4020-01-338-7008	2-260024073
7 5/8	350,000	4020-01-338-7009	2-260024074
8 3/16	420,000	4020-01-338-7010	2-260024075

Table 2-4.—Aramid Rope Substitution

ARAMID 4-STRAND CID-A-A-50435	NYLON 3-STRAND MIL-R-17343	NYLON PLAITED MIL-R-24377	NYLON DOUBLE-BRAIDED MIL-R-24050	POLYESTER DOUBLE-BRAIDED MIL-R-24677
3 3/8	4 1/2	4	4	4
3 1/2	5	4 1/2	4 1/2	4 1/2
3 3/4	5 1/2	5	5	5
4 1/8	6	6	5 1/2	6
4 3/4	7	7 1/2	7	7
5 3/8	8	9	8	8
5 7/8	9	10	9	9
6 1/4	10	11	10	10

through the Naval Supply System (stock system), the proper specification is assured.

Oil and grease do not cause synthetics to deteriorate, but they may make them slippery. When this happens, the line should be scrubbed down. Spots may be removed by cleaning with liquid soap and water or with a light oil, such as diesel oil or kerosene.

Four-Strand Aramid Line

Four-strand aramid lines are designed to fail sequentially, meaning that one of the four strands will fail before the other strands. This new line that has only been out for a couple of years has been proven to work better than a three-strand mooring line, and less line handlers are required due to the smaller size of line required to moor a ship. Table 2-3 is the proper procurement characteristics of aramid line and the stock numbers for ordering.

Aramid line is being phased into the Navy for three-strand nylon; table 2-4 shows the different sizes of lines from three-strand nylon to polyester double-braided line.

The following is an inspection guideline. Rope technology has not yet advanced to the point where a rope can be visually inspected to determine exact extent of damage. This is a recommended list for use as appropriate:

CHARACTERISTICS	RESPLICE (IF LOCALIZED)	REPLACE
1. Rope suspected of being shock loaded.		X
2. Rope that has exceeded 75 percent of its minimum breaking strength.		X
3. Bulk of surface yarns or strands reduced by approximately 50 percent for a linear distance equal to four times the rope circumference.	X	X
4. Three or more adjacent cut yarns in the strands of ropes 5-inch circumference.	X	X
5. Four or more adjacent cut yarns in the strands of ropes 5-inch circumference and over.	X	X
6. Stretch out: Circumference reduced by 5 percent from circumference when new.		X
7. Chockling	X	
8. Oil and grease	Wash in mild detergent	
9. Heavy surface fuzz progressive.	X Remove source of abrasion	X
10. Burns or melting visible for a length of over four times the rope circumference.	X	X
11. Rust on nylon.	X (or clean)	
12. More than four adjacent pulled cover strands (which cannot be reincorporated into cover braid).	X	X
13. Core visible through cover because of cover damage(except single braids).	X	X
14. Core damage - pulled, cut, abraded, or melted strands.		X
FOR THREE-STRAND AND EIGHT-STRAND PLAITED ROPES		
15. Damage in valley between strands.	X	X
16. Powdering between adjacent strand contact surfaces.	X	X
WHEN IN DOUBT REMOVE FROM SERVICE!		

Table 2-5.—Rope Elongation

TYPE	APPROXIMATE ELONGATION AT BREAK (PERCENT)		
	NYLON	POLYESTER	ARAMID
Three-strand	55	35	–
Double-braided	30	30	–
Plaited	65	45	
Four-strand	–	–	6

Nylon rope, on parting, is stretched nearly one-half of its original length. This length is recovered instantaneously on parting, causing snap back with hazardous force. In view of this danger, it is imperative that no one stand in direct line of the pull when a heavy load is applied to the line. Polyester rope is stretched nearly one-third of its original length and is equally dangerous as is aramid rope, which stretches six percent. Table 2-5 shows the approximate elongation of nylon, polyester, and aramid ropes at break. These elongation percentages were taken from the mil specs and commercial item descriptions for the ropes.

SPLICING LINE

LEARNING OBJECTIVES: Explain the different ways to splice line. Describe the difference between a long splice and a short splice. Explain how to make a double-braided eye splice and how to put a tattletale in all the mooring lines.

The ends of line may be joined permanently by a long splice or by a short splice. Whether a long or a short splice is used depends on how the line is to be used. The short splice is described in the NSTM, Chapter 613 and will not be repeated here. In this manual, we discuss the eye splice and the long splice.

EYE SPLICE

The eyes in mooring lines are normally 6 to 10 feet long, depending on the size of fittings (bollards, bitts, or cleats) used. The rule of thumb for the preferred length of the eye is five times the diameter of the fitting; this prevents uneven loading of the eye.

The following is a step-by-step procedure for splicing aramid line:

NOTE

The eye requires chafing gear for abrasion protection.

The eye splice of aramid line is a little different from any other line. Three main components are involved: the eye, the individual strands, and the standing part of the line.

1. Measure a distance of eight times the rope circumference from the end of the rope. Mark with a temporary whipping. Determine the eye size and form a loop that places the first whipping on the standing part at the end of the eye. Mark with a second temporary whipping.

2. Unlay the strands of the rope to the first whipping and cut out the center core. Looking in the direction of the standing part, tuck the first strand under the top two strands of the standing part from the left to right with the lay at the base of the second whipping.

3. Tuck the second strand under the next strand of the standing part with the lay.

4. Turn the rope over and tuck the three strand under the next strand of the standing part with the lay.

5. Tuck the fourth strand under the next strand of the standing part of the lay. This constitutes one full tuck.

6. Ensure all the working strands are pulled tight and free of twists.

7. Continue tucking all four strands in succession over and under the strands of the standing part for a total of six full tucks.

8. Tapering an additional two tucks by cutting approximately 1/3 of the fibers for each tuck (i.e., 2/3 remaining and 1/3 remaining in the last two tucks) for a total of eight full tucks required.

9. Use a light strain to set the splice.

10. (Optional) Marry the working strands using an inside whipping under the strands of the standing part at the last full tuck.

11. Cut the remaining tail off about 2 inches from where the strand exits the splice. If the strands are cut too close, they can work loose or out, causing the splice to slip.

12. Whip the bottom of the splice with polyester whipping.

THREE-STRAND EYE SPLICE

To make an eye splice out of manila or synthetic line, you must untwist the strands in the end of the line anywhere from 4 inches to 2 feet, depending on the size of line, and splice them into the standing part of the line by tucking the unlaid strands from the end into the standing part.

Learn to estimate the length of the line you need to unlay for the complete splice so you will not finish short nor waste a lot of line by cutting it off. An original round of tucks, plus three more complete rounds, is enough for an ordinary eye splice. Four tucks are mandatory in nylon because of its low friction and stretch characteristics.

With large lines you must whip the ends of the strands before you start; otherwise, they will unravel and become troublesome. Large lines also must be seized at the point where the unlaying stops, or you will have trouble working them. With any line up to about 2 inches, you can open the strands in the standing part with your fingers. The fid must be used for larger lines.

Figure 2-8 shows the knack of working the fid in making an eye splice. Lay out your line along the deck with the end to the right. Bend the line back until the eye is the desired size, and shove the fid through the standing part at the correct spot to raise the top strand. With your right hand, shove the fid through, away from you, holding the line with your left hand. Grab the raised strand with you left finger and thumb, and hold it up while you pull out the fid. Lay the fid down, pick up the proper strand in the end, and tuck it through the raised strand from the outboard toward you.

Your first round of tucks must be taken in proper order to avoid getting fouled up. Separate the strands in the end and hold them up, as shown in view 1 in figure 2-8. The middle strand (facing you) always tucks first. Be sure to keep the right-hand strand, as shown in view 2, on the side of the line that is toward you. Tuck that one next, over the strand you just tucked the other one under, and under the strand just below it, as shown in view 3.

Now turn the whole thing over. In view 4, you can see that you now have only one strand from the end left untucked, and only one strand in the standing part that does not already have a strand under it. Do not forget to tuck the last strand from outboard toward you.

The first round of tucks is the key to making a perfect eye splice; the rest is easy. Simply tuck each strand from the end over the strand of the standing part that it is now above, and under the next strand below that one until you tuck each strand twice more besides the original tuck. Three tucks is enough for natural-fiber rope. Four or five tucks are needed for synthetic fiber, especially the more slippery nylon.

LONG SPLICE

A long splice does not change the diameter of a rope materially; therefore, it is used to join two ropes when it is necessary that the rope runs over sheaves in a block. To make a long splice, observe the following steps:

1. Unlay the end of each rope 15 turns.

2. Place the ends together, as shown in view A of figure 2-9, and seize five of the strands together.

3. Unlay the loose strand ten more times.

4. Lay the opposite strand from the other rope in the groove left by inlaying the first strand (view B).

5. Tie an overhand knot, as shown in view C.

6. Cut out the seizing and unlay a strand in the opposite direction,

7. Repeat steps 4 and 5.

8. The an overhand knot in the two remaining strands.

9. Take a tuck with each strand or split each strand and make tucks in opposite directions with the halves,

View D shows the completed long splice.

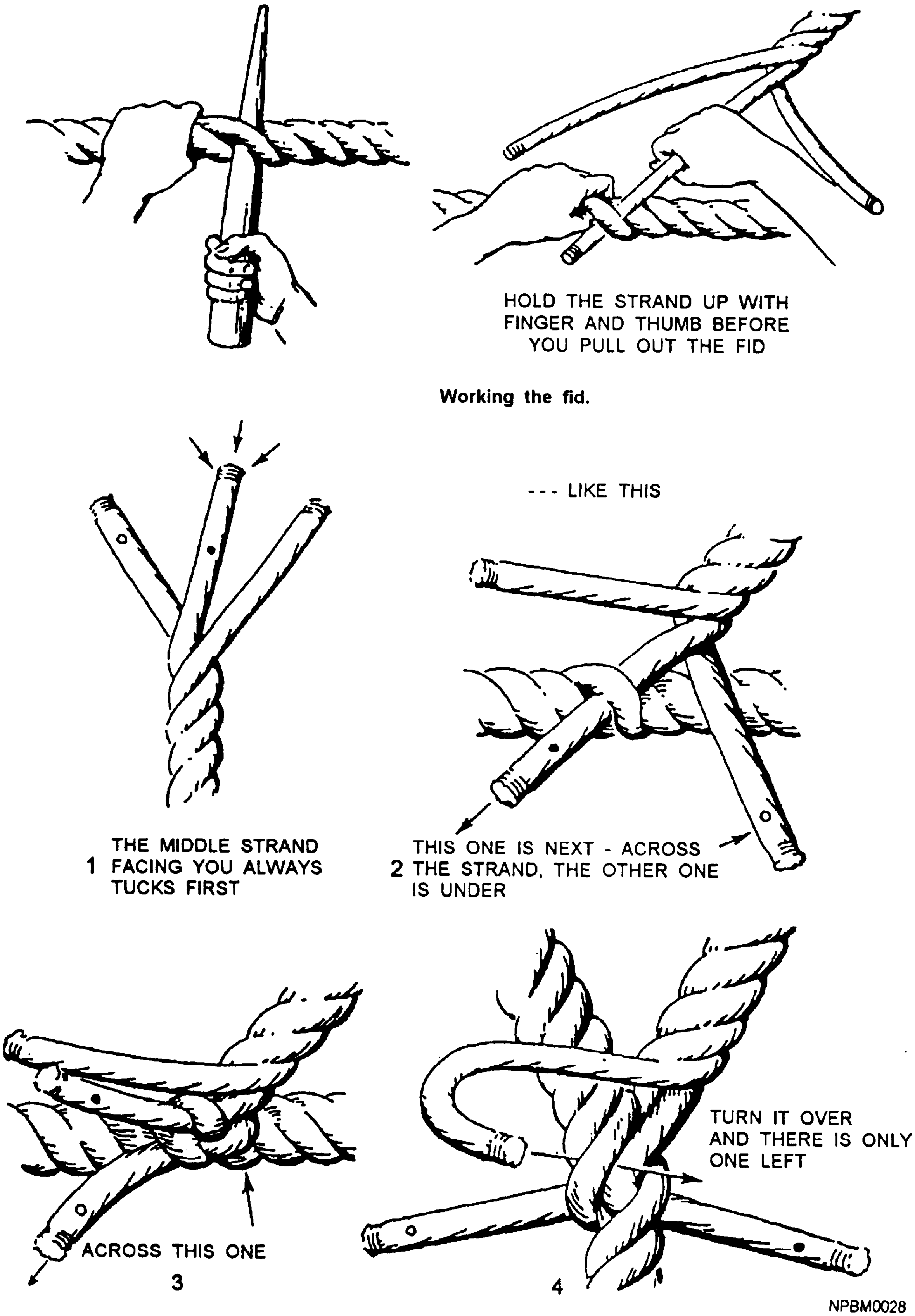


Figure 2-8.—Making an eye splice in a three-strand line.

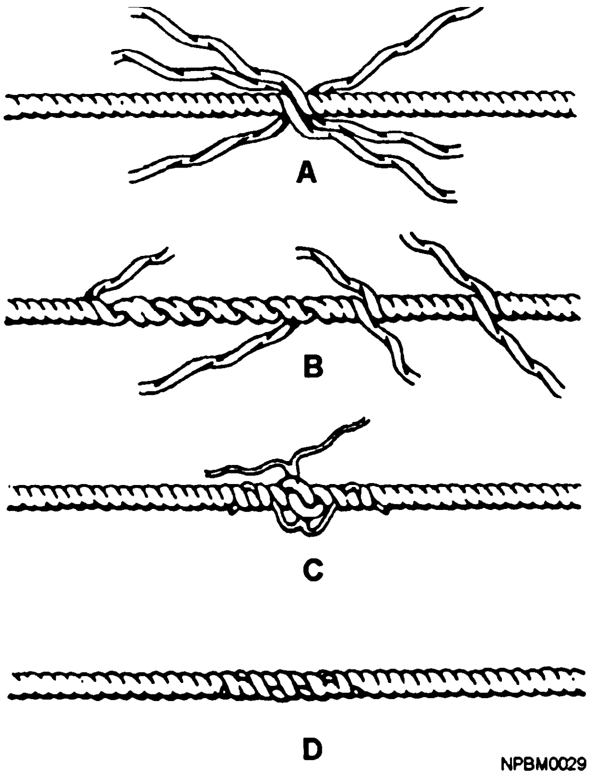


Figure 2-9.—Long splice in fiber line.

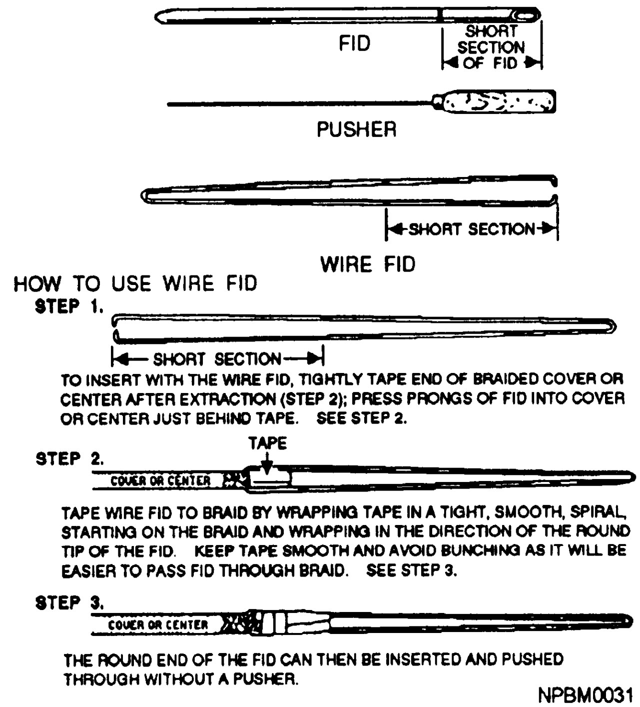


Figure 2-10.—Fids used for splicing double-braided line.

SPLICING DOUBLE-BRAIDED LINE

When double-braided nylon line is being spliced, the end must be worked into the center, and special tools are needed for the job. For line 3 inches in circumference or smaller, a tubular fid and a pusher are used. For line larger than 3 inches in circumference, only a wire fid is used. Steps 1, 2, and 3 in figure 2-10 show how to secure the fid to the line. Stamped on each fid is a number indicating the size of line for which the fid was made. Table 2-6 gives a line-fid size comparison if you should need to make your own, or measure to ensure you have the correct fid. Fids also serve as “rulers” to measure with while splicing is being done, as will be explained. The wire fid lengths in figure 2-11 are in 1/2 and 1/3 scale. When measuring 13 inches in circumference and smaller with a wire fid, you must double the measurements. For 14 inches and larger, you must triple the measurements. Friction or masking tape and a soft lead pencil, crayon, or preferably, a wax marking pencil are needed. Sharp-pointed shears also are handy.

The splice described here, and the line on which it is used, was developed by the Samson Cordage Works of Boston, Massachusetts.

STANDARD EYE SPLICE IN NEW DOUBLE-BRAIDED LINE

The standard eye splice can be performed on new line only. It retains up to 90 percent of the average new line strength. Until you have become familiar with splicing this material, each step should be followed in detail. Figure 2-10 shows the fids and pushers used for splicing; steps 1 through 3 explain how to secure the wire fid to the line that is to be spliced. Figure 2-11 shows how to mark the line and extract the core.

1. Tape the end to be spliced with one thin layer of tape. Then measure one tubular fid length (two wire fid lengths, because wire fid is 1/2 size) from the end of the line and mark. (This is point R [reference], step 1 of figure 2-11.) From R, form a loop the size of the eye desired and mark. (This is point X, where you will pull the core out of the cover.)

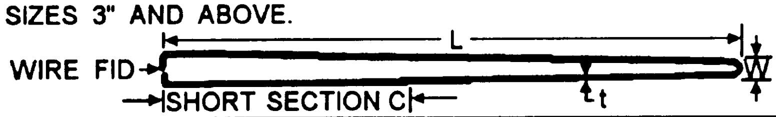
2. Tie a tight slipknot approximately five fid lengths from X. This must be done to keep the core and cover from becoming uneven. Bend the line sharply at X. With the pusher or any sharp tool, such as an ice pick, awl, or marlinespike, spread the cover strands to expose the core (step 2). Do NOT pull the cover strands away from the line or split the paired strands when you are spreading the cover, as this will distort the line

Table 2-6.—Braided Line Fid Specifications

SPECIFICATIONS FOR LINE SIZES 3" AND UNDER.

FID SIZE AND ROPE CIRCUMFERENCE	2-IN-1 BRAID I ROPE DIAMETER	FID SHORT SECTION LENGTH	TOTAL FID LENGTH
3/4"	1/4"	2 - 1/16"	5 - 1/2"
1"	5/16"	2 - 1/2"	6 - 3/4"
1 - 1/8"	3/8"	2 - 7/8"	7 - 3/4"
1 - 1/4"	7/16"	3 - 9/16"	9 - 1/2"
1 - 1/2"	1/2"	4 - 1/8"	11"
1 - 3/4"	9/16"	3 - 5/8"	12 - 1/4"
2"	5/8"	4 - 1/8"	14"
2 - 1/4"	3/4"	4 - 3/4"	16"
2 - 3/4"	7/8"	4 - 3/4"	19"
3"	1"	5 - 1/4"	21"

SPECIFICATIONS FOR LINE SIZES 3" AND ABOVE.



ROPE DIAMETER	ROPE CIRCUM-FERENCE	WIRE DIAMETER t	TOTAL WIDTH W	FID LENGTH L	SHORT SECTION C	FID SCALE
1"	3"	3/16"	3/4"	10 - 1/2"	2 - 5/8"	1/2
1 - 1/8"	3 - 1/2"	3/16"	3/4"	12 - 1/4"	3"	1/2
1 - 1/4"	3 - 3/4"	3/16"	3/4"	13 - 1/4"	3 - 1/4"	1/2
1 - 5/16"	4"	3/16"	3/4"	14"	3 - 1/2"	1/2
1 - 1/2"	4 - 1/2"	3/16"	3/4"	16"	4"	1/2
1 - 5/8"	5"	3/16"	3/4"	17 - 1/2"	4 - 1/2"	1/2
1 - 3/4"	5 - 1/2"	1/4"	3/4"	19"	4 - 3/4"	1/2
2"	6"	1/4"	1 - 1/4"	21"	5 - 1/4"	1/2
2 - 1/8"	6 - 1/2"	1/4"	1 - 1/4"	23"	5 - 3/4"	1/2
2 - 1/4"	7"	1/4"	1 - 1/4"	25"	6"	1/2
2 - 1/2"	7 - 1/2"	1/4"	1 - 1/4"	26"	6 - 1/2"	1/2
2 - 5/8"	8"	1/4"	1 - 1/4"	28"	7"	1/2
2 - 7/8"	8 - 1/2"	1/4"	1 - 1/4"	30"	7 - 1/2"	1/2
3"	9"	5/16"	1 - 7/8"	32"	8"	1/2
3 - 1/4"	10"	5/16"	1 - 7/8"	35"	8 - 3/4"	1/2
3 - 1/2"	11"	5/16"	1 - 7/8"	39"	9 - 1/2"	1/2
4"	12"	5/16"	1 - 7/8"	42"	10 - 1/2"	1/2
4 - 1/4"	13"	5/16"	1 - 7/8"	46"	11 - 1/2"	1/2
4 - 5/8"	14"	3/8"	4 - 1/2"	33"	8 - 1/4"	1/3
5"	15"	3/8"	4 - 1/2"	35"	8 - 3/4"	1/3
5 - 1/4"	16"	3/8"	4 - 1/2"	37"	9 - 1/2"	1/3
5 - 1/2"	17"	3/8"	4 - 1/2"	40"	10"	1/3
6"	18"	3/8"	4 - 1/2"	42"	10 - 1/2"	1/3
6 - 1/4"	19"	3/8"	4 - 1/2"	44"	11"	1/3
6 - 1/2"	20"	3/8"	4 - 1/2"	47"	11 - 1/2"	1/3
7"	21"	3/8"	4 - 1/2"	49"	12 - 1/4"	1/3

NOTE: WIRE FID SIZES 3" CIRC. TO 13" CIRC. ARE 1/2 SCALE - OVER 13" CIRC. ARE 1/3 SCALE. THIS IS NECESSARY IN ORDER TO KEEP WIRE FIDS TO A PRACTICAL LENGTH.

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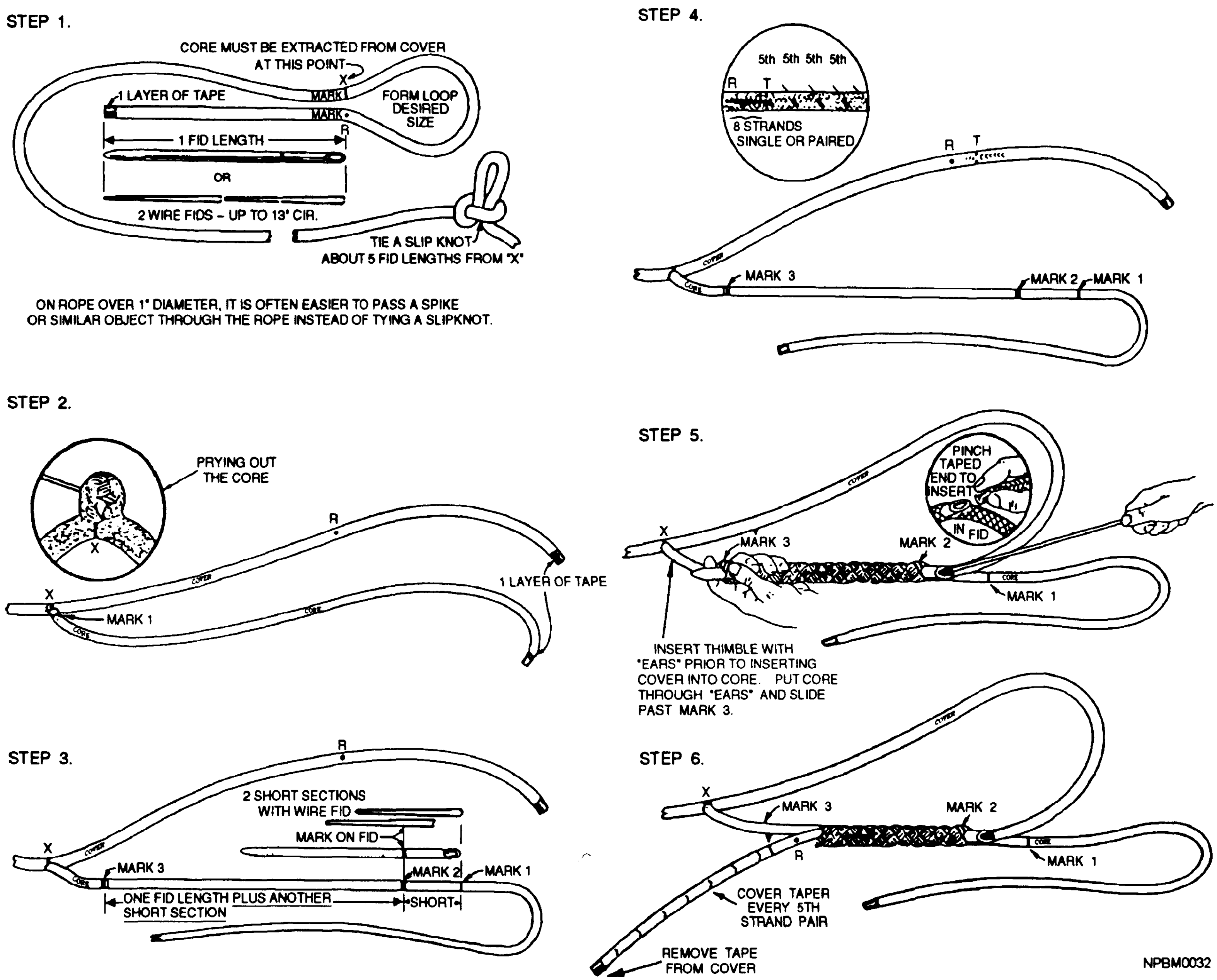


Figure 2-11.—Completing the double-braided eye splice.

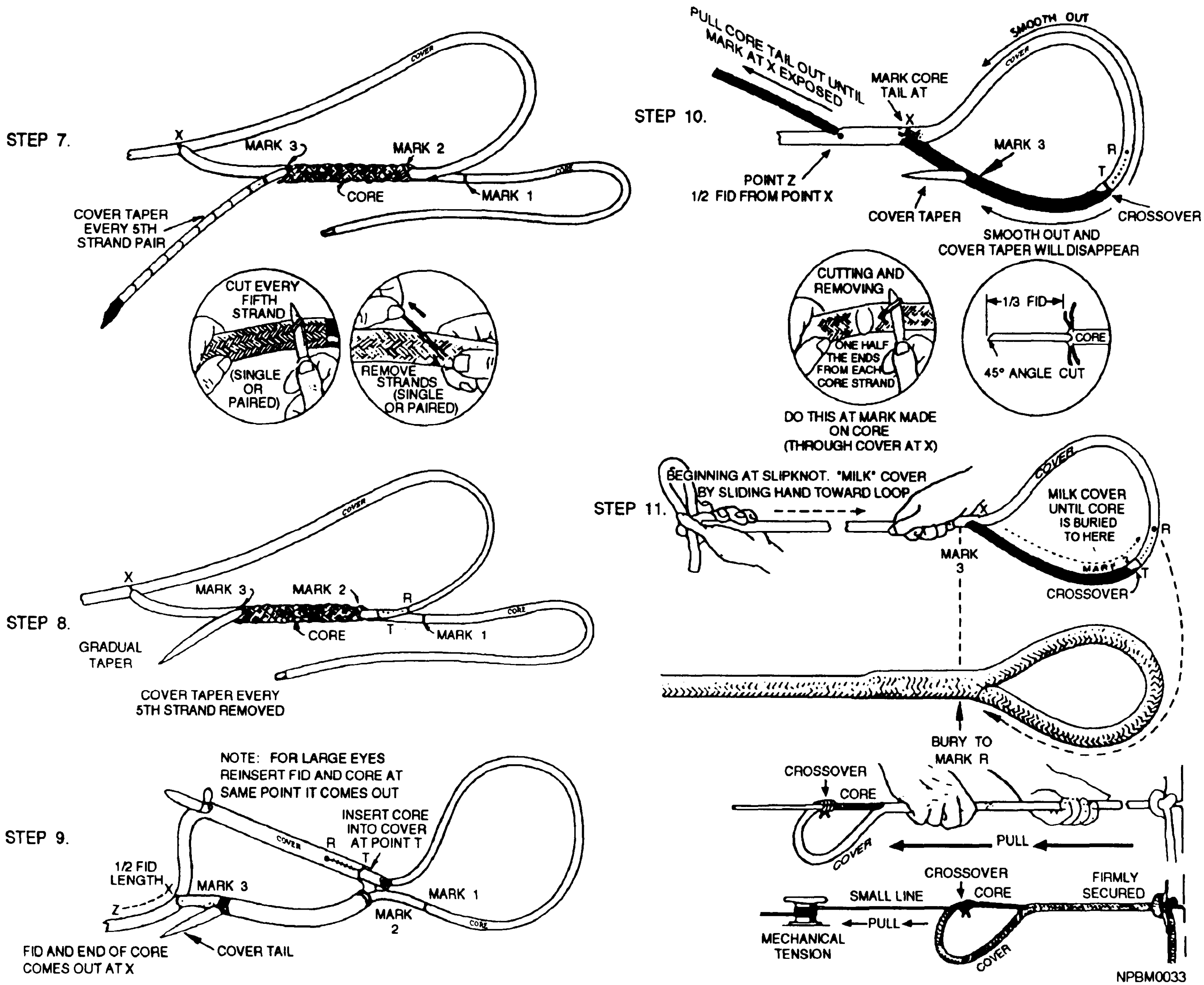


Figure 2-11.—Completing the double-braided eye splice—Continued.

unnecessarily. First pry, then pull the core completely out of the cover from X to the taped end of the line. Put one layer only of tape on the end of the core. To assure correct positioning of mark 1, do the following: Holding the exposed core, slide the cover as far back toward the tightly tied slipknot as you can. Then firmly smooth the cover back from the slipknot toward the taped end. Smooth again until all the cover slack is removed. Then mark the core where it comes out of the cover. (This is mark 1.)

3. Again slide the cover toward the slipknot to expose more core. From mark 1, measure along the core toward X, a distance equal to the short section of tubular fid (two short sections with wire fid) and make two heavy marks. (This is mark 2.) From mark 2, measure in the same direction one fid length plus another short section of the fid (with wire fid, double measurements) and make three heavy marks. (This is mark 3, step 3.)

4. The nature of the cover braid—it is made up of strands, either one or two (pair). Notice that half of the pairs revolve to the right around the rope and half revolve to the left. Beginning at R and working toward the taped end of the cover, count eight consecutive strands (single or pairs) that revolve to the right (or left). Mark the eighth strand. (This is mark T, step 4.) Make mark T go completely around the cover. Starting at T and working around the taped cover end, count and mark every fifth right and left strand (single or paired) until you have progressed down to the end of the taped cover.

NOTE

When inserting the fid in at mark 2 and out at mark 3, ensure no strands in the core are split.

5. Insert the fid into the core at mark 2. Slide it through and out at mark 3. See figure 2-11, step 5. Add extra tape to the tapered cover end, then jam it tightly into the hollow end of the fid (see insert). Hold the core lightly at mark 3; place the pusher point into the taped end; push the fid and cover through from mark 2 and out at mark 3. With the wire fid, first press prongs into the cover, then tape over. Then after the fid is on, milk the braid over the fid while pulling the fid through from mark 2 to mark 3. Take the fid off the cover. Continue pulling the cover tail through the core until mark R on the cover emerges from mark 3 (see step 6). Then remove the fid and the tape from the end of the taped cover.

6. Make sure the tape is removed from the cover end. Now taper the cover by starting with the last marked pair of cover strands toward the end; cut and pull them out completely (see step 7). Cut and remove the next marked strands and continue with each right and left marked strand until you reach point T; do NOT cut beyond this point. The result should be a gradual taper ending in a point. Very carefully pull the cover back through the core until point T emerges from mark 2 of the core (see step 8). From point X on the cover, measure approximately one-half of fid length toward the slipknot on the line and mark this point Z (see step 9).

7. You are now ready to put the core back into the cover from T to Z. Insert your fid at T (step 9); jam the taped core end tightly into the end of the fid. With the pusher, push the fid and core through the cover "'tunnel" past point X, to and through the cover at point Z. When using the wire fid, attach the fid to the taped core. After the fid is on, milk the braid over the fid while pulling it through from T to Z. When pushing the fid past X to Z, make sure the fid does not catch any internal core strands.

NOTE

Depending on eye size, the fid may not be long enough to reach from T to Z in one pass. If not, bring the fid out through the cover, pull the core through, and reinsert the fid into the same hole it came out of. Do this as many times as needed to reach point Z.

8. Alternately pull on the core tail at Z, then pull on the tapered cover at mark 3. The crossover should be tightened until the crossover is equal to the diameter of the line. Remove all the slack from the eye area by smoothing the cover from point T toward X. Mark the core tail through the cover at point X (see step 10). Then pull the core tail out until the mark just made on the core is exposed at Z. The diameter of the core must now be reduced by cutting and removing one strand of each group around the complete circumference. Measure one-third of fid length from the first reduction cut toward the end and make a mark. Cut off the remaining tail at this point. Make the cut on a 45° angle to prevent

a blunt end (see the inset of step 10). With one hand, hold the crossover part (mark T). Smooth the cover section of the eye out firmly and completely from the crossover toward mark X. The reduced-volume core tail should disappear into the cover at Z. Smooth out the core section from the crossover toward mark 3, and the cover taper will disappear into the core. Hold the rope at the slipknot and with your other hand, milk the cover toward the splice, gently at first, then more firmly (see step 11). The cover will slide over mark 3, mark 2, the crossover, T, and R. (It may be necessary to occasionally smooth out the eye during milking to prevent the reduced-volume tail from catching in the throat of the splice.)

If bunching occurs at the crossover, preventing full burying, smooth the cover from T to X. Grasp the crossover at T with one hand and then firmly smooth the cover slack (female side of eye) with the other hand towards the throat (X). Repeat as necessary until bunching disappears. Continue milking until all of the cover slack between the knot and the throat of the eye has been removed.

NOTE

Before burying the cover under the crossover, do the following:

- **Anchor the loop of the slipknot to a stationary object before starting to bury the cover. You can then use both hands and the weight of your body to more easily bury the cover over the core and crossover.**

- **Holding the crossover tightly, milk all excess cover from R to X.**

Flex and loosen the line at the crossover point during the final burying process. Hammering the cover at point X with a rubber or rawhide mallet will help loosen the strands.

With larger ropes, it is helpful to anchor the slipknot securely, attach a small line to the braided core at the crossover, use a rolling hitch and mechanically apply tension with either a block and tackle, capstan, come-a-long, or power winch. Tension will reduce the diameter of the core and crossover for easier burying.

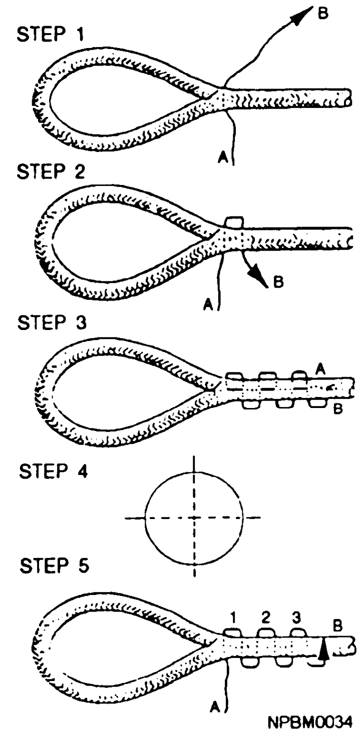


Figure 2-12.—Making the lock stitch.

Care must be taken to apply more tension than that for small lines safe working load.

9. Prior to whipping (fig. 2-12), it is to your advantage to stitch-lock the splice to prevent no-load opening. You will need approximately one fid length of nylon or polyester whipping twine. The twine should be about the same size as the strands of line you are stitching. Strands cut from the line may be used. To begin the lock stitch, pass the twine (A) through the line as shown in step 1, figure 2-12. Reinsert the twine as in step 2. (Ensure that all the stitching is just snug. DO NOT TIGHTEN.) Continue until you have four complete stitches. After you have four stitches, turn the line 90° and pass the remaining end (B) through the line perpendicular to the original stitches to make four more stitches. The line should now look like step 4. Now take ends A and B, tie a square knot, and bury it in between the cover and the core. You may now whip the line or leave it as it is.

You will become more proficient at splicing line each time you do it. Remember to follow each step the manufacturer has laid down in the splicing manuals. This must be done for safety reasons. The splices described and the methods for accomplishing them have been tried and proven. They leave no margin for shortcuts. As you progress in the Boatswain's Mate rating, you will learn new splices and various methods of applying line in a working environment.

Constantly coiling plain-laid synthetic line in the same direction tends to tighten the twist or unbalance the lay. To alleviate this condition, occasionally coil such line down against the lay. This line may be coiled on a reel in either direction, but each succeeding coil should be laid close to the preceding one to prevent binding in the under coils. Double-braided line and plaited line can be faked down in the usual manner or laid out in figure eights.

When a synthetic line is put under load, it stretches. When the load is removed, the line recovers to its original length. However, complete recovery takes time. If a line has been highly loaded for a long period of time, the total recovery may take as much as a month. Fortunately, most of this recovery does take place in the first several minutes after the line is unloaded. This recovery characteristic of synthetic line is called "memory." Because of memory there is one situation that should be avoided when synthetic line is being used—SYNTHETIC LINE SHOULD NOT BE STOWED ON A POWERED STOWAGE DRUM/REEL. If a synthetic line has been under load and then is put on a powered stowage drum/reel, where each wrap and each layer is tightly wound on the drum before the line has recovered its original length, then the line will continue to recover and shrink tighter and tighter on the drum. In several cases, this has caused steel drums to collapse suddenly and at the same time blow the flanges off.

The coefficient of friction of synthetic fibers is lower than that of manila, which means that synthetic lines will slip more easily than manila. Because of this tendency to slip, an extra tuck must be added when synthetic lines are being spliced. For the same reason, greater care must be used when you are springing or heaving on a synthetic line. Figure-eight turns on double bitts tend to lock under heavy strain. When the line thins down, the figure-eight turns slip suddenly, and the line surges so rapidly that it often rides up and over the top of the bitts. Therefore, extreme care should be exercised when synthetic line is being eased out from around bitts, cleats, or other holding devices under heavy load. For control in easing-out, take no more than two round turns on a cleat or bitts. When machinery is being used to heave on a synthetic line under heavy or impact loading, six or more turns should be taken on the capstan or gypsy head plus two riding turns, as shown in figure 2-13.

Because synthetic line, on parting, is stretched by as much as 50 percent (three-strand nylon) of its length, it parts with a decided snapback, traveling at near the speed of sound. Personnel should stay 90 degrees from the direct-line-of-pull when strains are applied. Those handling the line on a capstan, gypsy head, or bitts should stand outside the arc of swing (fig. 2-7), in case the line parts.

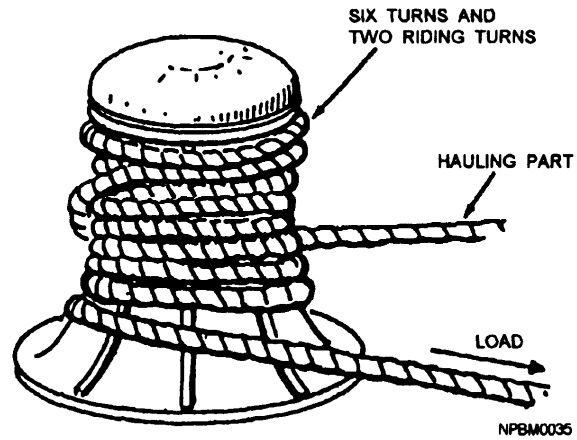


Figure 2-13.—Overriding turns for synthetic line on a capstan.

Synthetic line that has been under heavy strain may display glazed areas where it has worked against bitt and chock surfaces. This condition may be caused by paint or the fusing of the fibers. After long use, these ropes also become fuzzy on the surface. In either case, the effect on the strength of the rope is negligible. These ropes can hold a load, even though a number of the yarns have been abraded. Where such a condition is excessive but localized, the chafed section may be cut away and the ends spliced together. *NSTM,* chapter 613, describes the end-to-end splice in synthetic line.

Do not use manila, wire, or spring-lay rope in conjunction with synthetic line in the same chock or on the same bitts or bollards. Synthetic line will cut manila, and wire and spring-lay rope will cut both manila and synthetic lines. If you must place your mooring lines on bollards on which another ship has dissimilar hawsers, wrap the eyes of your lines with chafing gear before looping them over the bollards. Some ships slide a piece of old firehose on synthetic lines before splicing the eye, providing a permanent piece of chafing gear in the eye. Do not try this trick on natural-fiber lines, however, because the hose will hold moisture in the line much longer, hastening deterioration.

Every line used in the Navy is manufactured to certain specifications devised to produce the best lines for particular types of jobs. To ensure the longest life, use a line within its safe working load (SWL). The SWL of line ranges from one-sixth to one-tenth of the minimum breaking strength (BS) of the line when new, allowing for the type of application, the weather, and the blocks and other gear being used with the line.

Sailors who work with natural-fiber line soon learn how to judge the tension in such lines by the sounds they produce. Unfortunately, synthetic lines under heavy strain, even though they have thinned down considerably, give no audible or visual indication of stress even when about to part. For this reason, a tattletale cord should be attached to synthetic lines when they are to be subjected to loads that may exceed their SWLs. A tattletale cord is a bight of six-thread manila hanging from two measured points on the working line. The line, when tensioned to its SWL, will stretch to a certain percentage of its elastic length. When this point is reached, the tattletale cord becomes taut, warning that there is danger of exceeding the SWL of the line. Figure 2-14 shows a tattletale cord on a three-strand nylon line.

If a line is loaded beyond its SWL, it may reach a critical point, which is near the BS of the line. A line may repeatedly be brought to its SWL without impairing the line or reducing its useful life. From the standpoints of safety and economics, it makes sense to take precautions not to surpass the SWL of a line. Use tattletale cords and every other guide available to ensure that SWLs are not ignored. Lengths of tattletale cords and the distances between suspension points for various lines are shown in table 2-7. SWL is discussed more fully in a later chapter.

Do not use a single part of plain-laid line for hauling or hoisting any load that is free to rotate. Where one part is essential, use cable-laid hawsers, double-braided line, or plaited line. Use only nylon line stoppers for holding

Table 2-7.—Dimensions for Tattletale Cords

Type of Synthetic Rope	Length of TattleTale (Inches)	Distance Between Marks (Inches)
Nylon Three-Strand	35 1/2	30
Nylon Plaited	43 1/2	40
Nylon Double-Braid	43 1/2	40
Polyester Three-Strand	63 1/2	60
Polyester Plaited	62 1/2	60
Polyester Double-Braid	62	60

nylon hawsers under load. The two most commonly used stoppers are the crisscross and the rattail. The crisscross stopper is the preferred stopper for stopping off synthetic line. A 3-inch stopper is used for lines up to 6 1/2 inches in circumference, and a 5-inch stopper is used on line from 7 inches through 12 inches in circumference. In the crisscross method, pass the two legs, crisscross fashion, around the line being held at least six times and twist the ends together to hold the stopper. The rattail stopper may be used, with a rolling hitch and two half hitches, but under heavy loads, it will jam.

When you are referring to the BS of line, the current practice in the Navy is to use the minimum BS. "Minimum BS" is defined as the lowest BS encountered in all of the test samples broken. Line manufacturers usually publish average BSs, which may be 10 to 25 percent higher than the minimum BSs. The actual BS of

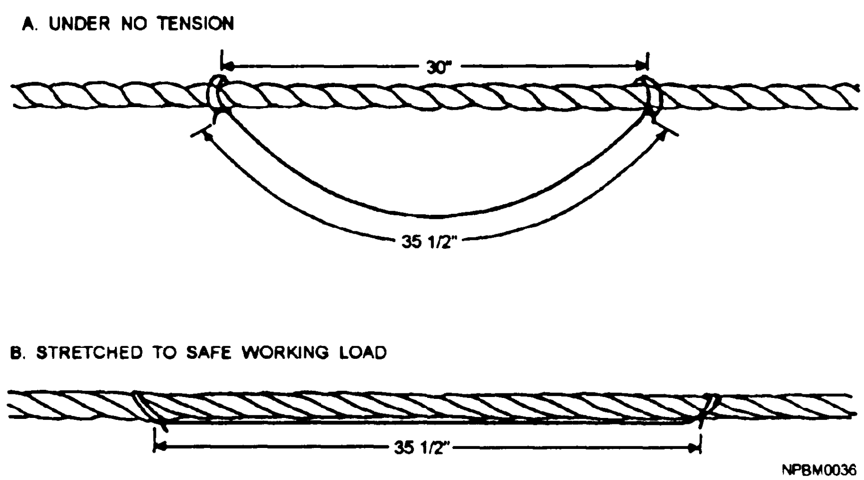


Figure 2-14.—Tattletale cord on a twisted nylon line.

a line can be anywhere from the minimum BS to 35 percent higher.

Chapter 613 of the *NSTM* covers the minimums BS and SWL of all the lines used in the Navy. Refer to this chapter before loading a line.

ALONGSIDE MOORING

LEARNING OBJECTIVES: Describe the procedures and precautions used in working lines and line-handling details. Identify personnel hazards including snap-back. Describe the use of heaving lines, bolos, and line-throwing guns in a mooring evolution. Explain all the safety precautions involving all the line-handling situations.

Mooring alongside a pier and getting under way from a pier are basic yet extremely critical functions performed by the deck department. To accomplish the mooring of a ship safely takes preparation, training, and the teamwork of all the hands. A sound working knowledge of capstans, gypsy heads, deck and pier fittings, and the proper use of mooring lines is a must to the successful mooring evolution.

MOORING LINES

Ships are moored to piers, wharfs, quay walls, and nested with other ships by mooring lines, which vary in size depending on the type of ship. For instance, a destroyer uses a 5-inch synthetic line, and a carrier uses an 8-inch synthetic line. In general, mooring lines must satisfy two requirements. First, they must be as light as possible for ease in handling; and second, they must be strong enough to take the strain of mooring, getting underway, and holding the ship in heavy weather.

Mooring lines are named, according to their use, as bowlines, stern lines, breast lines, or spring lines. The bowline runs through the bullnose or chock nearest the eyes of the ship and holds the bow in. The stern line runs through the stern chock or quarter chock, holding the stem in. A breast line is led nearly straight across to the pier, controlling the distance of the ship from the pier. Breast lines are called bow, waist, or quarter breasts. A spring line leads at an angle of about 45 degrees from the ship to the pier and controls fore-and-aft movement. Spring lines leading forward are the forward bow spring or the forward quarter spring. These lines keep the ship from going aft. Spring lines tending aft are the after bow spring or the after quarter spring. Their purpose is to keep the ship from moving forward.

The standard moor on most ships is six mooring lines. These lines are numbered from forward to aft and are called by number in line-handling evolutions because numbers are shorter and more precise than names. See figure 2-15. A ship may use fewer or more lines as necessary, in which case the numbers are changed accordingly. When the ship is in position and secure, the mooring lines are doubled up, which means that a bight of line is passed to the pier or to another ship, giving three parts of line. The bight is evened up with

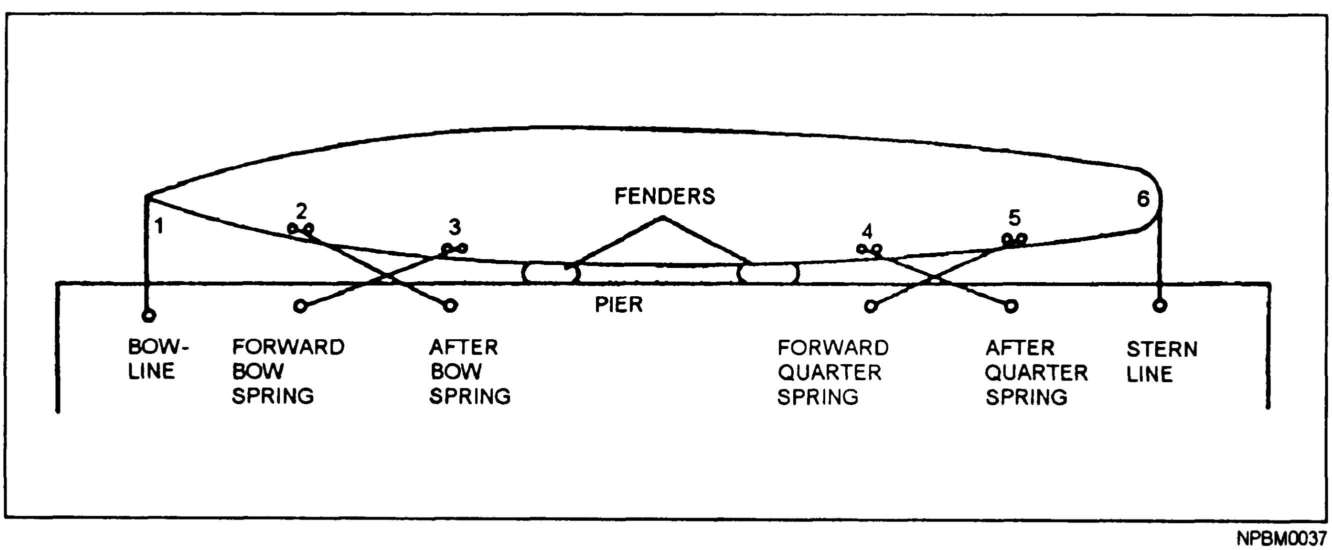


Figure 2-15.—Mooring lines of a destroyer.

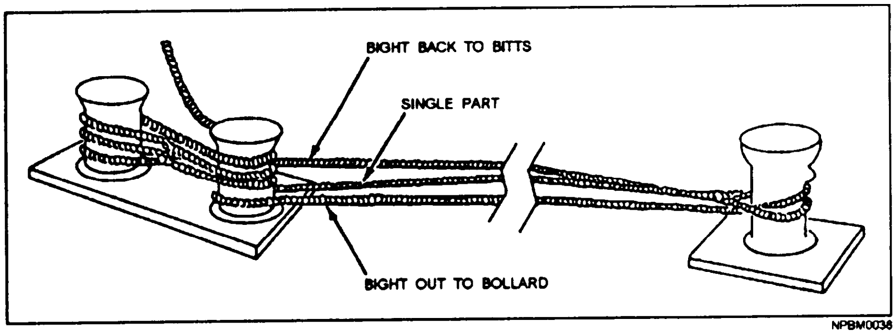


Figure 2-16.—Correct method of doubling up.

the single part of line so that each of the three parts is taking an equal strain. See figure 2-16.

Preparation to Moor

Well in advance of mooring, lines are broken out and faked down, each near the chock through which it will pass (fig. 2-17). An eye is passed through the chock and laid back over the lifeline. During this breakout phase, all the lines should be checked for abrasion, wear, breaks, or decomposition. The tattletale cord spliced into the synthetic lines must be checked.

> **CAUTION**
>
> **No synthetic line used as a mooring line will be used without the tattletale cord. It shows line handlers the line is stretching to its safe working load and to the danger point. Do not use a tattletale with natural-fiber rope. Since four-strand aramid fiber rope stretches only 6 percent at minimum breaking strength, tattletale cords cannot be used to determine the strain on these mooring lines.**

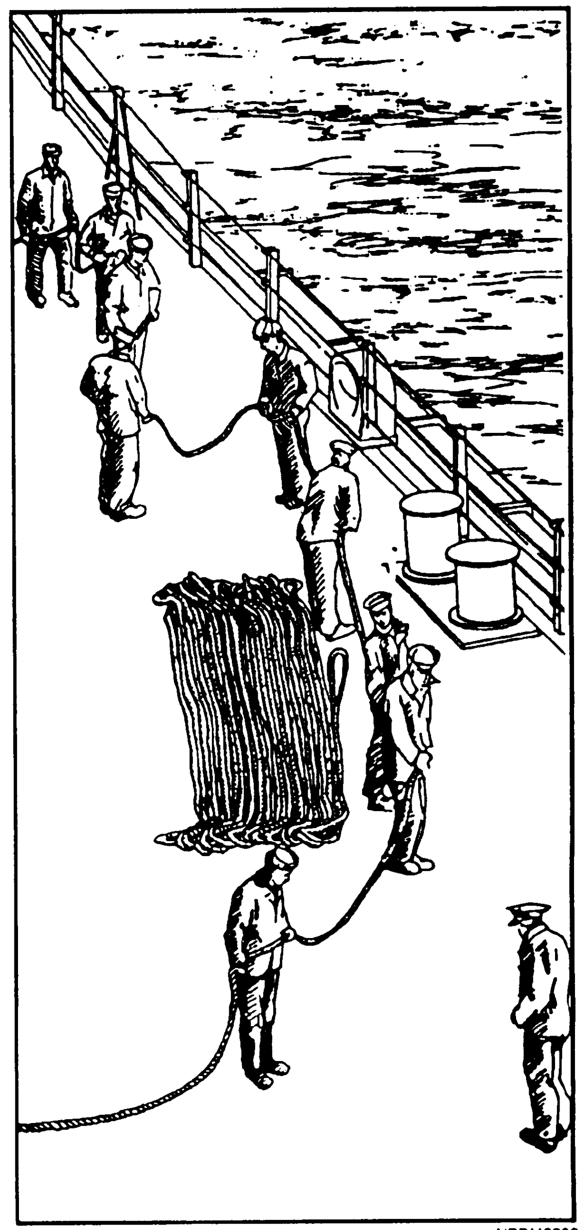


Figure 2-17.—Preparing to moor.

Heaving Lines

Heaving lines, bolos, and line-throwing guns play an important role when you are going alongside. The speed with which lines are sent to the pier is often critical, especially in strong winds or currents.

It is important to have more than one heaving line on station. Made up to trough in case the first throw fails, a second heaving line is readily available. Once the heaving line is successfully cast to the pier, it can be bent to the mooring line needed first. All the mooring lines larger than 5 inches must have messengers of 1 1\2 inches in circumference, and 12 to 18 feet long attached to them so that the heaving line does not part during delivery to the pier.

In addition to the heaving lines, it is useful to have bolo lines ready, both fore and aft. A bolo consists of a padded weight attached to the end of a nylon shot line. An experienced, skillful sailor can throw a bolo twice the distance of a heaving line, and because of its size and weight, a bolo is more effective in the wind. The bolo is also very dangerous, especially when large numbers of people are on the pier. With its size and speed of delivery, a bolo could seriously injure someone in the way. For this reason, its use is discouraged and sometimes prohibited by some commanding officers.

A third method of delivery, also posing danger to those on the pier, is the line-throwing gun. In mooring, it is used when the heaving line or bolo will obviously not be effective.

CAUTION

The line-throwing gun will not be loaded until it is actually needed; and when loaded, the gun must be pointed outboard, barrel up.

DECK MACHINERY

When the sea detail is set and the line-handling stations are manned, it is important to test the capstans and gypsy heads. The anchors will also be made ready to let go. This is done for emergencies on approach, or an anchor can be used as a poor-man's tug when laid underfoot in a mooring evolution. Anchors and anchoring are covered in chapter 4 of this manual. Once the capstans and gypsy heads are satisfactorily tested, the mooring lines may be fairled to power if desired.

FENDERS

The main object of fenders is to protect the ship from contact with the pier or another ship.

The most common ship fender is a pneumatic fender made of rubber, about 4 feet long and 3 feet in diameter. It should be positioned amidships at the extreme beam. This fender is normally the only one the ship rides against when it is alongside of another ship. A number of additional fenders, depending on the size and type of ship, are kept ready on the forecastle and on the fantail. These are normally smaller pneumatic fenders or "homemade" manila fenders about 4 feet long and 1 foot in diameter.

COMMANDS TO LINE HANDLERS

It is of the highest importance that the orders given to line handlers have the same meaning on deck as was intended by the bridge. All the orders from the bridge must be carried out immediately. The following examples and definitions are in common use and form the basis for orders to line handlers:

STAND BY YOUR LINES	Man the lines and stand ready to work.
PASS ONE	Pass line number one to the pier; place the eye over the appropriate bollard but take no strain.
TAKE A STRAIN ON ONE	Put line number one under tension.
SLACK ONE	Take all tension off of line number one and let it hang slack but not in the water.
EASE ONE	Let number one line out until it is under less tension but not slacked.
TAKE NUMBER TWO TO THE CAPSTAN	Lead the end of line number two to the capstan; take the slack out of the line but take no strain.
HEAVE AROUND ON TWO	Apply tension on number two line by hauling on it with the capstan.
AVAST HEAVING	Stop the capstan, or stop heaving around.
HOLD FIVE	Do not allow any more line to go out on number five even though the risk of parting the line may exist.
CHECK FIVE	Hold number five line but not to the breaking point; allow only enough line to render around the deck fitting to prevent it from parting.
SURGE FIVE	Hold moderate tension on number five line but allow it to slip enough to permit movement of the ship (used when moving along the pier to adjust position).

DOUBLE UP	Pass an additional bight on all mooring lines, or line indicated, so that there are three parts of each line to the pier. To ensure that the three parts take an equal strain, pass a stopper on the standing part and take a round turn on the barrel of the bitts closest to the chock. Next pass a bight of the line to the pier, then take the standing part to power, remove the stopper and take the slack out of the line (equalizing all three parts). Once this is done, pass the stopper and fairlead the standing part to the second barrel and figure-eight the line over both barrels to secure it.
SINGLE UP	Take in all bights and extra lines so there remains only a single part of each of the normal mooring lines.
TAKE IN ALL LINES	Used when secured with your own lines, it means to have the ends of all lines cast off from the pier and brought aboard.
TAKE IN ONE (OR NUMBER ONE)	When used by the Boatswain's Mate in charge on the forecastle, it is preceded by the commands "slack one" and "cast off one," which mean merely to retrieve line number one and bring it back on deck.
CAST OFF ALL LINES	When secured with your own lines, it is a command to those tending the mooring lines on the pier or on another ship to disengage or throw off the lines from the bollards or cleats. When secured with another ship's lines in a nest, it means to cast off the ends of her lines and allow the other ship to retrieve her lines.
TAKE IN THE SLACK ON THREE (OR NUMBER THREE)	Heave in on number three line but do not take a strain.

Often the ship must move up the pier or wharf in short steps; then the command "Shift lines on the dock forward (or aft)" or "Walk number one forward (or aft)" is given. Supplementary information about the distance of the move is also sent down from the bridge. Caution must be used in this movement, since control of the ship's position is still being exercised by the use of the mooring lines, and the ship's propulsion or tugs will be used to effect the move.

If the ship's auxiliary deck machinery should be used to haul in on a line, the command "Take one (number one) to the capstan" is given. This may be followed by "Heave around on one (number one)" and then, "Avast heaving on one (number one)."

DIPPING THE EYE

If two mooring lines are placed over the same bollard, the second one is led up through the eye of the first, then placed over the bollard. This procedure makes it possible for either line to be cast off without disturbing the other.

FRAPPING LINES AND RAT GUARDS

When pierside or inboard in the nest, the ship will normally frap her lines. This is done by wrapping the mooring line snugly with small stuff, marrying the three parts of the mooring line together.

When the frapping is complete, the rat guards are placed on the lines. Canvas chafing gear must first be lashed to the mooring line to protect it from the metal rat guard. Rat guards are circular metal disks, which are lashed together on a mooring line, with the concave side to the pier. Rat guards are not to be used when moored outboard in a nest; however, lines that are run to the pier must have them installed.

LINE-HANDLING SAFETY PRECAUTIONS

- Tend lines well behind the bitts in case the line surges or parts.
- Do not stand in the direct line of pull of a working line. Under no circumstances stand in the bight of a line.
- Do not even try to check a line that is running out rapidly by stepping on it.
- When handling lines, fake down the standing part to prevent fouling.
- Remember that nylon, polyester, and other synthetic lines are characterized by high elasticity and low friction. The following rules apply:
  a. An extra turn is required when you are securing the bitts, cleats, capstans, and other holding devices.
  b. When easing-out from holding devices, use extreme caution because of the high elasticity, rapid recovery, and low friction.
  c. Three strand nylon line, on parting, is stretched about 1 1/2 times its original length and snaps back at near the speed of sound.

d. Know your gear and its capabilities; tram deck personnel; quiz line handlers on their duties and on safety on station.

e. Make sure all the hands involved are safety briefed before and critiqued after an evolution.

f. Never use synthetic mooring lines without a tattletale cord.

KNOTS, BENDS, AND HITCHES

LEARNING OBJECTIVES: Identify the practical knots, bends, and hitches that are used in typical Seaman's work: reeving line bend, double Matthew Walker, fisherman's bend, single bowline on a bight, Spanish bowline, masthead knot, rolling hitch, timber hitch, marline hitch, Blackwall hitch, round turn with two half hitches, barrel hitch, and bale sling.

Among Seamen, the landsman's all-inclusive term *knot* must give way to *knot* in its more specific meaning and to the terms *bends* and *hitches.* Seamen, in addition, must know which knot, bend, or hitch will serve best in a particular circumstance.

KNOTS AND BENDS

A knot, according to a Seaman's use of the term, is usually a line bent to itself. The knot forms an eye or a knob or secures a cord or line around something, such as a package.

A bend ordinarily is used to join two lines together.

Reeving Line Bend

Frequently it is necessary to bend together two lines that must reeve around a capstan or winch drum. The best knot for this purpose is the reeving line bend, as shown in figure 2-18. As you can see, it consists of taking a half hitch with the end of each line around the standing part of the other and seizing the bitter ends. Make sure the seizings are tight; otherwise, the knot might pull out.

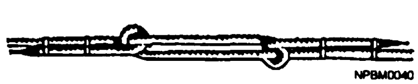


Figure 2-18.—Reeving Line bend.

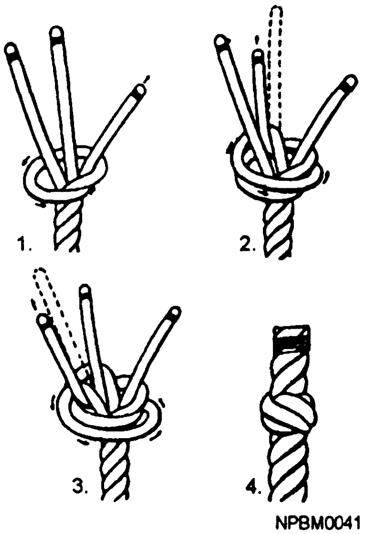


Figure 2-19.—Tying a double Matthew Walker.

Double Matthew Walker

The double Matthew Walker has many uses in fancy work, but it also has practical applications, such as keeping the end of a line from coming unlaid. This use should be considered only a temporary measure, because a proper whipping should be put on the line at the earliest opportunity and the knot cut off. Take a look at figure 2-19 before reading further.

To tie a double Matthew Walker, unlay 6 or 8 inches of line. Take the right strand, pass it around the other two and up through itself (view 1 of fig. 2-19). Next, pass the center strand around the third, under the first, and up through its own bight, as shown in view 2. Then pass the last strand around and under the other two, and up through its own bight (view 3). Tighten the knot by working out the slack and pulling tight. After tightening the knot, cut the ends off short or re-lay and whip them, as shown in view 4.

Fisherman's Bend

The fisherman's bend is a knot used to bend a line to a becket or eye.

To tie it, simply take two turns through the eye. Tie a half hitch through the turns and another half hitch around the standing part (fig. 2-20).

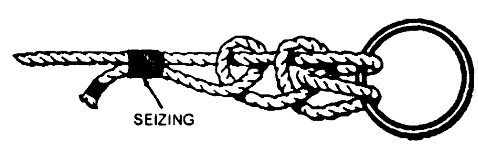


Figure 2-20.—Fisherman's bend.

Single Bowline on a Bight

The single bowline on a bight comes in handy whenever you need an eye in the center of a line. It can be tied quickly, does not jam tight, and you do not need an end of the line to tie it. To get your securing lines taut, use a single bowline on a bight for securing equipment or cargo.

Tie the knot well up on the standing part and run the bitter end around a stanchion or through a pad eye and back through the eye of the knot. Heave back on the bitter end in a line between the knot and stanchion or pad eye. This gives the same effect as having a block on the line at the knot and, discounting friction, doubles your pull. Heave it taut and secure the end. To tie this knot, form bights A and B, as shown in view 1 of figure 2-21. Next, lay part C between bights A and B, as shown in the second view. Then reach through bight A, over part C, and pull bight B back through A. Tighten by pulling on part D and bight B. (The completed knot is shown in view 3.)

Spanish Bowline

The Spanish bowline can be used whenever it is desirable to have two eyes in the line. Its primary use, however, is as a substitute for the boatswain's chair. Many prefer it to the French bowline because the bights are set and will not slip back and forth when the weight is shifted.

To tie this knot, take a bight and bend it back away from you, as shown in view 1 of figure 2-22, forming two bights. Then lap one bight over the other, as shown in view 2. Next, grasp the two bights where they cross (point a in view 2), and fold this part down toward you, forming four bights, as shown in view 3. Next, pass bight c through bight e and bight d through bight f (view 4). See the complete knot in view 5.

A word of caution here: ALWAYS use manpower to hoist a person in a boatswain's chair (or any substitute). Otherwise, if the chair or a part of the knot catches on a projection and the hoisting cannot be stopped in time, injury to the person seated is almost inevitable. Use enough personnel for the job, but no more.

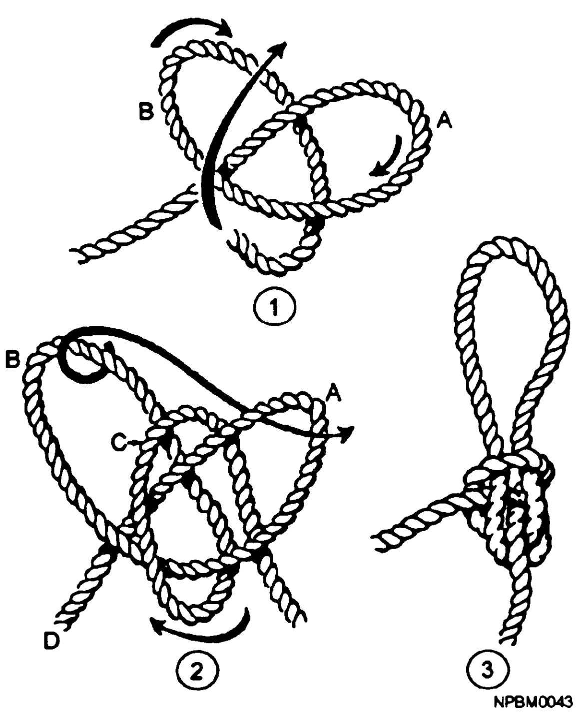


Figure 2-21.—Single bowline on a bight.

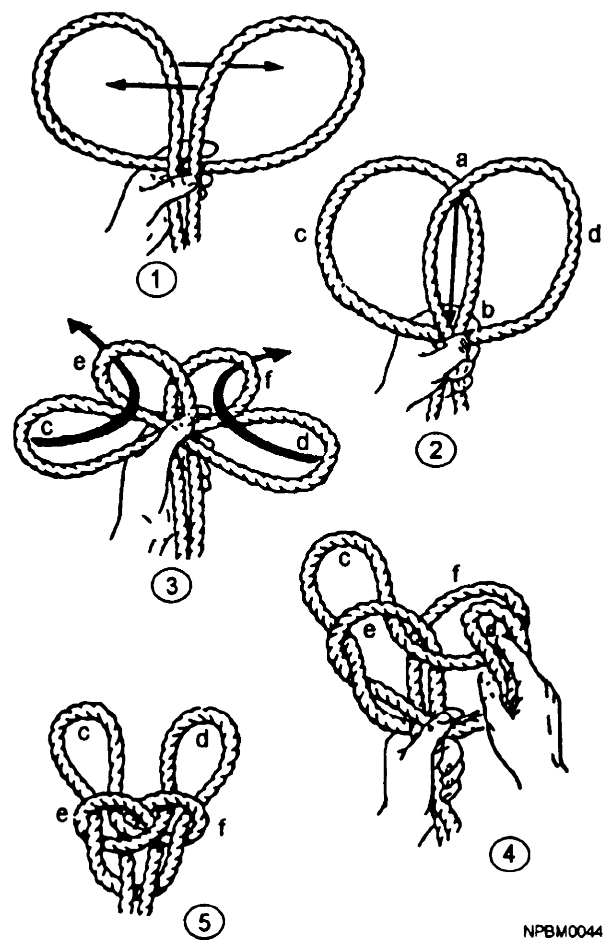


Figure 2-22—Spanish bowline.

Masthead Knot

The masthead knot is seen usually in fancy work, but it also has a practical purpose. In the days of sailing ships, masthead knots were set at the top of the masts, and the stays and shrouds were secured to the eyes of the knots. It is a good knot to remember if you ever have to rig a jury mast.

In tying the masthead knot, first lay up three underhand bights, the second on the first, and the third on the second, as shown in view A of figure 2-23. Then thread the inboard parts of the outboard bights under and over the parts of the other two bights, working each to the outside. Pull both bights tight. Work the slack into the knot to equalize the size of the three eyes (view B, fig. 2-23). Splice the two ends together and you have four eyes to which to secure stays and shrouds.

Rolling Hitch

The rolling hitch is one of the most useful and most important hitches used on deck. It can be used for passing a stopper on a boat fall or mooring line when you are shifting the fall or line from the winch or capstan to a cleat or bitts. It also may be used to secure a taut line back on itself. If properly tied, it will hold as long as there is a strain on the hitch.

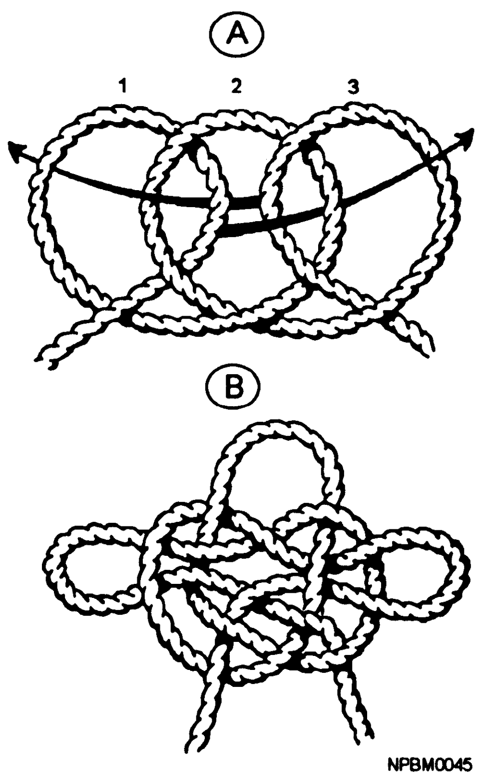


Figure 2-23.—Masthead knot.

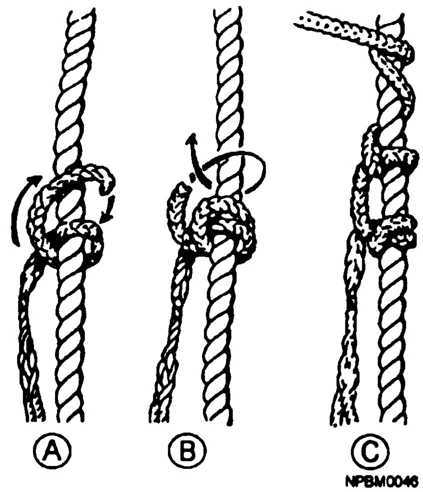


Figure 2-24.—Rolling hitch/passing a stopper.

When tying, take a half hitch around the line with the stopper, as shown in view A of figure 2-24. Pull tight and take another turn. This turn must cross over the first (view A) and pass between the first turn and the stopper (view B). This completes the rolling hitch itself, but it must be stopped off in one of several ways.

One method is to take two or more turns with the lay of the line and then marry the stopper to the line by hand or seize the stopper to the line with marline. Another method is to tie a half hitch directly above the rolling hitch. A third method is to tie a half hitch about a foot above the rolling hitch (view C), then take a couple of turns against the lay, and marry or seize the stopper to the line.

Timber Hitch

The timber hitch is used on logs, spars, planks, or other comparatively rough-surfaced material. It should

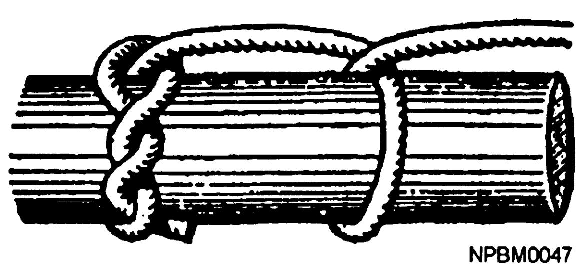


Figure 2-25.—Timber hitch and a half hitch.

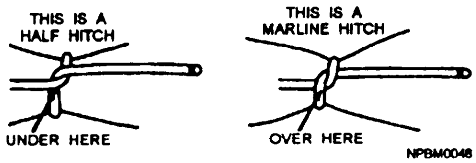


Figure 2-26.—Difference between a marline hitch and a half hitch.

not be used on pipes or other metal. (Proper methods of hoisting metal shapes are covered in chapter 9 of this manual.)

Look at figure 2-25 to see how to tie a timber hitch. Take one or more half hitches around the timber to cant the timber if it must be hoisted through a small hatch or other small opening.

Marline Hitch

Another hitch that requires no detailed explanation is the marline hitch. (Just remember that the end of the line goes over the standing part and under the round turn so that it binds itself.) This hitch is used to secure on furled sails and to frap awnings and doubled-up mooring lines (fig. 2-26). When cinched up, it will hold itself tight.

Blackwall Hitch

The Blackwall hitch, single or double, is used to secure a rope to a hook. It can be made quickly and, when tied properly, is secure. Except when there is insufficient rope end remaining to make a bowline, it seldom is used.

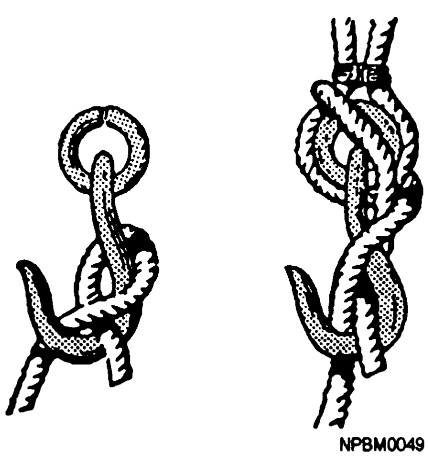


Figure 2-27.—Blackwall hitch, single and double.

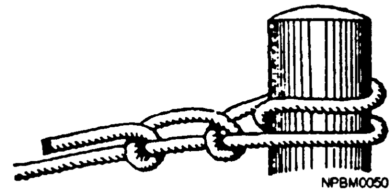


Figure 2-28.—Round turn with two half hitches.

To tie a Blackwall hitch, make an underhand loop, slip it up over the hook, pull it tight around the back of the hook, then slide it down onto the hook. In tying the double Blackwall hitch, pass the strap around the hook and eye in the whip, as shown in figure 2-27. Make sure the standing part binds the bitter end at the back of the hook and in the hook, as shown. Notice that the bight stays around the eye in the whip and is not slid down onto the hook.

Round Turn with Two Half Hitches

The combination of a round turn with two half hitches may be used in a ring, in a pad eye, or on a spar.

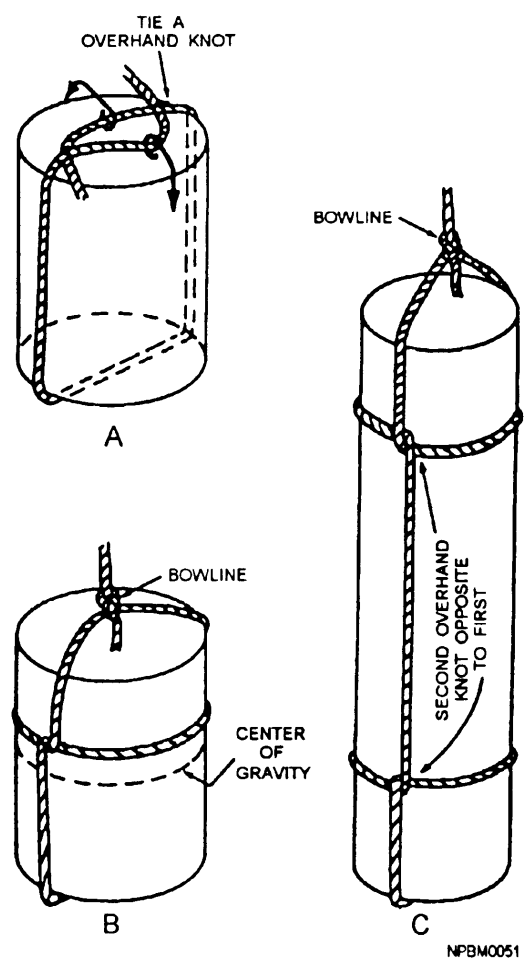


Figure 2-29.—Barrel hitch.

It is particularly useful on a spar because it grips tightly and holds its position (fig. 2-28).

Barrel Hitch

The barrel hitch may be used to hoist almost any bulky object, but it is particularly useful in hoisting barrels, drums, and boxes without tops.

To tie this hitch, pass the line under the bottom and tie an overhand knot, as shown in view A of figure 2-29. Pull enough slack into the knot to enable you to drop the knot down around the side of the object to be hoisted. The part of the hitch encompassing the object always should be located above the center of gravity, as shown in view B. Tie a bowline at the top, making certain that the hoisting part comes out of the eye (views B and C).

A long object of small diameter that must be hoisted from or lowered through a restricted opening can be handled as shown in view C. The first overhand knot should be looped down low to keep the hitch from slipping from under the bottom. The second overhand knot is looped near the top. If the center of gravity is near one end of the object, that end should be at the bottom, if possible.

Bale Sling

Closed drums and boxes, as well as numerous other items, can be hoisted by means of the bale sling, as shown in figure 2-30. A temporary sling may be fashioned simply by knotting the ends of a line together with a square knot or a becket bend.

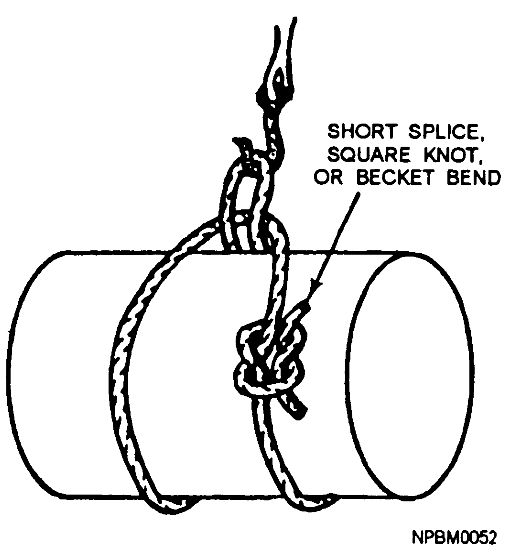


Figure 2-30.—Bale sling.

BENDS AND HITCHES

Bends and hitches are "nice to know," and knowing how to use them is invaluable to a Seaman.

Monkey Fist

In addition to its familiar place on the end of a heaving line, the monkey fist is sometimes used as fancy work on the top of lifeline stanchions. The monkey fist is composed of four sets of turns taken at right angles to each other. For clarity, figure 2-31 shows only three turns in each set; four turns per set are more commonly seen aboard ship.

To tie a monkey fist, start as in view A in figure 2-31, taking a set of turns around your hand. Then slip this set off your hand. Holding it as shown in view B, run the bitter end over your thumb, and down, under, and around the first set. Complete this set of turns. The last set of turns goes around the second set and through the first set, as shown in view C. Notice that the first turn of the last set serves to lock the first two sets in place. Complete the last set of turns. 'lighten up by working the slack back toward the standing part. Keep enough bitter end to secure with a half hitch and a flat seizing

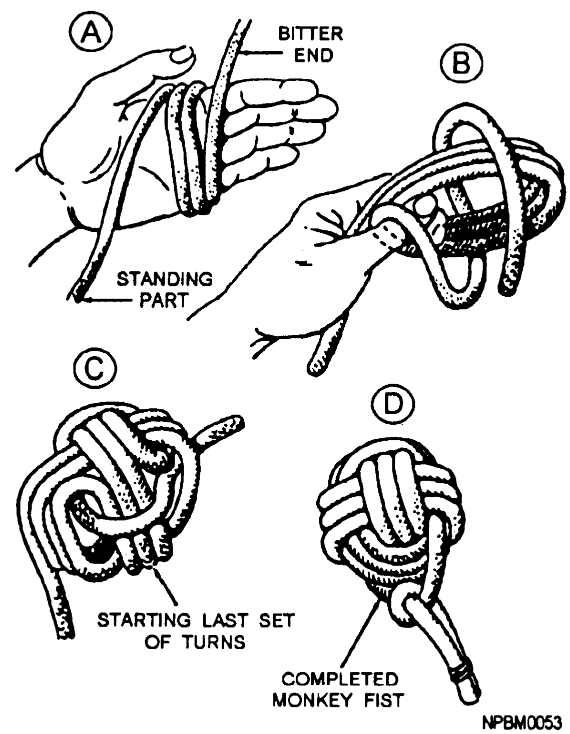


Figure 2-31.—Monkey fist.

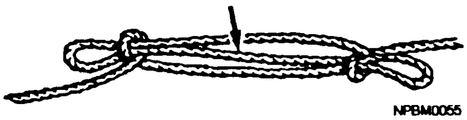


Figure 2-32.—Sheepshank.

(view D). In a properly tied monkey fist, the ends come out at opposite comers on top, as shown in view D.

Sheepshank

The sheepshank knot is generally thought of as merely a means to shorten a line, but in an emergency, it can also be used to take the load off a weak spot in the line.

To make a sheepshank, form two bights and then take a half hitch around each bight (fig. 2-32). If you are using the sheepshank to take the load off a weak spot, make sure the spot is in the part of the line indicated by the arrow.

Shortening a Sling

To shorten a sling, grasp the sling in your left hand, palm up, thumb pointing away from the center of your body. The standing part, or part around the load, leads out of the thumb side of your hand, as shown in view 1 of figure 2-33. Notice how the sling lays across the right wrist. Next, twist your left wrist so that your thumb points toward the center of your body. Reach across with your right hand and grasp the part of the sling coming out at the little-finger side of the left hand (view 2). Twist your left hand back to its original position and flip the part of the sling that was across your right wrist down between your hands, as shown in view 3. Now put the two bights together and slip both over the hook, as shown in view 4.

This also forms a knot, sometimes called a miller's knot, used to tie the tops of bags. It can also serve as a handcuff knot or be used to lash two spars or poles together. When properly tied and pulled tight, it will not slip.

Manrope Knot

The double wall and crown (or manrope knot), as the name implies, is fashioned from a wall and crown

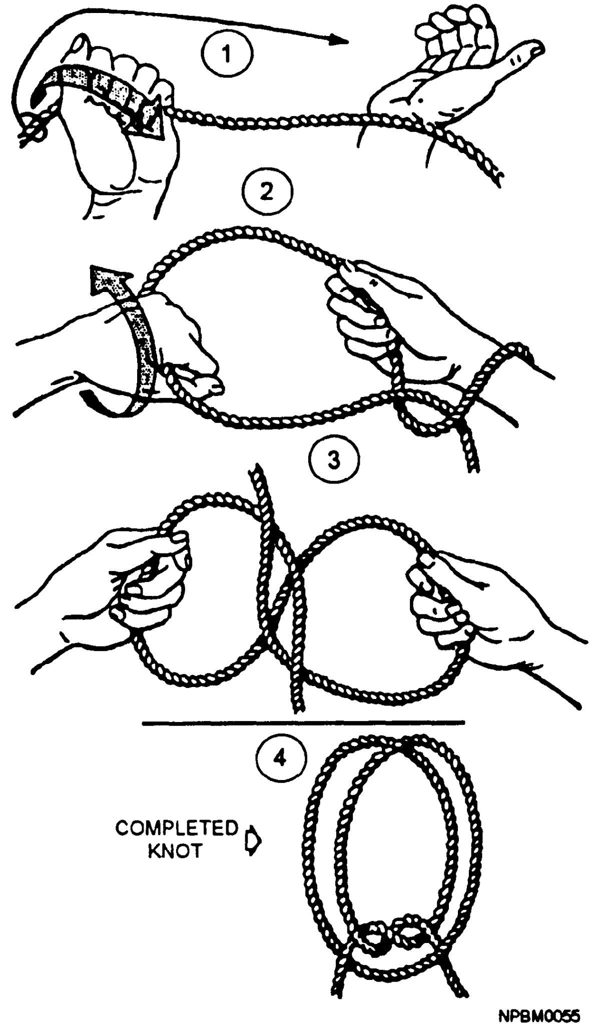


Figure 2-33.—Shortening a sling.

knot. It is used on the ends of the manropes of accommodation ladders or on other lines where large decorative knots are desired.

To tie a manrope knot, first tie a wall knot (fig. 2-34) and top that with a crown (fig. 2-35). Leave the wall and crown slack.

If, at this point, you were to flatten the wall and crown and look at it from the top, it would appear as shown in view A of figure 2-36. We do not recommend flattening the knot when you are tying it—we do it merely to show the next step. (See the arrow in view A and the cross-hatched strand in view B.) You cannot see

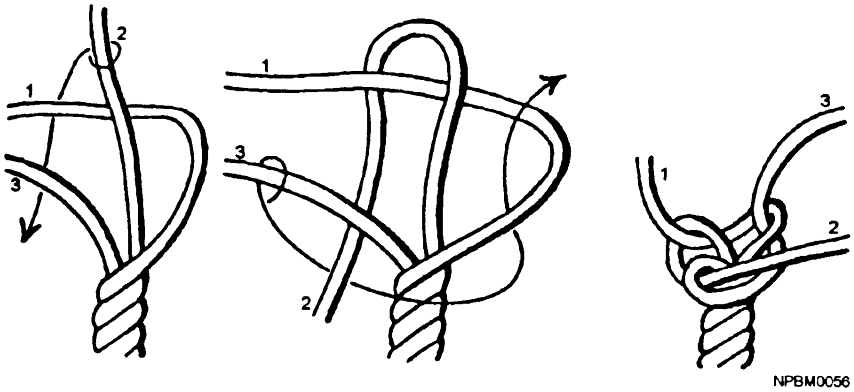


Figure 2-34.—Wall knot.

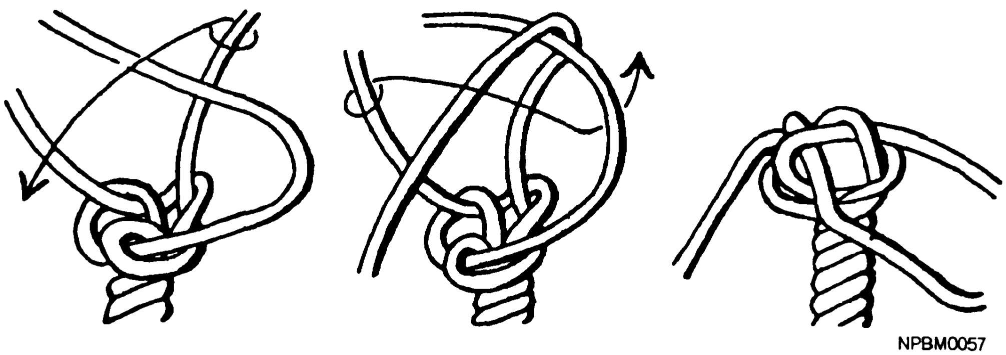


Figure 2-35.—Crown over a wall knot.

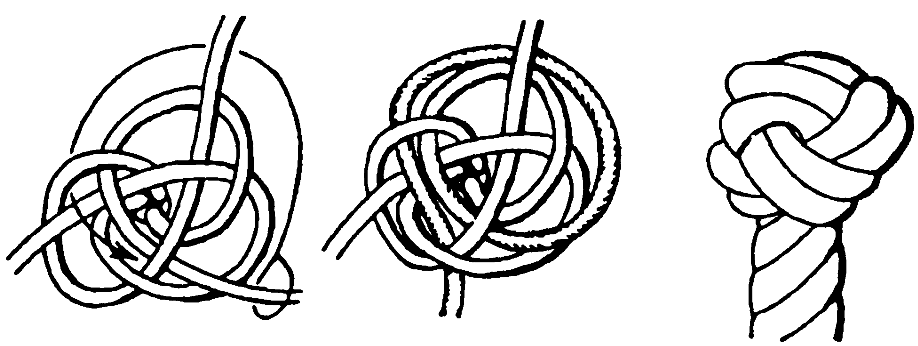


Figure 2-36.—Double wall and crown, or manrope knot.

this in the illustration, but each strand follows itself counterclockwise, going up under the adjacent strand and down through the knot. The ends come out at the bottom of the knot, alongside the standing part. The following little ditty may help you to remember the procedure: "First a wall, then a crown; now tuck up, then tuck down."

Tuck the other two strands and tighten the knot. (The completed knot should appear as shown in view C.)

LEARNING OBJECTIVES: Explain procedures for constructing ornamental or fancy work from line and fabric. Describe the following types of knots and sennits: Turk's head and coverings, such as coxcombing, crosspointing, fox and geese, and sennits, such as common sennit, flat sennit, or English sennit, square sennit, and Russian sennit. Identify procedures for making MacNamara lace and state its purpose.

Ornamental work or fancy work, as it is sometimes called, is made from various materials and serves mainly as decorative coverings in areas where an enhanced appearance is desired. This manual will cover only a few of the common types of ornamental work. Many books on knot tying are available through your ship or the local libraries. Two of the better known books are *The Art of Knotting and Splicing* and *Ashley's Book of Knots.*

TURK'S HEAD

A Turk's head is usually thought of as strictly ornamental work, but it serves, many useful purposes, such as keeping the leathers on lifelines or as the finishing touch on lanyards.

The three-strand Turk's head is simple and easy to tie. By adding extra diamonds, as will be explained, you can make one long enough to go around your ship if you want to.

Start with two round turns around your hand, and pass the end over the second turn and under the first turn (step 1 in fig. 2-37). Next, turn your hand so that you can see the back of it, as shown in step 2. Pull a bight of the first turn under the second turn. Pass the end through this bight, over the second turn, and under the first turn (shown by arrows in step 2, fig. 2-37). Now turn your hand back, with the palm toward you, and lead the bitter end up alongside the standing part. This completes the first lay of the three-strand Turk's head. Follow around for two more lays, then work out the slack.

To make a good tool for tightening a Turk's head, cut the handle off a toothbrush and sharpen it to a flat, square-pointed end. Spend a few minutes making this pricker, and later you will save hours while tying a Turk's head, because you can also use it as a needle when passing the second and third lays.

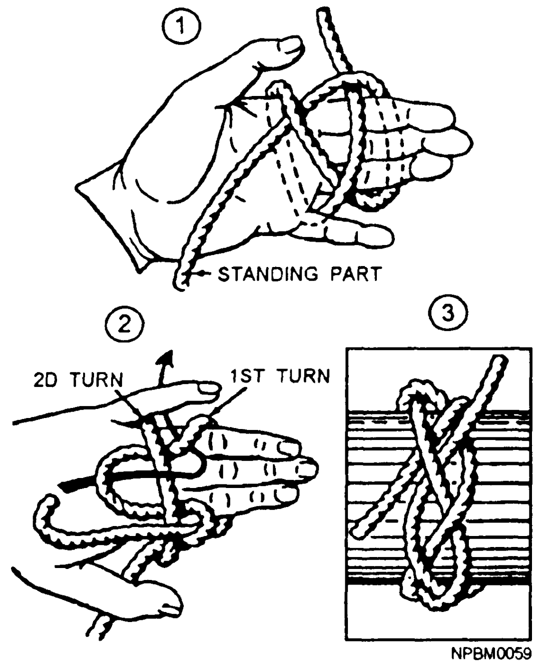


Figure 2-37.—Three-stand Turk's head.

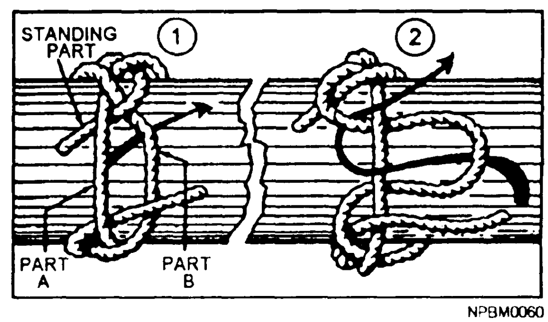


Figure 2-38.—Adding extra diamonds to a three-strand Turk's head.

To add extra diamonds to a three-strand Turk's head, complete the Turk's head as just described. (It should look like view 1 in fig. 2-38). You will need a little slack so, if necessary, work some into the Turk's head. Next, pull a bight of part A under part B, as shown in view 2. Then pass the bitter end under, over, and so forth, as shown by the arrow in view 2. If you want still more diamonds, repeat the preceding steps until your Turk's head is long enough for your purpose.

Make a four-strand Turk's head, as shown in figure 2-39. Start it, as shown in view 1, with two round turns and tuck the end under the second turn. Now turn your hand and tuck the end under again, leaving a bight, as

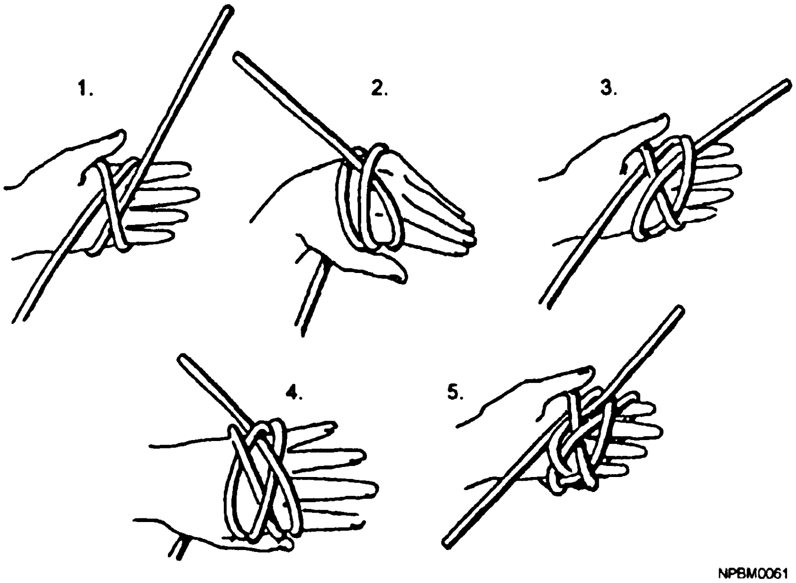


Figure 2-39.—Tying a four-strand Turk's head.

shown in view 2. Go over the next part, turn your hand, go over again, and then through the bight left on the last turn. Take it over and under again, as shown in view 4. Once more, pass the end over and under, ending up with the bitter end alongside the standing part, as shown in view 5. You can then follow around three or four more times to finish the work.

Make extra diamonds in a four-strand Turk's head as shown in the three-strand. If you wish to experiment, start with an overhand knot around your hand and go from there in the usual fashion.

Start the five-strand Turk's head with two round turns, as shown in view 1 of figure 2-40. Place the end over the second turn and under the first (view 2). Lay the working end over the turn nearest your wrist and bring it around to the palm side of your hand. Pass it under the turn under your thumb and over the other turn (view 3). Turn your hand over, as shown in view 4. Cross

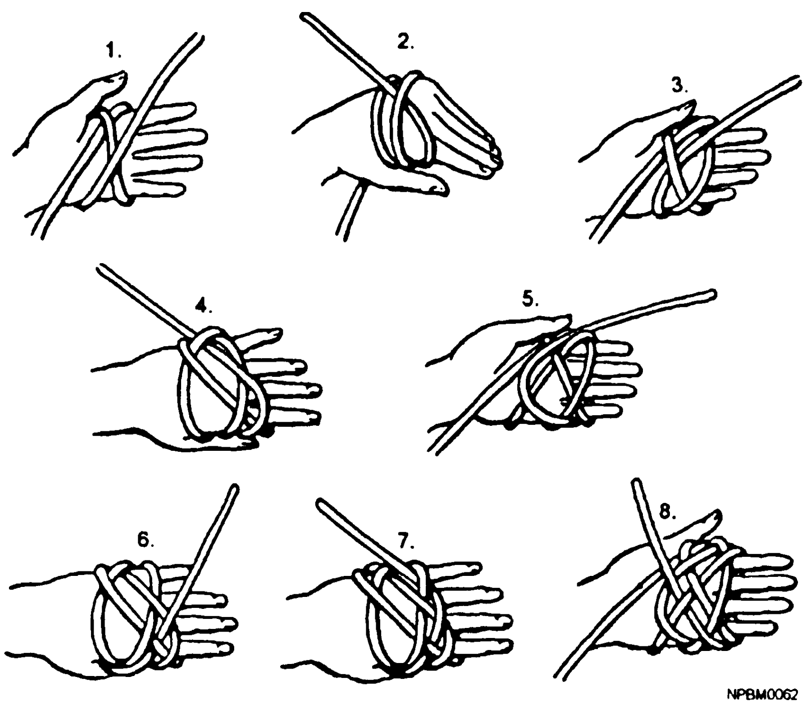


Figure 2-40.—Tying a five-strand Turk's head.

the turn nearest your fingertips and tuck your line under the next part (view 4). Turn your hand back, as shown in view 5. You are now ready to start your last turn. Do this by going over the line that lies across the standing part. The rest is under and over, all the way around, as shown in views 6, 7, and 8.

Learning to add extra strands to a Turk's head (that is, to make a six-strand Turk's head from a four-strand, or a seven-strand from a five-strand) is not too difficult, but it is much easier for you if someone shows you the process. The key to this is quite simple, once you get the hang of it. We will use a four-strand Turk's head for an example.

Complete the first lay of a four-strand Turk's head; then with the bitter end, follow the standing part to the side opposite where the standing part comes out. Leaving a bight at this side, cross under the part you followed across, and follow the same part back across again. This brings you back to the starting point and leaves a succession of alternate parts crossing two parts and under two parts. All you have to do now is pass your working end over and under all the way around, going over those parts that are over two parts and under those that are under two parts.

By repeating these steps again and again, you can make as many even-numbered-strand Turk's heads as you desire. Seven-strand and all other odd-numbered-strand Turk's heads are made in the same fashion from the five strand.

COVERINGS

Ornamental coverings may be used around stanchions, ladder rails, and numerous other items around the ship. Many types of variations or found, from purely ornamental to functional. Only a few of the most common are discussed in this section.

Coxcombing

Coxcombing is used to cover boat hooks, bucket bails, handrails for ladders, and so forth. It looks smart and affords a more secure grip. It is worked with three strands by tying consecutive half hitches, as shown in figure 2-41.

Seize the three strands on top of the rail as in the first sketch. Take one strand and tie a half hitch around the rail. Then half hitch the second strand around the rail in the opposite direction. Half hitch the last strand around the rail in the same direction as the first strand.

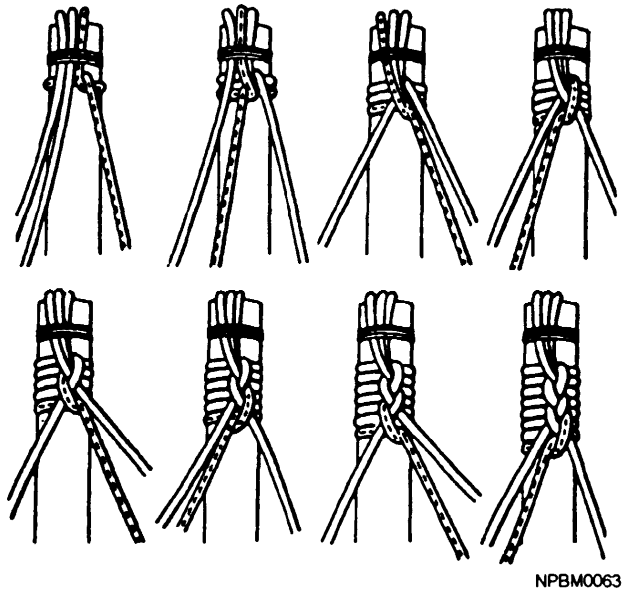


Figure 2-41.—Starting coxcombing.

Remember, the strands must be taken in turn, and the hitches must be taken first one way and then the other.

To find the length of the strands needed for coxcombing, multiply the length (L) of the rail, in inches, times the circumference (C), times the number of turns (T) to the inch. Divide the product by the number of strands (3). Thus you have an easily remembered formula:

$$\frac{L \times C \times T}{3} = \text{length of one strand, in inches}$$

Add about 10 percent to your answer for each strand to ensure an adequate working length.

Crosspointing

Crosspointing is generally used on stanchions but can also be used in many other places where a round core is to be covered. Crosspointing looks best on cores of fairly large diameter. Strips of canvas, leather, or small stuff, such as white line, in multiples of four are usually used for crosspointing.

(Length x 3 = ?) + (Cir. x 3 = ?) = Length of each strand

Since this is actually long enough for two strands double over the strands and seize the midpoint to the top of the core to be covered. Use enough strands to cover the circumference of the core, using an even number of strands.

Now place the strands in groups of four and use a simple basket weave over-and-under. Two or more persons are needed for crosspointing work because all

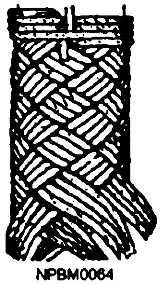


Figure 2-42.—Crosspointing.

the strands must be kept in hand to prevent them from unlaying again. Crosspointing is shown in figure 2-42. A turk's head should be used to finish off the top and bottom.

Fox and Geese

Making fox and geese is a simple and fast way of covering a handrail or stanchion. Fox and geese can be used any place coxcombing or crosspointing can be used.

At the top of the core, seize sufficient strands (odd number) of white line side by side to completely encircle the core to be covered (fig. 2-43). Have the length of each strand 1 1/2 times longer than the core. Now seize an extra-long strand to the core at any point at the top. This strand is called the working strand; it goes over and under the other strands, working around and around continuously. To find the length of the working strand, in inches, multiply the length of the core by the circumference, times the number of turns to make an inch of work. To determine how many turns there actually are to the inch, rather than estimate this value, make a dummy run with a short length as the working strand.

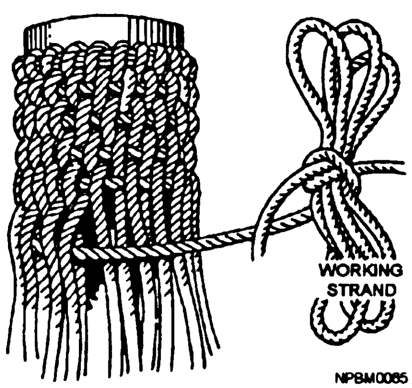


Figure 2-43.—Making fox and geese.

SENNITS

Sennit, or braid, is made of small cord, such as cod line or Belfast cord, and is used to form ornamental lines or lanyards. A well-known book of knots describes and illustrates approximately 400 sennits, so do not be misled into believing that the four described below are the only ones or even all the basic ones. The first three have been chosen because they are basic and, with slight variations, will give you a wide variety to use. The fourth is one of the most attractive, as you will see when you braid a few inches of it.

Common Sennit

A common sennit is made from any odd number of strands. Figure 2-44 shows the steps in making this sennit.

Divide the strands so that you have one more in your right hand than in your left. Pass the outboard strand in

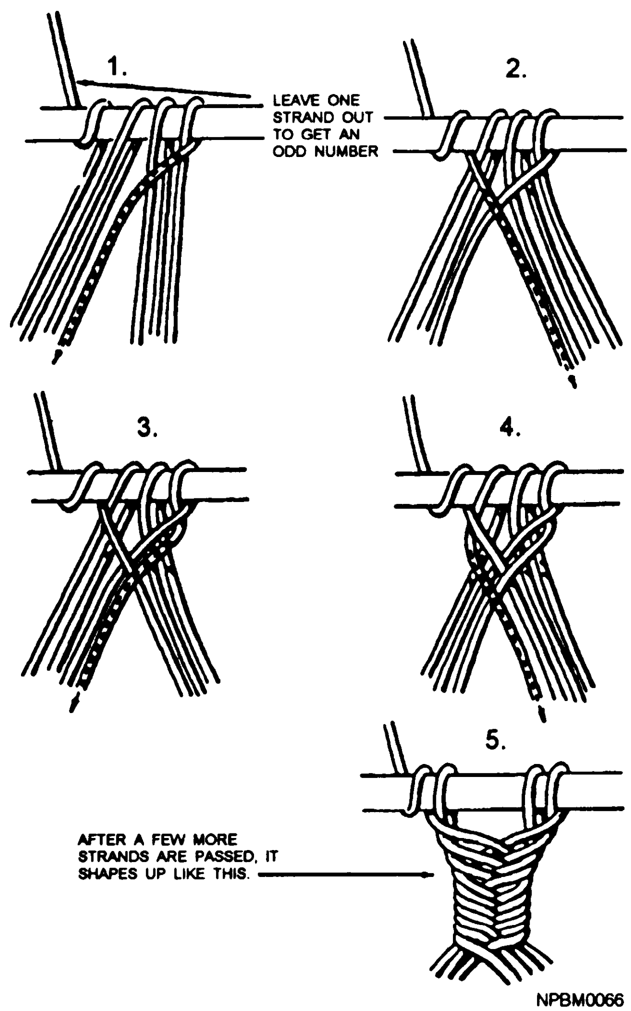


Figure 2-44.—Starting a common sennit.

your right hand over all the others on that side to the inside position in your left. Now, pass the outboard strand in your left hand over to your right in the same way. Continue passing alternate outboard strands until your sennit is as long as you want.

Flat, or English, Sennit

The flat, or English, sennit is also made from any odd number of strands. The only difference between it and the common sennit is that each outboard strand is woven over and under the strands on its own side before being brought to the inboard position in the other hand. Figure 2-45 shows how to start the flat (or English) sennit.

A variation of the flat, or English, sennit is to use any even number of strands. When starting to plait, take the outboard strand on one hand over the strand next to it and the outboard strand of the other hand under the next strand. When these two strands reach the center, pass one over the other before taking them in hand on the other side.

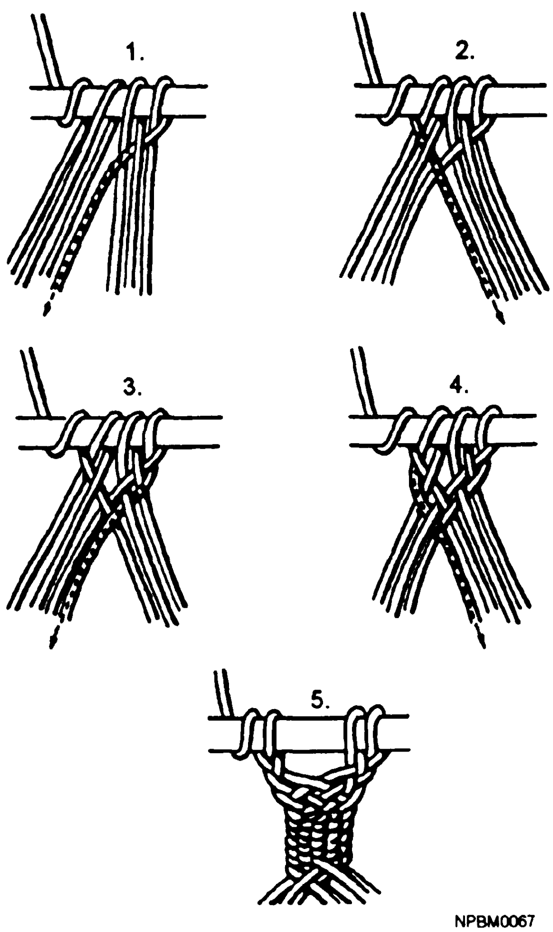


Figure 2-45.—Flat, or English, sennit.

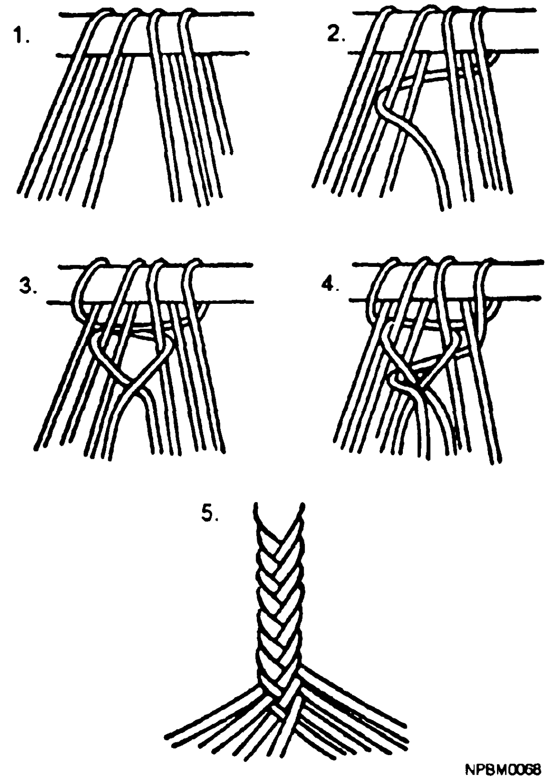


Figure 2-46.—Starting a square sennit.

Square Sennit

A square sennit must be made with eight strands or it will not come out square. Each outboard strand is passed around (behind) all but two of the other strands and brought back in front (to the side from which started). See figure 2-46. When enough strands are passed, the sennit begins to assume a perfectly square shape. Smart “dress” bow painters and stem fasts for gigs and barges can be made of white line in this sennit.

Russian Sennit

A Russian sennit is made from any number of strands divisible by 4, but do not use fewer than 16 or it will not show to the best advantage. When you are making this sennit, it is a good idea to work where there is some object on your right hand that will serve as a cleat. Around this object you can take turns on a half hitch with the working strand to hold it taut while you work the next strand.

To start the Russian sennit, pass the first strand on your left over two strands and under two strands, all the way across to the right. Place the lone strand on the right

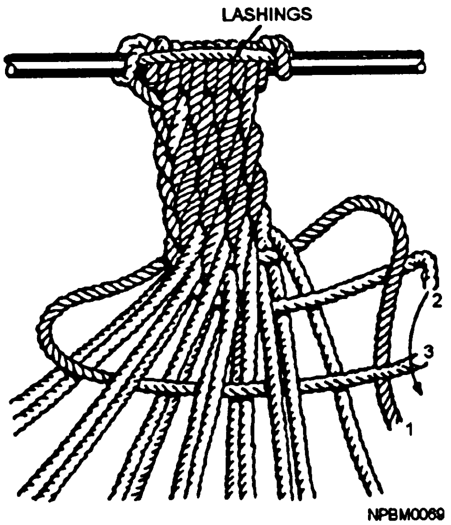


Figure 2-47.—Russian sennit.

over the working strand. Now secure the working strand on the cleat and use the second strand on the left for your next working strand. Always go over two and under two, but make sure that the strands are taken in their proper sequence. When you have worked the second strand to the right side, take strand one from the cleat and drop it over strand two. Secure strand two to the cleat and work strand three across, and so on. A Russian sennit is shown in figure 2-47.

MACNAMARA LACE

Fancy curtains and trimmings for quarterdecks, admiral's barges, and captain's gigs are made by stripping the cross strands from light canvas and then weaving them into intricate patterns. Any number of designs can be made by dropping or skipping strands. Figure 2-48 shows some sample work. Start by inlaying the crossthreads in a piece of canvas that is secured to a jackstay. Comb out the threads that are hanging down. Once this is done, start with the left and pair the strands in the desired size; square knot the pairs together, forming a diamond shape. Go back to the left, skip the first strand (this will begin your taper), and square knot the right-hand pair to the left-hand pair, all the way across. 'Then go back to the left and square knot the first strand to the second, and so on, to the end. Continue working the diamond-shape pattern, developing the pattern you want. Finish the work with a tassel made by knotting the strands together. MacNamara lace is a beautiful piece of work but is time-consuming. One thing to remember is to keep your square knotting straight. The best way to make the lace is with the help of an experienced Boatswain's Mate.

SEIZINGS

LEARNING OBJECTIVES: Describe four different types of seizing and explain their uses.

Seizings are used when two lines or two parts of a single line are to be married permanently. This should be done with "seizing stuff," which is generally rope-laid, tarred American hemp of 6, 9, or 12 threads. For seizing small stuff, however, sail twine is adequate.

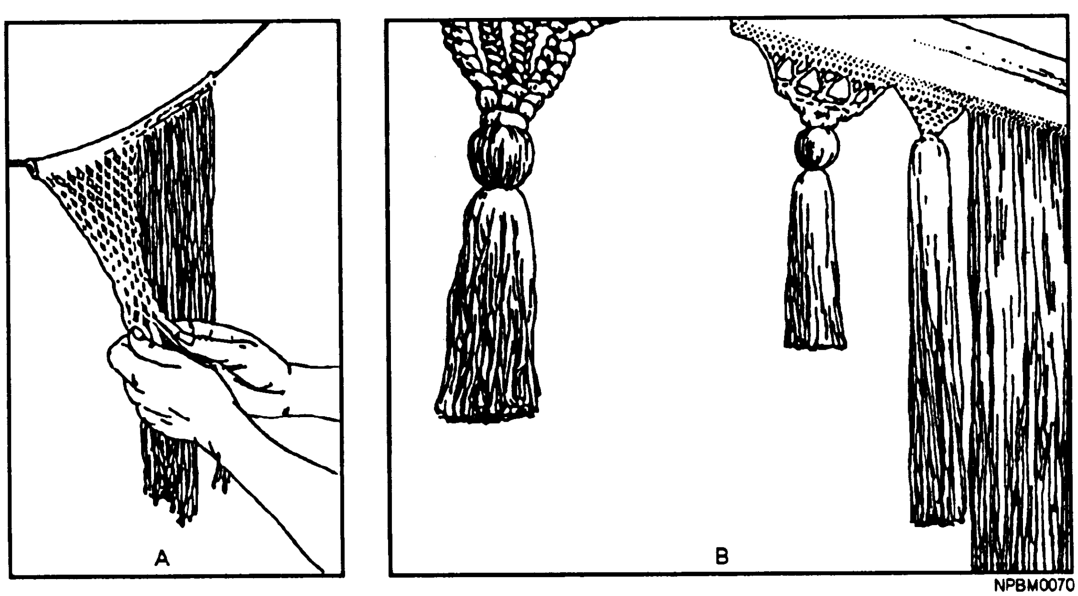


Figure 2-48.—Strands of unlaid canvas being square knotted into MacNamara lace.

Many types of seizings were used for special purposes in old sailing ships, but the four described here should suffice for Seamen in modem ships.

FLAT SEIZING

Flat seizing is light and is used where strain is not too great.

First, as in all seizings, splice an eye in the end of the seizing stuff. Take a turn around the line, and pass the end of the stuff through the eye. Pull it taut and double the stuff back, taking several turns around the line. Then pass the end under the turns and again through the eye. Last, tie a clove hitch over the turns and between, the two parts of the line. See views A and B of figure 2-49 for the steps in making a flat seizing.

ROUND SEIZING

View C of figure 2-49 shows the completed round seizing. Stronger than the flat seizing, it is used where strain is greater.

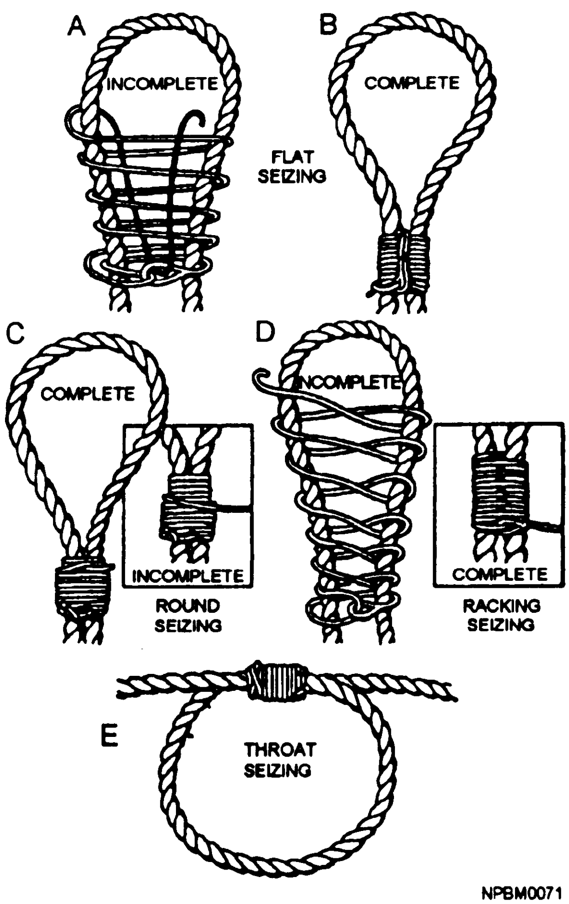


Figure 2-49.—Seizings.

Start it as you did the flat seizing, taking your turns and leading the end under them and back through the eye. Then take another row of turns over the top of the first row. Finish by tucking the end under the last turn and heaving taut or with a crossed clove hitch as in the flat seizing.

RACKING SEIZING

Use racking seizing where there is an unequal strain on the two parts of the line. Lay turns around the line in figure-eight fashion for about ten turns. Then pass the seizing stuff back in the opposite direction, and take a row of turns over the top of the racking as is done in a round seizing (fig. 2-49, view D). Finish off by passing the end through the eye again, and tie an overhand knot.

THROAT SEIZING

Throat seizing is actually a round seizing and is used wherever a temporary eye is needed in the middle of a line. View E of figure 2-49 shows a completed throat seizing.

MOUSING HOOKS AND SHACKLES

A hook is moused to keep slings, straps, and so forth, from slipping out of the hook and to strengthen the hook if there is the danger that the load will bend it. If the purpose of the mousing is to keep a strap or sling from escaping, marline or rope yarn may be used. If the purpose is to strengthen the hook, seizing wire or a shackle may be used. The proper method for each purpose is shown in figure 2-50.

Shackles are moused whenever there is the danger that the shackle pin will work loose and come out because of vibration. Several turns are taken through the eye of the shackle pin and around the shackle itself with seizing wire in such a manner that the pin cannot turn.

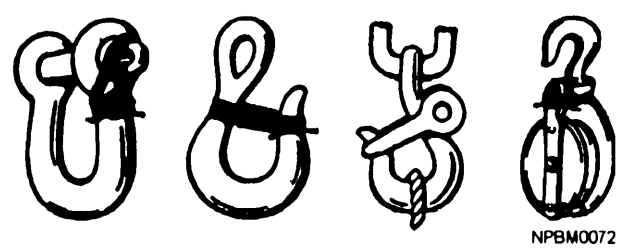


Figure 2-50.—Methods of mousing.

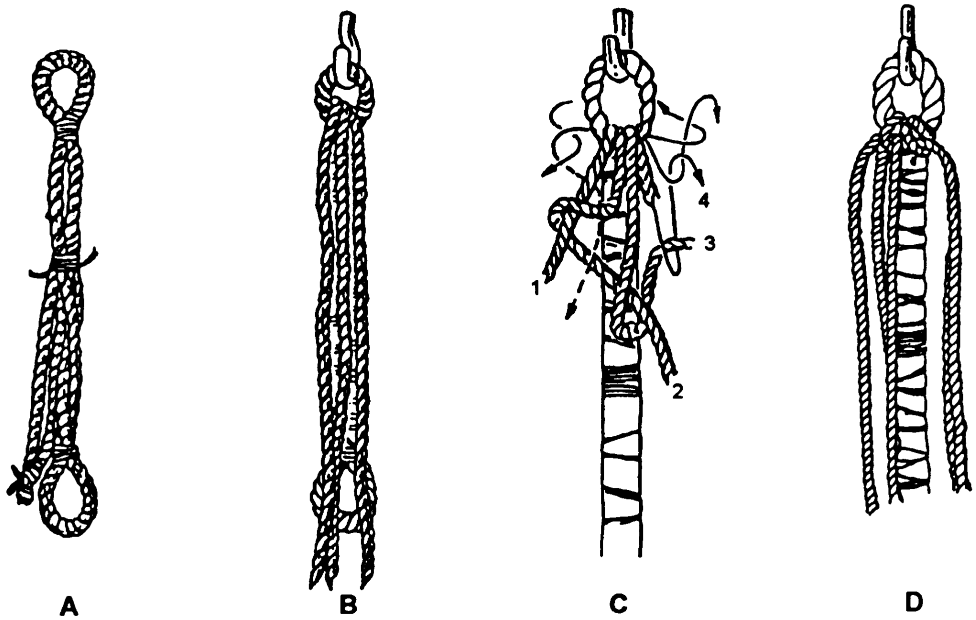


Figure 2-51.—Starting a boat fender.

MAKING A SMALL BOAT FENDER

LEARNING OBJECTIVES: Describe the purpose of a small boat fender. Explain how to make a small boat fender out of line.

The first step in making a boat fender is to lay a core, as shown in view A, figure 2-51, with or without two eyes, as desired. Manila around 2 1/2 inches in circumference is about right for the core of a medium-size fender.

Lay the line in bights and seize together (view A). Next, unlay an old piece of 6- or 8-inch mooring line and cut off three or four lengths of the strands ten times as long as your fender is to be. If you do not have any old mooring line that you can unlay, use some old 21-thread, or house line, round line, or ratline. (The size of the core determines the number of strands necessary; three strands are used in figure 2-51.) Pull the strands through the eye and even up the ends, as shown in view B. Put a temporary whipping on both ends to keep them from coming unraveled while working. Next, start tying wall knots, as shown in view C. View D shows the first row of knots completed and drawn tight.

After completing the last row of wall knots, divide your strands into pairs and tie a crown knot (fig. 2-52). Complete the fender by working the ends of the strands back up under the wall knots and cutting them off flush.

RATTAIL STOPPER

LEARNING OBJECTIVES: Describe the purpose of a rattail stopper and state procedures for making one.

Rattail stoppers are made in various sizes and lengths, depending on the jobs for which they are intended. A rattail stopper to be used on 6- or 8-inch mooring lines, for example, should be made from line at least 5 inches in circumference and should be about 10 feet long.

Cut a piece of line about 12 to 14 feet long and splice a 6- to 8-inch eve in one end. About 3 or 4 feet from the

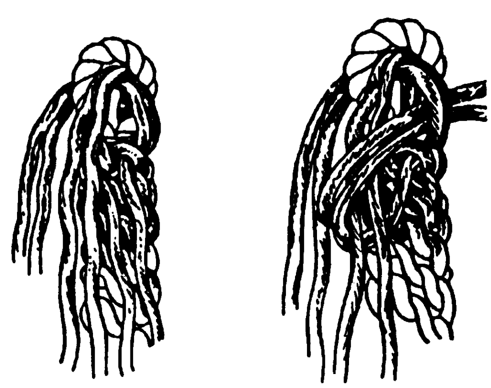


Figure 2-52.—Tying a crown with the pairs of ends.

eye (distance around bitt plus a foot or so), place a whipping. Unlay and comb out the sections of line from the whipping to the loose end. Separate the yarns into three equal parts, and gradually taper these parts by cutting out increasing amounts of fiber as you work toward the ends. Braid the parts into a flat-tapering strap. Place a whipping at the end to make the stopper ready for use.

WIRE ROPE

LEARNING OBJECTIVES: Explain how wire rope is constructed and used.

Although wire rope may only have a few applications in some Navy ships, in others, wire rope is extremely important. Naturally, a BM can be transferred to one of these ships at any time; therefore, it is important that every Seaman studying for BM learn all that can be learned about wire rope.

CONSTRUCTION OF WIRE ROPE

The basic unit of wire rope construction is the individual wire made of steel or other metal in various sizes. These wires are laid together to form strands. The number of wires in a strand varies according to the purpose for which the rope is intended. A number of strands are laid together to form the wire rope itself. Wire rope is designated by the number of strands per rope and the numbers of wires per strand. Thus a 6 x 19 rope has 6 strands with 19 wires per strand but can have the same outside diameter as a 6 x 37 wire rope, which has 6 strands with 37 wires of much smaller size per strand. Wire rope made up of a large number of small wires is flexible, but the small wires break so easily that the wire rope is not resistant to external abrasion. Wire rope made up of a smaller number of larger wires is more resistant to external abrasion but is less flexible.

The strands of the wire rope are laid up around a central core, which may be fiber, a single strand of wire, or an independent wire rope. A fiber core contributes flexibility, cushions the strands as the wire rope contracts under strain, and holds a portion of lubricant for continuous lubrication. A wire core is stronger than fiber and can be used where conditions such as high temperatures would damage fiber. Some end views of the arrangements of strands in wire ropes are shown in figure 2-53.

Wire rope may be fabricated by either of two methods. If the strands of wires are shaped to conform to the curvature of the finished rope before their laying up, the wire rope is termed "preformed." If the strands are not shaped before fabrication, the wire rope is termed "non-preformed." When cut, preformed wire rope tends not to untwist and is more flexible than the other.

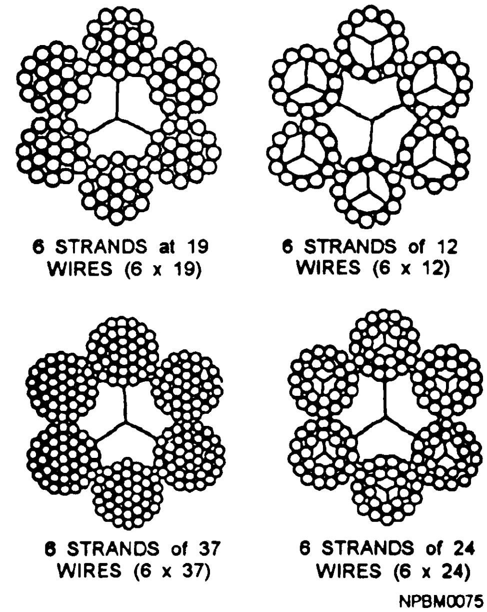


Figure 2-53.—Arrangement of strands in wire rope.

WIRE ROPE CLIPS

A temporary eye splice may be put in wire by using wire rope clips. The correct and incorrect ways of using these clips are shown in figure 2-54.

Always place the U-bolt over the bitter end and the roddle (saddle) on the standing part. Never saddle a dead

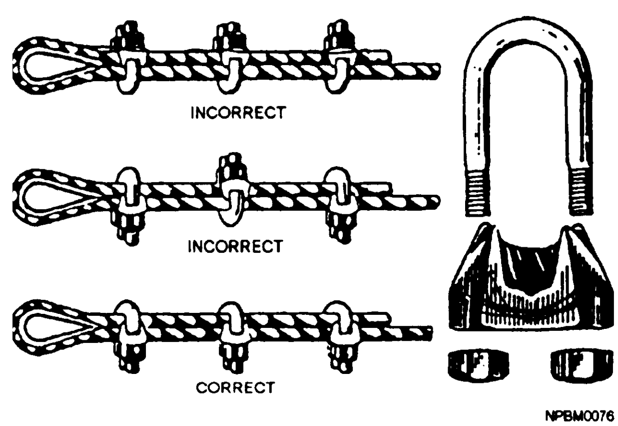


Figure 2-54.—The correct use and incorrect uses of wire rope

Table 2-8.—Minimum Number of Clips Required

Rope Diameter (inches)	All 6 × 7 Ropes; All Ropes With Independent Wire Rope Centers	All 6 × 19 and 6 × 37 Ropes	Proper Torque to be Applied to nuts of clips [ft/lb (Dry)]
3/8	4	3	45
1/2	4	3	65
5/8	4	3	95
3/4	5	4	130
7/8	5	4	225
1	6	5	225
1 1/8	6	5	225
1 1/4	7	6	360
1 3/8	7	6	360
1 1/2	8	7	360
1 3/4	8	7	590

horse. Space the clips a distance apart equal to six times the diameter of the wire. After a rope is under strain, tighten the clips again. On operating ropes, tighten the clips every few hours and inspect the rope carefully at points where there are clips. Pay particular attention to the wire at the clip farthest from the eye, because vibration and whipping are damaging here, and fatigue breaks are likely to occur.

To obtain maximum strength in a temporary eye splice, use the correct size and number of wire clips. The size is stamped on the roddle between the two holes. The correct number of clips to use for various sizes of wire ropes is shown in table 2-8.

For more information on wire rope, you will need to go to NSTM, Chapter 613, “Wire and Fiber Rope”. This tech manual describes the areas in more detail than we could possibly cover.

SUMMARY

In this chapter you studied about the differences in the construction and use of fiber lines and synthetic lines. You learned about fancy work and ornamental work and how each is used. You studied about safety precautions that you must observe when you are working with many types of lines.

Remember, when you need additional information about knots, line, or wire rope you should consult the *Naval Ship’s Technical Manual* that pertain to those subjects. Learn your knots as soon as possible so you will be able to do a better job for the Navy!

CHAPTER 3

DECK SEAMANSHIP

Deck seamanship is a vital area that you, as a Boatswain's Mate, will need to be knowledgeable in. With this knowledge, you will be able to assist newly reported personnel in learning deck seamanship onboard a ship.

ACCOMMODATION LADDERS

LEARNING OBJECTIVES: Define accommodation ladder. Identify the construction and use of the accommodation ladder.

Ships are fitted with accommodation ladders that can be rigged and lowered over the side. These ladders provide a convenient means for boarding or leaving an anchored vessel. Some accommodation ladders can be modified for use on a pier or a barge.

Large Navy ships have forward and after accommodation ladders, two on the starboard side and two on the port. If more than one ladder is rigged, the forward accommodation ladder is on the quarterdeck and is reserved for officers and ceremonies. The after ladder is used by work details and crew liberty parties. Some aircraft carriers are fitted with an accommodation ladder in their transom (on the stern of the ship).

The accommodation ladder, figure 3-1, has an upper and lower platform that is connected by the ladder and supported by either a chain or wire bridle and bail hanging by a pendant. Another method is the use of a

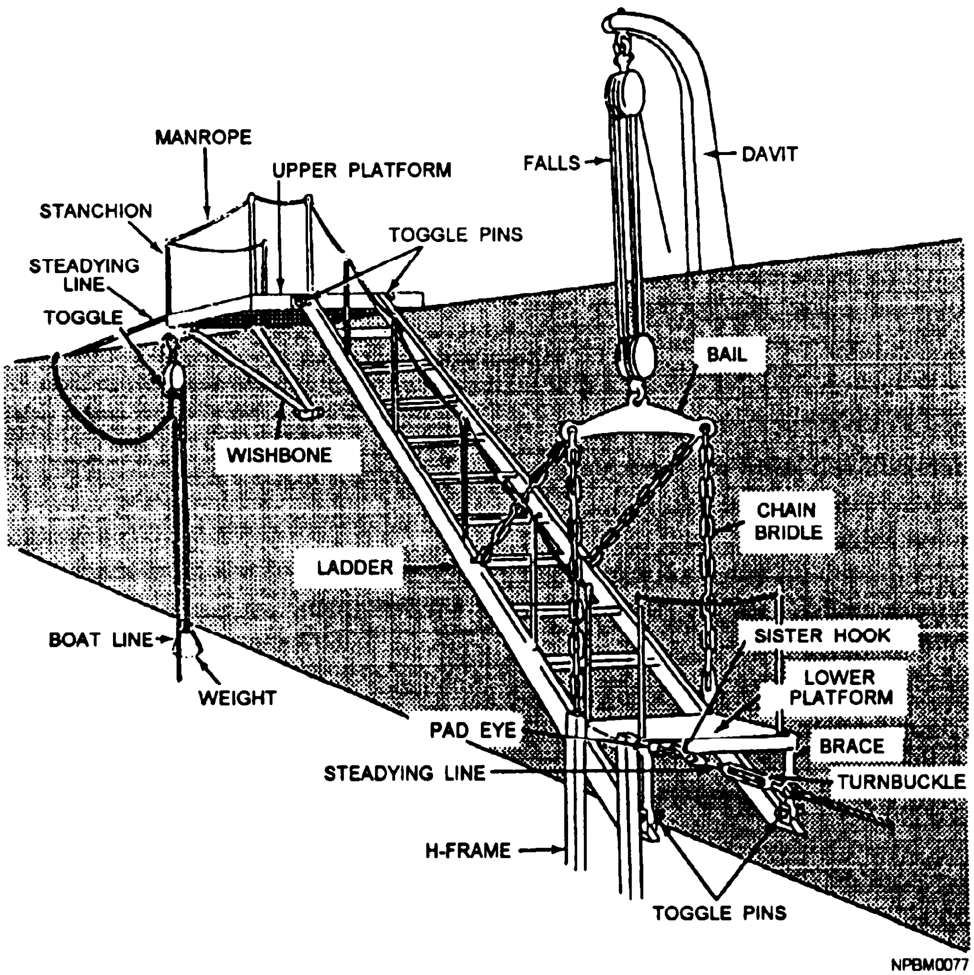


Figure 3-1.—Parts of an accommodation ladder.

metal bail shaped like an elongated upside down letter *U,* which holds the ladder by a pendant rigged to the side of the ship or from a J-Bar davit.

The lower platform of the accommodation ladder has additional parts that must be rigged. An H-Frame equipped with fenders is rigged to the outboard side of the lower platform. This H-Frame is where boats can come alongside to pick up or discharge passengers. The inboard side of the lower platform is fitted with ports called shoes, that when rigged hold the ladder in the proper position off the side of the ship. The shoes have pads attached to their ends to help prevent damage to the ship or the ladder. The lower platform also has turnbuckles, and in some cases, pendants to restrict the fore and aft movement of the ladder.

The upper platform is supported by a brace known as a wishbone. A single-sheave block is attached to the underside of the forward outboard comer of the upper platform. A line is rigged through this block which acts as a sea painter to keep a boat alongside in position with the accommodation ladder. A toggle between the strands of the line prevents the line from running up into the block and becoming inaccessible to a boat.

There may be some accommodation ladders made of steel still in service, but for ease of handling, the Navy has changed to aluminum.

When an accommodation ladder is secured for sea, everything is rigged in, disassembled in most cases, and stowed in brackets either on the rail or along a section of the superstructure. All of the smaller portable parts are stowed in a gear locker close to where the ladder is rigged. Care must be taken so that this essential gear is not carried off for other purposes.

When an accommodation ladder is rigged, the first thing that must be done is to follow the ship's plans. You should make sure that all parts are on hand and that the toggle pins and bolts are seized with short sections of wire and attached to the ladder. This will prevent them from being lost over the ship's side.

The next step is to rig the upper platform. Remember to be careful in lining up the brackets when you are engaging the bolts. Many a hand injury has occurred from careless or unsupervised rigging operations.

Once the upper platform is in place, the next step is to secure the ladder to it. This is an area where the ship's plans and design must be followed. Some ships have the ladder stowed against the rail. To attach this type of ladder, a series of outriggers (arms swung out from the ship) are used to lay the ladder on and seat the ladder to the upper and lower platforms. On ships that do not have outriggers, the J-Bar davit can be used to support the ladder over the side to attach it to the upper platform. Another method is to use a ladder that engages pad eyes on the side of the ship and holds them in place by a two-fold rigged to the superstructure.

Depending on the type and class of the ship, rigging procedures will vary. Again, the ship's rigging plans are a must.

Now that the ladder is attached to the upper platform, the lower platform and H-Frame must be rigged. It is easier if the H-Frame is rigged to the lower platform while it is still on deck. Once the H-Frame and lower platform are rigged on deck they must be worked over the side to attach to the ladder. This can be accomplished by use of the falls from the J-Bar davit or from some other suitable attachment point.

The ladder is now taking shape, and is nearly ready to lower. Big the bail and bridle to the ladder and attach the wire pendant between the bail and the J-Bar davit. On some ships, the pendant is rigged between the bail and a padeye alongside the ship.

With this equipage rigged, the ladder is ready to be lowered. Attach the falls to a sling on the lower platform. Make sure the hook is moused so the sling does not fall out of the hook.

If outriggers were used or if pad eyes and a two-fold are holding the ladder, lay back on the falls to take the weight of the ladder off of them. Either swing the outriggers in and disengage the ladder from the pad eyes, or disengage the ladder from the pad eyes and remove the two-fold. The weight of the ladder is now on the falls attached to the lower platform and the attachment points of the upper platform.

The accommodation ladder should be lowered smoothly, and it must always be controlled in its descent. As the ladder lowers into position, the pendant will extend itself between the attachment point and the bail. Keep an eye on the bridle and bail, to make sure they are not fouled as the ladder is lowered. The weight of the ladder will shift to the pendant, bail, and bridle when the ladder is in its down position. A crew member must now go down the ladder and rig the shoes. Shoes on an accommodation ladder are posts that slide out from the lower platform and act as fenders to keep the ladder in the proper position off the side of the ship. The shoes are secured by pins set in from the top of the lower platform into pre-drilled holes in the shoes. Turnbuckles are now rigged from the lower platform to the side of the ship. They prevent the fore and aft movement of the ladder.

While the above is being done, another crew member rigs the boat line. The boat line is nothing more than a block rigged under the forward outboard corner of the upper platform. It acts as a sea painter to assist boats making landing at the ladder.

The rails of the ladder are not set up and secured into position.

Remember, in some of these rigging procedures, personnel will be working outside of lifelines and over the side of the ship. It is absolutely necessary that all personnel be in life jackets and safety harnesses with proper safety lines rigged.

Pneumatic fenders are now lowered over the side of the ship. They are positioned fore and aft of the accommodation ladder to protect the ladder and the ship from boats coming alongside.

Once all of the steps in rigging the accommodation ladder have been accomplished, you are ready to receive boats alongside. One of the marks of a smart efficient ship, when going to anchorage, is not only the proper use of her ground tackle but also the manner in which she has her accommodation ladders and boat boom rigged.

As previously mentioned, some accommodation ladders can be modified for use on a pier or a barge. To do this, the lower platform and H-Frame are left off, and a roller and a safety step are installed at the bottom of the ladder, as shown in figure 3-2. The safety step assembly eliminates the foot hazard caused by the ladder roller.

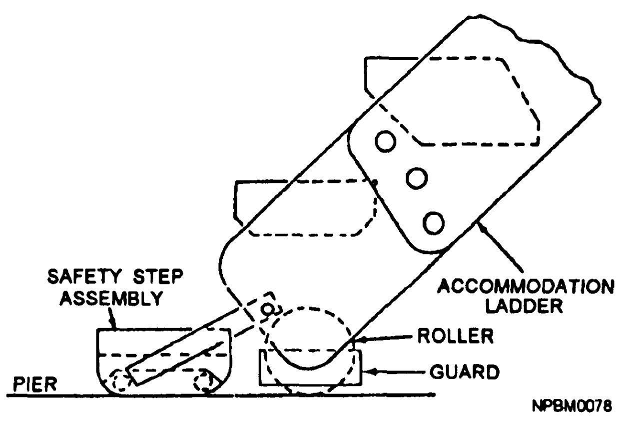


Figure 3-2.—Accommodation ladder rigged to the pier.

DECK FITTINGS

LEARNING OBJECTIVES: Describe the most common fittings used onboard a ship; they are cleats, bitts, padeyes, bollards, and chocks. Identify the difference between fenders and camels.

Deck fittings are the various devices attached to the hull that assist in handling the ship.

The most common fittings are found around the weather decks. A brief description of some common deck fittings (fig. 3-3) are as follows.

CLEATS

A cleat is a device consisting of a double-ended pair of projecting horns used for belaying a line or wire.

BITTS

Bitts are heavy vertical cylinders, usually arranged in pairs, which are used for making fast lines that have been led through chocks. The upper end of a bitt is either larger than the lower end or is fitted with a lip to keep

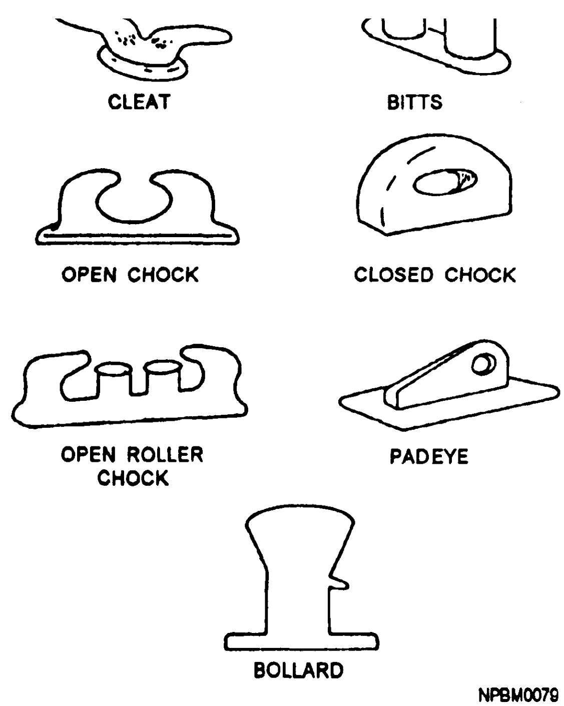


Figure 3-3.—Various deck fittings.

lines from slipping off accidentally. As bitts are required to take very heavy loads, extra frames are worked into their foundations to distribute the strain. Usually, there is a set of bitts forward and aft of each chock When constructed in pairs, each bitt is sometimes called a barrel.

CHOCKS

A chock is a heavy fitting with smooth surfaces through which mooring lines are led. Mooring lines are run from bitts on deck through chocks to bollards on a pier when the ship is moored. There are three types of chocks. An open chock is a mooring chock that is open at the top. A closed chock is a mooring chock closed by an arch of metal across the top. A roller chock is a mooring chock that contains a roller for reducing friction.

PADEYES

A padeye is a plate with an "eye" attached, welded to the deck to distribute the strain over a large area, and to which a block can be hooked or shackled. A padeye is also used in towing operations.

BOLLARDS

A bollard is a strong cylindrical upright on a pier, over which the eye (or bight) of a ship's mooring line is placed.

FENDERS

Fenders protect the ship from contact with the pier or another ship.

The most common ship fender is a pneumatic fender made of rubber, about 4 feet long and 3 feet in diameter. It should be positioned amidships at the extreme beam. This fender is normally the only one the ship rides against when it is alongside another ship. A number of additional fenders, depending on the size and type of ship, are kept ready on the forecastle and on the fantail. These are normally smaller pneumatic fenders or "homemade" manila fenders about 4 feet long and 1 foot in diameter. The Navy-type fender is shown in figure 3-4.

CAMELS

Camels are used to protect a fender system from damage due to the motion of moored ships and, where necessary, to provide proper clearance between a ship and a wharf or pier. Camels are floating separators which can be attached to a fender system, the wharf, pier, or the ship itself. The camels that are generally used for mooring a ship are shown in figure 3-5.

THE SEAMAN ALOFT

LEARNING OBJECTIVES: Describe the rigging used for going aloft. Explain all the safety requirements for going aloft.

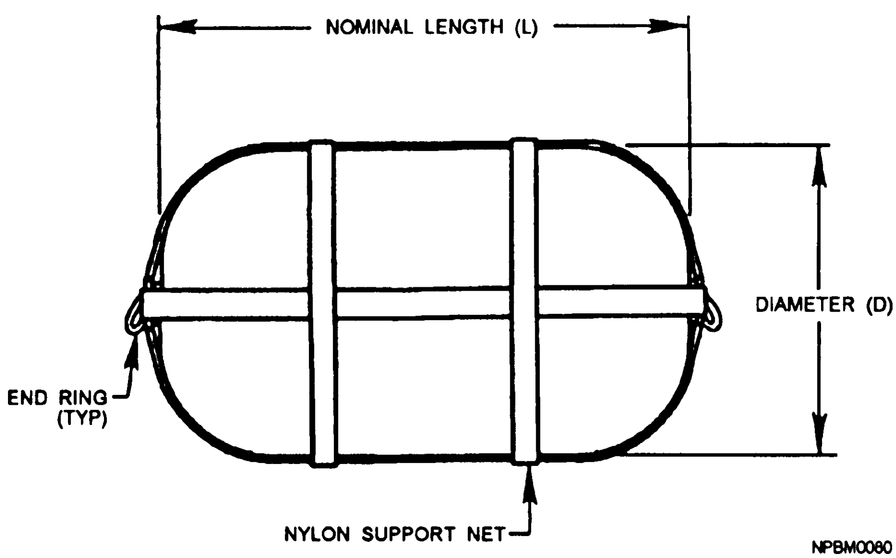


Figure 3-4.—Navy-style foam-filled fender.

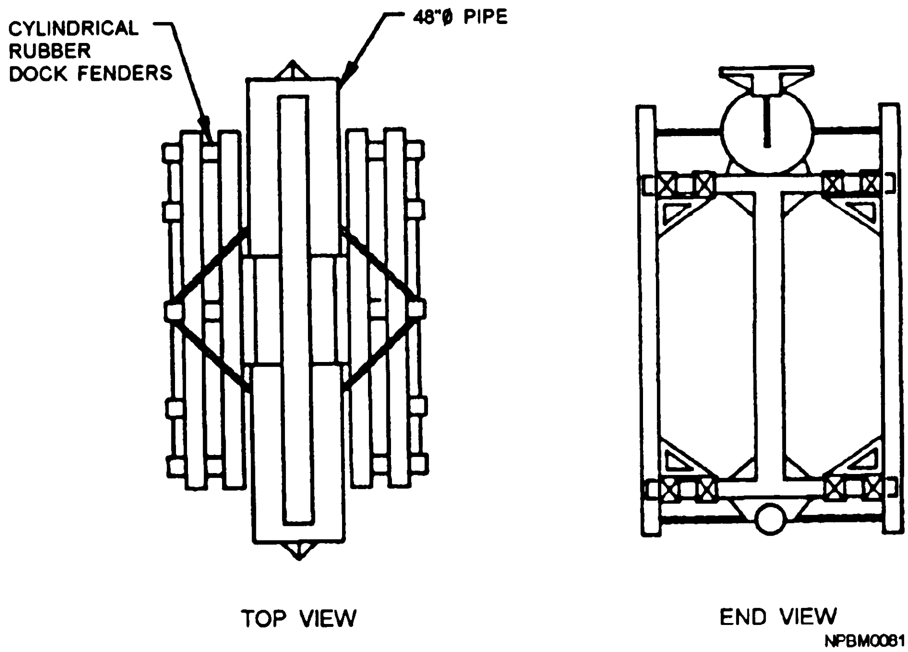


Figure 3-5.—Camels.

As a Seaman in the deck division, you will be involved in painting or doing repairs while working either aloft or over the side. To do these tasks safely, you must be able to correctly rig and use both the boatswain's chair and the stage. You must also know the safety precautions involved in working aloft or over the side.

BOATSWAIN'S CHAIR

The boatswain's chair is a hardwood seat attached to a double bridle of stout line, as shown in figure 3-6. It is always bent to the gantline by a double becket. A length of slack line is left hanging, as shown in figure 3-6, for use in securing to masts, or staying aloft.

For a straight drop, as when painting down a mast, rig the chair for self-lowering. When you are coming down a mast, you will often find that the ladder takes you only to the crosstree. You must be hoisted from there to the truck by personnel on deck. When there is no way of getting to the truck by ladder, a dummy gantline is usually left reeved from the crosstree up through the sheave at the truck and back to the crosstree. The dummy gantline makes it unnecessary for anyone to climb the topmast to reeve a chair gantline through. You must never let the end get away from you and reeve out.

A recommended method of securing gantlines is diagrammed in figure 3-7. The end of the chair gantline is secured to the end of the dummy gantline. This is done by butting the two ends together and seizing with turns of rope yarn back and forth between strands, so everything will pass through the sheave without fouling.

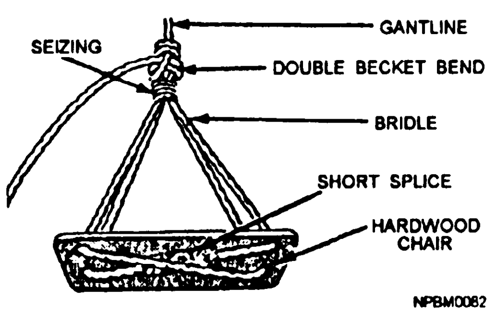


Figure 3-6.—The boatswain's chair.

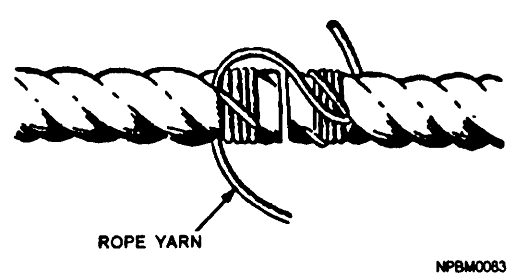


Figure 3-7.—Method of securing gantlines.

The chair gantline is hauled up and through by the dummy gantline, the chair is heaved from the deck to the crosstree, and the hauling part is passed down to the personnel or deck crew.

You should never attempt to hoist the chair aloft with the dummy gantline. All the tools and equipment are attached to the chair so hands are free and to ensure the safety of anyone below from falling objects. When you are ready to go up, and the deck crew is ready to heave around, get in the chair and give a signal to be pulled up. Assist the deck crew by hauling down on the hauling part. Keep your hands clear of the part the chair is on or they may get jammed into the sheave when you are two-blocked to the truck. When the desired working height has been reached, signal the crew below "To Hold What They Got." The deck crew will stop pulling and hold the chair in place. Reach above the double becket bend and firmly squeeze the two parts of the gantline together. When you have a good grasp, command the deck crew "Up behind." This tells them to let go of the gantline.

WARNING

At this point, your grasp keeps the chair from falling. With your right hand, pull the gantline through the bridle and squeeze them together just above the double becket bend.

Now the strain is on the bridle, as in the first view of figure 3-8.

With your free left hand, pull up some slack from below so that you will have enough to pass over your head, around the chair, and under your feet, as in the second view of figure 3-8. This maneuver is a bit tricky, especially if you have a bucket or two hanging on the chair, but you will not have any trouble if you have enough slack pulled up. Keep hold of the gantline with your right hand until you have worked the hitch up to the apex of the bridle, as shown in the third view of figure 3-8. Then hold the two parts of the gantline above your right hand with your left, and work the rest of the slack down.

You are now in no danger of falling, and all you have to do to lower the boatswain's chair is pull up the slack and pass it around. Before you go aloft for the first time, you should practice hanging off deck a few times.

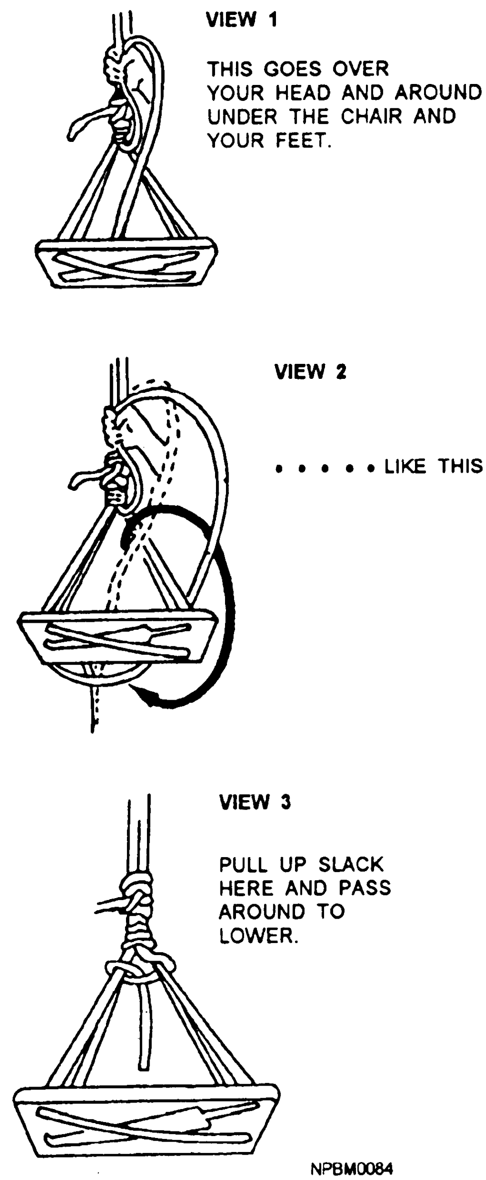


Figure 3-8.—Rigging for self-lowering.

RIDING DOWN STANDING RIGGING

Standing rigging usually leads too far out from the mast for you to lower yourself when slushing down. It is necessary for someone on deck to lower you down.

In riding down standing rigging, you bend the tail of your gantline (fig. 3-8) to a shackle placed around the wire. Never place the shackle pin on the wire. It may unscrew as it travels along, and if it opens and lets go, you will swing back against the mast hard enough to injure yourself. Always put the bow of the shackle around the wire.

The following safety precautions must be adhered to when personnel are to work aloft:

1. Obtain permission from the officer of the deck (OOD) before going aloft.

2. Ensure radio and radar units are OFF and the antennas are guarded. A "man aloft chit" is processed to ensure that key personnel are aware of any work being done aloft. The chit is signed by the ship's electrical maintenance officer (EMO), communications officer (COMMO), and command duty officer (CDO).

3. Tie tools and equipment to the boatswain's chair to prevent them from falling on personnel below.

4. Wear a safety harness and secure it to a fixed object above you once you are aloft.

WORKING OVER THE SIDE

LEARNING OBJECTIVES: Explain the procedures for working over the side and taking soundings

Personnel preparing to work over the side should notify the OOD. Upon securing, the OOD should again be notified.

All personnel working over the side of the ship on stages, boatswain's chairs, and on work floats or boats along the side of the ship are required to wear life jackets and, with the exception of personnel in boats, must be equipped with a parachute-type safety harness with safety lines tended from the deck above.

All personnel should be instructed in all applicable safety regulations before they are permitted to work over the side of the ship on scaffolding, stages, or in boatswain's chairs.

A competent petty officer must constantly supervise personnel working on scaffolding, stages, and in boatswains' chairs, and personnel must be assigned to tend the safety lines.

All tools, buckets, paint pots, and brushes used by personnel working over the side of the ship should be secured by lanyards to prevent their loss overboard or injury to personnel below.

STAGE

The stage is a stout plank to the underside of which two short wooden horns are attached athwartships, either by nailing or bolting on, a foot or two from either end. When the stage is rigged properly, all the weight comes on the plank. The chief purpose of the horns is to hold the plank off the side.

The gantlines on your stage may be rigged in one of two ways. The first is by means of an eye splice in the end of the gantline (fig. 3-9). Be sure to pass the part between the half hitches under the plank. If you pass it over, there will be nothing holding you up but the horns. The second method of rigging the stage is by means of the stage hitch, shown in figure 3-10. This method is the better of the two because there are two parts of the gantline under the plank instead of one, and there is no need to eye splice the end.

REEVING GANTLINES

The best way to reeve your gantline for lowering is over a smooth surface. Never have your gantlines running over a sharp edge. Place chafing gear wherever the lines from your shackles cross anything sharp.

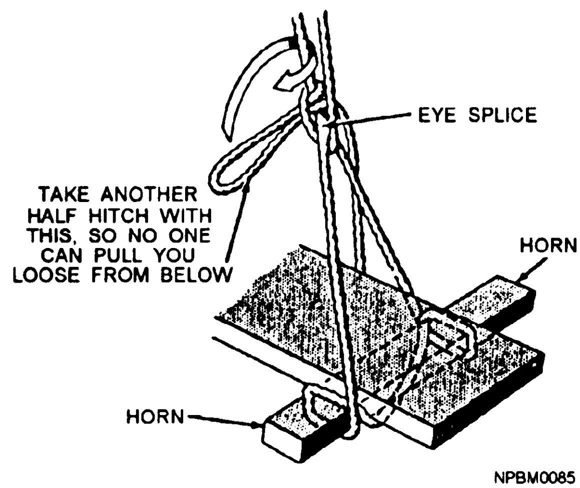


Figure 3-9.—Eye splice rig on a stage.

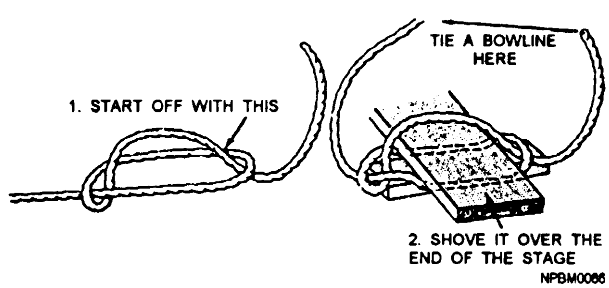


Figure 3-10.—Rigging with a stage hitch.

The following safety precautions should be observed while crew members are working over the side:

- Lower one end of your partner's stage at a time while your partner keeps the other side secured.
- Warn your partner before making moves that may jar the stage.
- Always wear a safety harness and lifeline when working on a stage.
- Always wear a life jacket when working over water.
- Keep clear of overboard discharges.
- Do not secure safety lines or gantlines to the stations that hold up the lifelines.
- Do not allow more than two persons on a stage at the same time.
- Secure tools to the stage with small stuff to prevent them from dropping.

TAKING SOUNDINGS

Soundings (measuring the depth of water) are taken when the ship is going into or out of port or approaching an anchorage. The hand lead is the most accurate means for obtaining soundings. It is used in shallow water and when the speed of the ship is slow. Even though ships today have modem depth-sounding equipment, lead lines are a mandatory piece of equipment and are routinely checked during inspections and refresher training periods.

LEAD LINE

The lead line or hand lead consists of a narrow block of lead weighing from 7 to 14 pounds, which is attached to a marked line (fig. 3-11). With the ship making 12 knots, a good leadsman can get reliable soundings down to 7 fathoms. At slower speeds, of course, the lead has time to sink even deeper before the ship moves up to it. The lead line may also be used for determining the direction in which a ship, practically dead in the water, is moving. Direction of movement is found by placing the lead on the bottom, directly below the leadsman, and noting the direction of the motion of the ship as shown by the change of direction of the lead line from the up and down.

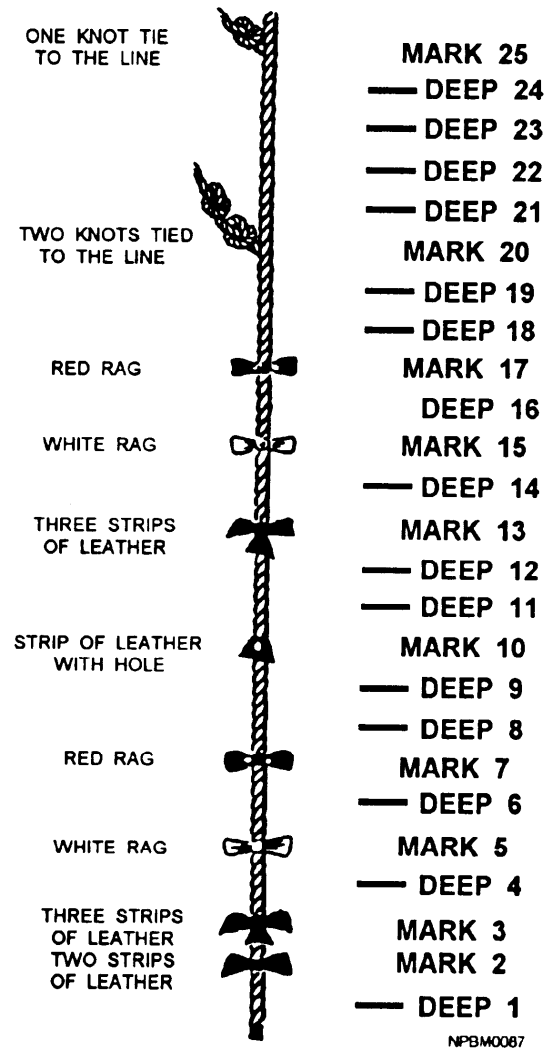


Figure 3-11.—Markings of lead tine.

Before heaving, the leadsman takes station in the chains, which usually are platforms projecting over each side at the after end of the forecastle. The lead is then lowered over the side and is supported in the heaving hand by a wooden toggle, inserted in the lead line about 2 fathoms from the lead. The spare line is coiled in the other hand, free for running.

To make the heave, start by calling out "Watch-O-Watch," then swinging the lead in a fore-and-aft direction outboard of the chains in order to gain momentum. When you can swing the lead in a complete circle, and the force is great enough, let go the lead as it swings forward at a point about level with the deck.

As the ship moves ahead, heave in the spare line rapidly. The marker should be read when the lead is on the bottom and the line hauled just taut, up and down. The ability to heave the lead can be acquired only by practice. It is necessary to practice with both hands because the right hand is used for heaving from the starboard chain; the left hand for heaving from the port chain.

A good heave has no value unless the depth can be read correctly and quickly. Learn the markings of the lead line, which are identified in figure 3-11.

Lead lines often are marked at each half fathom over the range of depth used most and may even have foot markings around the more important depths. Some lead lines are so fixed that the depth may be read at the level of the chains instead of at the water's edge. This procedure makes it easier to take sounds at night. Learn any special markings on the lead line that may be used on your ship.

Report each sounding to the bridge in a sharp, clear voice. When the sounding agrees with one of the marks, report it by mark as 2, 3, or 5.

When it falls on an even fathom between marks, report it as by the deep 4, 5, 8, or 9. If the reading does not give an even fathom, it is reported, for example, as "A quarter less three"; "And a quarter, four"; "And a half, four." Respectively, these reports mean there is 1/4 fathom less than 3 fathoms of water, 1/4 fathom more than 4, and 1/2 fathom more than 4. If the bottom is not reached, report "No bottom at (number of fathoms)."

LIFELINES

LEARNING OBJECTIVES: Describe the use and care of lifelines.

Personnel are not permitted to sit or lean on the lifelines at any time. Lifelines are safety barriers to prevent personnel from falling or being washed over the side. When lifelines are removed for any purpose, the officers and petty officers concerned are required to ensure that emergency lines are rigged and that everyone has been cautioned to keep clear. In port, when personnel are working over the side, they are required to wear life jackets at all times.

When the ship is under way and a crew member has to work outside the lifelines, permission must be obtained from the commanding officer.

At sea, weather decks of ships can be extremely hazardous, particularly aboard small ships. At any moment, the sea can submerge the main deck to a depth of several feet or a wave may come unexpectedly over the bow or fantail.

If your duties do not require you on the main deck, do not go there. Be aware of any locations on deck that present any tripping hazards. Line handlers should stand at least 6 feet away from the block through which the line passes. Always stand clear of the bights of a wire rope or a line.

CANVAS AND SYNTHETIC FABRICS

LEARNING OBJECTIVES: Describe the application and care of canvas and leather products. Explain how to sew the different types of stitches that are used in a deck force everyday life.

Canvas and leather have long been important in a seaman's life. You will learn how to sew small canvas articles by hand using some of the most common stitches. There are so many types of sewing machines in the Navy now that this manual will not cover them. You will need to consult your owner's manual to see how to use your type of sewing machine.

Canvas, often called duck, is a general name for a class of strong, heavy, plain cloth woven of cotton or linen. *Numbered duck* is the canvas encountered most often, but occasionally you see the terms ounce duck or army duck. Numbered duck runs from No. 1, the heaviest, to No. 12, the lightest. Numbers 7, 9, and 11 are no longer issued.

Each number means a certain weight in ounces per square yard of cloth. For example, No. 1 is 28.71 ounces per square yard, No. 6 is 20.74 ounces per square yard, and No. 12 is 11.16 ounces per square yard. Canvas in weights besides those designated specifically under the numbered system is called ounce duck. Army ducks are ounce ducks similar to numbered duck, but have finer yarns, higher cloth counts, and usually have lighter weights. The following items are a sample of articles made from different weights of canvas.

NO. OF CANVAS	ARTICLE
1	Sandbags
1	Hammocks
2	Hatch paulins

NO. OF CANVAS	ARTICLE
4	Berth bottoms
4	Seabags
4	Gun covers
4	Muzzle bags
6	Large boat covers
8	Hose rack covers
8	Soiled clothes bags
8	General-purpose paulins
10	Shower curtains
12	Destruction bags

Canvas usually is made up in bolts from 85 to 100 yards, but is issued by the linear yard, in widths from 22 to 72 inches.

Even with the best of care, canvas is relatively short-lived, and for this reason, the Navy is using more synthetic fabrics. They not only are lighter and easier to stow, but also are rot- and mildew-resistant.

Synthetic fabric, like synthetic line, is more costly than a natural fabric. Because of this greater cost, you must be more selective in its use.

One type of synthetic fabric used extensively for tarps and awnings and for boat, winch, and reel covers is a nylon cloth with a vinyl film on both sides. (The smooth or face side is the side to expose to the weather.) Two different companies furnish this type of cloth under their own brand names (Herculite #80 and Hypalon). These white or grey materials weigh approximately 19.6 ounces per square yard and come in 50-inch widths. They are fire-, water-, weather-, and mildew-resistant.

Another type of cloth, a black neoprene-coated material, is less suited for topside use but has many below-deck applications, such as for blackout and welding curtains. This material weighs approximately 2.3 ounces per square yard and comes in a 39-inch width. Generally, the same care should be accorded synthetic cloths as is given synthetic lines. When they are dirty, however, you should wash these fabrics with saddle soap or any other mild soap and water; scrub with a soft bristle brush, using a circular motion; and rinse with clear water. In some instances, two cleanings may be necessary.

All hems should be triple-folded and sewed, but reinforcing material and other patches may be sewed or cemented in place. When cementing a patch, clean the area with a solvent. Then apply a coat of cement to the patch and to the surface to be repaired or strengthened. Allow these coatings to dry, then apply second coats to each surface. When these coatings are tacky, position the patch. Rub or roll the patch to make certain that all points make contact.

With synthetic cloth, do not use manila for bolt ropes and lashings, because the manila will stain the cloth. Use cotton line or one of the synthetic lines. The eyelet-and-ring type of grommet has a tendency to slide and pull out of synthetic cloths; therefore, only the spur type of grommet is recommended.

TREATED CANVAS

Much of the canvas issued in the Navy is treated to make it resistant to fire, water, weather, and mildew. Some is waterproof and oil- and gasoline-resistant. Current specifications for building ships require that all topside canvas be treated according to the intended use. Canvas to be used below decks is usually white and untreated. Preservatives are available for shipboard use on untreated canvas or for retreating canvas.

CARE AND STOWAGE

Canvas is very expensive, so learn to care for it and make sure to never abuse it. New and unused canvas, spare covers, and so on, should be stowed in a clean, dry storeroom. Never store canvas where acid is or has been stowed; acid fumes are detrimental to canvas. Every effort should be made to provide a space free from rats, mice, and insects. Wet, painted, or oil-soaked canvas should not be stowed below decks. Occasionally it is necessary to scrub canvas that has become dirty or stained by grease or oil. Use a mild soap solution, rinse thoroughly, and hang the canvas up to dry.

All covers, awnings, and paulins should be inspected frequently and carefully, and all rips and torn or loose seams should be repaired. If a grommet tears out, sew a patch over the spot and put in another grommet. A larger size grommet may be substituted for one that has torn out if it is in a spot where appearance is unimportant. You can save time and trouble if you file away or enter into a log all information pertaining to renewing canvas articles aboard your ship.

Measuring Canvas

Take great care when measuring and cutting canvas—MEASURE TWICE AND CUT ONCE. When measuring canvas for items that will be stretched taut (awnings, for example), DEDUCT one-half inch for each linear foot in both width and length. If the canvas is to be loose (as for hatch hoods and gun covers), ADD one-half inch for each linear foot in both width and length. Use the old article for a pattern whenever possible. When it is not available, make a sketch of the item, showing all the necessary dimensions, and work from that.

Using the Allowance List

You should have a copy of the allowance list for bulk canvas and ready-made covers for your ship. The allowance list usually gives the amount of each type of canvas you should carry at all times. When the amount of any item on the list falls below this allowance, see that a requisition for the material is filled out at once.

The weight of canvas used for the various covers varies with the type of ship. See the ship's allowance list for the weights that should be used aboard your ship.

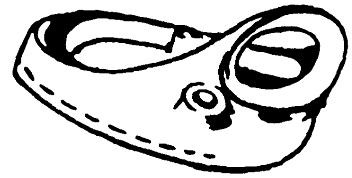


Figure 3-12.—Sailmaker's palm.

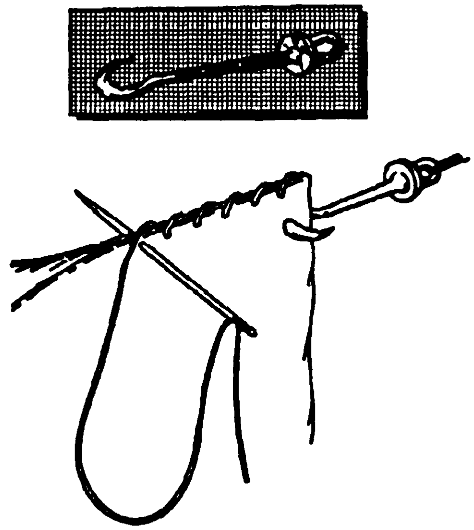


Figure 3-13.—Round-stitching a canvas held by a bench hook.

SEWING CANVAS BY HAND

In most instances when you are required to fabricate articles, you will need the appropriate tools, a few of which are as follows:

- Sail needles. Needles are numbered according to size; the higher the number, the smaller the needle. The heavier the canvas, the larger your needle should be. After being used, needles should be dried carefully and oiled or stowed in a container of powdered chalk to prevent them from rusting.

- Palms. Two types of palms are issued in the Navy; the sailmaker's palm and the roping palm. At first glance you probably see no difference, but if you check the metal slug you can see that the roping palm is designed for larger size needles. This is the palm to use when jobs require the largest needles—sewing on bolt ropes, for example. They are designed to be worn in the palm of the hand and are used to aid in pushing a sail needle through the material being sewn. See figure 3-12.

- Sailmaker's or bench hook. This hook (fig. 3-13) has a swivel eye. It is used to hold the ends of two pieces of canvas being sewn together, as shown in figure 3-13.

- Beeswax. This substance can hardly be called a tool, but it is a necessary item. It reduces the wear on the sail twine while sewing is being done, and it retards deterioration. To use it, run the sail twine through the block surface of the beeswax. This gives the twine a waxed coat.

- Sail twine. Many different types of twine are used for sewing, but the most common for sewing machines is listed in the stock catalog as mattress twine. Lacing twine (already waxed) is best for hand-sewing.

Stitches and Their Uses

The following are some of the common stitches that you will find useful in your work:

- Round stitch. The round stitch is the stitch most commonly used for joining two pieces of canvas.

Turn back the edges, hold the pieces together, and send the needle through both pieces at right angles to the seam, as shown in figure 3-13.

- Flat stitch. A flat stitch is used when a strong seam is required, as on a paulin or a sail. Pencil a guideline 1 1/2 or 2 inches from the edge of each strip of canvas, depending on how wide you want the seam. Crease each piece on a line slightly less than halfway to the guideline. Make the folds away from the guidelines and interlock the folds (fig. 3-14). Interlocking the edges forms a watertight seam and keeps a ragged edge from showing. Insert the needle at the guideline, and stitch diagonally so that the stitches appear at right angles to the seam on top but run at an angle on the reverse side. After completing one edge, turn the canvas over and sew the other edge of the seam. Fiat stitching also is used for patching.

- Baseball stitch. The baseball stitch is used to mend tears in light and medium canvas. Figure 3-15 shows how it is done. Keep enough tension on the thread to remove all loops and slack thread. Do not apply too much tension, however, because this tends to pucker or draw the seam out of line.

- Herringbone stitch. The herringbone stitch is used to mend tears in heavy or painted canvas. Figure 3-16 shows the steps in making this stitch. As you can see from the picture, the herringbone stitch is very strong if applied correctly, as each stitch locks itself as it begins the next.

Making a Seabag

A seabag may be any size desired, but 1 foot in diameter and 36 inches in length is about average. Use No. 4 weight canvas that is wide enough for the length of the bag plus an allowance for seams, to avoid sewing an extra seam. A 40-inch width is adequate. Cut a length equal to 3.14 times the diameter of the bag plus 3 inches for the seam. Fold back one-half inch at each end and draw a line 1 inch from each fold. Lap the ends and flat stitch each fold to the opposite part along the penciled line as in figure 3-14.

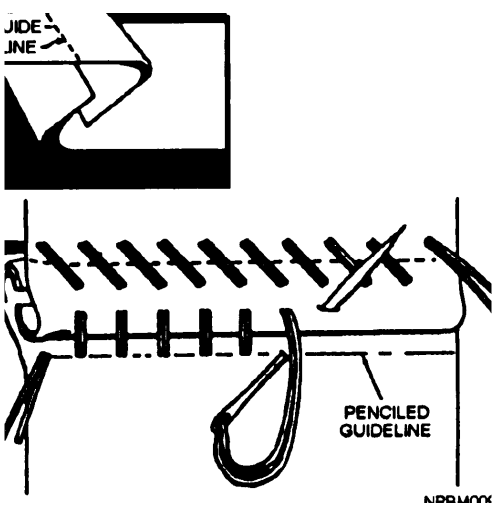


Figure 3-14.—Flat stitch.

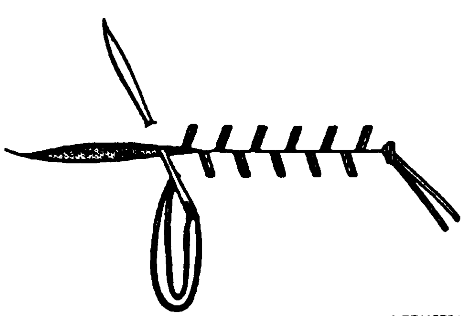


Figure 3-15.—Baseball stitch.

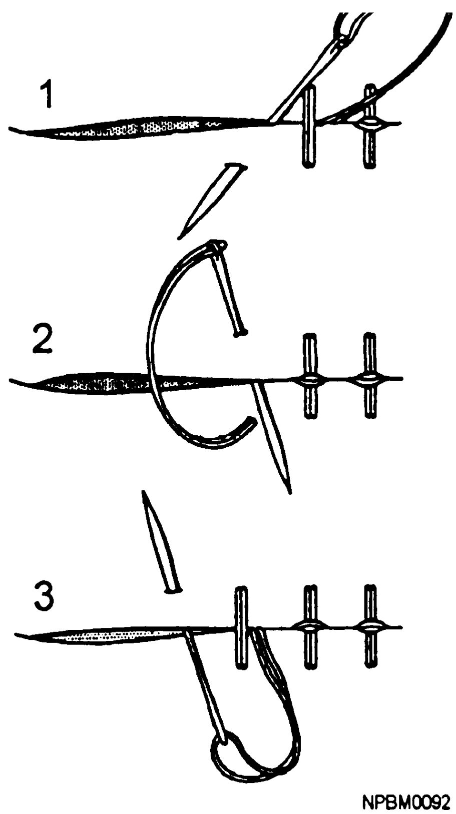


Figure 3-16.—Herringbone stitch.

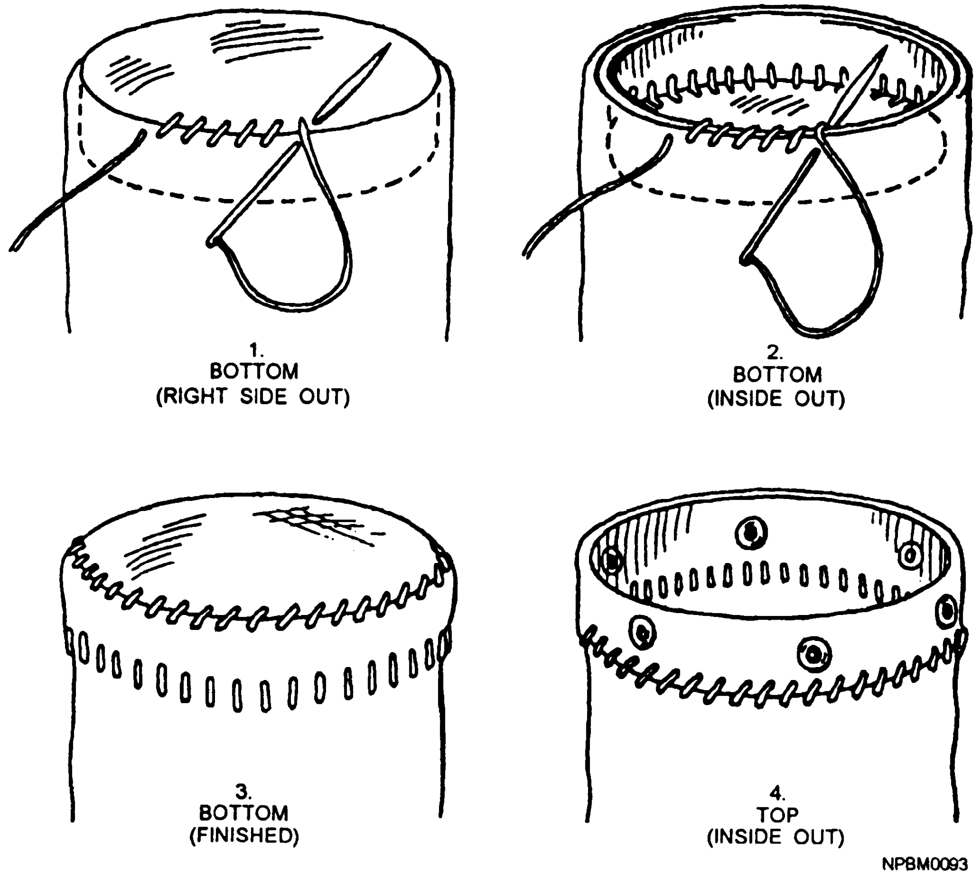


Figure 3-17.—Making a seabag.

Now for the bottom: With a piece of sail twine tied to a pencil, draw a circle 1 foot in diameter on a piece of canvas. Cut this out, leaving at least 1 inch outside the circle. Fold 1 inch of the sides down inside the tube. Insert the bottom in the tube and round-stitch it in place, sewing along the penciled circle as in step 1 of figure 3-17. If you want to make the bottom stronger, turn the bag inside out as in step 2 and round-stitch another seam. If you intend to double seam the bottom, leave 1 1/2 or 2 inches of extra material outside the circle when cutting out the bottom.

With the bag turned inside out, turn down 1 1/2 inches at the top, then fold it again so that you have three thicknesses where the grommets go. Flat-stitch this as in step 4. Insert four or six grommets equally spaced around this hem, and your bag is finished. (See the section in this chapter on inserting grommets.)

Sewing Bolt Ropes to Canvas by Hand

Bolt ropes are the ropes around the edges of awnings and sails. Their purpose is to take the strain of the stops, clews, reef points, and the like. To sew on a bolt rope, hem the canvas and lay the rope along the edge. Use a round stitch, the size of which is determined by the size of the rope. Sew the rope to the canvas, strand by strand, as shown in figure 3-18. Carefully observe the following points when you are sewing on bolt ropes:

- Keep the rope taut and the canvas slack.
- Do not bunch the canvas, but hold your needle at such an angle that it goes through the canvas a

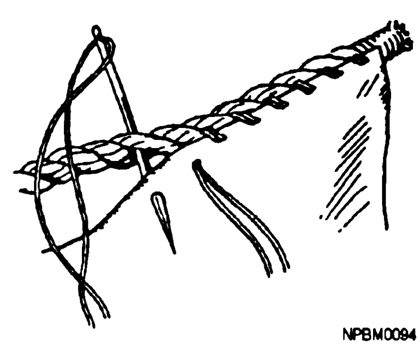


Figure 3-18.—Sewing a bolt rope to canvas.

fraction of an inch ahead of where it comes out from under the strand.

- Sew each strand to the canvas, making sure the needle goes under, not through, the strands.
- Do not let your stitches start to creep up around the rope, but keep them coming out of the rope in a straight line along the underside. If you let them creep, the canvas begins to curl around the rope.
- SEW THE BOLT ROPE TIGHT.

HAND-SEWING GROMMETS

Metal grommets have replaced the hand-sewn type. But if you are ever caught without the proper size of metal grommet, it is nice to know how to make one by hand. Properly made and sewn to the canvas, hand-sewn grommets are almost as strong as the metal type.

The first step is to fashion a two- or three-strand grommet of marline. To do this, form a ring with the marline, of the desired size. Start with an end, laying the strand about itself, as in view A, figure 3-19. Continue laying the marline about itself, as in making a piece of line, until you complete the circle, as in view B, figure 3-19. Half knot the ends and stretch this over a fid to make it round and firm. Next, take your sail twine and double it, then twist the two parts together and cover with beeswax. The next step is to punch a hole slightly smaller than the grommet in the canvas. Sew the grommet using a round stitch; keep your stitches close together to cover the grommet. See figure 3-20. After completing the stitches, shape the grommet again with a fid.

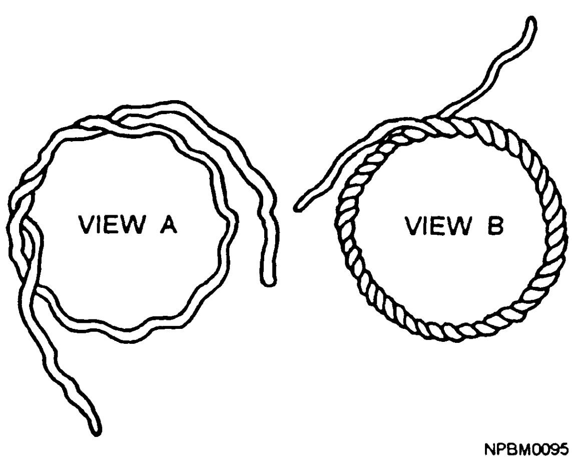


Figure 3-19.—Fashioning a marline grommet.

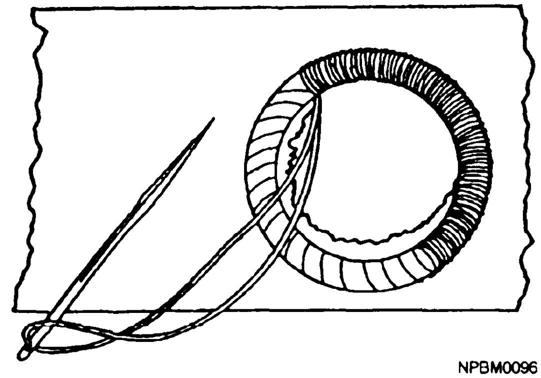


Figure 3-20.—Round-stitching a band-sewn grommet.

Using Metal Grommets

Several different types of metal grommets are in use, but the two that are most familiar are pictured in figure 3-21. The one in view A is called the eyelet-and-ring type, and comes in sizes 6 to 15, inclusive, with inner diameters from three-fourths of an inch to 2 inches. View B shows the spur type. It comes in sizes 0 to 6, inclusive, with inner diameters from one-fourth to three-fourths of an inch.

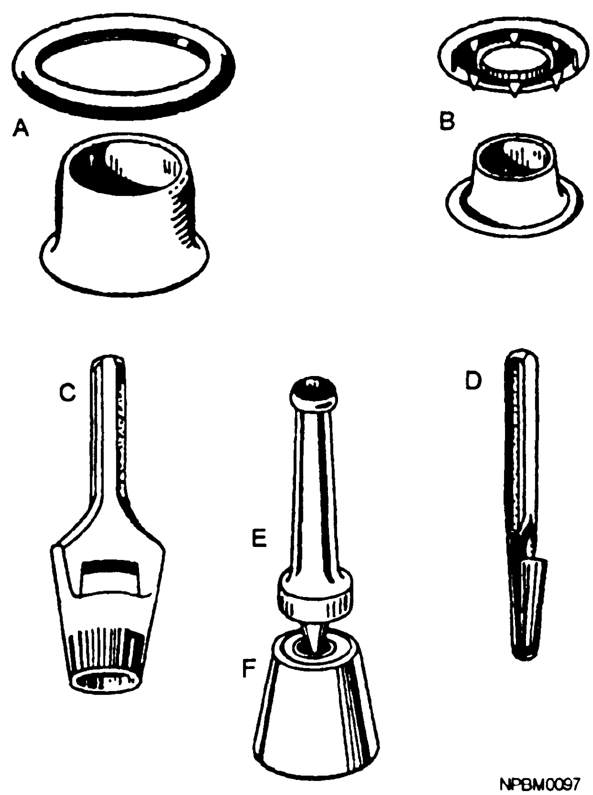


Figure 3-21.—Grommets, cutting punches, and inserting-punch die.

The cutting punches shown range in diameter from 1 inch down to seven-sixteenths of an inch in the double-bow type (view C), and from three-eighths to one-eighth of an inch in the single-bow type (view D). When using these to punch holes in canvas, lay the canvas on a piece of heavy sheet lead, and they will cut a neat, clean hole.

The grommet-inserting punches and dies are available in sets in the same sizes as the grommets; that is, from 0 to 15. Use the same size set as the size of grommet. In figure 3-21, view E shows the punch, and view F, the die.

The proper way to insert the spur type of grommet is to push the eyelet part of the grommet through the hole in the canvas. Place the eyelet on the die and, the spur over the eyelet. The punch fits inside the eyelet, and when struck with a hammer, curls the edge of the eyelet down over the spur. Do not pound too hard on the punch, because that causes the grommet to cut through the canvas, and later it may pull out.

The eyelet-and-ring type of grommet is especially for awnings and sails. Properly used, this is the best of all types. The ring part is sewn to the canvas the same as the handmade grommet. Then the eyelet is placed in the ring and set with the punch and die.

Sewing Metal Fittings to Canvas

Most metal fittings that must be sewn to canvas are rings of some sort. When sewing them on, as when making grommets, use your sail twine doubled and twisted together. Use as many round stitches as you can, stitching through the canvas over as great an area as possible, to spread the strain. Usually O-rings are secured to canvas by placing a webbed strap, folded canvas strip, or even a leather strap through the ring and sewing the strap to the canvas, using a flat stitch.

Awning hooks are positioned and prevented from sliding along the bolt rope by taking several crisscross stitches around the hook, see figure 3-22. Several stitches around the concave pad on each side of the hook will take the strain of the awning lashings.

It is a good idea to sew a reinforcing patch over the edge of canvas every place a metal fitting is to be attached.

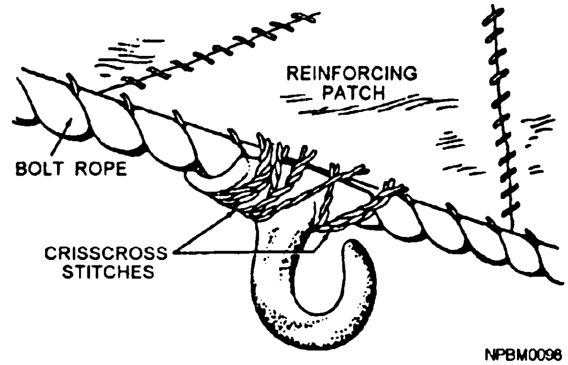


Figure 3-22.—Awning hooks.

AWNINGS

Awnings are canvas or synthetic coverings spread over the decks of a vessel to protect the crew from sun and weather. The center of the awning is held up by a strong fore-and-aft wire rope jackstay supported by intermediate stanchions. There may be a wooden strongback in place of the jackstay. The edges of the awning are hauled out and secured to ridge ropes along the rail. The ridge ropes in turn are supported by specially braced stanchions that usually can be taken down when the awnings are not in use. Edges of some awnings are secured to the ridge rope by lacings reeved around the ridge rope and through grommets in the awning or awning hooks sewn to the bolt ropes. Other awnings are equipped with stops and earrings spliced into the grommets. Earrings are larger and longer than the stops and are spliced at the corners and in the grommets that line up with the stanchions.

When spreading an awning, haul it over the jackstay and spread it out fore and aft. If the awning is large and heavy, it may be necessary to rig a block and tackle to haul it taut. Next, man and reeve off the earrings. Pull them taut and secure them temporarily to the ridge rope. Reeve off, set taut, and secure the stops temporarily to the ridge rope. It will be necessary to go back and tighten all stops and earrings to take the sag from the awning. Earrings and stops are secured by wrapping the bitter ends around the parts reeved through the grommets and around the ridge rope, tucking the ends between the parts.

During rains, awnings must be housed to allow them to shed water better. This is done by casting off two or more stops between earrings and securing them tautly to the lifeline. When awnings are secured by lacings reeved through grommets, it is almost impossible to house them. It may be to your advantage to replace the lacings with earrings and stops.

In particularly windy weather, awnings sometimes are furled. Cast off the stops and earrings and haul one edge across the jackstay to the other side. The awning is then rolled up and secured to the jackstay with marline hitches.

LEATHER

Hides and skins, being of animal origin, vary in area, thickness, and weight. Subsequent tanning and finishing processes further alter these features. The following information concerning the areas, thicknesses, and weights is therefore only approximate.

The various types of leather include rigging, harness, shoe, chamois, kid, lacing, belting, and various artificial leathers. Of these, the three you are most likely to need are rigging, belting, and artificial leathers.

Rigging leather is designated by weight as light, medium, and heavy, and ranges from 6 ounces per square foot to over 10 ounces per square foot. It is issued by the pound. There are approximately 20 square feet per hide, and each sixty-fourth of an inch of thickness equals approximately 1 ounce per square foot.

Belting is either round or flat and is issued in any desired length by the linear foot. Round belting comes in two widths: one-fourth inch and three-eighths inch. Width is used instead of diameter because, despite the name, round belting is oval rather than perfectly round. Flat belting may be either single or double ply. Single-ply belting is available in 1- to 6-inch widths; double-ply, in 2- to 12-inch widths.

The most common types of artificial leathers are used for upholstery and are issued by the square foot.

CARE OF LEATHER

Leather exposed to the elements should be kept well oiled or waxed. Any oil that does not contain harsh chemicals is suitable, but the best is neat's-foot oil. Leather in places such as on lifelines may be kept well preserved by the application of paste wax. Saddle soap, an excellent preservative and cleaner, can be used on holsters, shoes, jackets, and other leather wearing apparel. If leather becomes badly soiled and stained, wash it with a mild soap and water solution, rinse it well, and then dry it in a spot away from intense heat. After it is dry, apply saddle soap or neat's-foot oil to replace the natural oils of the leather.

Leather is especially subject to mildew and rotting. It is also highly susceptible to accidental cutting, gouging, and abrading. Excessive heat causes it to shrink considerably, with subsequent rending and cracking. Acids, corrosives, or their fumes have a disastrous effect upon leather.

The foregoing conditions should be borne in mind when leather is being stowed. Rolls must have top stowage to prevent crushing. Stowage must be well clear of any liquids or greases that might stain. To prevent sticking, paper should be placed between hides stowed one on top of the other. Original moistureproof wrappers should be left on as long as possible, to prevent mildew. Stowage should always be in a dry, well-ventilated compartment.

SEWING LEATHER

When two leather edges are joined by hand-sewing, the line along which the stitches are to run on each edge is grooved so as to countersink the stitches below the surface. Draw a line parallel and close to the edge first, then make your groove with a grooving tool (a dull knife will do). Use a block of wood for a straightedge. Next, punch holes along the grooves for the stitches.

The shoemaker's or cobbler's stitch is shown in figure 3-23. A variation of this stitch is to cut the leather carefully so that the edges abut. Angle the grooves toward the edges of the leather and sew through the

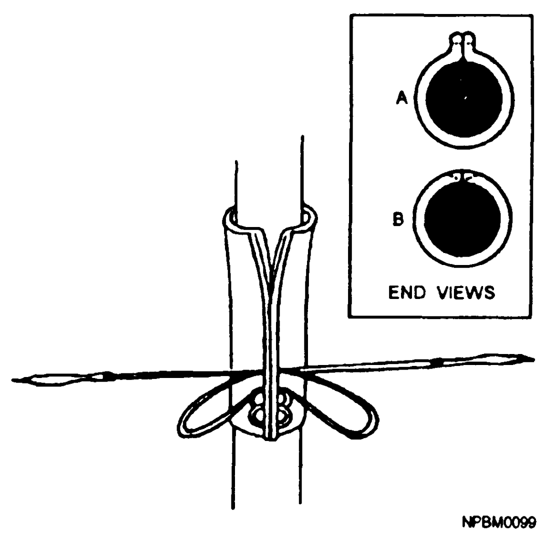


Figure 3-23.—Shoemaker's stitch.

edges. This variation is particularly useful in sewing leathers on the looms of oars, but great care must be taken to trim the leather so that the edges butt and yet the leather is tight around the loom. Inset A of figure 3-23 shows the end view of the regular shoemaker's stitch. Inset B of figure 3-23 shows the variation.

For easier handling of leather, soak it in a bucket of water for a few minutes.

SUMMARY

This chapter has dealt with various types of deck seamanship equipment and knowledge of a Boatswain's Mate's job and how to use them in everyday life. You must be very knowledgeable in all areas of the seamanship and areas of working over the sides or aloft. Always remember, SAFETY comes first.

CHAPTER 4

GROUND TACKLE, TOWING, AND SALVAGE

Two of the many responsibilities that Boatswain's Mates have are the care and handling of the ship's ground tackle and towing gear. In this chapter, we cover the different types of anchors, the various parts that make up the anchor chain, the handling equipment that is used, and the care and maintenance of ground tackle. We describe the events in letting go and weighing a single anchor and discuss the sequence of events in mooring to a buoy. In addition, we cover a ship's ability to tow, as well as being towed, including high-speed target towing. We also cover a little bit about salvage.

GROUND TACKLE

LEARNING OBJECTIVES: Describe and identify all the areas dealing with ground tackle and related appendages.

The *Naval Ships' Technical Manual (NSTM),* chapter 581, states that ground tackle is the equipment used in anchoring and in mooring with anchors. Ground tackle includes the following:

- Anchors
- Anchor chain, wire rope, synthetic rope, or combinations of these materials when used with anchors
- Appendages, consisting of connecting shackles or links, detachable links and end links, bending shackles, mooring swivels, detachable link tool sets, clear hawse pendants, dip ropes, chain stoppers, wrenches for chain stoppers, outboard swivel shots, chain cable jacks, anchor bars, and anchor marker buoys

ANCHORS

Anchors used in the Navy today can be grouped according to type as follows:

- Stockless anchors
- Lightweight-type (LWT) anchors
- Two-fluke balanced-fluke anchors
- Navy-type stock anchors
- Mushroom anchors

Stockless anchors are easy to stow and, for this reason, were adopted by the Navy. Three designs of stockless anchors are in use on naval ships: the commercial stockless anchor, the standard Navy stockless anchor, and the Mark 2 stockless anchor. (See fig. 4-1, views A, B, and C.) The essential differences in these anchors are in the length of the flukes and in the

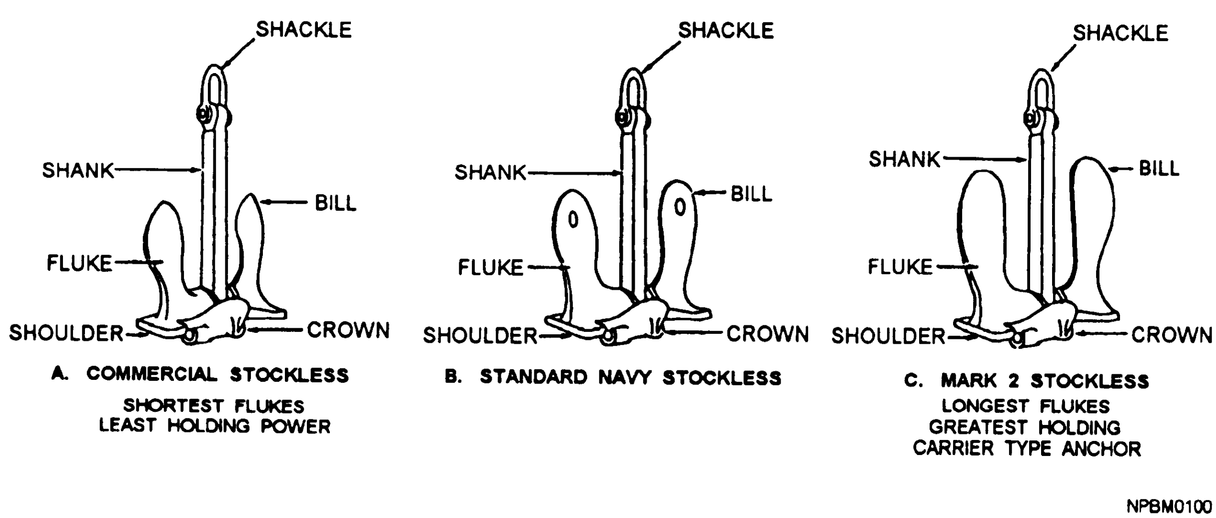


Figure 4-1.—Stockless anchors.

holding power. The Mk 2, with its long flukes, has the greatest holding power. It is made in the 60,000-pound size for use aboard the larger aircraft carriers. The commercial stockless anchor has the least holding power and the shortest flukes.

Lightweight-type (LWT) anchors have high holding power for their weight. Two types of LWT anchors are used on Navy ships: the Mk 2 LWT anchor and the wedge block LWT anchor. These, as well as the commercially made Danforth anchor, are shown in views A, B, and C of figure 4-2. For example, a 10,000-pound LWT anchor is designed to have the holding power in a sand bottom approximately equal to the 22,500-pound standard Navy stockless anchor. LWT anchors are used as bow and stem anchors. Sizes below 150 pounds are used as boat anchors. The wedge block LWT anchor differs from the Mk 2 LWT anchor in that it has wedge block adapters. When installed, the wedge blocks give an angle of 30° between the shank and the flukes. When removed, a 50-degree angle is attained. With a 50-degree fluke angle, this anchor has a considerably higher holding power in mud than with a 30-degree fluke angle.

The two-fluke balanced-fluke anchors (view A of fig. 4-3) are used for anchoring some surface ships and the newer submarines. This anchor is normally housed in the bottom of the ship. This anchor is used on surface ships where the ship's conventional anchors interfere with the ship's sonar dome. Navy-type stock anchors are used chiefly as boat anchors, in sizes below 150 pounds (view B of fig. 4-3). A variation of this anchor, with only one fluke, is used as an ice anchor.

Mushroom anchors (view C of fig. 4-3) are used by some older submarines and for special purposes, such as moorings for buoys and torpedo-testing barges. They are mushroom-shaped with a shank projecting from the center of the cupped side.

IDENTIFYING ANCHORS

Each anchor of over 100 pounds ordered by the Naval Sea Systems Command is assigned a serial number, which is cast or cut into the anchor before it is delivered. Serial numbers are found on the crown of the old-fashioned anchors, on the flat of the crown of the stockless anchors, and on the shank of the lightweight anchors. These numbers must be recorded in your anchor log. Be certain to record the proper numbers. Do not confuse these numbers with other figures, such as the weight of the anchor.

CHAIN AND APPENDAGES

Modem Navy anchor chain is made of die-lock chain with studs. The size of the link is designated by its diameter, called wire diameter. The *Federal Supply Catalog* lists standard sizes from 3/4 to 4 3/4 inches. Wire diameter is measured at the end and a little above the center line of the link. The length of a standard link is 6 times its diameter, and its width is 3.6 times its diameter. All links are studded; that is, a solid piece is

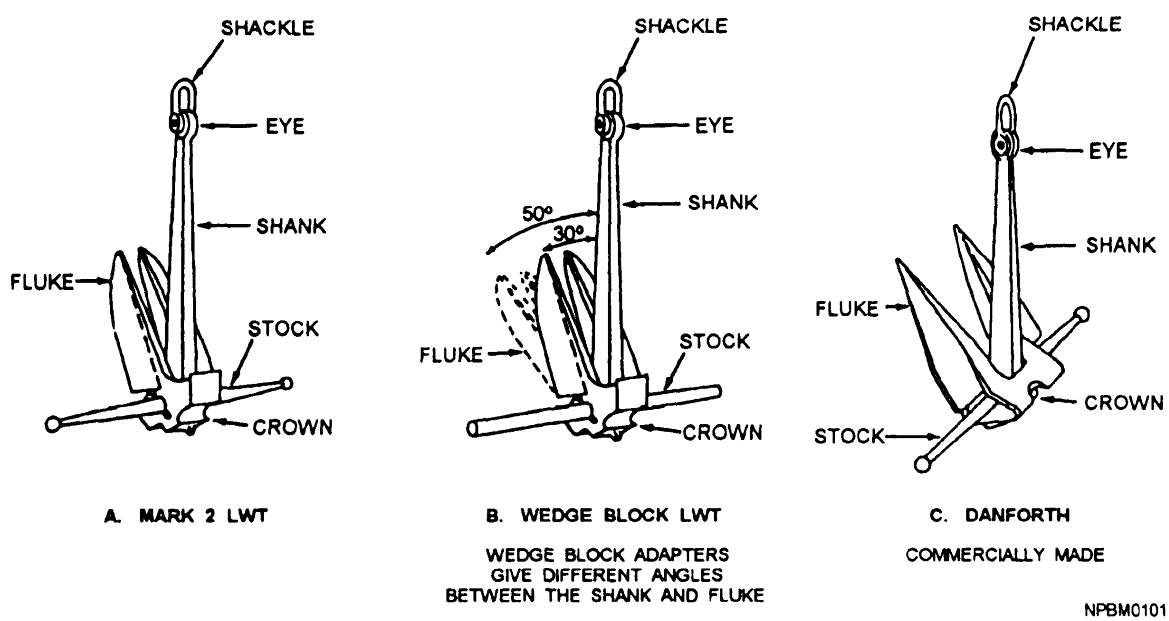


Figure 4-2.—Lightweight-type (LWT) anchors.

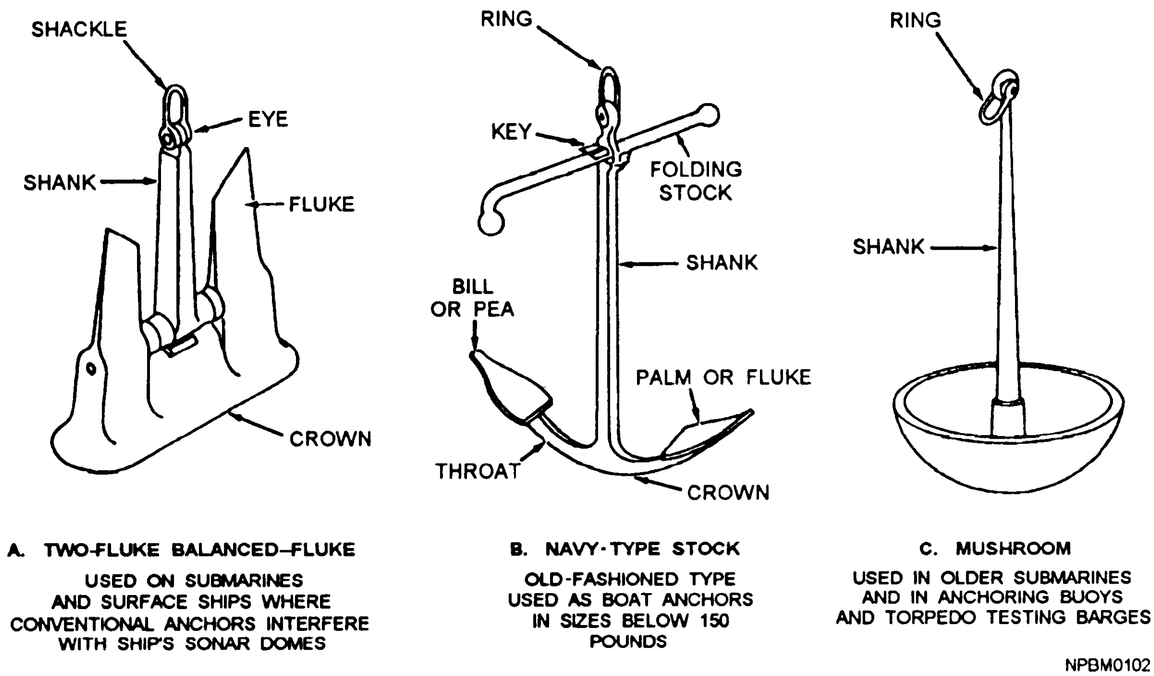


Figure 4-3.—Types of anchors.

forged in the center of the link. Studs prevent the chain from kinking and the links from pounding on adjacent links.

Anchor chains furnished in time of war have been of all types: wrought iron; BBB close link steel; die-lock chain, forged and welded; stud-link; and cast steel. Die-lock chain is standard in the Navy today.

Heavy-duty and high-strength die-lock chain are similar to some of the smaller sizes of standard die-lock chain but have higher breaking strengths, as compared to standard die-lock chain. Size for size, the links fit the same wildcat.

Chain Nomenclature

A chain is made up of many parts besides links, and a variety of equipment is used to maintain the chain. The following topics describe a chain and its associated hardware:

- **STANDARD SHOTS.** The lengths of chain that are connected together to make up the ship's anchor chain are called shots. A standard shot is 15 fathoms (90 feet) long. Each shot of the chain usually bears a serial number, either stamped or cut at the time of manufacture, on the inner side of the end links of each shot. If an end link is lost or removed from a shot, this identification should be either cut or stamped on the inside of the new end link of the altered shot.

- **DETACHABLE LINKS.** Shots of anchor chain at one time were joined by an ordinary U-shaped shackle called a connecting shackle. The connecting shackle was replaced by the Kenter shackle, which in turn was replaced by the detachable link, shown in figure 4-4. The Navy type of detachable link consists of a C-shaped link with two coupling plates, which form one side and stud of the link. A taper pin holds the parts together and is locked in place at the large end by a lead plug. Detachable link parts are not interchangeable, so matching numbers are stamped on the C-link and on each coupling plate to ensure identification and proper assembly. You will save time and trouble when trying to match these parts if you disassemble only one link at a time and clean, slush, and reassemble it before disassembling another. When reassembling a detachable link, make sure the taper pin is seated securely. This is done by driving it in with a punch and hammer before you insert the lead plug over the large end of the pin. Detachable link toolbox sets contain tools, including spare taper pins and lock plugs, for assembling and disassembling links and detachable end links.

- **BENDING SHACKLES.** Bending shackles are used to attach the anchor to the chain.

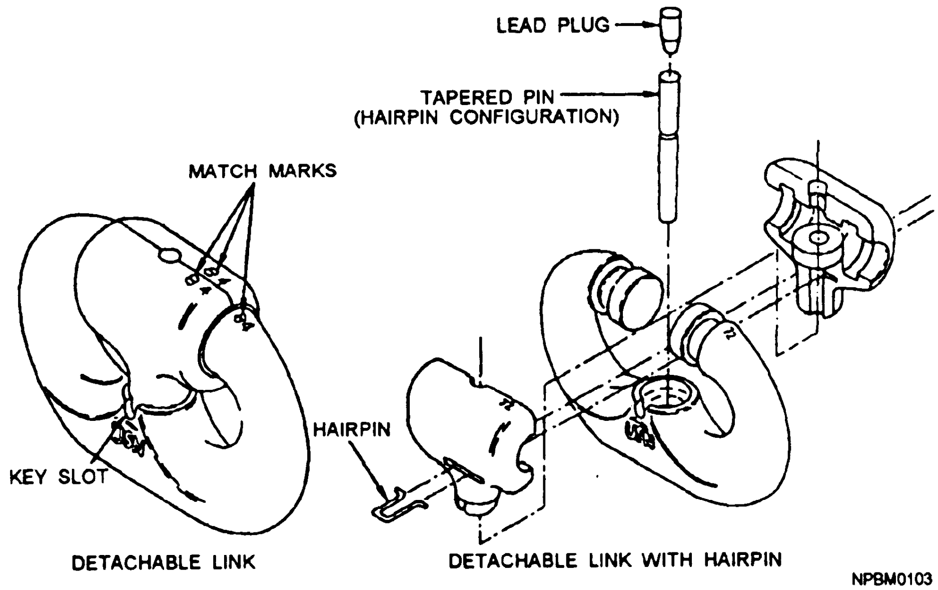


Figure 4-4.—Detachable link.

- **CHAIN SWIVELS.** Chain swivels (fig. 4-5) are furnished as part of the outboard swivel shot. They minimize kinking or twisting of the anchor chain.

- **OUTBOARD SWIVEL SHOTS.** Standard outboard swivel shots (fig. 4-6), also termed *bending shots,* consist of detachable links, regular chain links, a swivel, an end link, and a bending shackle. 'They are fitted on most vessels to attach the anchor chain to the anchor. They also make it possible to stop off the anchor and break the chain between the windlass and the anchor. The taper pins in the detachable links in the outboard swivel shot are additionally secured with a U-shaped, stainless steel, wire-locking clip (sometimes called a hairpin). This hairpin, inserted in holes drilled through the coupling plates, engages a keyway or groove on the taper pin. (See fig. 4-4.)

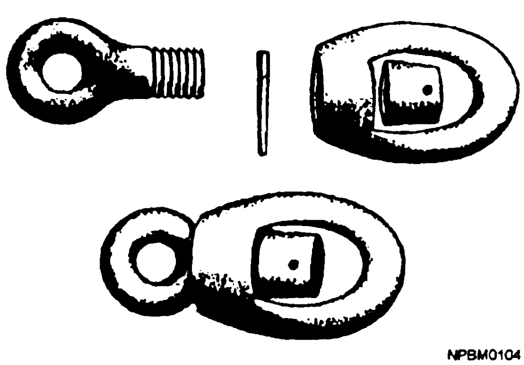


Figure 4-5.—Chain swivel.

- **RIDING, HOUSING, AND TOWING CHAIN STOPPERS.** Riding and housing chain stoppers consist of a turnbuckle inserted in a short section of chain with a slip or pelican hook attached to one end of the chain and a shackle at the other end. The housing stopper is nearest the hawsepipe, the riding stopper is farther aft. These stoppers are secured by the shackles to permanent padeyes on the vessel's deck. Chain stoppers are used to hold the anchor taut in the hawsepipes, to ride at anchor, or to hold the anchors when the anchor chain is disconnected for any reason. When in use, a stopper is attached to the anchor chain by straddling a link with the tongue and strongback of the pelican hook. When riding to anchor with more than one stopper on the chain, equalize the strain on the stoppers by adjusting the settings of the turnbuckles. Large chain stopper wrenches are issued for this purpose. Special housing chain stoppers, such as the devil's claw or the paw1 type of stoppers, normally are used with horizontal windlasses and where space limitations do not permit use of Navy standard stoppers. Although stoppers alone are more than adequate for holding the anchor, they should be backed up with the wildcat brake. Upon anchoring, you should first set the wildcat brake band, then set the stoppers tight, making sure you equalize the tension on them, so that one

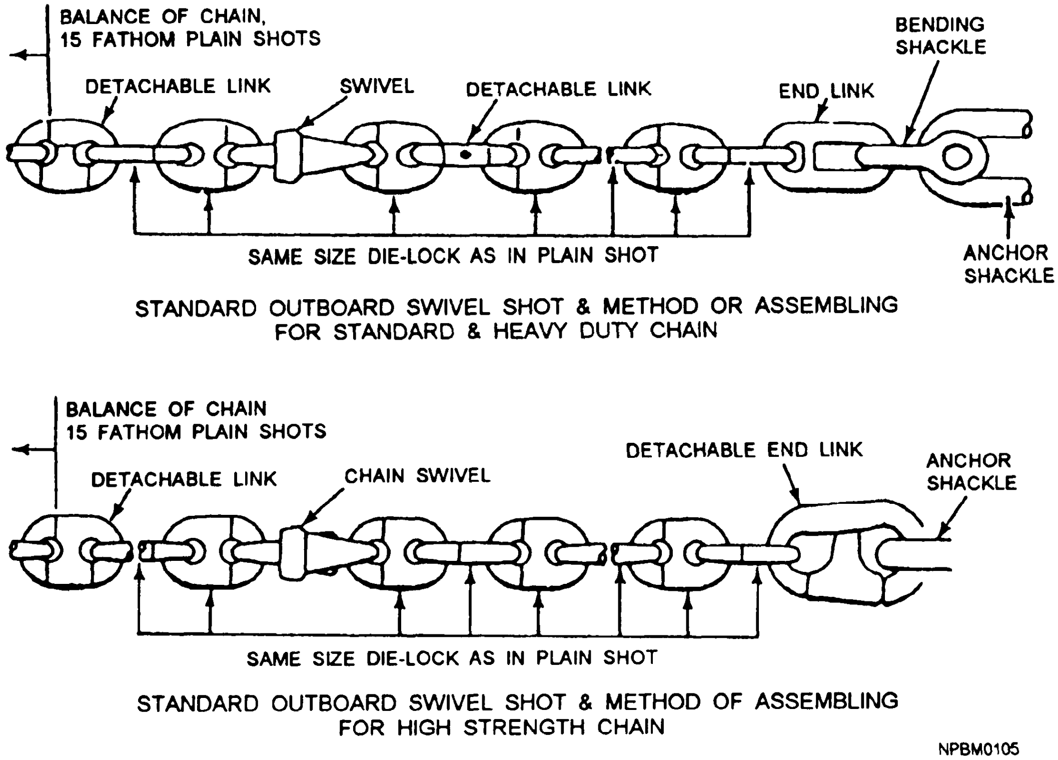


Figure 4-6.—Outboard swivel shot.

is not loaded more than the other. The wildcat should be left disconnected from the windlass. A Navy standard chain stopper is shown in figure 4-7.

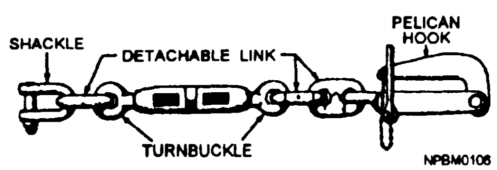


Figure 4-7.—Chain stopper.

Towing chain stoppers are similar to riding and housing chain stoppers, except towing chain stoppers have locking plates added. (See fig. 4-8.) These locking

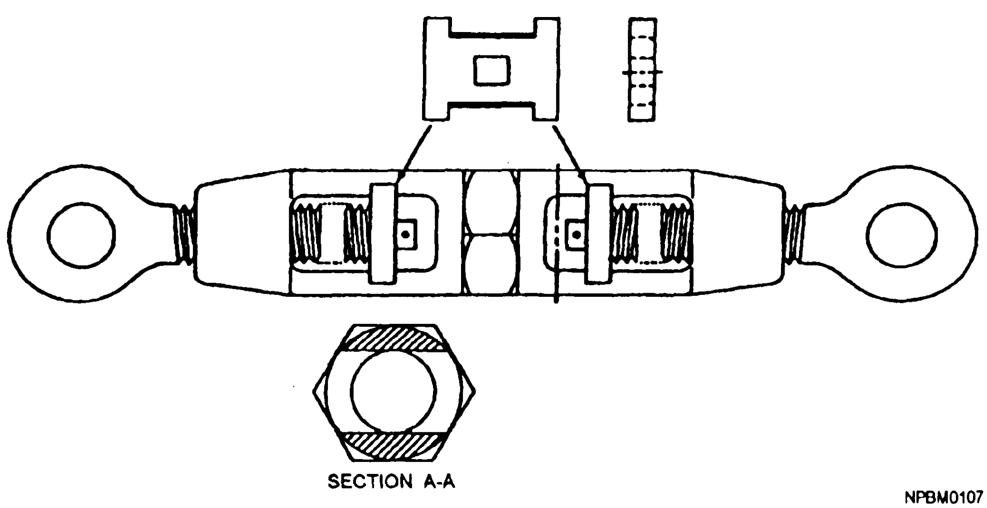


Figure 4-8.—Anchor chain stopper modified for towing.

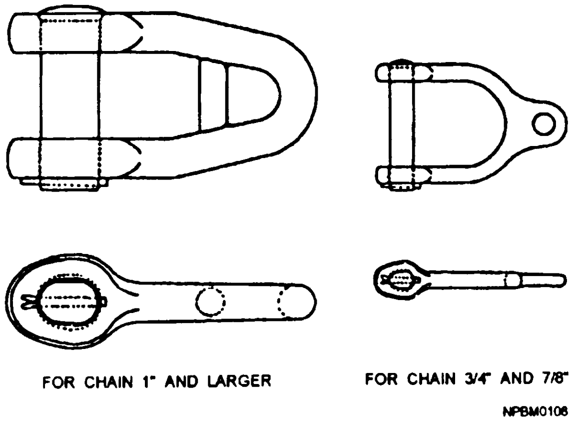


Figure 4-9.—Mooring shackles.

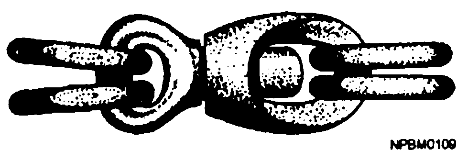


Figure 4-10.—Mooring swivel.

plates prevent the towing chain stopper from unscrewing when subjected to the shock loading of the towing hawser. Towing chain stoppers should be used whenever the ship is being towed.

- **MOORING SHACKLES.** Forged steel mooring shackles (fig. 4-9) are used to attach the anchor chain to mooring buoys. All mooring shackles, regardless of size, have a standard mortise (opening) of 7 inches. Mooring shackles should not be used for any other purposes.

- **MOORING SWIVELS.** Forged steel swivels, with two links attached at each end, are used to moor with two anchors. They are inserted in the chain outboard of the hawse and serve to keep the chain from twisting as the ship swings. Mooring swivels should be attached in the chain with the eye-end outboard, or down, to prevent them from hooking on the outer lip of the hawse when they are heaved back aboard. However, most ships today have large rounded lips on the hawsepipes, making it unlikely that a reversed swivel will catch. A mooring swivel is shown in figure 4-10.

- **CHAIN CABLE JACKS.** A cable jack (fig. 4-11), consisting of a lever mounted on an axle and two wheels, is used to handle anchor chain in sizes 2 3/4 inches and above. It is used to pick the chain up to pass a chain stopper. A pinch-point crowbar type of anchor bar is issued for smaller sizes of chain.

- **CLEAR HAWSE PENDANTS.** A wire rope pendant, 5 to 15 fathoms long, with a thimble at one end and a pelican hook attached to a length of open-link chain fitted in a thimble at the other end. It is used in clearing a hawse fouled by the anchor chain. (See fig. 4-12.)

- **DIP ROPES.** A fiber rope pendant, fitted at one end with a thimble and a dip shackle large enough to engage a link of the anchor chain is used to moor or clear a hawse. Dip shackles and proportional dimensions for the different sizes of chain can be found in chapter 581 of NSTM.

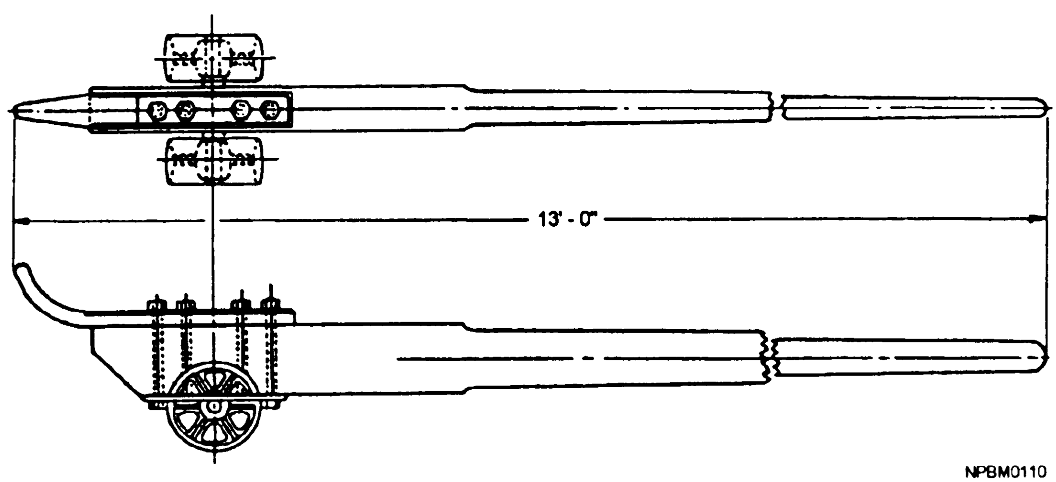


Figure 4-11.—Cable jack.

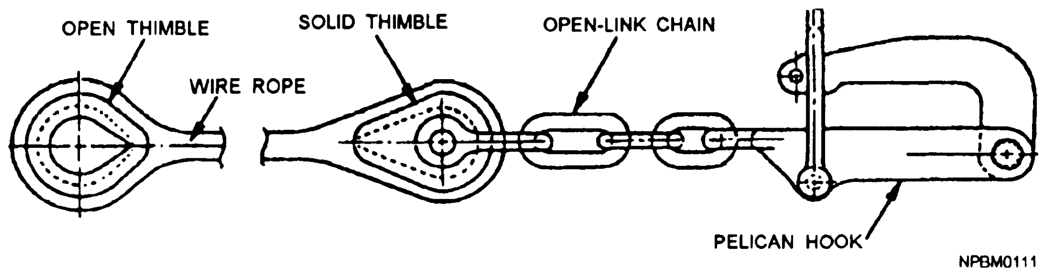


Figure 4-12.—Clear hawse pendant.

Anchor Chain Markings

The detachable links of anchor chain are painted red, white, or blue as follows: red, to indicate 15 fathoms; white, 30 fathoms; blue, 45 fathoms; red, 60 fathoms; white, 75 fathoms; and so on.

At the 15-fathom mark, one link on each side of the detachable link is painted white, and one turn of wire is wrapped securely around each stud. At the 30-fathom mark, two links on each side of the detachable link are painted white, and two turns of wire are wrapped around each of the last white studs. At the 45-fathom mark, three links on each side of the detachable link are painted white, and three turns of wire are wrapped around each of the last white studs. At the 60-fathom mark, four links on each side of the detachable link are painted white, and four turns of wire are wrapped around each of the last white studs, and so on, for each shot.

Each link of the entire next-to-last shot is painted yellow. The last shot is entirely red. These last two shots are the warning and the danger shots. Their purpose is to show you the approach to the bitter end of the anchor chain.

Securing the Bitter End

The bitter end of the anchor chain is secured to a padeye in the chain locker by a safety anchor shackle. The padeye, welded to a specially reinforced bulkhead, is rated at 1.75 times the breaking strength of the shackle. The strength of the shackle must approximate the weight of 20 shots of anchor chain hanging from the hawsepipe.

CARE OF GROUND TACKLE

LEARNING OBJECTIVES: Describe the recovery and loss of ground tackle and explain the proper way to report loss of ground tackle.

Anchors, chains, and appendages are to be kept in good condition by the ship's force. The chain is overhauled whenever necessary and precautions taken to see that the various shots are properly marked and in good order. As the chain comes in, when a ship is getting under way, each link is examined for cracks and other defects. Two competent observers, preferably petty officers, are detailed to examine the chain.

Disassembly of detachable links in the outboard swivel shot with hairpins requires removal and probable destruction of the lockwire. Replacement wire of the same type should be available before removal for inspection of the detachable link. Replacement hairpins can be fabricated on board ship from corrosion-resistant steel. (See NSTM, chapter 581, or applicable MRC.)

Anchor chain and appendages are carefully examined for cracks, excessive wear, distortion, or other defects. Parts that require coating are painted with anchor chain gloss black paint, (See NSTM, chapter 581.) Shackle bolts, locking pins, and swivels are examined carefully and put in order. The turnbuckles in chain stoppers require frequent attention to keep them clean, free from rust, and well lubricated with new lubricant.

Anchor chain larger than 1 1/2-inch-wire diameter is overhauled, wire brushed, and placed in a good state of preservation as often as the inspection required by NSTM, chapter 581, indicates that it is necessary. At least once each 18 months all anchor chain (including shackles, shackle pins, and detachable links), regardless of size, are examined, overhauled, and placed in a good state of preservation. To distribute the wear uniformly throughout the length of the chain, shift the shots to a new position as necessary during this inspection. If during overhaul of the chain, significant defects are discovered, bring them to the attention of the Naval Sea Systems Command; and when it is not practical to make immediate replacement, shift the defective shots to the bitter end of the chain.

Recovery of Ground Tackle

When a chain has been slipped or parted, every possible means is used to recover both the anchor and the chain. When recovery by the ship's force is impossible, the lost anchor and chain are buoyed and bearings are taken of the location of the loss.

Report of Loss of Ground Tackle in Service

In the case of loss or failure of an anchor chain or any of the anchor chain appendages, a photograph and a description of the failed surface are forwarded to NAVSEA, Code 56W23, and NAVSSES, Code 07 1B, Philadelphia, PA, and the failed parts retained until told to dispose of by proper authorities.

When an anchor fails in service and any portion(s) is/are recovered, the fractured surface of the failed part is thoroughly cleaned with fresh water, dried, and then coated with rust-preventive compound. At the request of the type commander or the commanding officer with the concurrence of the type commander, the recovered portions are sent to the Norfolk Naval Shipyard for examination to determine the cause of failure. A letter is written to the Naval Sea Systems Command and a copy enclosed with the failed part sent to Norfolk, containing the following information concerning the circumstances of the loss or failure, as available:

- Date and time.
- Wind velocity and sea conditions at the time of the failure.
- Statement as to whether the requirements specified for care and inspection of ground tackle have or have not been carried out.
- Date of the last inspection of ground tackle by ship's force.
- Scope of anchor chain to hawsepipe and depth of water, in fathoms.
- Description of failed parts and surface.
- Special circumstances, if any. Apparent contributing causes.
- Statement as to whether the lost ground tackle was or was not recovered.
- Anchors: type, weight, serial number, and name of manufacturer.
- Chain and appendages: type, manufacturer, size, and quantity.
- Apparent cause.

The shipyard sends copies of the report of its investigation to NAVSEA and to the ship involved.

ANCHORING AND MOORING

LEARNING OBJECTIVES: Describe all areas of anchoring and mooring. Explain the following areas as you as a Boatswain's Mate will need to know; scope of chain, weighing anchor, and mooring to a buoy. Describe the purpose of cranes, capstans, winches, and windlass.

Letting go a single anchor is perhaps the simplest way of securing a ship to the bottom, and when the holding ground is good, the ship should ride easily in bad weather, provided an ample scope of chain is used. One disadvantage is that in a strong current, or in a gale, the ship may sheer considerably. Also, when a ship is anchored, it swings to the combined efforts of the wind and current. Therefore, it is necessary to have an unobstructed area equal to the length of the ship plus the scope of chain used. If, for some reason, the anchorage does not afford such an area, the ship must be moored.

A ship is moored when the port and starboard anchors are down at a considerable distance apart and with such scope of chain on each that the ship is held with its bow approximately midway between them. A ship moored requires an unobstructed area reduced to a circle with a radius only slightly larger than the length of the ship.

Mooring to a buoy is another way of securing a ship. The buoys are usually anchored with a three-point moor. This requires the ship to use only its anchor chain forward and, if it is mooring bow and stern between two buoys, also use a mooring line aft. The radius of swing is limited to the ship's length and the scope of anchor chain veered or the area between the two buoys, In this section, we will cover the equipment used and the personnel involved in letting go a single anchor. Mooring with more than one anchor is covered in other training manuals for Boatswain's Mate and in ship-handling books and courses.

ANCHORING

The ship's first lieutenant is in charge on the forecastle while the ship is anchoring and weighing anchor. Aboard most ships, the first lieutenant's assistants are the ship's Boatswain and Chief Boatswain's Mate. In their absence, the senior BM of the division responsible for the ground tackle is the first lieutenant's assistant. An EN (Engineman) or MM (Machinist's Mate) is present to operate the anchor windlass, and an EM (Electrician's Mate) must be in the anchor windlass room to take care of any electrical failure. The first lieutenant has a telephone talker, whose duty is to relay orders and information between the forecastle and the bridge. The BM in charge of the anchor detail musters the detail and ensures that all necessary gear is available. Several Seamen, whose duties are discussed later, are required also.

Necessary equipment is as follows:

- Detachable link toolbox set
- Chain stopper wrench
- Chain cable jack or anchor bar
- Maul
- Telephones
- Anchor buoy and line

On ships with two wildcats, both anchors are made ready for letting go. While this is being done, the telephone talker receives from the bridge such information as the anchor to be used, depth of water, type of bottom, scope of chain to be used, and any other data pertinent to the operation.

The exact procedures for making the anchor ready for letting go may vary, but the following tasks must be performed: The first lieutenant or the Boatswain's Mate in charge must give a safety briefing. All personnel involved in the anchoring evolution must be in the proper uniform; that is, with trouser legs tucked in, wearing hard hats with chin straps, and wearing safety goggles. Only necessary personnel will be allowed on the forecastle. The Seaman tending the lead line, in addition to wearing a hard hat, must wear a safety harness and life jacket. All personnel should be quizzed about their jobs, and they must be exact in their answers.

The windlass is tested; the anchor in the hawse is freed. The anchor will be walked out if anchoring in deep water or if the bottom is rocky; otherwise, the brake is set and the wildcat is disengaged. All but one stopper is taken off, and the anchor buoy is shackled to the chafing chain or pendant. The chain locker is checked for any loose gear that may become wedged in the chain pipes or come flying out, endangering the personnel on deck.

While the anchor detail gets the ground tackle ready, the Quartermasters on the bridge take bearings, and the navigator plots the bearings on a chart and advises the conning officer of the ship's position. Distances to the anchorage are relayed to the forecastle.

In letting go by the stopper, the weight of the anchor must be on the stopper. The brake will be released on the command "STAND BY."

In letting go by the brake, the weight of the anchor is on the brake and the stopper with the windlass disengaged. The stopper is taken off at the command "STAND BY."

At the command "STAND BY", the personnel on the forecastle are alert and ready, awaiting the next command. When letting go by the stopper, two Seaman take stations at the stopper. When the command "LET GO" is given, one Seaman pulls the pin from the stopper tongue. The other Seaman, with a maul, knocks the bail off the tongue of the pelican hook and steps clear, and the chain will pass through the hawse with a roar.

If the anchor buoy was not stopped off with sail twine, the Seaman tending it must let it go exactly at the command "LET GO." On the bridge, the anchor ball is hoisted. The flag is hauled down from the truck, and the jack and ensign are hoisted smartly fore and aft.

You will notice that the ship is moving (usually backing) when the anchor is dropped. This keeps the anchor chain from piling on itself, damaging the chain, or piling on the anchor or fouling the anchor.

When the anchor is dropped and hits bottom, set the brake to help prevent piling. Make reports to the bridge informing them on the initial status of the anchor, how much chain is out, what position it tends, and what strain it has on it. Also inform the bridge whether the anchor buoy is watching. (This means that the buoy has surfaced and marks the location of the anchor.) As the ship gains sternway, veer your anchor chain out by the brake about a shot at a time to control the speed of the chain, and continue to veer until sufficient chain is out to ensure the pull on the anchor is horizontal on the bottom. The brake is now applied, and the anchor is set by the ships backing down and riding on the chain. Once the anchor is set and holding, the brake is taken off, and the chain is veered to the desired scope.

As each chain marking passes the wildcat, the report "(Number) fathoms on deck" is made to the conning officer. The direction the chain is tending is indicated by pointing the arm and/or reporting "Chain tending (number) o'clock." Depending on the preference of the commanding officer, the way reports are given may vary from ship to ship. These reports enable the conning officer to maneuver the ship properly.

If the chain tends around the stem, report it to the bridge. The chain must be allowed to run freely, lest the sharp bend around the stem damages a link. Detachable links are particularly susceptible to damage in this fashion.

If the anchor chain starts to get near the sonar dome, the situation is reported to the bridge, because the anchor chain rubbing against the sonar dome can seriously damage it.

When the desired scope of chain is out, the order "PASS THE STOPPERS" is given. The brake is set, and the stoppers are applied and evened up; the brake is taken off; then the chain is slacked between the windlass and the stopper. The brake is set, and the wildcat is left disengaged. Before securing, all gear is picked up and stowed.

Scope of Chain

Under normal conditions, a ship usually anchors to a scope of chain between five and seven times the depth of the water. When a ship at anchor is subjected to heavy weather, a strain much stronger than normal is placed on the chain. More and more of its length lifts off the bottom as the strain increases. When the scope is not long enough, the chain lifts all the way to the shank, and the anchor breaks out and drags before the chain parts. With too long a scope, however, the breaking strain of the chain is reached and the chain parts before its entire length lifts off the bottom.

Weighing Anchor

When the ship is weighing anchor, have the same gear and personnel available on the forecastle as for anchoring. In addition, there must be a grapnel for retrieving the anchor buoy, and a saltwater hose must be rigged to wash the mud from the anchor and chain.

The following procedures are carried out in making ready for weighing anchor. After the windlass is energized, engage the anchor windlass, release the brake, and test its operation. Then set the brake, cast off the riding stopper and clear it from the chain. The anchor is now engaged, held by the brake and backed up by the housing stopper. When ready, the report "Ready to heave in" is made to the bridge.

The ship will be riding on its anchor chain, as shown in view A of figure 4-13. If wind or current are strong, the conning officer may put on enough turns to take the strain off the ground tackle.

On the command "HEAVE AROUND," the brake is taken off and the chain is heaved in enough to take the strain off the stopper. The stopper is cast off, and heaving around is resumed. Reports are made to the bridge periodically on the direction that the chain is tending, the amount of chain out, and what kind of strain is on the chain.

If the command were "HEAVE AROUND TO SHORT STAY," the chain would be heaved in just short of breaking out the anchor, as seen in view B of figure 4-13. When the chain is at short stay, it is reported to the bridge.

When the command "HEAVE AROUND AND UP" is given, the chain will be heaved in. When the flukes of the anchor have broken out and the crown still rests on the bottom, the reports to the bridge would be "Anchor breaking ground," and then "Anchor is up and down," as seen in view C of figure 4-13.

When the anchor is free from the bottom, the report to the bridge would be "Anchors aweigh," as seen in view D of figure 4-13. The jack, ensign, and anchor ball will be hauled down, and the underway ensign hauled smartly to the truck.

When the anchor comes into view and its condition can be noted, the report "Anchor in sight" is made. With this report, you let the bridge know if the anchor is clear, fouled, or shod (meaning caked with mud and bottom).

The anchor is reported as housed when the shank is in the hawsepipe and the flukes are against the ship's side. The anchor buoy is recovered as soon as possible, and the report is made to the bridge when the anchor buoy is on board.

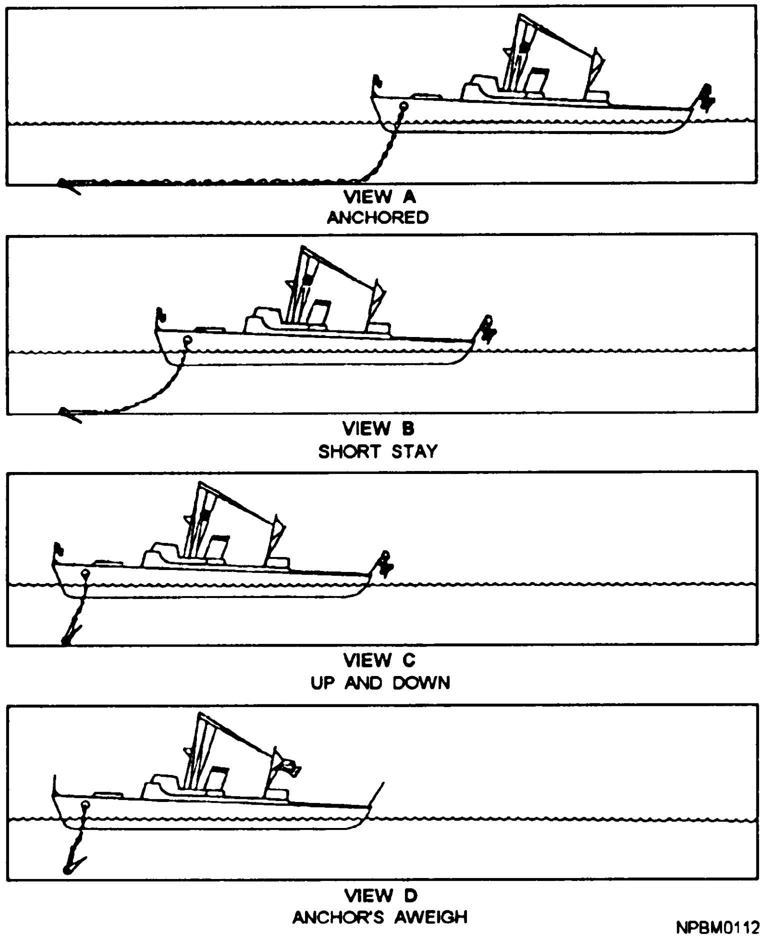


Figure 4-13.—A ship from anchored to underway.

The anchor is again made ready for letting go and kept that way until the anchor detail is told to secure it after the ship is outside the harbor or channel.

To secure the anchor for sea, set the brake; then pass and even up the stoppers (meaning that they take equal strain). Take off the brake; then slack the chain between the wildcat and the stopper. Set the brake and disengage the wildcat. To prevent water from entering the chain locker, secure the buckler plates over the chain pipes (on some ships, canvas chain pipe covers go over the plates).

MOORING TO A BUOY

When the ship is about 1,000 yards from the mooring buoy, a boat containing a buoy party of three or four personnel, in addition to the boat's crew, is lowered to the water. All hands in the boat must wear life jackets and must be qualified second class swimmers.

The ship is maneuvered so as to come to a stop with the bow directly over the buoy. The boat comes alongside the buoy and two members of the buoy party get on the buoy. Then the crew members in the boat take from the ship the ends of the dip rope, a messenger, and a mooring/buoy wire with a mooring shackle that is large enough to engage the ring on the buoy. The shackle pin is secured to the shackle with a lanyard to prevent its loss. The wire is shackled to the ring, and the dip rope is passed through the ring and tied to the messenger. Then the crew gets back into the boat, and the boat clears the buoy.

Meanwhile, these mooring preparations are made on the forecastle: The anchor is disconnected, and the mooring shackle is secured to the anchor chain. 'The dip rope is fastened to the chain a short distance above the shackle. The other end of the dip rope is pulled back aboard by means of the messenger and is taken to the capstan. In the meantime, the mooring/buoy wire is heaved taut. The mooring/buoy wire serves to hold the bow of the ship in position. The mooring shackle is pulled into position by walking out the chain and heaving around on the dip rope. The buoy party again gets on the buoy and secures the shackle to the ring. Then the mooring/buoy rope is slacked off, unshackled, and the moor is complete.

Trolley Method

The trolley method of mooring to a buoy is a simple and rapid means of easing the bitter end of the chain (controlled by an easing-out line) down to the mooring buoy by letting it slide on the wire shackled to the buoy. (See fig. 4-14.)

One or more large shackles over the buoy wire serve as trolleys. Connect the chain to the trolley by a short wire strap passed around the stud of a link near the bitter end. Enough chain must hang free to allow it to be shackled easily to the mooring ring. Connecting it to the fourth or fifth link usually provides the proper amount of free-hanging chain. Other preparations on deck are much the same as for the ordinary method of mooring to a buoy, except that sufficient chain for the maneuver is roused up and allowed to hang in a bight over the side during the approach, and it is not necessary to use a dip rope. The easing-out line, in addition to controlling the travel of the chain during the mooring operation, prevents the bitter end of the chain from dropping into the water during the approach.

When mooring by the trolley method, the buoy party in the boat takes only the end of the wire to the buoy. The wire is either shackled directly to the ring of the buoy, or a short wire strap is passed through the ring and the eye of the wire, and the ends of the strap are

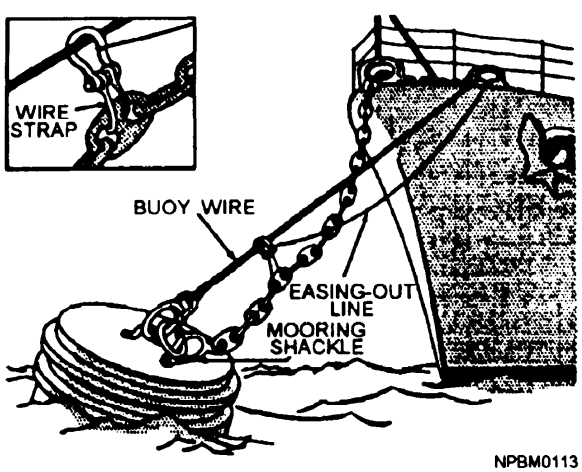


Figure 4-14.—Trolley method.

shackled together. The buoy party is always provided with a strap when the size of the ring on the buoy is unknown. If possible, the buoy wire is connected to a ring other than the one to which the chain will be shackled.

The ship is maneuvered to bring the bullnose abreast of the buoy and about 10 yards away. Once the buoy wire is secured, it is heaved taut and kept that way. The chain is allowed to slide down the wire by slacking off the easing-out line, and the mooring shackle is secured to the ring of the buoy by the buoy party. The wire is then slacked and cast off, completing the moor.

On ships with unusually large and heavy chain, two or more trolleys should be used, and it is a good idea to pass a line from the deck, through the ring of the buoy, and to secure it to the mooring shackle or the first link. Then, by using this line and the easing-out line, the personnel on deck are able to assist the working party on the buoy to get the mooring shackle into position.

Bow and Stern Buoy Moor

The bow and stern buoy moor is used by all navies. It is used throughout the world where the harbors are small and congested or in areas where ships are out of service.

In this type of moor, mooring the ship's bow to the forward buoy is accomplished in either manner described in the preceding section. At the same time, a stem line or cable is run to the stem buoy. The ship approaches at an angle of about 20° to the geographical line-of-bearing of the two buoys. While lines are being passed to the bow buoy party, similar lines are passed from the ship by boat to the stem buoy party. After the lines are made fast to the buoys, adjustments are made from on deck to spot the ship equidistantly, bow and stem, from the respective buoys. Most ships use an anchor chain forward and a nylon towing hawser or a wire rope aft.

Slipping a Mooring

For this maneuver, a strong line or flexible wire is run through the buoy ring and back on deck for use as a slip rope. A strain is taken on it, and the chain is unshackled. Should the ship be riding to a bight of the chain, an easing-out line is used to ease the chain through the ring while the chain is being hauled in. The ship now rides to the slip rope, and unmooring is completed by letting the end of the slip rope go and reeving it through the buoy ring.

SAFETY PRECAUTIONS FOR ANCHORING AND MOORING

There are many foot, hand, head, and eye hazards involved in working with anchors and anchor chain. Personnel safety requires proper supervision and good judgment.

Rousing out anchors or anchor chain onto a drydock floor, barge, or pier for inspection, overhaul, or preservation is an extremely dangerous operation that must be supervised by experienced personnel. There is the danger that the anchor will be accidentally dropped or that the chain will take charge and run uncontrollably over the wildcat and slide back down the chain pipe or over the side of the ship, barge, or pier.

The following safety precautions must be enforced:

- Observe standard safety precautions, and be alert at all times for possible malfunctioning of the equipment.

> **WARNING**
>
> **Make sure you have at least one stopper set up on the anchor chain anytime you engage or disengage the windlass. Ships with two separate brakes (hydraulic and manual) must have both brakes set, or one brake and one stopper must be set prior to engaging or disengaging the anchor windlass.**

- Engage and use the wildcat while you are rousing out or restowing the anchor chain.
- Always wear safety goggles, safety shoes, safety helmets, and gloves.
- Always wear an approved life preserver on a barge or pier while you are rousing out or restowing the anchors or anchor chain.
- Ensure that while the anchor is being lowered for inspection or overhaul, personnel working on the drydock floor, barge, or pier always stand well clear.
- During rousing out or restowing operations, never step over or straddle the anchor chain.
- During rousing out or restowing operations, never stand between the chain and the side of the ship.
- When attaching hauling-in and easing-out lines, use rope preventers and stops that are large enough to support the load.
- Before disconnecting the anchor chain for any reason, always take the following precautions:

a. To prevent accidental dropping of the anchor caused by inadvertent tripping of the chain stopper when disconnecting the anchor chain for any reason, back up the chain stopper with a wire rope preventer.

b. To prevent the chain from running back into the chain locker, secure the chain above the chain pipe with a wire rope pendant or steel bar.

> **CAUTION**
>
> **Ensure the wildcat is engaged and the wire rope or bar is removed before operating the windlass.**

- When rousing out chain onto a barge that has no retaining sides or onto a pier that is not directly under the hawsepipe, ensure that each shot of chain is controlled with rope stops so that the anchor chain will not take charge and run uncontrollably over the side.
- In general, when hauling more than 60 fathoms of chain, do not exceed about half speed on the anchor windlass.
- House the anchor in the hawse at the lowest speed range.
- When dropping anchor, do not let the chain attain excessive speed. Control the speed of runout by applying and releasing the wildcat hand brake.
- Make sure the wildcat locking heads are fully engaged or disengaged before starting the windlass.
- See that all unnecessary personnel are clear of the area before anchor-handling operations.
- When at sea, give particular attention daily to the security of the anchors. Ensure that the bitter ends

of the chain (except when roused on deck for overhaul) are securely fastened in the chain lockers. A shackle and a padeye are provided in the chain locker to secure the bitter end of the chain and prevent it from inadvertently paying out. The size of the shackle used must be such that its breaking strength will approximate the weight of 300 fathoms (20 shots) of anchor chain hanging from the hawsepipe. For suggested sizes of safety anchor shackles. The strength of the padeye must be 1.75 times the strength of the shackle.

- When at anchor, ensure that nothing interferes with the readiness to veer, slip, or bring in the chain or to let go the spare anchors.
- Where appropriate, standard practice is to anchor with the detachable link located just inboard of the riding stopper, and the detachable link tool set should be readily accessible for use in slipping the anchor chain in an emergency. Anchors should have anchor buoys attached by means of a sufficient length of 21-thread manila to allow the buoy to surface in the depth of water in which anchored.
- Fasten the anchor chain in the chain locker with the bitter-end fitting provided to prevent inadvertent loss of ground tackle in the event the chain takes charge while being paid out.
- Make sure there is no twist in the chain between the wildcat and the bitter-end fitting. A twist may prevent the chain from properly seating on the wildcat and cause jumping.

CRANES, CAPSTANS, WINCHES, AND WINDLASSES

Only personnel who have been instructed in the duties required and are authorized specifically by the first lieutenant are allowed to operate cranes, capstans, winches, and windlasses. A list of authorized operators is kept in the weapons (or deck) department office. Except in an emergency, operation of the machinery is supervised by either a responsible officer or a petty officer. The method of operation and necessary special instructions are posted at the place of operation. Safety guards must be kept in place around windlass crossheads, cogwheels, or other moving parts.

TOWING

LEARNING OBJECTIVES: Describe the different areas in which to tow a ship or to be towed. Identify the following areas and describe the purpose for each one: rig for tow and be towed, approach the tow, passing the tow, getting in step, dropping the tow, and towing a target.

All naval vessels are required to be able to tow and be towed. Equipment varies with the types of ships, and procedures vary with the circumstances. Equipment used, as well as procedures for towing and being towed, is listed in the ship's towing bill.

RIGGING FOR TOWING OR BEING TOWED

To describe every towing rig would be impractical, so we have limited our description of rigging for towing to the standard synthetic gear and some parts of the wire rigs for emergency towing on destroyer-class ships.

NAVSEA provides the latest guidance concerning authorized synthetic towing hawsers and end fittings. The preferred towline is a nylon rope of nonrotating construction that is either plaited (MILSPEC 24730) or double-braided (MILSPEC 24677). These lines must have a minimum breaking strength within 10 percent of the breaking strength of the emergency tow hawser shown in the ship's plans. NAVSEA does not recommend the use of swivels with any of these towlines.

The towing gear consists of reinforced structure points (referred to here as hard points), a chafing chain, towing hawser, and connectors. On the towed ship, the chafing chain and hard points are usually made up from the ship's anchor chain and chain stoppers fair-led through the bow chock. A typical arrangement is shown in figure 4-15. On the towing ship, the hard point is provided by a towing pad which is usually located on the centerline, although it is sometimes found on the quarter because of equipment interference. A section of chafing chain is connected to the pad by a pelican hook, which is used for dropping the tow in case of emergency. The other end of the chafing chain is fair-led through a closed chock on the stem. A typical arrangement is shown in figure 4-16. Since it is logical to assume that the reason a ship has to be towed is because it has lost power, the rigging arrangement aboard the ship to be towed must be laid out so no power assistance is

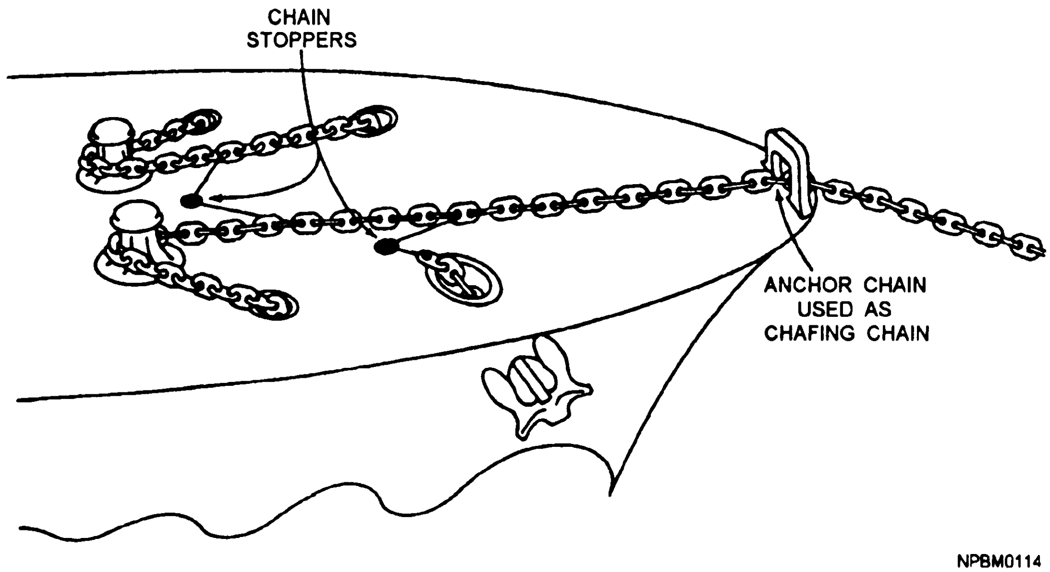


Figure 4-15.—Typical bow chafing chain arrangement for being towed.

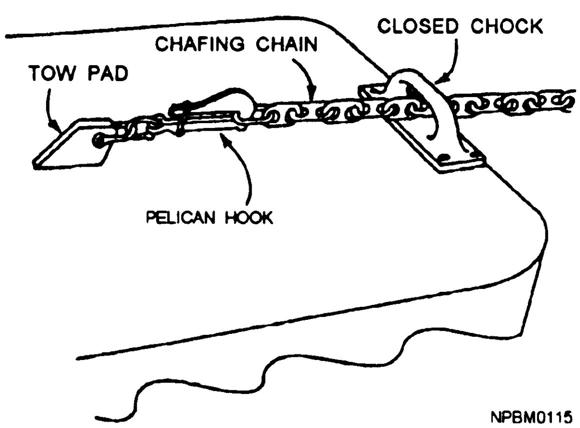
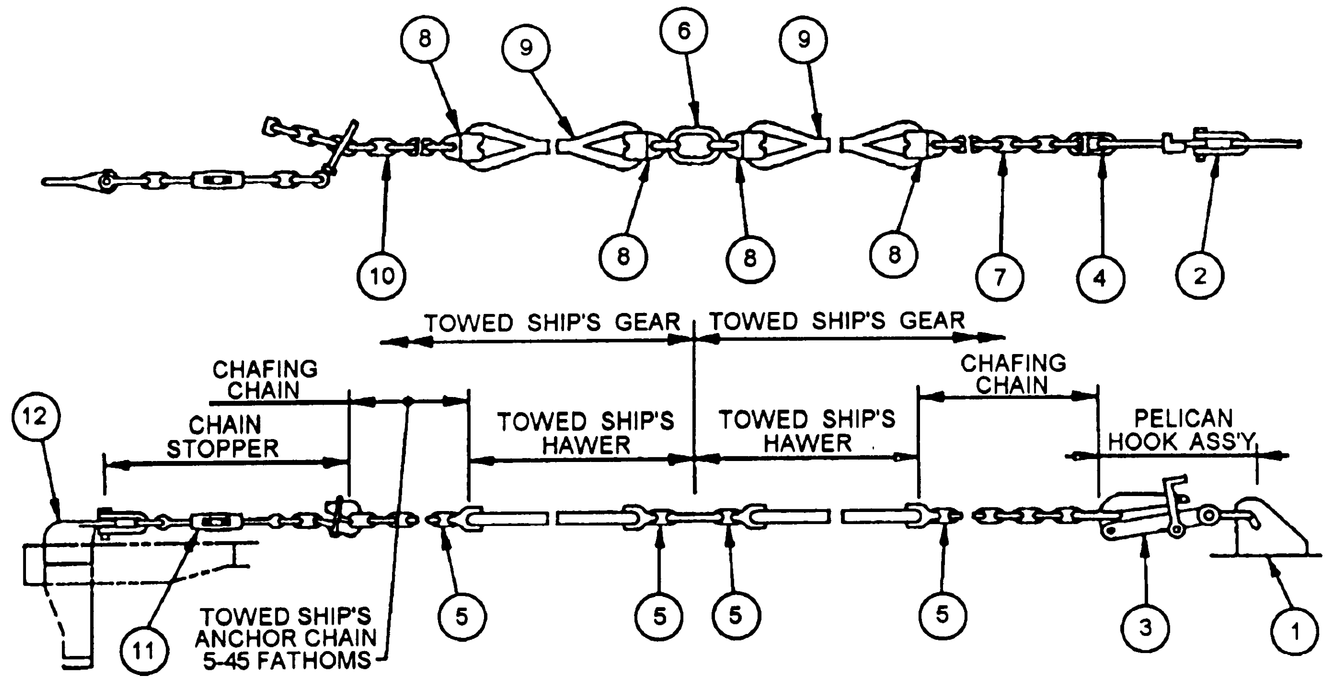


Figure 4-16.—Typical stern chafing chain arrangement for towing.

required. Therefore, practice operations should be performed with the towed ship using no power equipment.

Towed-Ship Rigging Procedure

The towed ship rigs for being towed by breaking the anchor chain inboard of the swivel shot. The anchor not in use is secured in the hawsepipe by a chain stopper and a preventer made of wire. The wildcat brake is set up. When the chain pipe has a compressor, it is used to keep the chain from falling back into the chain locker; when there is no compressor installed, a bar through the chain and across the chain pipe can be used for this purpose. The chain is then moved over in alignment with the bow chock. It will be hauled through the bow chock later by the towing hawser as a strain is taken on the hawser by the towing ship. The connector fittings are standard rigging and detachable links of the size of chain being used. The towing hawser is either wire, the size and length of which is according to the ship's plans, or synthetic hawser 600 feet long. Attached to the hawser is a messenger made up of 100 fathoms of 3-inch line and 50 fathoms of 1 1/2-inch line. (For a 10-inch circumference or larger hawser, use the 4-inch in place of the 3-inch.) Two 100-fathom lengths of 6-thread or g-thread line is attached to the 1 1/2 line and ran outboard on both sides of the ship; then the 6-thread line is attached to the shot line, reducing the weight on the shot line while the messenger is passed to the receiving ship. The hawser and messenger are faked out and stopped off to a strongback, with turns of 21-thread line running over a chop block to provide constant control while paying out the hawser. These stops are cut on command as the hawser pays out. A retrieval line is connected to the anchor chain end of the towing operation to retrieve the towing hawser. The same procedure is followed on the towing ship, except the pelican hook is rigged to the hard point, and the chafing chain to the pelican hook, fair-led out the stem chock. You will notice that we have referred to the ship to be towed as being the provider of the rig. Which ship ultimately provides the initial hawser is a command decision, and circumstances will be different in each case.



ASSEMBLY OF TOWING GEAR

PIECE	DESCRIPTION	PIECE	DESCRIPTION
1	TOWING PAD	7	CHAIN
2	SHACKLE	8	TOWING THIMBLE
3	PELICAN HOOK	9	TOWING HAWSER
4	END LINK	10	ANCHOR CHAIN
5	DETACHABLE LINK	11	CHAIN STOPPER
6	NATO LINK	12	CHAIN STOPPER DECK PADEYE

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Figure 4-17.—Towing hawser arrangement.

When both ships' hawsers are used to increase the length of the tow to 1,200 feet (fig. 4-17), one ship will haul in the other's hawser and connect the two hawsers together with a pear-shaped detachable link, then pay out the hawser as the other ship goes ahead, taking up the slack as it goes, until all the hawser is out. When both hawsers are not used, the ship receiving the other's hawser connects it to either the anchor chain, broken forward, or the chafing chain, rigged aft.

The messenger is secured to the towing hawser as shown in figure 4-18, view A; or if a wire hawser is to be used, it may be modified as in view B. If desired, a third method may be used; that is, a strap is eye-spliced, as an extension to the messenger, and a shackle used to make the connection between the messenger and strap, which is secured to the hawser as in view A.

Approaching the Tow

The position the towing ship takes in relation to the tow depends on which vessel drifts faster. When the towing ship drifts faster than the tow, the towing ship takes position forward and to windward. When the tow drifts faster, the towing ship takes position ahead and to leeward. The idea is that one ship drifts past the other, allowing more time for passing and hooking up the towline. The towing ship always ensures there is plenty of room to maneuver. If a normal close approach cannot be made, because of sea conditions, the towline messenger may have to be buoyed with life jackets and floated down to the tow. Often, however, the approach is close enough to use heaving lines, so there should be three or four heaving lines on deck, as well as a line-throwing gun and bolos.

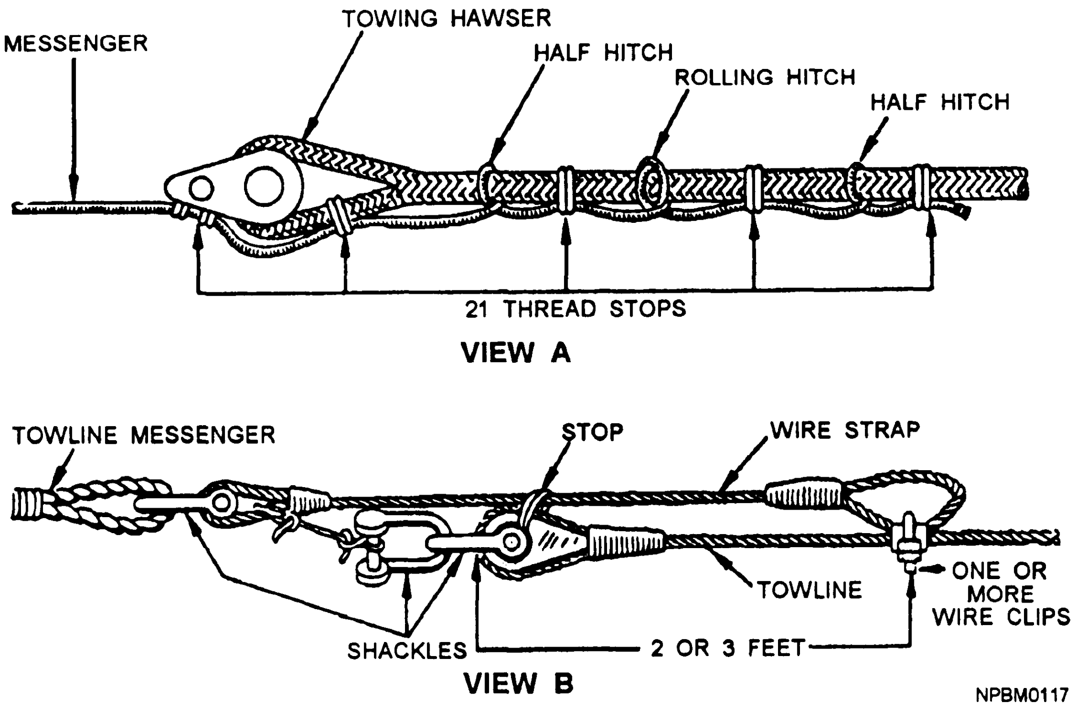


Figure 4-18.—Method of securing messenger to towline.

Passing the Rig

The end of the towline messenger is passed as soon as possible to the towing ship. During the approach, personnel on the towing ship are stationed at intervals along the deck to receive the towline messenger. Once the messenger is received, the end is led through the stern chock and run forward. You may take the messenger to a capstan, but this method is much slower than heaving it in by hand until a heavy strain is taken. The final hauling of the towing hawser is usually done by the capstan. Once the end of the towing hawser is aboard, the seizing that secures the coupling to the messenger is cut, and the towed ship's hawser is connected to your hawser. A stopper is bent onto the hawser; the messenger is removed; and the towlines are hooked up but not yet deployed. The towing ship puts on turns sufficient for steerageway and continues at this steady speed until the towline is completely taut. This slow speed deploys the towline off the towing ship, a slow orderly fashion, until all the faked out line is off the deck and the chafing chain has been hauled through the stern chock.

The added tension hauls the remaining towline off the towed ship until its anchor chain comes taut. At this point, the bar is removed from the chain over the chain pipe and the brake on the wildcat is slackened. The chain is permitted to be hauled out until it clears the bow chock by 6 or more feet. The brake is applied and two towing chain stoppers are passed onto the chain.

While a ship is towing, an emergency release capability is required. The chain is veered out to the first detachable link; the stoppers are passed forward of the detachable link. This will provide access to the link in case the tow must be released.

Getting in Step

When a ship is towing with synthetic line, no catenary is required. It is not uncommon to have the hawser completely out of the water; in fact, it is desirable because it lowers the towing resistance and prevents the line from being damaged by bottom fouling or objects in the water. When heavy seas are encountered, the rule is slow down. At this point, it is important to keep the ships in step to lessen the surge loads. To do this, cast off the stoppers, and adjust the scope to get the vessels in step. The tow must ride so that it reaches the top of a crest at the same time the towing ship does. If not, the towing ship might reach the crest while the tow is in a trough, whipping the towline out of the water and

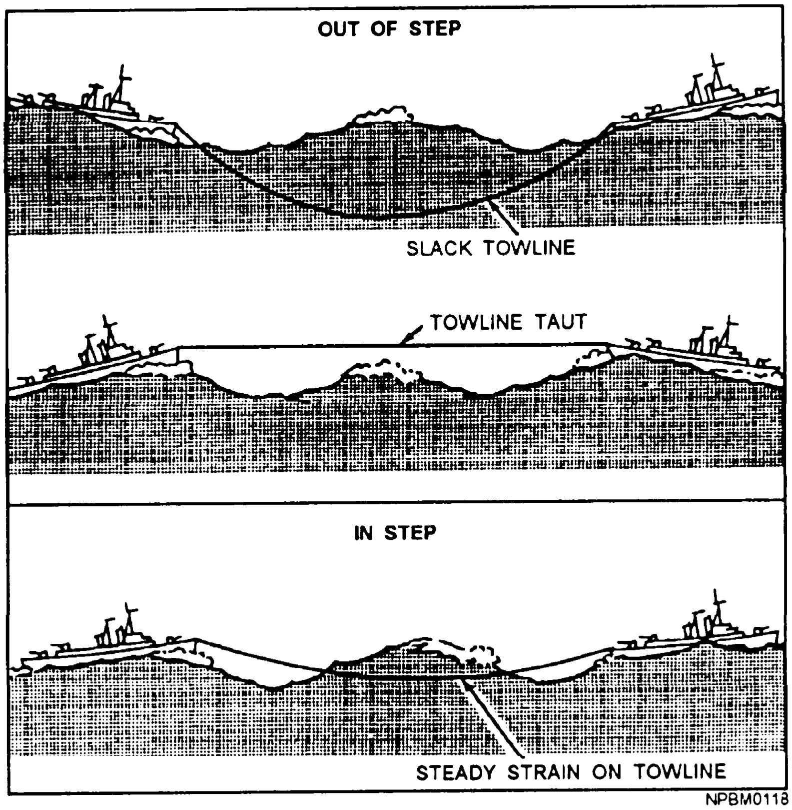


Figure 4-19.—Examples of out-of-step and in-step during towing.

subjecting it to unnecessary and dangerous strains. (See fig. 4-19.) When the scope is adjusted properly, the chain is secured in the same way as before.

Dropping the Tow

When the ships are dead in the water and the order is given, the tow engages its wildcat, casts off the stopper, and heaves in on the chain. When the end of the towline is aboard, the messenger is bent on the towline. Turns are taken around the capstan with the messenger, and the chain is walked out until the strain is on the messenger. Then the towline is unshackled and eased out. Personnel on the towed ship run in the towline by capstan or hand. Care must be taken on the towing ship that the catenary does not become too heavy for the crew on the towed ship to handle.

When a recovery line is rigged on the towing ship, the end of it is led through the towing chock from outboard to inboard and hauled in by hand (or, if necessary, by power) until the chafing chain and the inboard end of the towline are aboard. Then the towline is hauled the rest of the way in.

HIGH-SPEED TARGET TOWING

Although many types of sled targets have been developed, the catamaran-hulled Williams target-tow sled is the prevalent target used by the U.S. Navy (fig. 4-20).

The Williams target is towed from a synthetic bridle shackled to the inboard sides of the catamaran hulls. The

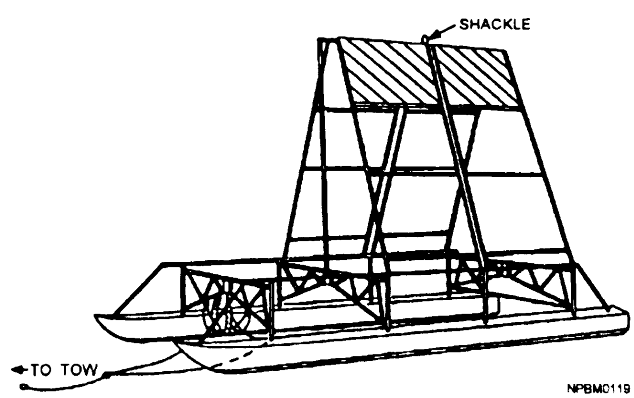


Figure 4-20.—Williams sled.

two bridle legs are joined by either a joining shackle or a triangular flounder plate. A 30-foot pendant of synthetic line is also shackled to the flounder plate. The pendant is shackled to the main synthetic towline.

The main towline is usually a 3-inch-circumference, double-braided nylon rope. The required length is about 4,500 feet. It is important that a nonrotating line be used in this application. If a three-strand line were to be used, the torque generated would list the target and might cause a damaged sled to capsize.

TOWING A TARGET

When the tow is to commence at the target's berth, make up the target to the towing ship bow-to-stern alongside and shackle the towline to the target bridle pendant. When the ship is clear of the pier, stop the engines and slip the target mooring lines. The target will reverse direction and swing into position unless there is too much way on the ship. Too much way will cause the target to be towed stem first. Ensure that the target does, in fact, tow bow first, as the target has a tendency to stream aft without reversing itself, and will end up by straddling the towline in a stem-first position. Tow the target at short stay until congested waters are cleared. Steaming at short stay does not affect maneuverability or speed.

If a delivering ship, usually a motor launch, is to bring the target out of the harbor to the towing ship, the towing ship must stop so that the launch can easily approach the towing ship's stern.

When clear of the harbor and congested waters requiring towing at short stay, stream about 600 feet of towline. If the towline is not on the drum of a towing machine, pay it out using a gypsy head or capstan to maintain control. Ships with towing bitts can control the veering of the towline by taking turns around the bitts and allowing the towline to slip. When 600 feet of towline has been payed out, stop off the towline to the towing bitts with the towline passing over the stern roller. Then slowly increase the speed until the target is towing steadily. At the firing range, the towing ship slows to one-third speed and commences veering the towline. Veering the line at 150 feet per minute is the safest way to stream.

When the day's firing is over, shorten the towline to 600 feet. A ship with a towing machine slows to approximately 5 knots and heaves at no more than 100 feet per minute. Destroyers must use gripping devices and heave the towline cable in small segments using the boat winch or windlass, Fake the towline on deck or spool it on a reel immediately. MSOs can use one drum of the sweep-wire winch.

For entering port, the tow can either be brought alongside or be snubbed up tight to the fantail. In the former, the use of riding lines (as mentioned for streaming), which have been stopped off on the tow hawser during streaming, contribute to the ease of bringing the sled alongside. If snubbed up to the fantail, the sled should be brought up tight, but not so tight as to damage the floats or tow rig. In this position, the ship is free to maneuver, including backing down, without damaging the sled; however, if backing down for any distance, the ship's speed must remain under 5 knots, preferably 2 to 3 knots.

PASSING THE TARGET TO A COMBATANT SHIP

It is sometimes necessary to exchange the target during an exercise. The method described for delivering a target to a towing ship does not apply on the open sea when both ships are large; the method described in the following paragraphs is used in water depths over 1,500 feet. (See fig. 4-21.)

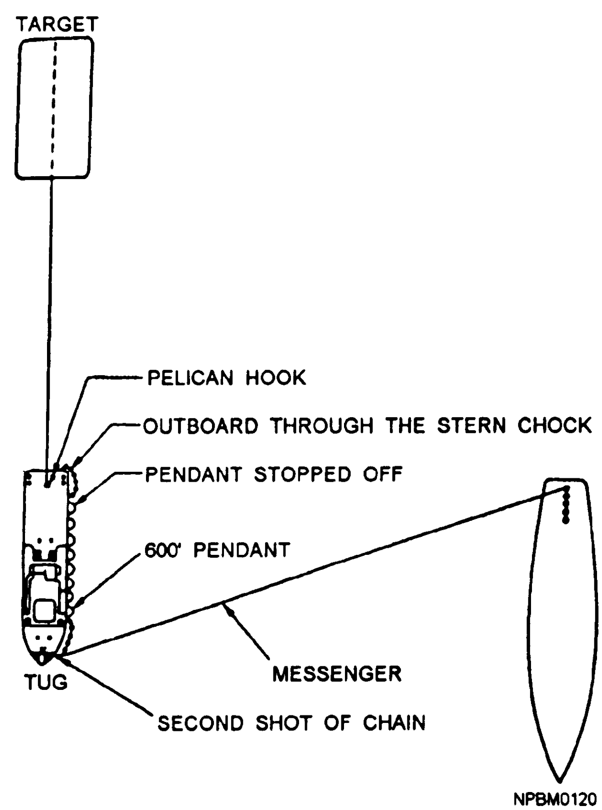


Figure 4-21.—Passing the target to a combatant.

Required gear on the combatant ship, in addition to the towline and bridle already made up to the target, consists of an additional 600-foot length of towline and two 12-foot lengths of 1 1/2-inch chafing chain. Shackle this gear to the main towline in the following order:

1. One of the lengths of chain
2. The wire pendant
3. The other length of chain

Stop off the pendant along one side of the towing ship. The towing ship selects the side and speed for passing, and signals them to the combatant ship well in advance of passing the tow. While the gear is being prepared, the combatant ship steams into the wind alongside the towing ship. The combatant ship signals when ready to receive the tow. The towing ship passes a line over to the combatant ship and hauls back the messenger, which is secured to the second length of chain. Figure 4-20 shows the relationship between the gear and ship at this point in the operation. The combatant ship hauls the messenger in through the towing chock, bringing the chain and pendant aboard; the towing ship cuts the chain and pendant free from the stops as the combatant ship hauls it away. When the chain comes aboard, it is secured to the pelican hook, which is located so that the chafing chain extends through the towing chock.

When both ships have signaled their readiness to complete the transfer of the tow, the towing ship trips its pelican hook and steams clear.

TOWING SAFETY PRECAUTIONS

For careless personnel, there is some danger involved in towing. The following is a list of safety precautions that must be strictly observed:

NEVER

- Never rig a towline that cannot be cast off quickly.
- Never make a sharp turn in shallow water with a long scope or towing hawser out except to avoid collision or grounding.
- Never let the tow get forward of the beam.
- Never tow in a heavy sea with short scope.
- Never use a towing hawser that is kinked or badly frayed.
- Never fail to cast off the tow if there are definite indications that it will sink.
- Never abandon a tow because it may become a menace to navigation.
- Never take a tow without thoroughly inspecting the bridle, towing pads, chafing chains, retrieving wire, cargo (safe and properly secured), and watertightness of the vessel.
- Never allow the propeller of a tow to turn unless the lubrication system is working.
- Never trust inexperienced personnel to splice a towline.

ALWAYS

- Always step up speed three to five turns at a time until towing speed is reached.
- Always have an anchor on the tow ready for letting go.
- Always set a towing watch on both ships.
- Always provide emergency means for cutting a towline (axe and chop block for hawser or cutting torch for wire).
- Always keep unnecessary personnel from the vicinity of the towline.
- Always have personnel involved in rigging and unrigging towing gear and handling lines wear life jackets, safety helmets, and safety shoes. Personnel handling messengers and synthetic towlines may wear gloves, and personnel handling wire rope must wear gloves. Rings, loose clothing, and so on, should not be allowed to be worn.
- Always remember that the long catenary in a towline acts as a spring inserted in the hawser. Until that spring reaches its total extension (that is, until the towline rises out of the water and becomes taut), there is no danger of parting it unless it hangs up on the bottom.

SALVAGE

LEARNING OBJECTIVES: Describe all salvage operations and the purpose for salvage. Identify the following areas of salvage; rescue salvage, harbor salvage, offshore salvage, combat salvage, salvage planning, and salvage methods.

The term *salvage* covers everything from refloating stranded vessels to wreck removal. World War II provided a prime example of the value of salvage operations. The U.S. Navy salvage organization during this period salvaged and reclaimed ships and equipment worth over 2 billion dollars. Boatswain's Mates should be proud of this remarkable feat, for a good share of the credit goes to persons of that rating.

This section presents information on salvage which has been accumulated the hard way, through experience gained in hundreds of rescue and salvage jobs. On paper, a lot of it sounds easy; but take it from the experts, it's not. Each salvage operation presents its individual problems; such as location, weather, degree of damage, type and shape of the bottom, state of sea, tide, and current. These factors will be discussed later, but first let's take a look at some of the broader aspects of salvage.

PRINCIPAL TYPES OF SALVAGE

It is, of course, impossible to place all wrecks into a neat category. Nearly all will fall within one of four principal types of salvage. The types of salvage are the following:

- **RESCUE SALVAGE.** Rescue salvage provides emergency salvage services to vessels and aircraft in distress at sea. The most important service is towing damaged ships to a safe harbor. Fire fighting, pumping, and minor patching also are services a salvage ship can render in an emergency. Major problems are storms and gales, fire, collision, machinery failure, shifting cargo, loss of rudder or propeller, and battle damage.
- **HARBOR SALVAGE.** Harbor salvage consists of salvaging ships, removing wreckage, and general salvage work in harbors. Collision is the chief cause of damage to ships in a harbor. After a collision, either one or both ships may be sunk or beached. Perhaps one of the ships sinks in the main channel, blocking the channel completely, or it sinks alongside the best pier, preventing cargo unloading. You can be sure of one thing, the Navy will be called upon to provide a salvage ship or salvage team. (In wartime, salvage teams are activated.)

Weather is another major enemy to ships in a harbor. Often a storm strikes without warning, catching harbor craft and barges with single lines out and ships anchored with insufficient chain. The results are beached barges, sunken harbor craft, and stranded ships.

Another feature of harbor salvage is harbor clearance away from the combat area. A great deal of this type of salvage was performed during World War II.

Ships used for rescue salvage can also be used for harbor salvage. In addition, LCUs can be adapted to the task. This is done by equipping them with shear legs designed to lift from 20 to 30 tons. Small boats, preferably LCMs, are used as diving barges and small freight carriers.

- **OFFSHORE SALVAGE.** Offshore salvage is concerned with refloating vessels stranded or sunk in exposed locations along a coast. Strandings occur as the result of many factors, such as weather, errors in navigation, poor seamanship, improper shiphandling, and engineering problems.
- **COMBAT SALVAGE.** Combat salvage consists of services rendered to an amphibious assault force and is not limited to salvage alone. These services are performed by a combat salvage group composed of one or more salvage teams and salvage vessels of all types. This group is manned and equipped to rescue personnel, retrieve stranded craft from the beach, effect emergency repairs ashore or afloat, fight fires, give emergency supplies, aid in damage control afloat, tow disabled craft, perform underwater surveys, and do general repairwork.

THE SALVAGE PROBLEM

Offshore salvage is the most prevalent type of salvage requiring Navy assistance. It is also the most difficult and dangerous type of salvage. Let's consider a stranding situation as being representative of problems that may be encountered in all types of salvage.

Ships run aground under any number of circumstances. In fact, no two cases are exactly alike or require the same salvage procedure. The immediate danger of further damage, however, is present in nearly all strandings. Additional damage can be caused by the ship's pounding on the bottom, being driven further on the beach, broaching to the sea, or any combination of these factors.

Pounding is caused by the varying degree of buoyancy of a stranded vessel. The waterline changes constantly as succeeding waves pass the vessel. This produces an alternate increase and decrease in the ship's total buoyancy. Bottom damage occurs when this condition is great enough to lift the vessel off the bottom and abruptly drop it back again. Pounding damage ranges from opening a few seams to creating serious holes. In any event, it renders salvage of the wreck more difficult.

Each wave that strikes against a stranded vessel exerts a force on the vessel, tending to drive it further inland. Bottom friction and weight inertia of the wreck are the only factors that resist this force. In addition, wind augments the force of the sea in most situations. A wreck in a pounding condition will always be moved further inland and harder aground. Even ships hard aground are lifted and moved inland by large swells. The difficulty of the salvage problem increases as the ship is forced inshore.

Stranded vessels aground forward, with their sterns seaward, are affected less by the forces tending to move them inland. All action possible must be taken by the ship's company immediately after stranding to maintain this attitude and keep the ship from broaching. Broaching is a particular danger for two reasons: first, because the vessel will be driven further inshore and harder aground; second, because of the secondary currents set up around the bow and stern. These currents are of greater velocity than normal and scour sand away at the ship's extremities, piling it up amidships to leeward of the vessel. Thus, supported only by amidships, the ship's back often will be broken, rendering it a total loss.

The commanding officer of the stranded vessel must consider all three of the foregoing dangers. The CO also must appreciate the necessity for taking action immediately to combat these initial dangers and prevent further damage to the stranded vessel. The following measures constitute good ship procedure in most stranding cases:

- Make no attempt to refloat the vessel under its own power if wind and sea conditions indicate the possibility of the vessel's working harder aground, pounding, or broaching.
- Lay out anchors to seaward to prevent the vessel from working further ashore.
- Ballast down the vessel by flooding selected compartments and holds. This prevents the vessel from working harder on the beach and also prevents bottom damage from pounding.

SALVAGE PLANNING

The salvor makes an estimate of the situation immediately upon arriving at the scene of a stranding. The salvor must determine whether the proper steps have been taken to secure the ship, thus preventing it from moving further inland, pounding, or broaching. As soon as the salvor is satisfied that the wreck is safely anchored or ballasted, steps are taken to determine, as accurately as possible, the exact physical position of the vessel, how the stranding occurred, and complete weather and current information. Soundings are taken along the sides of the vessel and in the entire grounding area. These soundings provide the basis for deciding on the direction of pull when the time comes to refloat the vessel.

The next step after the initial investigation is to gather additional information. The salvor must know the equipment available on the wreck; the number, capacity, and location of the ship's winches; available power; range of tide; removable weights; the speed and course of the vessel at the time of grounding; the size and weight of the vessel; disposition of cargo; location and extent of hull damage; and so forth. With this information, the salvor can decide on the best method(s) of salvage and, if beach gear is available, develop a layout plan. These methods must always be approved by the commanding officer of the stranded vessel.

SALVAGE METHODS

It is beyond the scope of this text to discuss more than a few of the more common salvage methods. In fact, the number and variations of these methods depend only on the ingenuity, skill, and experience of the salvage crew. The methods treated here are applicable in most stranding situations.

- **SCOURING CURRENT.** One of the greatest aids in the retraction of stranded vessels is the use of the scouring current effect from powerful tugs. This method of scouring a channel can be used to its advantage only when the stranded vessel is resting on a sand, mud, or gravel bottom. It has negligible effect on rock or coral.

Scouring tugs are breasted alongside each other and trimmed by the stem. Lines secure the tugs to port and starboard of the stranded vessel in such a manner that their combined screw currents are directed diagonally down and under the hull. One system commences scouring with the tugs secured amidships and, as the operation continues, the tugs are moved aft (or forward, as the case may be). Vessels with twin out-turning screws are excellent for this work. To emphasize the effectiveness of this method, we can consider a stranding case in New England. Here a single tug scoured a 10-foot-deep channel under the stranded vessel, enabling another tug to pull it off the beach.

- **WRENCHING.** Wrenching is another practical aid in salvage operations. As often happens, it may be that the stranded vessel is resting on a type of bottom unfavorable for scouring action, or the water may be too shallow to permit working a tug alongside. In this case, a straight pull or the wrenching method may be employed. A valuable tip to remember is that a stranded vessel can best be pulled off the beach in the direction opposite to the course held when it went aground.

A tug is usually the best type of vessel available immediately for dispatch to aid a stranded vessel. As most inshore tugs are commanded by First Class and Chief Boatswain's Mates, you are apt to be confronted with this situation. The wrenching and pulling method, then, is of particular importance to you.

While you're on the way to the scene, make all preparations for letting go your anchor. You must carry out one or more of the stranded vessel's anchors, and run out a towline, including rigging a Liverpool bridle.

When you arrive, communicate with the commanding officer of the stranded vessel. By this time, the CO will have analyzed the problem and can tell you how you can assist. If the wrenching and pulling method is decided upon, your first step is to run out your towline, If possible, anchor while doing this, to prevent being washed up on the shore.

Getting the messenger to the stranded ship is always a problem. At times the job can be done by means of a shot line, or even a bolo line. Salvage ships can use a pair of scuba divers to swim the messenger across the water. If the surf isn't too great, a small boat will serve the purpose.

As a last resort, the messenger can be buoyed and floated to the grounded ship. When using this method, do not attempt to float the end straight down to the ship, but pay it out approximately parallel to the shore in such a manner as to use *set* to the fullest advantage.

Figure 4-22 shows one method of putting set to work. The tug takes a position upcurrent from the stranded ship and pays out the messenger until the end is near the shore. Then, the tug comes about and runs past the grounded ship, paying out the messenger as she goes.

If the grounded ship has no power and a small crew, the towline also should be buoyed. It may be impossible for the crew to heave in a heavy towline that is dragging across rocks or through sticky mud.

Some suggested buoys are empty oil drums, inflatable rubber or plastic floats, shoring timbers and, if nothing else is available, life jackets. The number needed will depend upon the weight of the towline and the amount of water the buoys will displace. An empty oil drum, for example, displaces over 400 pounds of water, and a 2-inch wire rope with a fiber core weighs approximately 6 pounds per linear foot. A drum every 60 to 65 feet would be adequate in this case.

The stranded ship must be ready in all respects to attach the towline. In addition, it must be ready to let go an anchor after it clears the beach. Stranded ships sometimes come off the beach with a bound and can run down the towing vessel unless an anchor is used to prevent it.

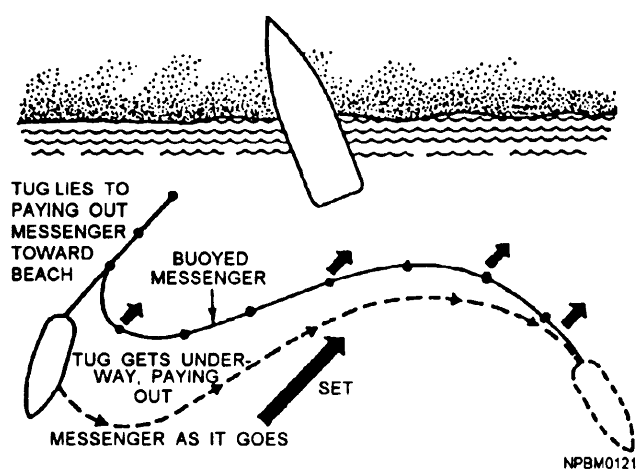


Figure 4-22.—One method of floating a messenger to a stranded ship.

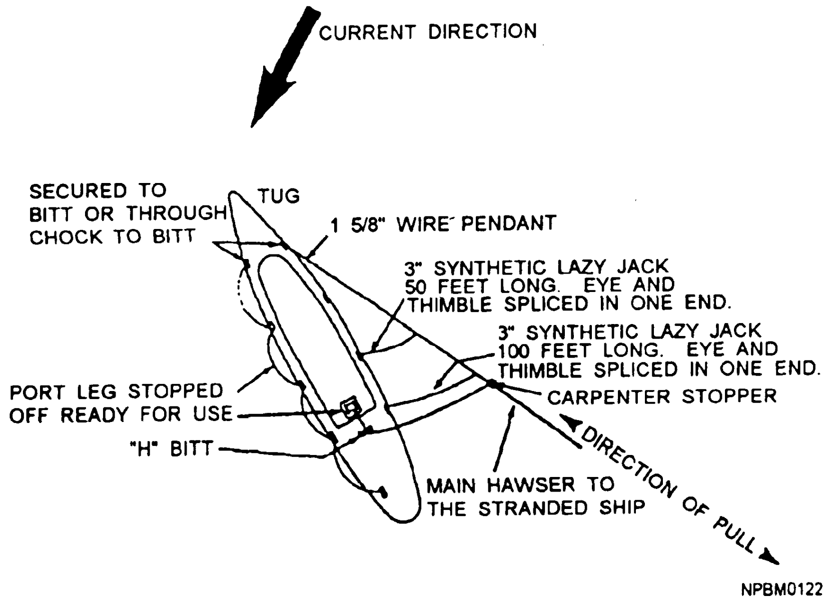


Figure 4-23.—The Liverpool bridle.

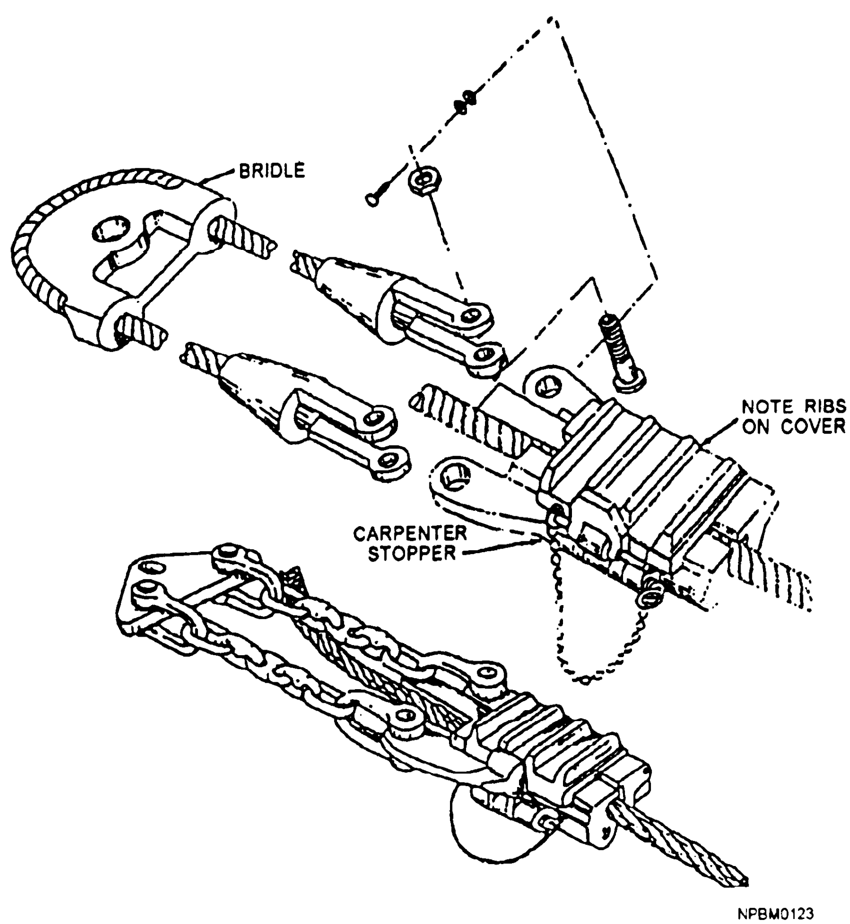


Figure 4-24.—Carpenter stopper.

After the towline is secured on the stranded ship, run out far enough to provide a good catenary in the towline. Then attach a Liverpool bridle (fig. 4-23) to the towline by means of the carpenter stopper (fig. 4-24).

The Liverpool bridle is a towline harness designed to permit a towing vessel to maintain fine control over heading and position. The lazy jacks are retrieving lines only and take no strain, nor does the section of towline between the carpenter stopper and the winch. Thus, the point of tow is forward of the vessel's normal pivoting point, and she is able to maneuver to keep her head more or less into the sea. By rigging a bridle on either side, the towing point can be easily and quickly shifted from side to side to facilitate wrenching operations and to adjust to unexpected changes in current direction. Notice that the bridle on the weather or current side is used. Useful in most stranding cases, the Liverpool bridle is essential in circumstances where currents and weather make it impossible for a conventionally rigged towing vessel to maintain its station clear of reefs.

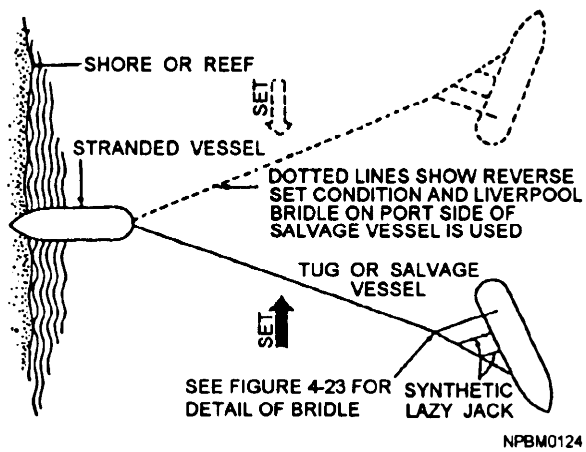


Figure 4-25.—Straight pull method with a Liverpool bridle.

If the stranded vessel is only lightly aground forward with the stern afloat, a straight pulloff is the simplest and most direct method of assistance. The straight pull method is shown in figure 4-25. However, this type of pulloff is not always effective; in which case, wrenching action proves advantageous. The wrenching method is usually augmented by laying out the stranded ship's anchors, one to either quarter at about a 20-degree angle to the ship's centerline. The tug, using a Liverpool bridle, wrenches the offshore end of the stranded vessel to one side. This rotation of the vessel serves two purposes: first, it breaks the grip of bottom suction; second, it shortens the distance between forecastle and anchor on the opposite side from the assisting vessel. Slack in the chain is taken in by the stranded vessel, and the chain is hove taut and secured. The operation is repeated on both sides alternately, using the length of the ship as a lever arm. This action is shown in figure 4-26.

Moving the wreck is slow, and little distance is gained in the beginning. But, ships hard aground have been moved by the wrenching method. The tug should be ready at all times to tow the vessel clear of the beach when it is pulled free.

- **BEACH GEAR.** Beach gear provides the most effective force that can be used for refloating stranded vessels. In general, it consists of a complicated arrangement of anchors laid out offshore and connected to the stranded vessel by strong wire ropes. The ship's winches can obtain a heavy strain on the wires by using purchase gear. A beach gear layout is composed of a number of individual sets of gear. Deck space

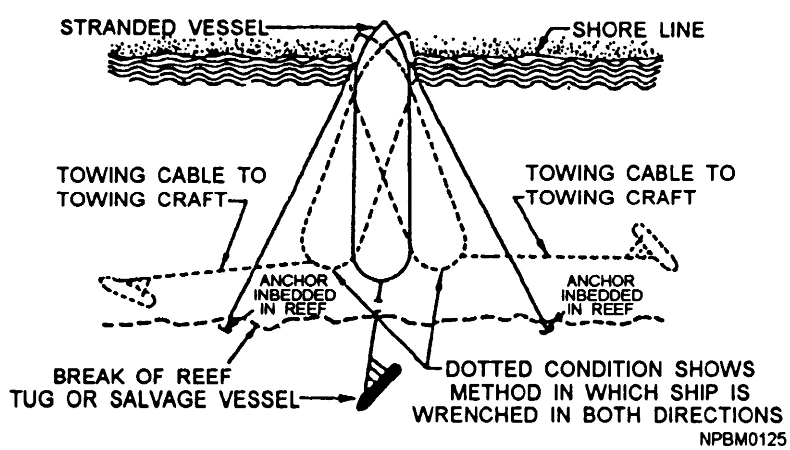


Figure 4-26.—Wrenching operation.

available on the stranded vessel for purchase gear layout is the only limiting factor to the total number of sets that can be used.

One of the most important phases of using beach gear is developing a complete layout plan. This plan is the responsibility of the salvage officer and should include all of the following information:

- Position of the wreck
- Soundings in the area
- Line of direction of each set of beach gear
- Layout of purchase gear aboard the wreck
- Pumping plan for flooded spaces
- Procedure and sequence for casting off beach gear
- A planned course of action after refloating

The layout plan, in addition, covers all phases of the pulling operations, including wrenching of the vessel before the final heave. The salvage officer must ensure coordination in all phases of the refloating operation.

SUMMARY

In this chapter we have covered numerous areas in which you, as a Boatswain's Mate, must be familiar with and ways in which you must be able to take charge of the Seaman to have a safe operation. You should make sure all personnel are trained in all areas of towing, anchoring, and salvage operations to ensure it a safe working area for all these types of events.

SAFETY, THINK, ACT, LIVE

CHAPTER 5

BOATS AND DAVITS

When you finish this chapter, you should be familiar with the most common types of boats, davits, and the usual items included in a typical boat outfit. You should have learned the basics of lowering and hoisting a boat by davits and cranes, and also learned how to maintain inflatable lifeboats.

A NAVY BOAT

LEARNING OBJECTIVES: You will be able to describe the standard allowance and equipage of the boats. Explain the weights and capacities of boats and the fire hazards in powerboats.

A Navy boat is an uncommissioned, waterborne unit of the fleet not designated as a service craft and is capable of limited independent operation. It may be assigned to and carried on a ship as a ship's boat or assigned to a shore station or fleet operating unit.

STANDARD ALLOWANCE OF BOATS

The allowance of boats for forces afloat is established by the Chief of Naval Operations (CNO). The allowance for shore stations is established by the Commander, Naval Sea Systems Command.

Boats may also be assigned by the CNO for the use of flag officers. When so assigned, these boats are not part of any ship's allowance, but are the custody of the flag. Boats that are assigned for the personal use of flag officers are referred to as barges. Boats assigned for the personal use of chiefs of staff; for squadron, group, and division commanders, who are not of flag rank; and for the commanding officers of ships are referred to as gigs.

STANDARD EQUIPAGE OF BOATS

Every Navy boat in active service is required to have a complete outfit of equipment. This equipment enables the boat, with its crew, to perform normal day-to-day functions and to weather minor emergencies, such as small tires. This equipment used to be issued with the boat, but now it is necessary to requisition part of it. The coordinated shipboard allowance list (COSAL) includes all of the items each boat on your ship is allowed—the items furnished with each boat, and the items required to be requisitioned. The equipment initially furnished with each boat, called portable parts, generally consists of the following items:

- Backboards
- Bitts, chocks, and cleats
- Buoyancy tanks or flotation material
- Canopies
- Fire-extinguishing systems (built in)
- Engine and engine accessories
- Flagstaffs
- Fuel tanks, piping, and fittings
- Horn
- Piping systems and hand bilge pumps
- Portable gratings or shutters, rails
- Seat cushions (refer to *NSTM,* Chapter 583)
- Slings
- Towing posts
- Ventilation sets, electrical (gasoline engines only), and ventilator cowls

A copy of each boat's outfit should be available to the boat coxswain and the division BM. It is also a good idea to enter the list in the front of the boat log.

When a boat is turned in, the boat's outfit also must be turned in unless the boat is to be replaced by one of the same type. In that case, the outfit is retained on board. If a boat is to be replaced by a boat of a different type, only those items that are allowed on the new boat may be retained.

MAN OVERBOARD (BOAT RECOVERY) EQUIPMENT

To complete your boat's outfit, the following items are required for special situations, such as man overboard, when the boat is assigned to make the rescue. The following equipment is for the SAR swimmer during man overboard:

- Wet suit ensemble
- Wraparound mask (with chemical light attached)
- Snorkel
- Rocket jet fins
- UDT life vest, or SAR 1 life vest
- Swimmer tending line
- Swimmer harness complete with 4-inch and two 6-inch chemical lights, strobe light, one "J" knife, and one whistle

The additional boat equipment that must be requisitioned consists of the following:

Quantity	Item
1	Boat hook 6 feet
2	4-pound grappling hooks with 100 feet of 3/4-inch nylon line spliced to the chain
1	Pair of hand shears for material cutting
1	V-bladed rescue knife
1	Hatchet
2	Battle lantern
5	Flashlights
1	Portable radio set (PRC-90) and Motorola HT 220
2	Set of semaphore flags
1	Hand-held signal light
1	First-aid kit with airway tube
1	Boarding ladder
1	Survivor, rescue sling
1	Very pistol with red, white, and green flares
1	45. Cal. Pistol
2	Blankets

Quantity	Item
1	Swimmer/survivor tending line—300 yards of 800-pound-test, 1/4-inch-diameter, yellow polypropylene line, installed on a compact reel with a quick-release hook spliced on the end for the D ring on a swimmer's harness
1	Rescue litter with flotation assembly
1	24-inch life ring with at least 100 feet of heaving line attached to the life ring.
6	Orange vinyl balls with line

THE BOAT BILL

Every Navy ship, regardless of class, is required to have a boat bill that is tailored to that ship's needs. Regulations and guidelines for the boat bill are set forth in OPNAVINST 3120.32.

The boat bill will identify the responsibilities of the ship's personnel and set the procedures for operation of the ship's boats.

DAILY BOAT REPORT

One of the many responsibilities of the first lieutenant is to make sure that an inspection of the ship's boats and their equipment is conducted daily. This inspection must include a test of the boats' engines, including their fuel and oil levels, lights, horns, and fog signals. It will also include an inspection of each boat's hull, fittings, and the standard and required equipage.

Most ships have the boat report checklist form so that each item is inspected and nothing will be overlooked.

WEIGHTS AND CAPACITIES OF BOATS

Specific data must be available to all personnel who work with boats, This data must indicate each boat's size and dimensions, its hoisting weight, its cargo capabilities, and how many personnel it will accommodate safely.

The Navy has many types of boats whose daily use aboard ship includes carrying passengers, cargo, combat

Table 5-1.—Weights and Capacities of Boats

BOAT	LENGTH (TO NEAREST FOOT)	BEAM (TO NEAREST FOOT)	HOISTING WEIGHT 1	CARGO CAPACITY 2	PERSONNEL CAPACITY 3
MWB (Mk 10)	26	8	6,400	3,000	18
MWB (Mk 11) (Mk 12)	26	8	6,200	3,600	22
24′ RIB (Mk 1, 2)	24	9	5,300	2,000	15
24′ RIB (Mk 3)	24	9	5,600	1,900	15
33′ UB Mk 3	33	11	12,200	7,100	42
40′ UB Mk 4, 5, 6	40	12	17,000	11,800	71
50′ UB Mk 4	50	14	27,200	23,400	142
LCPL (Mk 11)	36	13	18,500	3,000	17
74′ LCM 8 steel	74	21	131,300	120,000	—

1. Boat in all respects ready for service: Completely fitted out, fuel tanks full, and boat outfit and weights representing crew (at 165 pounds per person aboard).
2. To nearest hundred pounds below capacity.
3. Exclusive of crew.

troops, and vehicles. Table 5-1 lists pertinent information for several common types of boats. If you should require similar data for other types of boats, consult the *NSTM,* chapter 583.

CAUTION

- When carrying liberty parties, you must never exceed the boat's capacity.

- When you are carrying stores, the load, including the crew and stores, must never exceed the maximum cargo load given on the boat's label plate.

- When carrying stores and liberty parties together, you must never exceed the boat's rated cargo capacity. If necessary, a corresponding reduction in passengers must be made to accommodate the cargo. In addition, a reduction in weight and capacity is always needed in extreme weather and in the open sea.

FIRE HAZARDS IN POWERBOATS

A fire can be serious anywhere, but it is particularly dangerous in a powerboat. Although boats are equipped with fire-fighting devices, the best safeguard for those concerned with handling boats is an intelligent appreciation of the fire hazards and knowledge of how to eliminate or reduce the hazards. A discussion of some of the more common fire hazards and how they can be avoided follows:

- Cleaning with fuel: Because fuel vapor is highly combustible when mixed with air, using fuel to clean the engine or bilges is strictly prohibited.

- Clothing and oily waste or rags: Keep the engine space clear of clothing. Stow cleaning rags and waste in a closed container. After use, dispose of them safely. Clean engines, clean engine spaces, and clean bilges are requisites of a safe boat.

- Fuel leaks: Fuel in the bilges or in a free state in a boat is dangerous. The fumes may be ignited easily, resulting in a fire. If fuel from a leak (or fuel spilled while the boat is being fueled) runs into the bilges, the bilges must be washed down, pumped out, dried, and aired thoroughly.

- Bilges and sumps: Bilges and sumps must be kept dry and washed out frequently to clear them of fuel and oil. The forward and after engine space bulkheads must be watertight in the bilges so that liquid and gas will not pass into adjacent compartments.

- Poorly insulated exhaust pipe: Improper insulation of the exhaust pipe where it passes through the hull may set the boat afire. Report any defects of this type immediately to the first lieutenant.

- Dirty engines: Greases and oil, with which an engine becomes encrusted, will feed a fire, enabling it to get out of control rapidly. To prevent this, clean the engine at frequent intervals.

- Electric wiring: Electric wiring is not permitted in the bilges. The battery box must be located outside a closed engine compartment and should be provided with a suitable drip-proof cover. Have all naked electric terminals wrapped with insulating tape.

- Battery charging: Charging batteries produces sufficient hydrogen gas that if trapped and ignited will cause an explosion. Batteries should be charged either on deck or in an open space in the boat until the operation is completed. The lead-lined receptacle for batteries should be well ventilated.

- Smoking and loose matches: Smoking in any powerboat is strictly prohibited. Only safety matches are allowed on board naval ships and in naval boats.

- Fueling: Fueling of all boats should be accomplished during daylight hours with the boat in the water.

Special fueling precautions as outlined in the *NSTM,* chapter 583, must be considered when gasoline-engine powerboats are being fueled, but the following general procedures are applicable for all powerboats. Although many of these precautions concern duties or functions specifically charged to the boat's engineer or to the ship's engineering department (such as cleaning the engine compartment, fueling the boat, and charging the batteries), the boat's coxswain must be alert at all times for any violation of the following safety precautions:

- No passengers are allowed aboard during refueling.

- The hinged covers fitted on the engine hood should be open to permit free circulation of air around the engine. These covers should not be closed until fueling is completed and the engine is operating satisfactorily.

- Tanks and filling pipes should be inspected, and fueling should not take place unless filling pipes are tight at all joints.

- Cutoff valves should be closed at tanks.

- The hatch in the coxswain's flat on motor launches should be tightly secured.

- All openings near filling pipes through which fuel vapor might pass into closed compartments should be closed.

- The grounding wire clip (fitted on the end of the hose ground wire) should be attached to the screw provided in the deck flange of the filling pipe. On the 26-foot motor whaleboats, on which no such screw is provided, the grounding wire should be clipped to the 1/4-inch, copper, gooseneck vent pipe fitted on the tank. (Diesel engine boats are not required to be fitted with the grounding screw.)

- One member of the boat crew should stand by with a portable CO_2 extinguisher, ready for use, until the fueling is completed and the engine is operating satisfactorily.

Follow these procedures when refueling:

1. Unscrew the filling pipe cap.

2. Open the filling pipe flap and sound the tank to determine the approximate amount of fuel required.

3. Insert the hose nozzle, open the nozzle valve, and fill the tank. In standard tanks, the filling pipe is the only opening provided for escape of vapor forced out of the tank during fueling. Take care to avoid pushing the nozzle so far into the filling pipe that it chokes the opening and thus prevents the escape of the displaced vapor around the nozzle.

4. Take care that the fuel does not overflow the tank.

5. When the tank is full, remove the hose nozzle, close the flap, and screw on the cap.

6. Detach the ground wire clip.

7. If any fuel is spilled, wash the area down and wipe it dry.

HANDLING BOATS WITH A CRANE

LEARNING OBJECTIVES: Describe the safe handling of boats using a crane to hoist in and out of the water. Explain the use of boat slings and their proper use for hoisting a boat out of the water.

Hoisting boats in and out while the ship is at anchor is fairly simple, compared with the same operation when the ship is under way. For this reason, discussions in this chapter are concerned principally with the latter. This section describes the procedure when a crane is being used.

BOAT SLINGS

Except for certain boats, complete hoisting slings are issued with each boat fitted for hoisting by slings, even though a boat habitually is slung at davits. When a boat is transferred, either turn the slings in or transfer them with the boat.

Because boats of a given type frequently differ in details of design, you will find that slings for a given boat are not always suitable for use on all other boats of that type. For this reason, slings are marked at the time of manufacture with copper bands showing the type of boat for which they were made. The issuing shipyard adds to the bands the number of the boat for which the slings are issued. Each sling, after manufacture, must be tested for a 100-percent-over-normal working load; and when issued, a copper seal must be attached, stating the date, where, and by whom the sling was last tested.

Any repair activity that has the capability of testing slings, hoisting shackles, rods, pins, chain links, and rings following the applicable plans is authorized to manufacture such equipment following the applicable plans. Manufacture cannot be accomplished if the equipment is available as a standard stock item.

Before your ship accepts a newly issued, repaired, or altered set of slings, the slings must be tested for fit by hoisting the boat with them, using the normal hoisting equipment.

Side guys—steadying lines for slings—are required by standard plans to be made of fiber line. These side guys are not intended to take any part of the weight of the boat in lifting. The following procedures for adjusting the side guys should be followed in slinging a boat:

- When the boat is in the skids, attach the wire or chain legs to the proper hoisting eyes. Secure a shackle to each padeye or cleat intended for the manila side guys, and reeve the guys through these shackles.

- Hoist the boat until the slings take a strain on all lines. Even up the guys and secure them with a rolling hitch backed up by a half hitch, and seize the bitter ends to the standing parts with marline. Periodically, adjust the lengths of the side guys to compensate for any stretching. Do NOT use wire-rope side guys.

In the event that surface inspection by ship or yard personnel reveals wearing of the serving and there is the possibility of exposing the wire-rope slings to moisture, remove the serving, parceling, and worming and carefully inspect the wire for signs of rust or deterioration. Survey any rusted or deteriorated slings at once and replace them if necessary.

HOISTING OUT

Regardless of when or how a boat is hoisted out, the coxswain is responsible for making the boat ready and for getting the crew into the boat. The coxswain must make sure that the engineer checks the fuel and tests the engine. The coxswain also checks the boat plugs and makes sure that the appropriate boat equipment is in the boat and that the slings are rigged and fenders are in place. When the boat is ready in all respects and each member of the crew is wearing a life jacket and hard hat, the coxswain reports to the BM in charge.

On deck, have personnel rig the sea painter, break out ball fenders and steadying lines, clear the deck area of nonessential gear, test the crane, and rig the safety runner and tripping line. View A of figure 5-1 shows a safety runner rigged for hoisting out a boat. Once a boat with this rigging is waterborne, a pull on the tripping line drops the slings. (View B shows the runner rigged for hoisting in a boat.) This simple rigging arrangement enables personnel on deck to unhook or hook on a boat,

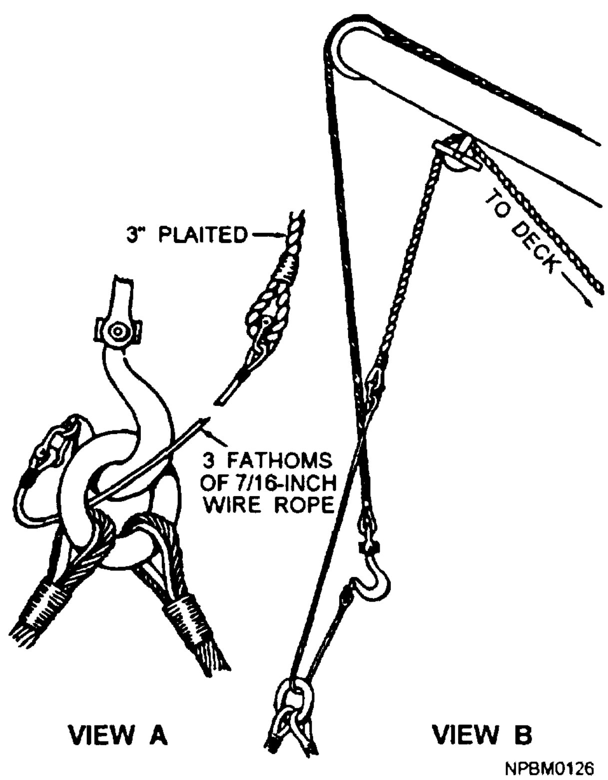


Figure 5-1.—Safety runner.

quickly and safely, the instant the person in charge deems appropriate. Its value may readily be appreciated if you consider the way the sea falls from under a boat and the resultant sudden strain when the whip again takes the weight of the boat.

If the sea is at all rough, there should be at least four steadying lines on the boat—two at each end (one leading well forward, one aft) and the other two inboard. If the position of the boat in its skids allows, the sea painter should be attached to the boat before hoisting. Often, however, you will find it necessary to swing the boat to the rail before you can secure the sea painter in the boat.

When you are ready to hoist away, set the whip or falls taut, release the gripes, and station personnel around the boat to steady it until it is clear of the skids. Hoist the boat just high enough to clear the rail, then swing it over the side. Stop the boat at the rail for the crew to board it (and when hooking it in, have the crew disembark at the same place). Adjust the sea painter so that when the boat is in the water, the boat tows from the sea painter—not from the whip or falls. While the boat is being lowered, rig two or more ball fenders and lower them down the ship's side, keeping pace with the boat. Have the personnel on the steadying lines prevent the boat from swinging. If the crane has a fall instead of a whip, and the ship is rolling or pitching, use a steadying line on the fall block. If the crane has a fall, use a safety runner. The pendant consists of a length of nylon line, a thimble, and hooks compatible with the crane hook and boat sling thimble. The safety runner must have a safety factor of "six" on the ultimate strength of the material used. The safety runner will isolate the boat crew from handling the heavy lower block of the crane. During the boat's descent, keep the safety runner taut, ready to trip instantly. Stop the boat before it becomes waterborne and start the engine. Once the engine is running properly, continue lowering the boat to the water.

The most dangerous time in hoisting out a boat is the moment it becomes waterborne. For the safety of the crew, as well as the gear, you must not allow the boat to become waterborne and then snap back on the fall or whip.

Therefore, try to set the boat down when the water under it is comparatively smooth. Judge the roll of the ship and watch the waves. As the ship rolls toward the boat, lower the boat smartly and trip the slings from the hook as soon as the boat is waterborne.

The boat then rides to the sea painter, and by using the rudder, you, as the coxswain, can steer the boat from the ship's side. Have personnel standing by in the boat to cast off the after, then the forward steadying line as soon as the boat is waterborne. When the boat gains enough headway to take the strain off the sea painter, the bow hook casts off the painter and personnel on deck haul the end aboard ship by means of the retrieving line.

HOISTING IN

In general, the procedure for hoisting in a boat is the reverse of hooking out; but adjustment of the sea painter so that the boat will tow directly under the falls or whip is most important. Once the painter is rigged, mark it so that thereafter it may be rigged to the correct length, making it unnecessary to readjust it to get the boat in position to hoist.

If the slings are not in the boat and the weather is mild, you may have the boat come alongside, take the sea painter, and secure it to an forwardmost inboard cleat. Lower the slings, as shown in view B of figure 5-1. Keep the boat under the hook while the slings are being secured.

If the weather is rough, however, bring the boat alongside to pick up the slings, then have the boat lie off while the crew rigs them. Lower the slings to the boat by the crane with the safety runner ready for tripping, as in view A of figure 5-1. With slings ready, have the boat come alongside. The bow hook secures the sea painter, and the coxswain slows the speed of the engine until the boat is towing from the sea painter. By judicious use of the rudder, the coxswain can keep the boat away from the ship's side yet under the hook. At this time, the steadying lines are passed to the boat. The safety runner is disconnected from the tripping line, passed through the ring of the slings, and reconnected.

The deck crew should lower the hook smartly, and once the boat crew hooks on, the boat should be picked up quickly and smoothly. There is no hard-and-fast rule that tells the boat crew when to slip the ring of the slings into the hook; however, they should watch the rise and fall of the boat, time it with the roll of the ship, and considering the speed of the hook, estimate the best time to hook on. No one should ever straddle a leg of a sling during the hooking-on process.

Great difficulty is often encountered in plumbing the boat over the skids or chocks long enough for it to be lowered in place accurately. In such a situation, use four steadying lines, especially if the boat stows close to the ship's side. Lead the lines from opposite sides of the boat at the bow and stem so that they cross and give better leads for steadying the boat as you lower it into position.

Regardless of the method used to hook in a boat, in heavy weather you will normally find it best to disembark both passengers and crew at the lowest weather deck. Before attempting this, have the boat snubbed in against the ship's side with frapping and steadying lines.

HANDLING BOATS WITH DAVITS

LEARNING OBJECTIVES: Explain the common types of boat davits and what class of ships they may be installed on. Describe the proper procedures for hoisting boats in and out of the water.

There are davits of various designs to accommodate the needs of the ship's boats and structure. This discussion will cover only a few types of boat davits. For more information on handling boats with davits see *NSTM,* chapter 583.

Basically, a set of davits is nothing more than a special crane that is designed for handling a boat or boats in a safe and timely way.

The essential function of the davit arm (or arms, as applicable) is to swing out the boat from the inboard position to a point outboard of the ship's side from which the boat may be lowered; the reverse of this process occurs when the boat is hoisted. Hoisting operations are controlled by wire rope falls from which a hoisting hook (or hooks) is (are) suspended (depending on whether the davit is the single arm with trackway davits are placed across the tracks and the falls slacked off, allowing the davit arms to rest against the keeper bars. Depending upon design, a pair of these davits may handle from one to four boats and are designated as single-, double-, triple-, or quadruple-bank davits.

DOUBLE-LINK PIVOTED GRAVITY DAVITS

The double-link gravity davit is designed to launch or stow one or more boats. Depending on the davit design, one boat may be stowed griped in against the davit arms, or two boats may be stowed between the davits, one above the other. A third boat may be carried suspended by the falls and secured to the ship's side.

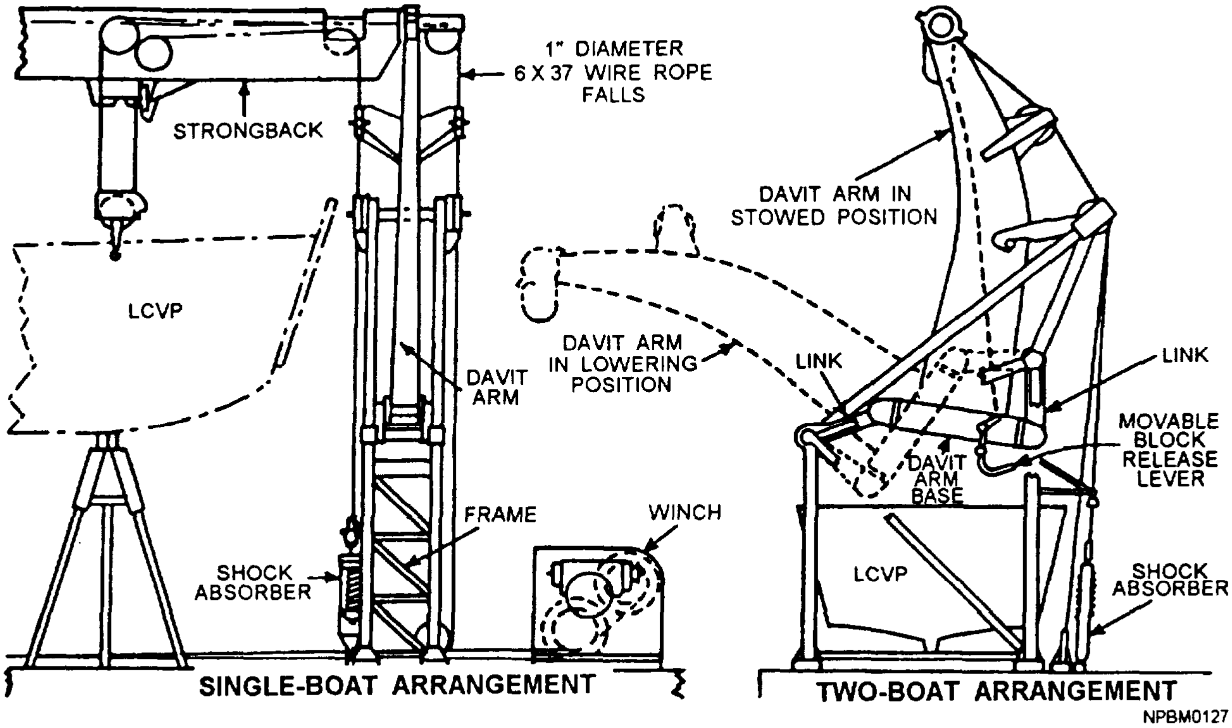


Figure 5-2.—Double-link pivoted gravity davit.

Each davit frame is made up of two identical units trussed together by structural steel. See fig. 5-2. The davit arm is supported by tow links and swings between the two units. One end of each link fits between two padeyes at the end of the davit arm base; the other end of the link is supported by the davit frames.

A davit arm locking mechanism is designed for locking the arm in one of two positions. The first (LOCKED) position prevents racking of the davit arms and strongback when the vessel is under way. The other is a READY position.

The winch is capable of hoisting the fully loaded boat at a speed of 40 feet per minute.

SINGLE-ARM GRAVITY DAVITS

The single-arm gravity davit is used today on DD, CGN, and FFG class ships. It allows a superior boat-handling procedure and permits the extension of rescue boat handling to higher sea states than considered safe with conventional double-arm davits. The main features of the single-arm davit that permit this improvement are as follows:

- Use of a single lifting point that minimizes boat hookup time and effort. A quick-acting hook and special boat bail enable lifting at a single point. Hence, the relatively dangerous and time-consuming process of threading two hooks through bow and stern hoisting rings is eliminated.

- Use of high speed to lift the boat clear of the water as soon as the hook is engaged with the boat bail. A two-speed winch (both high and low speed) is provided for lifting the boat at high speed.

A typical trackway, single-arm boat davit arrangement is shown in figure 5-3. A single part fall is rove from the single davit head, through a hydraulic ram hoist, to an electromechanically driven single-drum winch. The ram hoist is operated by hydraulic fluid from a nitrogen-charged accumulator and is actuated with a control valve located at the control console.

GRAVITY DAVITS

Gravity davits are found on most Navy ships. They are the trackway, pivoted boom, or the double-link pivoted type. (See fig. 5-4). Gravity davits, which handle the larger boats such as LCPLs, are generally equipped with a strongback between the davit arms. An electrically powered two-drum winch, located in the immediate vicinity of the davits, provides power to hoist the boats. Cranks can be attached to the winch for

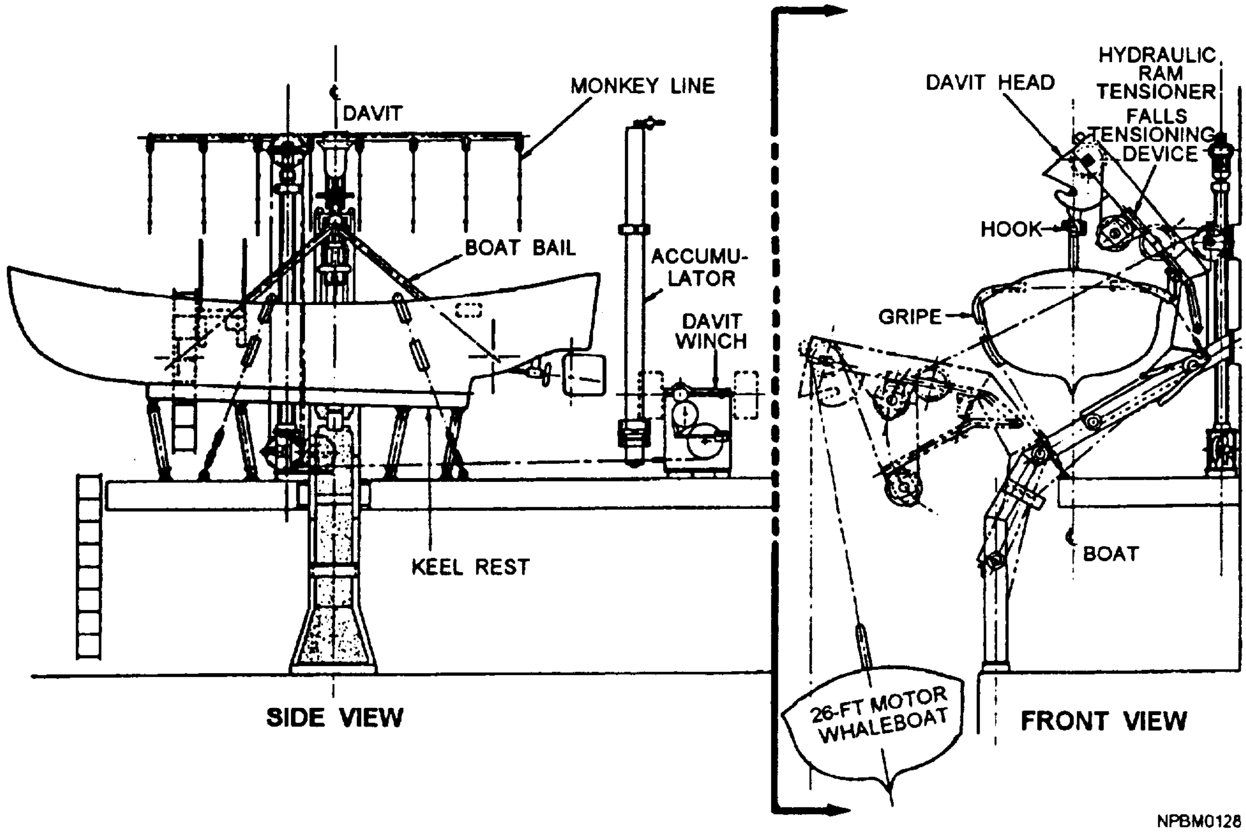


Figure 5-3.—Single-arm trackway gravity davit.

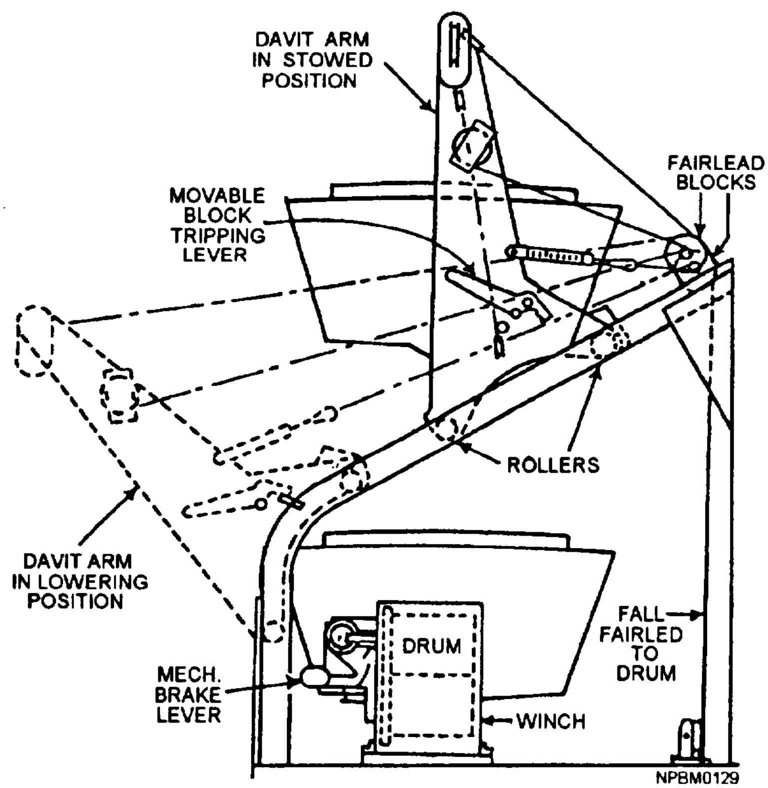


Figure 5-4.—Trackway gravity davits.

hoisting by manpower. Power is not required to lower boats. The boat lowers by gravity as it is suspended from the falls, and the descent speed is controlled with the boat davit winch manual brake. Gravity davits are rigged in such a way that when the falls are two-blocked, continued heaving pulls the davit arms up to the stowed position. Keeper bars, provided with most trackway davits, may then be placed across the tracks and the falls slacked off, allowing the davit arms to rest against the keeper bars. Automatic davit arm latches located at the stowed position are provided with pivoted gravity davits.

At present, either type of gravity davit may or may not be modified. When the falls of the unmodified davit are two-blocked, two pins are inserted through the strongback to hold each movable block in position. The modified davit has movable blocks that latch automatically when two-blocked.

Depending upon design, a pair of these davits can handle from one to four boats and are designated as single-, double-, triple-, or quadruple-bank davits. In the single-boat arrangement, the boat hangs from the davits or rests in chocks on deck when stowed. The two boats of the double-bank davits are secured in skids—one boat stowed above the other. With the triple- and quadruple-bank davits, one boat is carried at the rail outboard of the two or three other boats, which are nested. The rest of this discussion on gravity davits is concerned mainly with multiple-bank davits.

SLEWING BOAT DAVIT

Slewing boat davits have a single arm mounted on a pedestal, which in turn is mounted to the ship. The arm slew rotates about the vertical axis of the pedestal to move the boat inboard and outboard. This boat davit design, commonly called a slewing arm davit (SLAD), is used to handle rigid inflatable boats (RIB). The boat or boats is/are stowed on the deck of the ship next to the pedestal. The slewing boat davit is electrically powered and it is also a mechanical boat davit (fig. 5-5).

FALLS TENSIONING DEVICE

The pivoting arm type of falls tensioning device is shown in figure 5-6. It consists of an arm, pivoting on the davit, which is just heavy enough to counterbalance the padded weight on the end of the single fall. It serves the purpose of keeping slack out of the fall when hooking on and unhooking.

While you are preparing to hoist in a boat, the falls can be lowered within reach of the personnel in the boat.

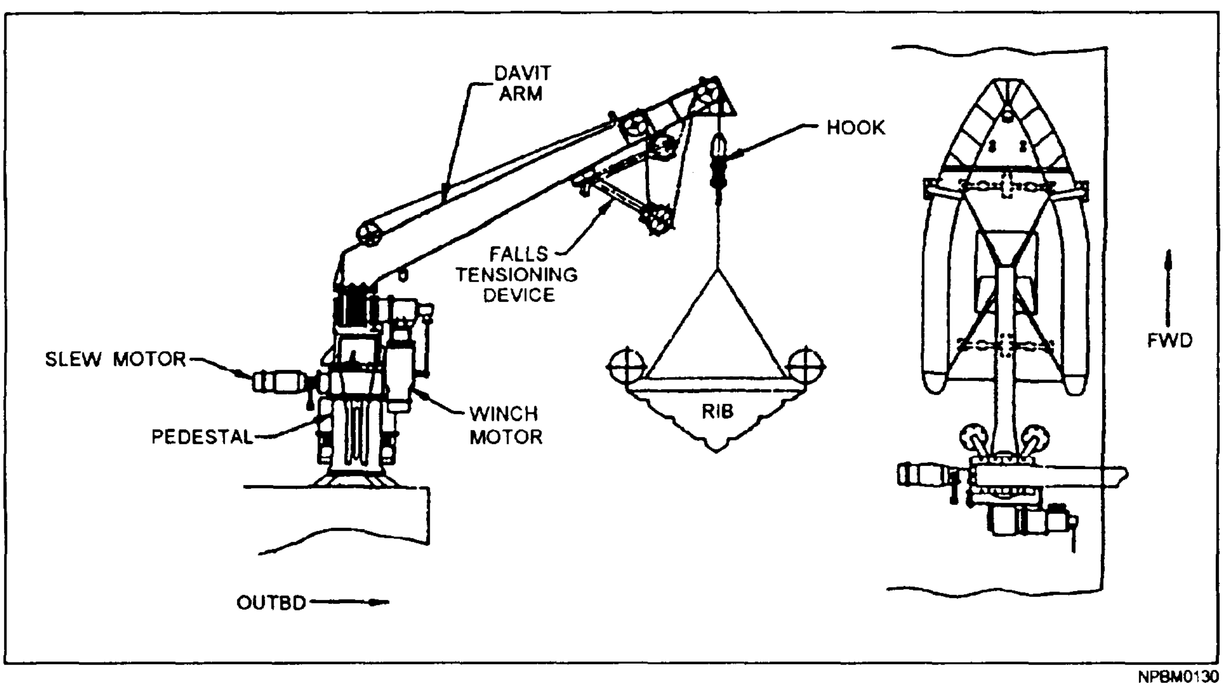


Figure 5-5.—Slewing arm davit (SLAD).

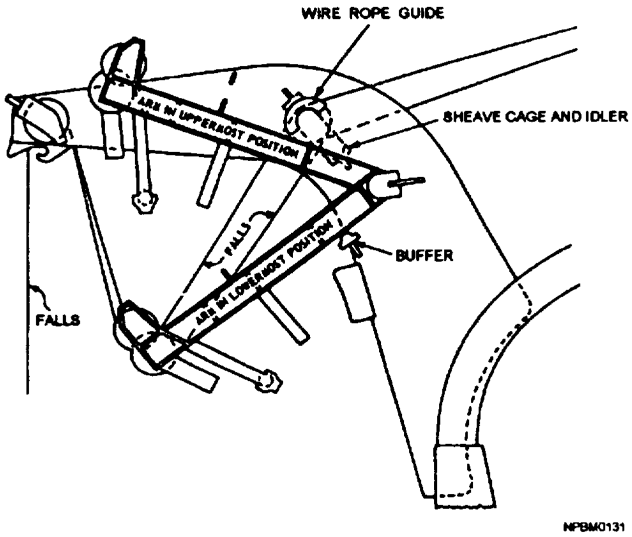


Figure 5-6.—Falls tensioning device.

When the boat is in position, a person can pull a fall down and hook on. The weight of the pivot arm prevents the fall from flopping around if the boat rolls or pitches. When a fall is unhooked, the tensioning device hoists the fall clear of the boat.

HOISTING IN.—You recover the boat by slamming the hook against the boat bail. When the hook tripper bill is latched, you can rapidly raise the boat clear of the water. You then use the winch to raise the boat and davit arm to the stowed position. You cock the extended ram to the retracted position by continuing to haul in the wire rope with the winch.

Standard Release Gear

On boat davits, the standard release gear used by the Navy is the Raymond releasing hook. The outer end of the tripper is weighted so that when the boat is in the water and the load is removed from the hook, the tripping device will automatically tumble, casting the boat shackle or sling hoisting ring out of the hook, releasing the boat. To assist the boat crew in hooking up, provide the weighted end of the hook with a lanyard, which is passed through the shackle or boat sling hoisting ring and hauled back on to engage the ring and hook. This lanyard must be held tight by one of your crew until the load on the hook prevents the tumbling of the tripping device.

Lowering Boats in Davits

The boat coxswain is responsible for making the boat ready and getting the crew into the boat. The coxswain must make sure that all of the boat equipment is on hand and that the boat plugs are in place. Everything must be rigged properly, and the fenders must be in place. The boat engineer checks the fuel and oil levels and tests the engine.

As coxswain, let the BM in charge know when the boat and crew are ready for lowering.

When the BM in charge of the lowering detail is satisfied that all is correct and the bridge gives permission to lower the boat, the operation can begin.

Have all personnel in the boat wear an inherently buoyant life jacket and hard hat. In addition, have them keep a monkey line or life line in hand for safety during lowering and hoisting operations.

During lowering, have the monkey lines hang over and inboard, between the ship and the boat. By doing this, you will prevent the lines from being fouled around an object or structure of the boat and also have the lines clear of the boat once it is in the water.

When the boat is just clear of the water—that is, out enough that it is not slapped around by a wave-stop lowering and start the engine. This gives the boat maneuverability once waterborne. With the engine in operation, lower the boat to the water.

Once the boat is waterborne, at the order “Cast off aft,” have the after fall released. At the order “Cast off forward,” have the forward fall released. The falls are pulled clear of the boat by the frapping lines. The boat is now riding to the sea painter, and the boat crew will cast off first the after and then the forward steadying lines. When the boat gains headway, they cast off the sea painter and the boat is free.

Hoisting Boats by Davits

The procedure for hoisting a boat by davits is the reverse of the lowering operation. The personnel on deck should have everything ready in advance. The davits are swung out, and the boat falls and monkey lines are lowered and held to the ship by frapping lines. Fenders are rigged, and the handling equipment is energized and tested.

The ship should provide a lee for the approaching boat; that is, the ship moves slowly ahead in a direction to protect the boat from the sea and the wind.

As the boat comes alongside, the sea painter is passed to the boat and secured over the forward inboard cleat. As the boat rides back on the sea painter, the boat falls and monkey lines are eased out to the boat. The forward fall is secured first, then the after fall. When all is hooked up and secured, the crew on deck takes the slack out of the falls, hoists the boat aboard and secures it. Davits should be stopped at the lowest weather deck to disembark the boat crew.

Punt Operations

When painting over the side of a ship in a punt boat you must always remember that you must be in a life jacket at all times in a punt. You will always have a petty officer in-charge when you are working in a punt. You will have all boat equipment in the boat whenever in use.

BOAT BOOMS

LEARNING OBJECTIVES: Define boat boom. Describe the purpose of the boat boom.

Ships that are at anchor, or are moored to a buoy, rig out their boat booms for the purpose of mooring their boats well clear of the side. This method of securing is known as "hauling out to the boom." Forward booms are called lower booms; after booms are called quarter booms.

The attachment point (fig. 5-7) is a spar secured by a gooseneck to a pin on the side of the ship, which allows

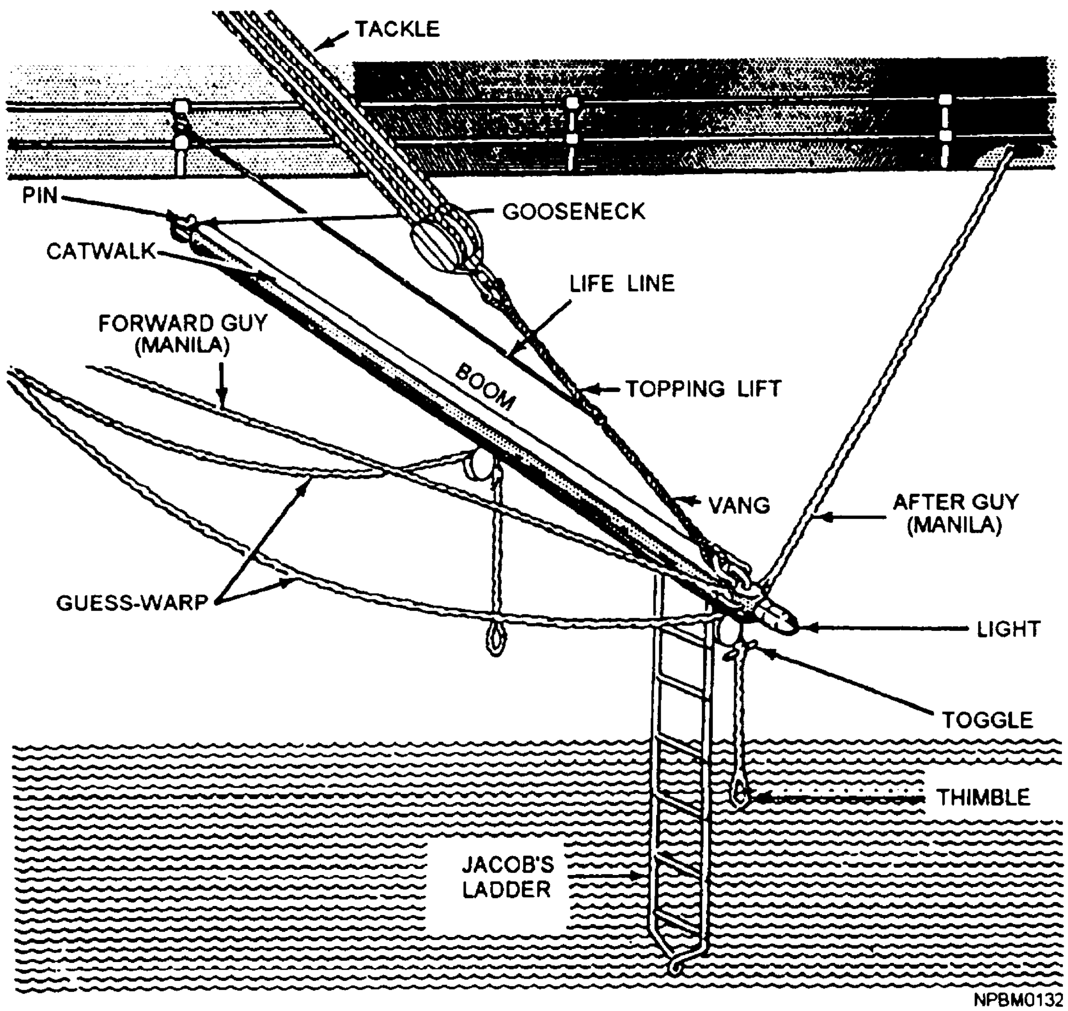


Figure 5-7.—Parts of a boat boom.

free motion fore and aft. The outboard end of the boom hangs from a wire and tackle combination called the topping lift. Fore-and-aft motion is controlled by nylon forward and after guys or wire pendants.

A strong line called a guess-warp leads from well forward on the ship, out through a block in the end of the boom, and ends in a wood thimble through which boats can reeve their bow lines. A toggle is seized between strands of the guess-warp above the thimble to keep it from running up (out of reach) when a boat lets go. One or more Jacob's ladders from the boom permit boat crews to come aboard.

Rigging the boat boom is a simple matter. Ladder, guys, and guess-warp are attached, and the guys are led out fore and aft. The after guy usually is marked at the point where it secures, then it is made fast at this point first. Next, the boom is started out by a shove with a boat hook, or anything else suitable, and the forward guy is heaved around until the after guy is taut and secured.

You will find it easier to climb the Jacob's ladder hand over hand from one side, as you would climb a rope, instead of facing it as you would a rigid ladder. Be certain you have a good hold on the life line before you transfer from the ladder to the boom, and keep hold of it as you come in to the side. If you fall off, you are as likely to injure yourself against the boat as you are by falling in the water. Always wear a properly secured life jacket when you travel over the boom. You may be a good swimmer, but you cannot swim if you are unconscious.

In making fast to the guess-warp by the boat painter, always reeve the painter through the thimble and secure its end back in the boat so you will not have to get at the thimble to let go. Always have the boat ride to a long lead on the painter. The shorter the painter, the more up and down the strain, and the more the boat's weight will come on the boom as it dives down on a swell.

INFLATABLE LIFEBOATS

LEARNING OBJECTIVES: Describe CO_2 inflatable lifeboats used in the Navy today. Explain what they are designed to do and how they operate, are maintained, and stowed aboard Navy ships.

Experience from disasters and experiments conducted under different conditions have proven that it is essential that personnel who abandon ship in water below 70°F be kept entirely out of the water and protected from the elements if they are to survive.

Navy ships have inflatable lifeboats installed on board that not only keep surviving personnel out of the sea, but also have canopies to provide shelter from the elements. As with many safety items, we tend to accept them as just another fixture installed on board. Unfortunately, improper installation and maintenance have accidentally launched some inflatable boats or, worse, made them useless when needed.

STANDARD ALLOWANCE

The standard shipboard allowance of inflatable lifeboats is a quantity that will provide room for 100 percent of the ship's crew. The issue of inflatable lifeboats is determined and approved by NAVSEA. The replacement of an inflatable lifeboat that is part of the ships allowance for reasons of loss, survey, or deferral for repair must be made by requisition procedures to the Ships Parts Control Center (SPCC), Mechanicsburg, Pennsylvania, with a copy of the action requested sent to NAVSEA.

TYPES OF INFLATABLE LIFEBOATS

The Navy has successfully used many types of rigid and inflatable lifeboats throughout the years. Today, on Navy ships, you will have either the Mk 5 Mod 2, 15-person or the Mk 6, 25-person encapsulated lifeboats. These lifeboats come packed in rigid fiber glass containers and are complete with survival gear and rations inside the lifeboat. These containers are then stowed in cradles or racks designed to accommodate them aboard ship.

CHARACTERISTICS OF INFLATABLE LIFEBOATS

The Mk 5 Mod 2 and Mk 6 inflatable lifeboats are designed for compact stowage aboard ship and for quick inflation if it becomes necessary to abandon ship. A few

Table 5-2.-Characteristics of Inflatable Lifeboats

BOAT TYPE	CAPACITY	WEIGHT (lbs)*	DIMENSIONS-INFLATED		DIMENSIONS-CASE/ CONTAINER		
			L	W	H	W	L
Mk 5 Mod 2	15 persons	450	15´8"	7´4"	27" Rigid Container	dia	56"
Mk 6	25 persons	515	17´9-3/4"	8´10-1/2"	27" Rigid Container	dia	56"

characteristics of these boats are shown in table 5-2. The lifeboats may be inflated by pulling on the sea painter (length, 100 ft), which extends through the opening at one end of the container. The sea painter is faked into a tube inside the carrying case, and the entire length must be pulled out of the container to activate the inflation valves.

The boat is constructed of neoprene-coated fabric and consists essentially of a lower tube 12 inches in diameter surrounded with an upper tube 10 inches in diameter. Each tube is individually inflated by a compressed air charge contained in a suitable size cylinder, and the canopy support tubes are interconnected with the respective compartment of the upper tube. Each tube is divided into two separate compartments by means of vertical fabric bulkheads so that puncturing either compartment will not allow complete deflation.

A fabric bottom is attached to the bottom of the lower tube and supports the manually inflatable and removable floors. These floors are equipped with handlines so that they may be used as emergency flotation equipment.

The upper and lower tubes are individually inflated by compressed air charges contained in two 250-cubic-inch cylinders at a pressure of 5,000 psi. One cylinder inflates the lower tube. The other inflates the upper tube and the canopy bows.

The inflatable floors and cross tubes are inflated by means of the hand pumps stowed in the pockets attached to the canopy support tubes.

The hand pumps are also intended for topping-off the lower and upper tubes if the pressure becomes low after initial inflation.

After inflation, the overall length of the boat is 15 feet 8 inches, the width is 7 feet 4 inches, and the overall height is 4 feet 4 inches.

The compressed air charges, at 70°F. will inflate the lifeboat to a pressure greater than the nominal pressure of 2 psi. This overpressure will be relieved by four relief valves—one in each of the four flotation compartments. The relief valves open at 3.5 psi and close at 2.6 psi.

The double-layered canopy has boarding openings at each end of the lifeboat that are fitted with closures that may be closed as desired. The air space (about 3 1/2 inches) between the two layers of canopy fabric provides insulation against extremes of heat and cold.

A raincatcher tube for the collection of rainwater is installed in the top of the canopy, near the center of the lifeboat. The lower end can be tied off to allow water to accumulate in it. Two plastic bags for the collection and storage of water are provided in the survival equipment.

Life lines are provided around the inner and outer circumference of the boat. The outside line is intended to be an aid to boarding, and the inside line is intended for use by survivors during heavy weather.

A righting line, knotted at 12-inch intervals, is attached to the bottom of the raft and can be used to right the lifeboat should it inflate upside down or be capsized from wave and wind action.

Rope ladders, located at each end of the lifeboat, are used for boarding.

LAUNCHING PROCEDURES

The Mk 5 Mod 2 and Mk 6 boats can be launched by being manually placed overboard or, if left on a sinking ship, they will automatically launch themselves.

Automatic Launching

In the event of a catastrophe causing loss of the ship before the boats can be launched manually, the boats will sink with the ship to a depth of 10 to 40 feet, at which depth the water pressure will activate the hydrostatic release, releasing the boats, automatically, to float to the surface. Boats stowed in rigid containers will have the sea painter attached to the cylinder valve actuating cables and the lifeboat stowage. As the ship continues down, the painter will pay out to its full length, creating a pulling force on the cylinder valve activating cables, releasing the compressed air into the boat and inflating it automatically. The painter has a predetermined breaking strength less than the buoyancy of the boat, allowing it to break once the lifeboat has surfaced.

Manual Release Launch

In the event of an abandon ship situation when there is sufficient time, trip the hydrostatic release manually by hitting its release button with the heel of the hand. Upon clearing the stowage straps, push or roll the boat overboard. Then pull the painter, actuating the cylinder valves and inflating the boat. Secure the painter to a D ring on the boat (and at the stowage), which prevents the boat from drifting away from the ship.

NOTE

The survival gear for boats packed in rigid containers is packed in the lifeboat, where it is immediately available when the lifeboat is inflated.

Inflation

The boat has the latest in improved inflation systems. The compressed air cylinder, under high pressure, ensures rapid (20 to 30 seconds) inflation at temperatures as low as -20°F. At high ambient temperatures, the compressed air system creates a somewhat higher than normal pressure in the hull tubes. This pressure is relieved by the pressure relief valves installed in each of the tube compartments. These valves will relieve at 3.5 psi and close automatically at 2.6 psi.

The boat, after initial inflation, will be quite firm. Cooler air temperatures will cause the boat tubes to soften. This is normal. As the sun causes the temperatures to rise during the day, the heat causes the tubes to firm up again. Use the hand pumps to "top off" the boat to normal pressure when required.

Inflate the inflatable floors and cross tubes by means of the hand pumps as soon as possible after you board the lifeboat, as they provide insulation against the colder water temperature.

Stowage

The standard Navy lifeboat stowage cradle requires a 15-degree lip on the outboard side of the lifeboat cradle. The purpose of this lip is to prevent the lifeboat from falling out of its cradle if the hydrostatic release is accidentally tripped. (See fig. 5-8.)

Many cruisers, destroyers, frigates, and auxiliary-type ships have their inflatable lifeboats stowed in overhead racks. A ratchet assembly is used to pull a

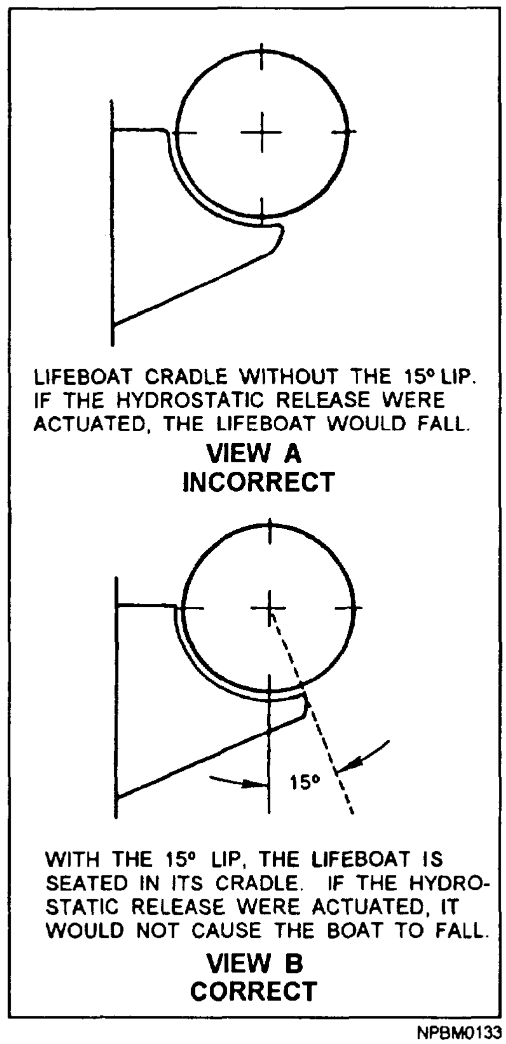


Figure 5-8.—15-degree lip on cradle.

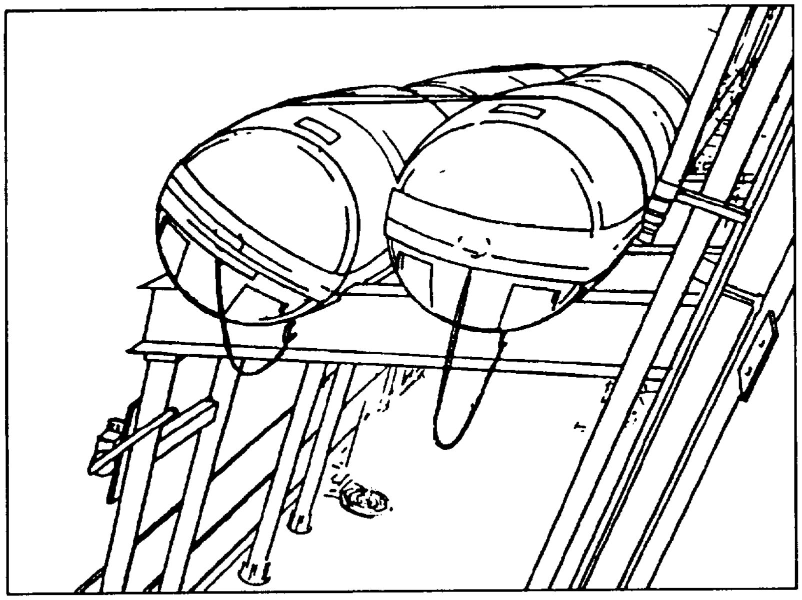


Figure 5-9.—Correct racket assembly arrangement.

stainless-steel strap to lift each lifeboat out of its cradle. (For properly installed ratchets and stainless-steel straps, see fig. 5-9.)

Securing Harness

The lifeboat is held securely in its stowage by three assemblies in one. A hydrostatic release mechanism, a plastic-coated wire-rope harness, and a 1/4-inch-diameter double braided nylon cord. The 1/4-inch nylon cord is provided as an emergency means of launching the lifeboat in case the hydrostatic release device is frozen or inoperative. No substitutions of the nylon cord is authorized. It is attached to the shackle on the hydro-static release device by means of a bowline. The bitter end is passed through the thimble of the wire-rope harness, then back through the shackle five turns, and secured with a clove hitch and two half hitches. In an emergency, if the gear fails to work as designed, the nylon cord is easily cut with a knife. Figure 5-10 shows a properly secured lifeboat.

Painter Line

The painter line for automatic launching of encapsulated lifeboats is 100 feet long and faked inside the container to actuate the air inflation bottles. The following five-step procedure is recommended:

1. Remove the painter cork from the lifeboat container grommet.

2. Determine the length required for the painter to reach from the lifeboat to where it will be fastened to the ship's structure.

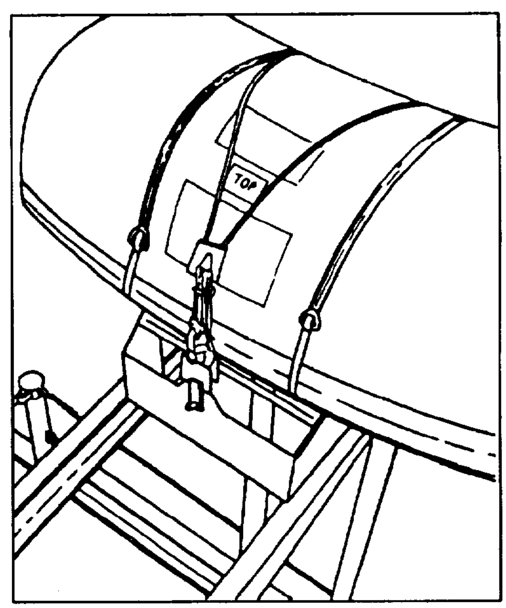


Figure 5-10.—Properly secured lifeboat.

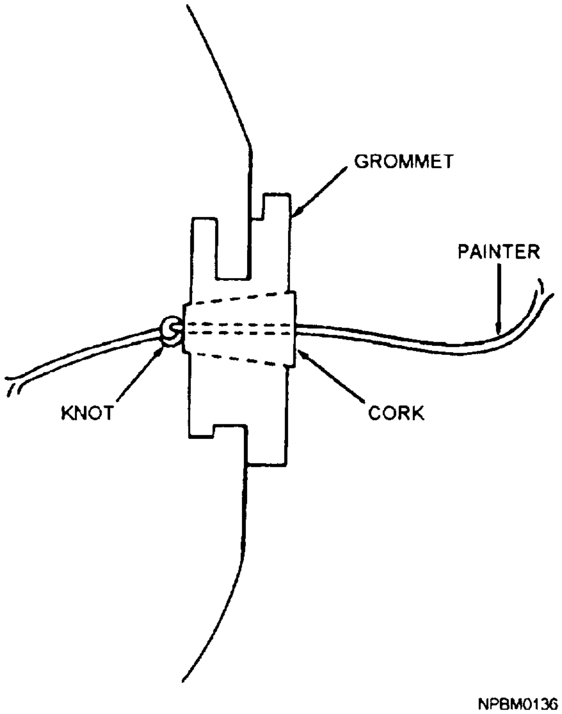


Figure 5-11.—Container grommet (Mk 5 Mod 2 and Mk 6).

3. Tie an overhand knot in the painter line at the point determined above and immediately on the inside of the container next to the cork. (See fig. 5-11.)

4. Reinstall the cork securely into the grommet.

5. Fasten the painter securely to the ship's structure at a point accessible to the person launching the lifeboat.

Maintenance and Repair of Mk 5 Mod 2 and Mk 6 Lifeboats

Minor and major repairs to the Mk 5 Mod 2 and Mk 6 lifeboats are accomplished only by certified repair facilities. A repair facility is any NAVSEA-approved activity designated to accomplish minor and major repairs, inspection, maintenance, and survey of inflatable boats. The following designated activities are presently approved Navy repair facilities:

1. Philadelphia Naval Shipyard
2. Norfolk Naval Shipyard
3. SIMA Activities
   a. SIMA Norfolk
   b. SIMA Pearl Harbor
   c. SIMA Mayport
   d. SIMA San Diego
   e. SIMA San Francisco
   f. SIMA Long Beach

Inflatable lifeboats and lifeboat stowages aboard ship must have periodic planned maintenance following the appropriate maintenance index page (MIP).

The Mk 5 Mod 2 and Mk 6 container banding must be inspected to assure that both bands are intact. In the event that the bands have been parted or tampered with or that the container has been damaged extensively, the boat must be removed to a repair facility for inspection, repaired if necessary, repacked, recertified, and returned to shipboard stowage.

NOTE

In some instances, nylon straps may be present instead of cables. The straps must be replaced with nylon-covered, corrosion-resistant steel (CRES) cables.

You visually check the hydrostatic release assembly. You ensure compression of the tensioning spring. You do NOT paint the release assembly. In the event the release is painted, you must remove and replace it. You will turn in the removed releases to a repair facility for testing and refurbishing.

You install the hydrostatic release device with the main body or diaphragm bell housing fastened to the ship's structure and fasten the smaller release clip to the securing bridle. You face the hydrostatic release actuating mechanism outboard to alleviate the possibility of accidental release.

You check the painter line from the container to assure that it is securely tied directly to the ship's structure.

For further information on inflatable lifeboats, including itemized lists of survival gear for other small boats that may be used for lifeboats and stock numbers, you refer to NSTM, chapter 583.

SUMMARY

This chapter has covered numerous areas that are very important to the BM rating. The areas discussed are just briefly covered here but are covered in detail in the NSTM, chapter 583. Just remember that when you are in any small boat being hoisted in and out of the water ALWAYS WEAR a hard hat and a life jacket.

CHAPTER 6

BOAT HANDLING

The moment you become the coxswain of a boat will probably be the first time in your life that you have been given so many responsibilities.

In this chapter, you will gain most of the knowledge needed to operate a small boat safely. You will learn of the forces affecting a boat, boat safety and etiquette, and how to read and care for a boat compass and navigational charts. Furthermore, you will learn how to maneuver a boat in confined areas and how to beach and retract landing craft. You must also become familiar with terms used in the "Rules of the Road," understand distress signals, and properly interpret lights and sound signals.

Your ability in boat handling will increase the more you operate a small boat and have the basics committed to memory.

A COXSWAIN'S RESPONSIBILITIES

LEARNING OBJECTIVES: Describe the duties of a boat coxswain. Identify the responsibilities related to boat seamanship, including handling the craft, compasses and charts, and Rules of the Road.

You must become completely familiar with everything relating to the care and handling of your boat. You must know its physical characteristics, dimensions, draft, and cargo and passenger capacities in both fair and foul weather. These capacities are stamped on the boat label, and you must not exceed them. During heavy weather, in particular, overloaded boats or boats with an unevenly distributed load can swamp easily, and in such circumstances, lives could be lost. Occasionally, it may be necessary to remind the OOD of your boat's capacity to discourage overloading. When loading ashore, you are responsible for not overloading.

You are responsible to the officer in charge of the boat for having it clean and ready for use, with a complete boat outfit in good condition. Before making the accommodation ladder, coxswains of officers' motorboats, gigs, and barges must ensure that the seat cushions are in place, the boat cloths are spread, and the boarding ladders (if provided) are placed properly.

You are responsible for the training and conduct of the boat crew. You must see that the crew is available when needed and that each crew member is wearing a clean uniform of the day. Problems may arise on some ships when white uniforms are required, but according to custom, each member of the boat crew should be in a clean, pressed uniform before assuming the duty. Ship's regulations frequently require the boat crew to wear clean white sneakers. This is a safety factor, primarily, but it is also an aid in keeping boats looking neat, and you should always enforce this regulation. Oilskins or rain clothes supplied for your crew are your obligation, too. They should all be of one type, if possible, and should be kept in the boat when not being worn. Wearing foul weather clothing is strictly prohibited for boat crews unless weather requires its use. The senior officer present afloat (SOPA) provides instructions that set the uniform for boat crews. If you are unfamiliar with those instructions, check with the OOD before reporting for boat duty. Then, inform your crew of the proper uniform so that all will be dressed correctly before being called away.

When called away, man your boat promptly, lie off until signaled to make the gangway, and do not leave until you receive your orders from the OOD. Immediately upon return to the ship, inform the OOD whether the orders were carried out; if they were not, state the reason.

Officers of the deck are responsible for the appearance of the ship, and because they cannot see the ship from a distance, most of them will appreciate your quietly informing them of any irregularities you may notice about the ship (for example, items hanging over the side, loose gun and gun director covers, Irish pennants, and the like). Make it a habit to look for such things when you are returning to the ship.

Before leaving your boat, you must make sure that it is secured properly and that a boat keeper, if required, is in the boat. If the boat is secured alongside a pier, make sure there is enough slack in the lines to allow for the rise and fall of the tide. To do so, you must have a good idea of the range and state of the tide. Check with the

Quartermaster of the watch for this information. Figure 6-1 shows the proper way to secure a boat to a boom. Run the bow painter through the deadeye of the guess-warp, through the hoisting padeye, and then throw a clove hitch (backed up by a half hitch) around the Samson post. Have enough slack in the painter to allow for the bounce of the boat on the waves. When the weather is rough, the stern fast should be thrown over the boom guy and secured back on itself with a rolling hitch and one or more half hitches. When other boats are at the same boom, leave fenders rigged over the side. When your boat is secured properly, report to the OOD. Before securing for the night when you have the running duty, be sure the personnel on watch know where you can be found. As a coxswain, you are responsible for calling your crew.

A beach guard usually is on duty at fleet landings during liberty hours. When boats are waiting to make the landing, you must lie to until called. Make your landing quickly, repeat your orders to the beach guard, embark or disembark your passengers, and wait for orders to shove off. When there isn't a beach guard present, custom and common courtesy require that you wait your turn before going alongside. Defer to boats carrying officers senior to those in your boat. When your orders are to wait for a certain period or person and if space is at a premium, lie off while waiting.

Remember that among other things, a ship may be judged by its boats and the appearance and conduct of the boat crews. An untidy or disorderly crew in a dirty boat reflects discredit to its vessel, whereas smart crews in clean boats create good impressions. Even more important to you as an individual is the fact that you will come under the eye of most of the ship's officers, and the impression you make in your boat will definitely be remembered when recommendations for advancement in rating are being considered.

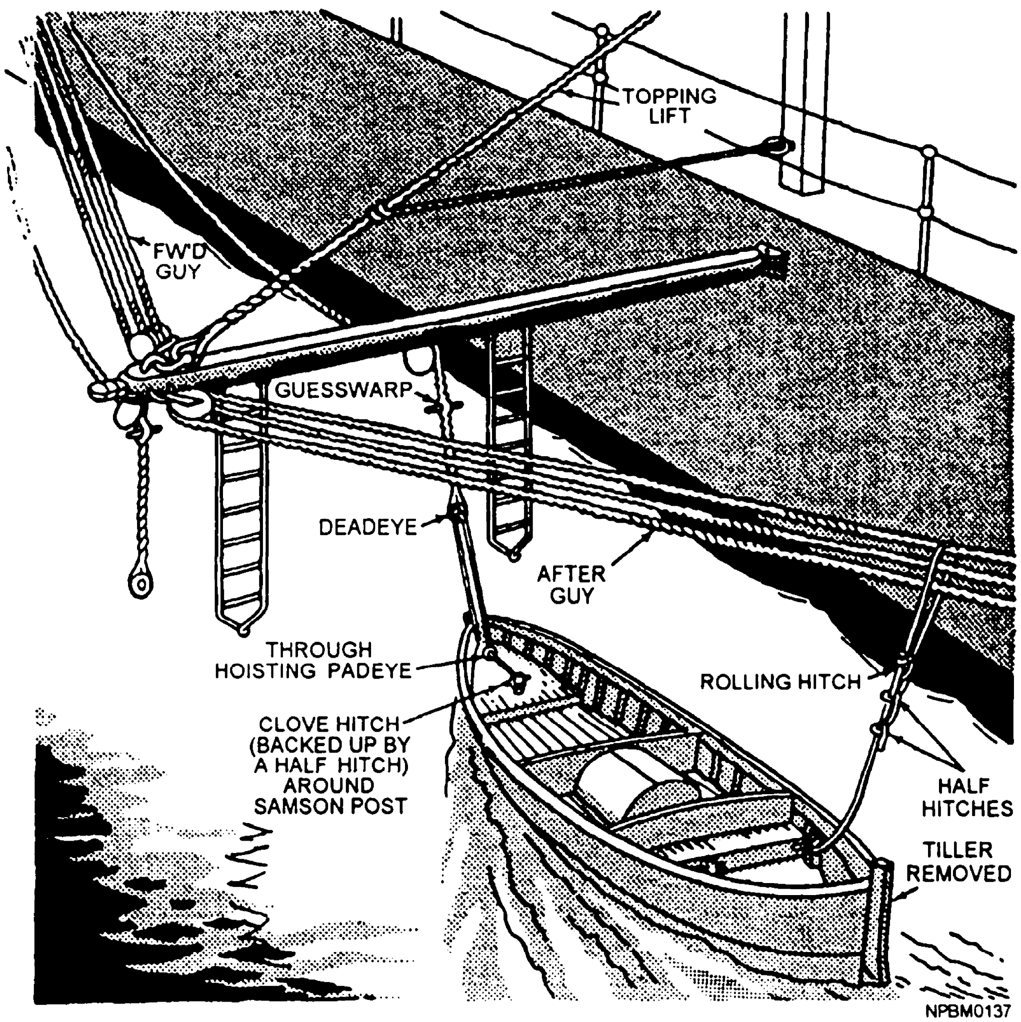


Figure 6-1.—Securing a boat to a boom.

As the coxswain of a boat, you are responsible for the conduct of all passengers. You must ensure that they are seated properly and that they remain so, that they keep their hands and arms off the gunwales, and that they observe boat etiquette at all times. As coxswain, you must enforce the no-smoking regulation, and assign one member of the boat crew to act as a bow lookout.

In addition, you must require the boat crews and passengers to wear life jackets when weather or sea conditions are hazardous. In the past, when Navy boats swamped (although the boats usually did not sink), many lives were lost. This generally was caused by the "powerful" swimmers leaving the boat and then not being found before they drowned. In the event of a swamped boat, insist that all hands remain with the boat lest individuals who separate themselves from the group become lost. Even if the boat sinks, encourage everybody to remain in a group, where the strong assist the weak. Remember: Emphasize to your people, it is much easier for rescue boats to find one large group than two or three dozen individuals scattered about. When you can get your anchor line or any other line from the boat before the boat sinks, tie the ends of the line together and have everyone secure to it with the belts of their life jackets. If the boat does not sink, try to anchor the boat to keep it from drifting out of the traffic lanes.

A COXSWAIN'S AUTHORITY

Along with your many responsibilities as a boat coxswain, you have considerable authority. Subject to the orders of the officer of the deck and the senior line officer embarked, you as the coxswain, have full charge of the boat and its crew. Your passengers, regardless of rating, also must obey your orders when they concern the operation of the boat or the safety and welfare of personnel aboard. You, as the coxswain, have the authority to quell any disturbance, and if unable to do so, can request assistance from the senior officer or petty officer embarked. Any disturbance or unusual occurrence should be reported to the OOD immediately upon return to the ship.

BOAT OFFICER

During heavy weather and any other time deemed necessary, an officer (or chief petty officer, in some instances) is assigned to each duty boat. A boat officer naturally has authority over you, as coxswain. The boat officer, however, does not assume your responsibilities or relieve you of your normal duties. The situation is somewhat like the relationship between the officer of the deck and the commanding officer on the bridge. You, as well as the boat officer, are responsible for the boat and for the safety and welfare of the crew and any passengers. Furthermore, you still are the coxswain and are expected to act as the coxswain. The boat officer may, however, choose to relieve you.

The senior line officer embarked (eligible for command at sea) assumes ultimate responsibility for the boat. The boat officer is responsible for informing such officer of the situation.

BOAT ETIQUETTE

A key essential for a smart crew is proper, seamanlike conduct. Here are a few rules of boat etiquette, established by custom and regulations, that can serve as your guide to proper conduct when in boats. Observe the rules closely, and insist that others in your boat do likewise.

- When there is no officer, petty officer, or acting petty officer in a boat lying at a landing, gangway, or boom, the personnel seated in the boat rise and salute all officers passing near. When an officer or petty officer or acting petty officer is in charge, that person alone renders the salute.

- Unless the safety of the boat would be imperiled, the coxswain in charge of the boat will stand and salute when officers enter or leave their boats.

- When boats with embarked officers or officials in view pass each other, the coxswain and the senior officer embarked should render hand salutes. The coxswain of the junior boat should idle the engine during the salute. After the officer returns the salute, resume speed. Unless it is dangerous or impractical to do so, coxswains must rise while saluting.

- When a powerboat salutes another boat in passing, crew members outside the canopy stand at attention, facing the other boat.

- When a powerboat is carrying an officer or official for whom a salute is being fired, slow the engines and disengage the clutches on the first gun, and head the boat parallel to the saluting ship. During the salute, only the person being honored rises and salutes.

- Enlisted personnel who are passengers in the stern sheets of a boat always rise and salute when a commissioned officer enters or leaves.

- Boat keepers and all other personnel in boats not under way and not carrying an officer, a petty officer, or an acting petty officer in charge, stand and salute when an officer comes alongside, leaves the side, or passes near them. They should remain standing until the boat passes or reaches the ship's side.
- Personnel working on the ship's side or aboard a boat do not salute unless ATTENTION is sounded.
- Salutes aboard powerboats should be extended to foreign military and naval officers.
- During morning or evening colors, you should stop powerboats. As the coxswain, stand at attention and salute. Have all others sit at attention.
- No junior should overhaul and pass a senior without permission. The junior always salutes first, and the salute is returned by the senior. When a doubt exists about the rank of an officer in a boat, it is better to salute than risk neglecting to salute an officer entitled to that courtesy.
- Subject to the requirements of the rules for preventing collisions, junior boats must avoid crowding or embarrassing senior boats. At landings and gangways, juniors should give way to seniors. Juniors should show deference to their seniors at all times by refraining from crossing the bows of their boats or ignoring their presence.
- Junior personnel precede senior personnel into a boat, and they leave after the senior personnel unless the senior officer in the boat gives orders to the contrary. As a general rule, seats farthest aft are reserved for senior officers. In motor launches and motor whaleboats with no officers embarked, the stem sheets are reserved for chief petty officers.
- Officers seated in boats do not rise in rendering salutes except when a senior officer enters or leaves the boat.
- The position of attention in a boat is sitting erect.
- Enlisted personnel who are passengers in running boats with an officer on board maintain silence under ordinary circumstances.
- Boats transporting senior officers to a landing should be given first opportunity to land.
- Except when excused by proper authority, boats should stand clear of shore landings and the ship's gangways while waiting, and the crews should not leave their boats. When a long wait is probable during bad weather or at night, you may request permission to make fast to a boom and to come aboard.
- When a visiting party is alongside, the petty officer in charge should go aboard and obtain permission before allowing any of the visiting party to leave the boat.

The display of the national ensign, personal flags and pennants, bow insignias, hails and replies, and boat calls are covered in NTP 13 (B) *FLAGS, PENNANTS, AND CUSTOMS,* and will not be repeated here.

FORCES AFFECTING A BOAT

LEARNING OBJECTIVES: Understand the forces that effect a boat under way and explain how they react on the boat's motion.

Before you attempt to handle a boat, you should understand the forces that affect a boat under various conditions. A coxswain who thoroughly understands these forces can use them to maneuver the boat, and, as the coxswain, you would not be required to fall back on an often painful trial-and-error method of learning boat handling. The following discussion concerning single-screw boats pertains to boats having right-hand propellers.

FORCE FACTORS

For all practical purposes, you cannot compress water. Force applied to water creates a high pressure, and water flows to a low-pressure area, producing a force known as DYNAMIC PRESSURE.

High- and low-pressure areas in a ship or boat are created by the propeller and the rudder. As the propeller revolves to go forward, the shape and the pitch of each blade develops a thrust derived from a low-pressure area on the forward face of the blades and a high-pressure area on the after face of the blades. The force set up by this displacement of water is transmitted along the propeller shaft to thrust the boat ahead as the boat moves in the direction toward the low-pressure area. This force is PROPELLER THRUST.

The rudder exerts its force in a somewhat similar manner. When the rudder on a moving boat is set at an angle to the centerline of the craft, a high-pressure area forms on the leading surface. As a result of the difference in areas, the water exerts a force against the leading surface of the rudder, which, in turn, forces the stern in the direction opposite that to which the rudder is set. This is called RUDDER FORCE.

Side Force

In maneuvering a single-screw boat, side force ranks next in importance to propeller thrust. Side force is defined as a force that moves (walks) the stern of the boat in the direction of the propeller's rotation. Naturally, the upper blades exert a force opposite to that of the lower blades. But the lower blades are moving in greater water pressure; consequently, the force of the lower blades is greater. While going ahead, the stem tends to starboard; while backing, the stern walks to port. (See fig. 6-2.)

Frictional Wake Current

A vessel moving through water drags some of the water along because of friction between the skin of the ship and the water. This is called frictional wake current. Frictional wake current at the waterline is zero at the bow, increasing to maximum at the stern. It also is maximum at the waterline and decreases with depth toward the keel. It decreases the efficiency of both the propeller and the rudder and also diminishes the effect of side force. The degree of frictional wake increases proportionately to the boat's speed and is greatest in shallow water. Thus, the higher the speed, the less the effect of side force. To counteract the effect of skin friction, the underwater hulls of ships and boats are streamlined.

Screw Current

Screw current, caused by the action of a rotating propeller, consists of two parts: the portion flowing into the propeller is the SUCTION CURRENT and the portion flowing away from the propeller is the DISCHARGE CURRENT. Suction current is a relatively minor force in boat handling. Discharge current, however, is a major force in two main respects.

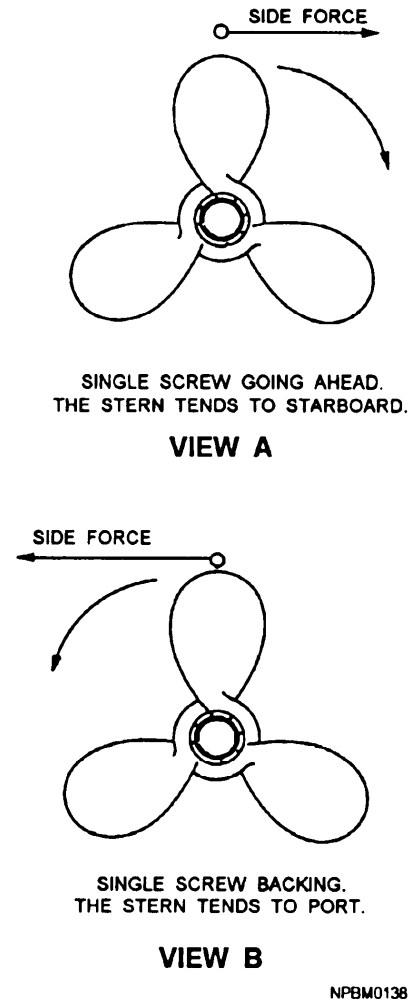


Figure 6-2.—Effects of side force.

It is a strong force acting on the rudder with the screw going ahead. Because of the part of the discharge current that acts against the boat's counter, it is a strong component of side force when the screw is backing.

TYPICAL SITUATIONS

LEARNING OBJECTIVES: Explain the force factors described in typical boat handling situations; rudder action, screen currents, and direction of the boat. Describe the effects of a small boat going astern and forward.

Now, let us examine the effect of the forces just described in a few typical situations. We will assume there is no wind, tide, or current, except in certain instances where it is so stated.

Boat and Screw Going Ahead

When a boat is dead in the water, with the right rudder, on and the screw starts turning over, the screw current hits the rudder and forces the stern to port. With left rudder on, the stem moves to starboard. As the boat gathers way, the effect of the screw current diminishes, and the normal steering effect of the rudder controls the boat's head.

When the boat is proceeding ahead in the normal manner and the rudder is put right, the boat first falls off to port. When the rudder is put left, the boat goes to starboard. The entire boat is thrown slightly to the side, but the stem gives way to a greater extent. The boat advances two or three boat lengths along the line of the original course before it commences to gain ground in the desired direction. At higher speeds, advance is slightly less than at lower speeds, and turns are executed more quickly. Because of advance, trying to execute a turn to avoid an obstacle only a short distance ahead can result in disaster.

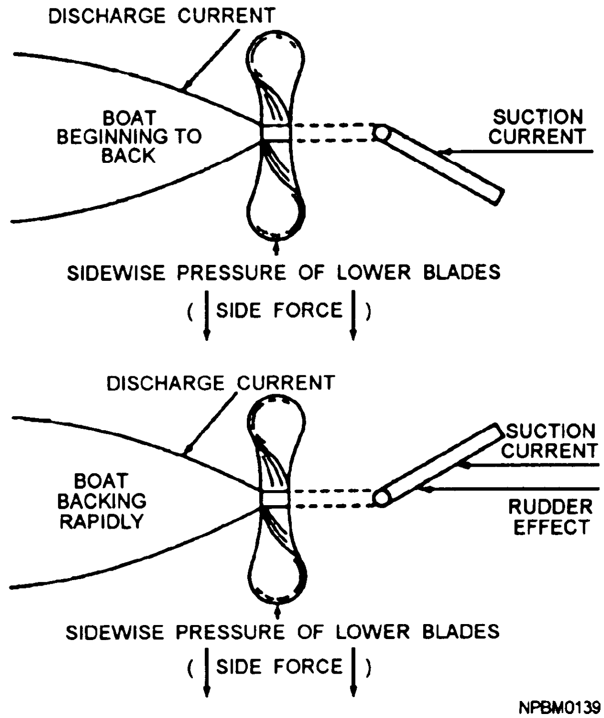


Figure 6-3.—Boat and screw backing.

Boat and Screw Backing

When you are backing down, four distinct forces are involved in steering. They are discharge current, side force, suction current, and rudder effect. The combination of these forces is such that it is almost impossible to back in a straight line.

Discharge current (from the propeller) and side force tend to throw the stem to port. (See fig. 6-3.) The relatively weak suction current acts to throw the boat to the side on which the rudder is, but suction current is negligible at slow speeds, as is rudder effect. But with the rudder on, as the boat gathers sternway, the water through which the boat is moving acts on the rudder and augments (increases) the effect of screw current (fig. 6-3). This usually slows, but does not necessarily stop, the stem's swing to port. When backing long distances, you will find it is necessary to occasionally reverse the rotation of the screw and shift the rudder long enough to straighten out the boat.

Strong winds affect backing ships and boats. Ships with high superstructures forward, as well as many boats, will back into strong winds. Until you discover differently, however, assume that a boat will back to port.

Boat Going Ahead, Screw Backing

A boat going ahead with the screw backing is an important illustrative case, for it is the usual condition when danger is discovered close aboard. You might assume that the rudder would have its usual effect in such a situation, BUT THIS IS NOT TRUE. As soon as the propeller starts backing, the forces discussed earlier combine and begin to cancel rudder effect.

When the rudder is left amidships, the head falls off to starboard, and the boat gains ground to the right as it loses way. This is because both side force and discharge current force the stern to port.

When the rudder is put hard right at the instant the screw starts to back, the boat changes course to starboard. The stem continues to swing to port unless, as the boat gathers sternway, the rudder effect is great enough to take charge.

When the rudder is put hard left at the instant the propeller backs, the boat's head goes to port at first, and as the speed decreases, the head usually falls off to starboard. Some boats and ships, however, back stem to starboard for a while if there was a distinct change in course to port before the screw started backing.

Boat Going Astern, Screw Ahead

With the boat going astern, the screw going ahead, and the rudder amidships, side force and screw current are the strongest forces. They oppose each other; hence, the resultant effect is difficult to determine. You must try it on your boat to obtain the answer. When the rudder is put hard right, the discharge current greatly exceeds the side force and the normal steering effect of the rudder, and the stem swings rapidly to port. Throwing the rudder hard left causes the stem to fall off to starboard.

MANEUVERING A BOAT

LEARNING OBJECTIVES: Describe the theory of boat handling, including making landings and getting under way from piers, using force factors, lines, and currents. Explain how to moor and get under way from piers, and floating docks.

Many books on boat handling tell the beginner to make a landing, heading into the wind, if possible, or to make it on the side of the pier where wind or current will set the boat down on the pier. This is good advice, but any sailor knows that a boat coxswain has few chances to select landings. Consequently, the coxswain must learn the effects of the elements on the boat and to control the boat under any condition. The coxswain will be able then to get under way or make a landing when and where directed, in a smart, seamanlike manner. With experience, the coxswain will be able to weigh circumstances and handle the boat correctly in an almost second-nature manner.

The pointers that follow, plus a firm understanding of the preceding section, will assist you in learning the intricacies of boat handling. You, as coxswain, should remember though, that boats do not always respond exactly as theory predicts and that there is no substitute for actual experience.

Throughout this section, we assume that the boat handler (coxswain) knows how far the boat, going at various speeds, will travel before a reversing screw stops the boat or changes its direction. We also assume that the boat handler knows how far the boat will fetch (glide) with the screw in neutral.

MAKING A LANDING WITH A SINGLE-SCREW BOAT

Making a landing usually involves backing down. For this reason, procedures for landing port-side-to differ from those for a starboard-side-to landing. Let us first consider a port-side-to landing.

Port-Side-To Landing

Making a port-side-to landing is easier than making a starboard-side-to landing, because of the factors discussed already. With no wind, tide, or current with which to contend, you should make the approach normally at an angle of about 20° with the pier. You should have the boat headed for a spot slightly forward of the position where you intend to stop. Several feet from that point (to allow for advance), put your rudder to starboard to bring your boat parallel to the pier, and simultaneously commence backing. Quickly throw the bow line over. Then with the bow line around a cleat to hold the bow in, you can back down until the stern is forced in against the pier.

When the wind and current are setting the boat off the pier, make the approach at a greater angle and speed. Make the turn closer to the pier. In this situation, you can get the stern alongside easier by using hard right rudder, kicking ahead, and using the bow line as a spring line, as in figure 6-4. To allow the stern to swing in to the pier, you must not snub the bow line too short.

When wind or current is setting the boat down on the pier, make the approach at about the same angle as when you are being set off the pier. Speed should be about the same or slightly less than when there is no

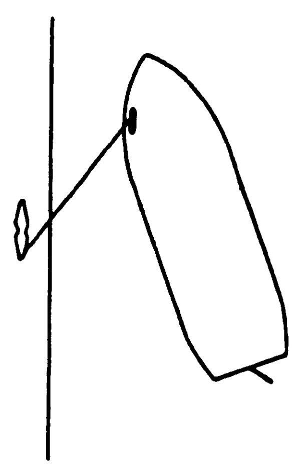


Figure 6-4.—Making a port-side-to landing, using a spring.

wind or current. Commence the turn farther from the pier because the advance is greater. In this circumstance, you should bring the stern alongside by either of the methods described, or the centerline of the boat can be brought parallel to the pier and the boat will drift down alongside.

Starboard-Side-To Landing

Making a starboard-side-to landing is a bit more difficult than making a landing to port. The angle of approach should always approximate that of a port-side-to landing. Speed, however, should be slower to avoid having to back down fast to kill headway, with the resultant swing of the stem to port. A spring line should be used when you are working the stem in alongside the pier. Get the line over, use hard left rudder, and kick ahead.

When you cannot use a spring line (as when you are making a gangway), time your turn so that, when alongside the spot where you intend to swing, your bow is swinging out and your stem is swinging in. When it looks as though the stem will make contact, back down; as you lose way, shift to hard right rudder.

Making Use of the Current

When there is a strong current from ahead, get the bow line to the pier, and the current will bring the boat alongside as in view A of figure 6-5.

When the current is from aft, you can achieve the same result by securing the boat with the stem fast, as shown in view B, fig. 6-5. You should exercise care during the approach, because a following current decreases rudder efficiency and steering may be slightly erratic.

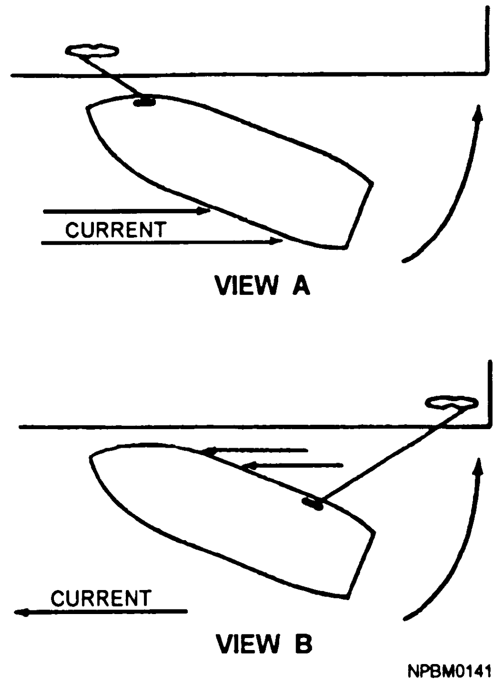


Figure 6-5.—Making use of the current.

GETTING UNDER WAY FROM A PIER

When you are coming alongside, procedures for getting under way depend upon which side of the pier the boat is located, as well as the state of current, wind, and so on.

Starboard-Side-To

The easiest way to get under way when you are starboard-side-to a pier is to cast off the stem fast, hold the bow line, give the boat hard left rudder, and commence backing. When the stern is clear of the pier and there is no boat or other object astern, cast off the bow line and back out of the slip. When a wind or current is coming from astern or the slip is long, you will do better to turn in the slip (room permitting) as shown in figure 6-6.

Port-Side-To

The easiest way to clear a port-side-to landing is to use the bow line as a spring line. Cast off the stem fast, give the boat left full rudder, and kick ahead until the

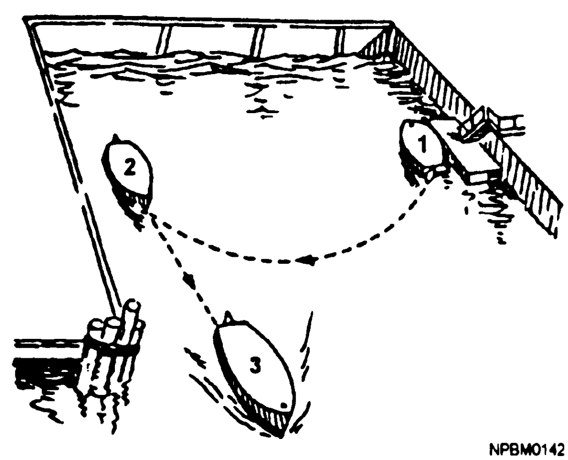


Figure 6-6.—Turning in a slip.

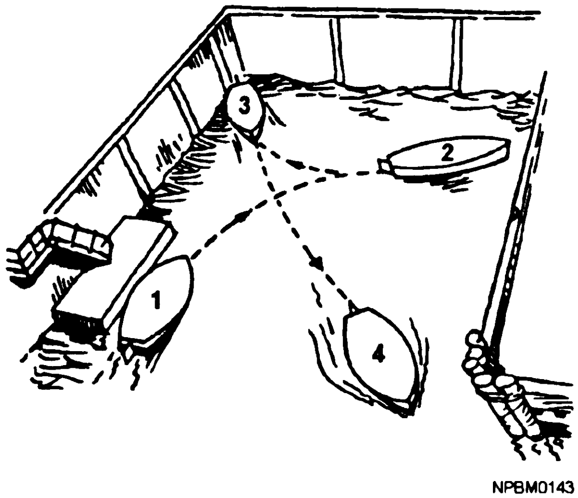


Figure 6-7.—Another way of turning in a slip.

stem is well clear. Then cast off the spring line and back out of the slip. You can use another method of clearing the pier by following the maneuvers in figure 6-7.

TWIN-PROPELLER BOATS

On twin-propeller boats, the starboard screw is right-handed and the port screw is left-handed. The lateral (sidewise) forces produced by one screw cancel those of the other when both are going ahead or astern. When one screw is going ahead and the other is going astern, however, the forces complement each other and the effect is doubled. For this reason, you will find that maneuvering a twin-screw boat is considerably simpler than maneuvering a single-screw boat. You need not worry about the separate forces or their combined effect; think of it as a lever with a force (screw) at each end and the load (boat) in the middle. Thus, you readily can see how quickly a particular maneuver may be accomplished by using the correct propeller combinations along with the appropriate rudder angle. For example, to turn your boat 180° to starboard for a dead stop, use right full rudder, port engine ahead, and starboard engine astern. Your boat will make the turn in little more than its own length, whereas if in a single-screw boat you would require considerably more space to complete the same turn.

You will also find it much easier to get into a short berth or other confined spaces with a twin-propeller boat. Consider the situation shown in figure 6-8. How would you maneuver the LCM into the space at the pier? You should put over your bow line, throw your rudders right full, back the starboard engine, and kick the port engine ahead. Adjust your throttles, as necessary, to

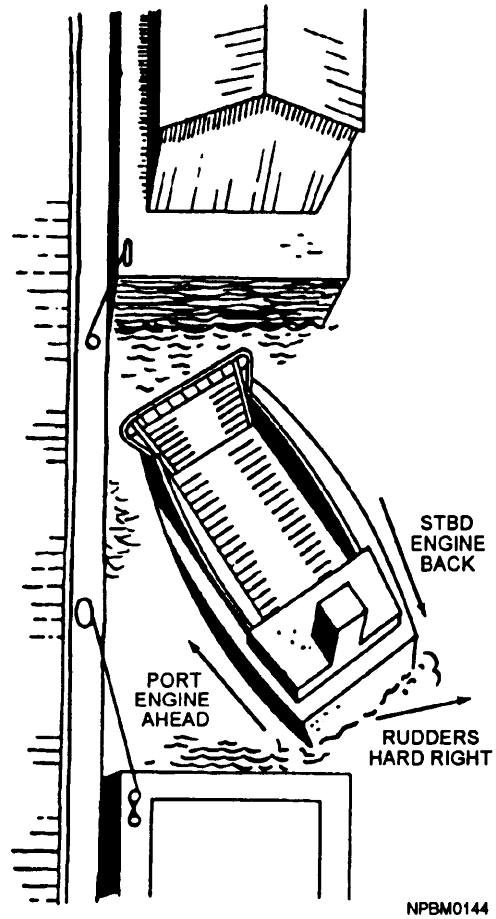


Figure 6-8.—Maneuvering a twin-propeller boat into a short berth.

keep from gaining headway or sternway. The stern will walk right into the pier. To get out, put on left rudder, back your port engine, and put the starboard engine ahead. When the stern of the LCM clears the ship astern, back both engines and use the rudders and throttles to keep a steady course.

Almost all the maneuvers required of a boat can be accomplished by varying the direction and speed of the engines and by not using the rudders. As an experienced coxswain, you can also maintain a fair course by varying the number of turns of the propellers.

BEACHING AND RETRACTING BOATS

LEARNING OBJECTIVES: Explain the difference between beaching and retracting boats from the beach. Describe how to beach a small boat and retract from the beach.

To understand this section, you must know the definitions of the terms used, and you should know a little about what causes a surf. The terms and their definition are as follows:

- Breaker: A wave that breaks into foam.
- Breaker line: The outer limit of the breaker area; also called the surf line.
- Comber: A long curling wave of the sea.
- Crest: The top of a wave, breaker, or swell.
- Foam crest: The top of the foaming water that speeds toward the beach after the wave breaks.
- Surf: The waves of the sea as they break upon a reef or shore.
- Surf zone: The area between the first break in the swells and the shoreline.
- Swell: A broad, rolling movement of the surface of the water that continuously moves without breaking.
- Trough: The valley between waves.

Surf is caused by the swells as they move in toward the beach. As this movement approaches shore, it is confined between the rising ocean floor and the surface of the water. The more confined the water becomes, the more the crests peak up in the form of combers. (See fig. 6-9.) Combers usually, but not always, form into breakers.

Sometimes two or more less-well-defined surf belts are caused by a sandbar or reef between the outer surf (or breaker) line and the beach.

Breakers vary in size and sometimes may follow a sequence for a short interval—a large breaker following a certain number of smaller ones. There is no regularity to the pattern, so do not count on, for example, every seventh breaker being larger than the six preceding it. The sea just does not work that way. The interval between breakers is fairly constant, tending to stay the same for several hours.

Swells causing surf are created by winds far out to sea, and the interval between swells is determined by the distance the swells travel from their origin, which may be several hundred miles.

The important points for you to remember about surf are the following:

- Do not be lulled into expecting the surf to be consistent.
- Respect the surf.

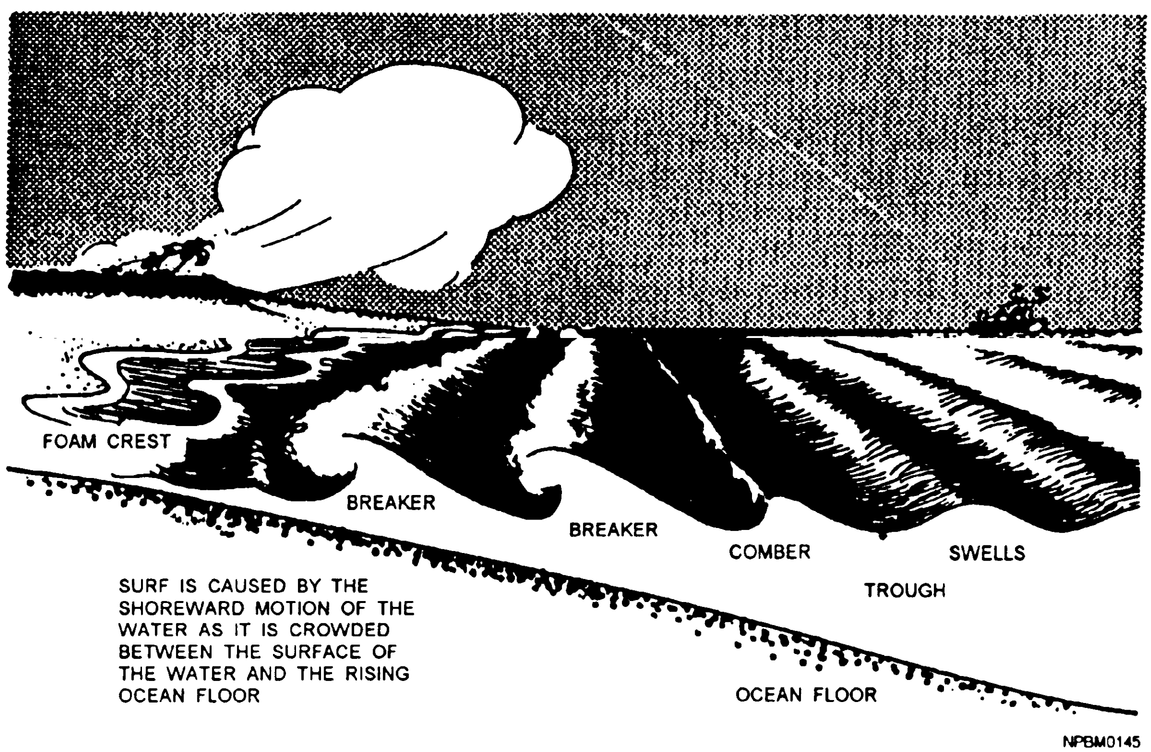


Figure 6-9.—Cross-sectional view of surf.

- Learn how to make the surf work for you while beaching and retracting.

BEACHING

The greatest danger in beaching a boat is that it may broach. Broaching is caused by the surf hitting the boat on a side or quarter, resulting in the boat being thrown broadside onto the beach. ‘This is a dangerous situation, for the boat takes a severe pounding from the waves and may fill with water or even capsize. A boat can also broach in a surf when it isn't near the beach. Usually, this is caused by the stern being raised higher than the bow. The bow is driven into a relatively slow-moving mass of water while the stern comes hurtling on. The inevitable result is that the boat goes stem over bow, casting all hands into the sea. If you carry out the following instructions and are alert, you should be able to beach a boat in a moderate surf without broaching.

Because the majority of beaching occurs during, or in training for, amphibious operations, most of our remarks concern LCMs, which are the boats used in the greatest numbers for these operations.

Beaching an LCM

Because of the twin propellers, it is easier to prevent an M-boat from broaching. The coxswain merely has to speed or retard one or the other of the engines to keep the boat stem to the seas. Antibroaching lines, however, are less effective because of the much greater weight. Consequently, an LCM coxswain should not depend on them.

A partially broached M-boat often can be freed under its own power. For example, if the stem lies to port, throw the rudder hard left, gun the port engine in reverse, and kick the starboard engine ahead.

Before entering the surf zone, line up your boat with the spot where you intend to beach. You should not change your course inside the breaker line. Estimate the rate at which the waves are rolling in, and adjust your speed to ride in just behind the crest of a breaker or comber, as shown in figure 6-10. Keep your boat at an angle of 90° to the surf. The surf normally goes in parallel to the beach, but the boat's angle in relation to the surf—not the beach—is the important consideration.

If you should ground before arriving at the beach, do not assume that the water is shallow the rest of the way in and drop your ramp. Chances are that your boat is on a sandbar, and the water from the bar to the beach may be several feet deep. Keep your screw turning ahead slowly until a wave lifts the boat, then gun your engine. If this does not get the boat over, cut your engine, wait for the boat to be lifted again, and once more gun your engine. Repeat this procedure until your boat is over the sandbar and then proceed to the beach.

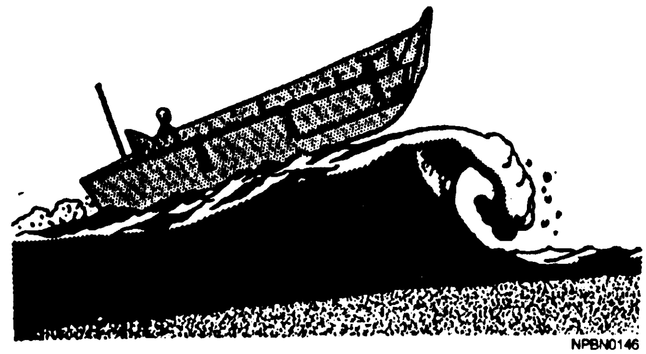


Figure 6-10.—Riding a breaker to the beach.

Your boat should hit the beach at a good speed so that the entire keel grounds. Keep the engine turning over at 1,200 rpm to hold the boat securely on the beach. Idle down when the water recedes, to avoid letting the screw race wildly in the shallow water.

Antibroaching lines may help to prevent a boat from broaching. The use of lines is shown in figure 6-11.

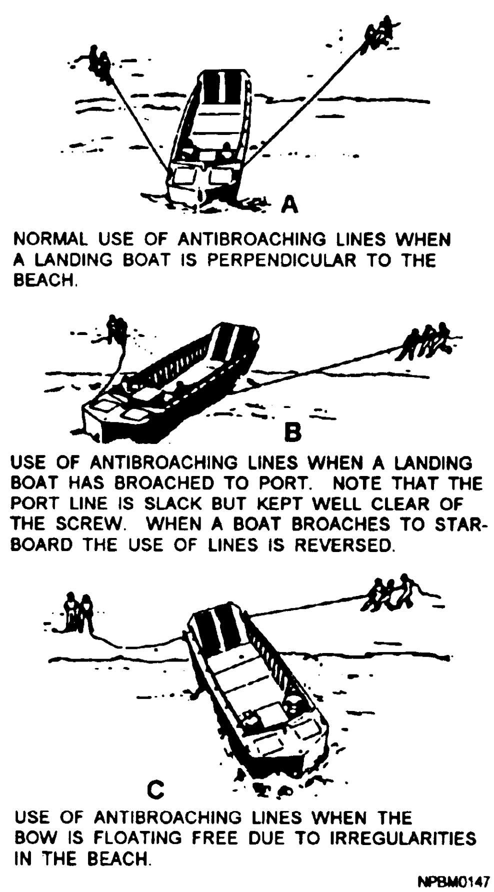


Figure 6-11.—Use of antibroaching lines.

Should the boat engine fail before beaching, wait until the boat is well within the length of your anchor line from the beach (less than 25 fathoms), then drop the anchor, pay out the line, and let the boat surge to the beach with each breaker. If you consider it unsafe to beach in this manner because of high surf, anchor your boat and wait for the salvage boat. A salvage boat is a specially equipped boat used to keep the landing beaches clear, hauling off broached and disabled craft.

To prevent your boat from broaching after hitting the beach, (in addition to using antibroaching lines) keep breaking seas dead astern, drive well up on the beach, and gun your engine when waves lift the boat. Line up your bow with some object on the beach, then you will be able to tell if the angle of the boat changes. If the stern falls off, throw your rudder in that direction and accelerate the engine. If the bow starts to swing, put your rudder to the opposite side, and drive higher onto the beach.

Sometimes it is possible to free a broached boat without outside help. Put the rudder toward the beach, and when a wave lifts the boat, gun the engine. Discharge current tends to force the stern away from the shore.

The coxswain of the boat that may be broached and hard aground should not hesitate to call for assistance from the salvage boat. Prompt action by the salvage crew reduces the time the sea has to pound the boat against the shore.

RETRACTING

Retracting is the most difficult part of the landing operation, and it is during this time that an unskilled coxswain is most likely to allow the boat to broach. As a coxswain, you can get away from the shore safely and successfully if you observe the following procedures:

1. Set the rudder amidships before you attempt to retract.

2. Line up the bow with an object on the beach, so that you instantly will notice any swing of the boat and can correct it before it is too late.

3. Shift the engine into reverse. Wait for a wave to float the boat, then gun the engine. Usually, the boat will back a short distance.

4. When the wave recedes, slow the engine to restrain the screw from racing needlessly when it loses its bite. Slowing the engine also prevents the rudder and sked from digging into the sand.

5. If your bow begins to fall off, turn the rudder in the direction of the swing. This should bring the bow back, but ease your rudder soon enough so that you do not overcorrect.

6. Once the boat is floating free, keep backing (stern to the sea), taking each breaker with caution until the boat is outside the breaker line.

7. Finally, on the crest of a wave, throw your rudder hard over, shift into forward, and gun the engine. This action causes the boat to pivot quickly to meet the next wave bow on.

> **NOTE**
>
> **Promptly call for the salvage crew if you are unable to get off the beach.**

BEACHING OTHER BOATS

In addition to boats designed specifically for beaching, sometimes it becomes necessary to beach other boats. If this happens, you should apply the following suggestions:

You should lie to the outside of the breaker line and ponder the situation. Select your landing spot with care, studying the shoreline and the reefs and rocks offshore. They may provide a clue to the location of a lee where you can land with the least danger. Such a study also may forestall your being surprised by a barely noticeable sandbar or reef that could make it necessary to change course on your way to the beach.

You should handle any boat in a manner similar to that used for LCMs, and make a bow-first run to the beach. In high surf, however, use a sea anchor (drogue) or a surf line when it is advantageous.

Sea Anchor

A sea anchor, or drogue, is a cone-shaped affair made of canvas, open at one or both ends. (See fig. 6-12.) It is equipped with a towline secured at the large

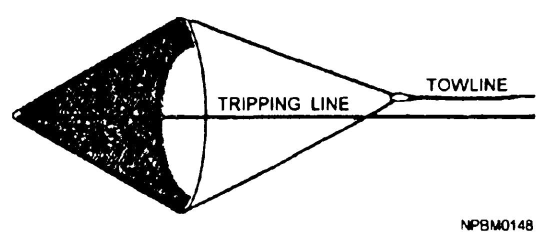


Figure 6-12.—Sea anchor or drogue.

end and a tripping line at the small end. The tripping line is attached in such a way that securing it and slacking off the towline causes the sea anchor to invert and lose its drag.

A sea anchor towed 20 to 30 fathoms behind a boat under either power or oars serves to keep the stern or bow, as appropriate, into the surf. When a large breaker approaches, the tripping line is slacked off, and the sea anchor fills and drags. After the breaker passes, the tripping line is secured and the towline is slacked. In this way the drogue does not impede the desired progress toward the beach, but definitely assists in preventing the boat from broaching.

Surf Line

When the surf zone is not too wide, it is sometimes possible to drop an anchor outside the breaker line and pay out a surf line (100 to 150 fathoms) around the samson post or a towing bit over the bow or stern. By snubbing the line at the approach of large breakers and slacking after they pass, you can ease a boat to the beach, often without using any power.

LIFEBOATS AND SIGNALS

JCS Pub 2, Unified Action Armed Forces requires that a ship at sea have at least one boat rigged and ready for lowering to be used as a lifeboat. The ship's boat bill specifies the exact condition of the lifeboat and the items of equipment that must be in the boat.

At the beginning of each watch, the lifeboat coxswain musters the crew, checks the boat and gear, has the engine tested, and reports to the officer of the deck. The crew of the lifeboat will consist of the following personnel:

- Boat officer with binoculars and rifle
- Coxswain
- Engineer
- Signalman
- Bow hook (must be SAR qualified)
- Rescue swimmer (must be SAR qualified)

In addition to the rescue swimmer's qualification, the bow hook must be rescue swimmer qualified also. All other personnel in the boat must be at least second-class swimmers.

The maximum number of personnel authorized luring hoisting or lowering is seven.

NOTE

In an emergency situation, where human life is in jeopardy, the number of personnel authorized during hoisting (seven persons) can be increased to save the lives of the survivors. All personnel should be debarked at the rail or the lowest weather deck with the exception of the boat crew personnel required for hoisting in the boat.

The lowering of boats while under way is described in chapter 5, so the topic is not discussed here. However, if you stand BM watches or if you are coxswain of a lifeboat, make certain that you know the procedure for lowering lifeboats on your ship.

If a person goes overboard and it is necessary to use a boat for recovery, you must know the recovery procedures. Quick recovery is particularly important in cold water in which a person can live only a few minutes. Time must not be lost; the person may be dying.

Once in the water, you probably will be directed to the victim, but the victim's position relative to the ship undoubtedly will change before you get there. For these reasons, a simple system of signals has been adopted to direct the boat to the individual. Although there will be a Signalman and an officer in the boat, you, too, must know these signals.

By day, the signals are flags hoisted where seen best; at night, the signals are given by flashing light or pyrotechnics. Figure 6-13 shows the flaghoist, flashing light, and pyrotechnic signals and their meanings. At night, pyrotechnics fired by the Mk 5 pyrotechnic pistol may also be used to direct the boat.

You should approach a person in the water from downwind, so that the boat is not blown on him/her. Make the last part of the approach with the engine stopped, and attempt to make the recovery at the bow. If possible, try to avoid having the screw turning over in the vicinity of the person.

If you are picking up survivors from a plane crash or ship disaster and they are in lifeboats, beware of the approach you make so that you do not foul your screw in a lifeboat's sea anchor.

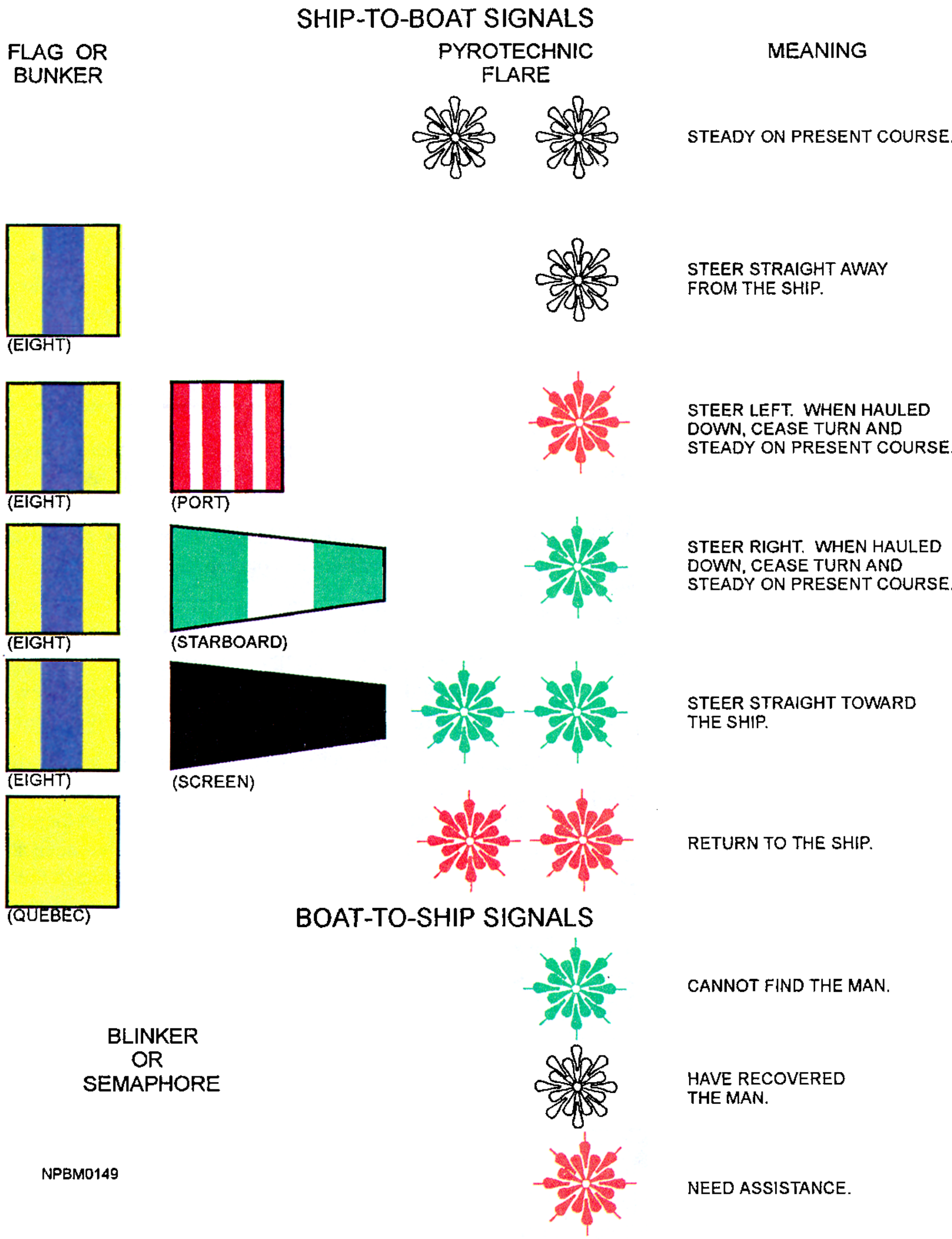


Figure 6-13.—Man overboard/pilot rescue signals.

COMPASSES AND CHARTS

LEARNING OBJECTIVES: Use compasses and navigational charts. Know how to read a compass and compensate for errors. Explain the information contained on a navigational chart.

Both the magnetic compass and the gyroscopic compass were explained in the Seaman rate training manual and are not discussed here. The rest of this chapter, however, takes up many things that you must know concerning the use of a compass.

A boat must never leave the ship without a compass. You never know when fog will set in or a sudden rain squall will blot out objects that were in clear view a few minutes earlier. You may think that you can steer a reasonably straight course under such conditions even without a compass, but it is impossible. Many coxswains who have become lost will bear witness to this fact.

Trust your compass. At times you may swear something has gone wrong with it, but that is your imagination not a faulty compass. Do not try to make your way from ship to ship by listening to the ships' bells. The sound in a fog is deceptive, seeming to come from anywhere or everywhere at once. However, if you should become lost, the best thing you can do is listen for bells and try to find the nearest ship. Upon finding a ship, either request permission to stay there until the fog lifts or ask the OOD to determine a course to your ship. Never leave your ship without learning which berth the ship is in. If you should decide to remain at the ship, ask the officer of the deck to inform the OOD about your ship and your whereabouts.

Handle your compass with care so that you may rely on it in time of need.

COMPASS ERROR

Two forces make up compass error. They are variation and deviation.

Actually, Earth is a huge magnet, and magnetic north is over a thousand miles from the geographic North Pole. And, as you know, a magnetic compass points to magnetic north instead of to the true geographic pole. The amount the compass is offset from the true pole is called variation. Variation differs at various points on Earth's surface, and at many points increases or decreases by a certain known, annual rate.

Variation

Variation for any given locality, together with the amount of annual increase or decrease, is shown on the compass rose of the chart for that particular locality. This is true of large-scale charts, where the variation is constant throughout the area. On small-scale charts of large areas, however, variation is shown by lines (isogonic lines) running through points with the same amount of variation. Along each line or every fifth line, variation is printed, and rates of annual changes are shown between the lines.

Figure 6-14 shows a compass rose that indicates that in 1957 there was a 26°45' easterly variation in that area, increasing 11' annually. The total amount of variation is found by multiplying the number of years since the year printed in the compass rose by the rate of annual change. The result is either added to or subtracted from the variation given, depending on whether the error is increasing or decreasing. In this instance, total variation in 1980 would have been 23 years x 11' annual increase added to the variation given, or 26°45' + 4°13' = 30°58'.

Variation remains the same for any heading of a ship or boat at any given locality. No matter at direction your boat is heading, the magnetic compass, if affected by variation alone, points in the direction of the magnetic pole.

Deviation

Deviation is caused by the magnetic metallic masses in and on a ship. It is built into a ship and the ship, in effect, becomes another magnet. We do not intend to give you a detailed explanation of how this force affects a magnetic compass, but where deviation exists, it must be corrected. Although it remains a constant amount for each compass heading, it gradually increases, decreases, increases, and decreases again as the ship swings through a complete 360° circle.

Deviation must be considered in correcting compass error; consequently, the deviation for any given heading of a ship must be known. Before the ship puts to sea, it is swung through the complete circle from 0° to 360°, and the amount of the compass deviation is noted at every 15° swing. This is calculated by various methods, generally by comparison with the gyro-compass, or by reciprocal bearings on a compass on the beach, which is unaffected by the metal in the ship.

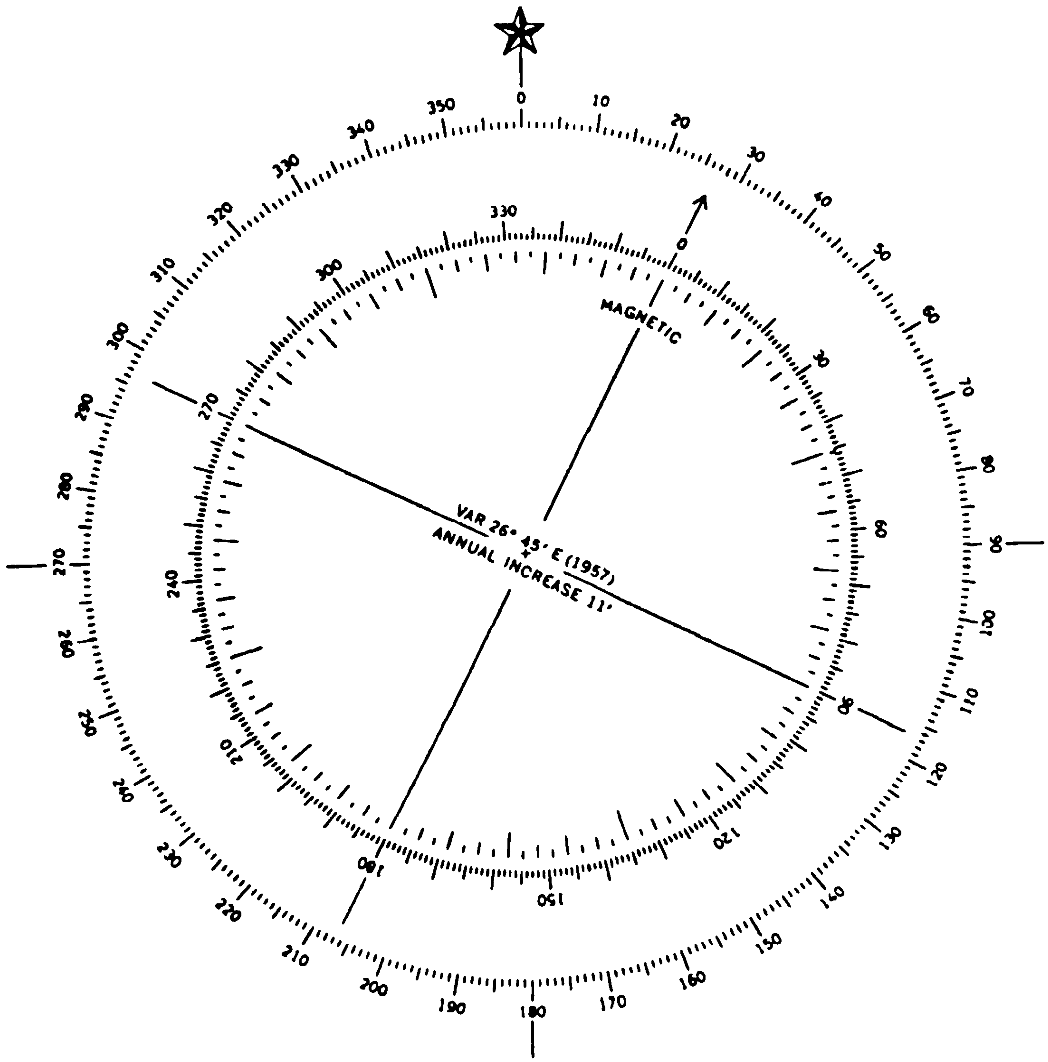


Figure 6-14.—Combination compass rose.

Table 6-1.—Typical Deviation Table

DEVIATION TABLE					
Ships Heading Magnetic	DEV.	Ships Heading Magnetic	DEV.	Ships Heading Magnetic	DEV.
000°	14°W	120°	15°E	240°	4°E
015°	10°W	135°	16°E	255°	1°W
030°	5°W	150°	12°E	270°	7°W
045°	1°W	165°	13°E	285°	12°W
060°	2°E	180°	14°E	300°	15°W
075°	5°E	195°	14°E	315°	19°W
090°	7°E	210°	12°E	330°	19°W
105°	9°E	225°	9°E	345°	17°W
				360°	14°W

The results are compiled in a table called the deviation table (table 6-1). Every 15° is considered close enough, and in using the table, you take the deviation for the heading nearest the heading you are checking. In other words, if you look in this table for the amount of deviation for a 17° heading, you would select the deviation for 15°, or 10°W. When using a boat compass, you must understand deviation to understand the next topic.

Correcting Compass Error

The course you take from a chart usually is a true course. You must convert the true course from a magnetic compass to a compass course. To convert, you must apply the compass error (variation and deviation) to the true course. Changing a true course to a compass course is called UNCORRECTING, and changing a magnetic course to true course is CORRECTING. You can remember this easily if you think of something that is TRUE as being CORRECT or already corrected. Another handy memory aid, CAN DEAD MEN VOTE TWICE, gives the key to the problem of changing from one to the other. Each word in our memory aid represents a word in our problem as follows:

CAN	COMPASS
DEAD	DEVIATION
MEN	MAGNETIC
VOTE	VARIATION
TWICE	TRUE

Variation and deviation are always given as EASTERLY or WESTERLY errors, and when you are CORRECTING (converting from compass to true), ADD easterly errors, and SUBTRACT westerly errors. When you are UNCORRECTING (converting from true to compass), SUBTRACT easterly errors, and ADD westerly errors.

Suppose the true course, taken from a chart, is 095°; variation taken from the same chart is 2° westerly; and deviation, taken from the deviation table is 3° westerly. Now work the problem. Put down the things you know as follows:

C	D	M	V	T
—	3°W	—	2°W	095°

Do not forget the W (for westerly) or E (for easterly); otherwise you will not know whether to add or subtract the error. Now, true course was given, and you want to find compass course. You are uncorrecting; therefore, you add westerly errors and subtract easterly errors. Both errors are westerly, so you add them both.

C	D	M	V	T
100°	3°W	097°	2°W	095°

Compass course is 100°.

Now, solve a problem converting compass course to true course. You have given: compass 193°, variation 7° easterly errors, and deviation 2° westerly.

This time we are correcting; therefore, add easterly and subtract westerly errors.

C	D	M	V	T
193°	2°W	191°	7°E	198°

After a little practice, you should be able to work these problems in your head. Because it is compass course or true course you are interested in, find the algebraic sum of the two errors. An algebraic sum is obtained by adding the two errors if they are in the same direction, or subtracting the smaller error from the larger error if they are in opposite directions. The total error then is added to or subtracted from whichever course is given.

In many boats, deviation is very small or nonexistent, and when this is true, merely apply variation and you have your answer. In some boats, however, the motor and the other metal objects do cause deviation. These boats must be swung, deviation tables made out, and the date used when the compass corrections were made.

NAVIGATIONAL CHARTS

Navigational charts contain a wealth of information for you, as a boat coxswain, as well as for the navigator. These navigational charts are a printed reproduction of a portion of the Earth's surface depicting water and land. A chart uses standard symbols, figures, and abbreviations to show channels, data on water depth, character of the bottom and the shore, location of navigational aids, and prominent landmarks, including rocks, reefs, sandbars, and piers.

Numbers indicating water depth are placed throughout the water area of the chart. Depths are figured at mean low water and are given on a U.S. chart either in feet or fathoms. Whether the soundings are in feet or fathoms is shown under the title of the chart. Also shown under the title are such data as the scale of the chart, the units of measurements that heights are given in, and other pertinent information peculiar to that chart. When you study a chart, these are the first items to notice.

The symbols for prominent landmarks have abbreviations next to them. The meanings are clear enough to require no definitions here. Figure 6-15 shows the symbols for some of the dangers you may encounter in water areas. For further information on symbols and abbreviations used on nautical charts, refer to the current edition of Chart No. 1 Pub., which has a complete list of illustrations that have been approved for use on nautical charts.

The limits of channels are marked by buoys, and these buoys are indicated on charts by a small dot and a diamond. The dot shows the location of the buoy, and the diamond is most often the same color as the buoy. Small figures and letters alongside the buoys give the number and color of the buoy, type of buoy, color of light, and any pertinent information about it. In addition, the limits of dredged channels are represented by straight, black dashed lines.

In general, small boats need not stay in the channels; and in crowded harbors, they are better off to one side or the other. Larger shipping has the right of way. When you lay out a course, make certain that there are no obstructions along it and that there is plenty of water.

MARITIME BUOYAGE SYSTEM

LEARNING OBJECTIVES: Identify all maritime buoyage systems and explain what each buoy means for a coxswain.

Until 1982, as many as 30 different buoyage systems were in use around the world. An agreement was signed establishing two international buoyage regions with all maritime countries to condense all buoyage into one system. (See fig. 6-16.) This agreement was sponsored by the International Association of Lighthouse Authorities (IALA) and bears its name.

The IALA Maritime Buoyage System provides rules that apply to all fixed and floating markers other than lighthouses, sector lights, range lights, lightships, and large automatic navigational buoys (lanbys).

BUOYS

Buoys are moored floating markers, placed to guide ships in and out of channels, warn them away from hidden dangers, and lead them to anchorage areas. Buoys are of various sizes and shapes; however, their distinctive coloring, shape, and topmark indicate their purpose by day and their light color and phase characteristics by night.

Although buoys are valuable aids to navigation, they must never be depended on exclusively. Buoys frequently drag their moorings in heavy weather or may be set adrift if run down by passing vessels. Lights on lighted buoys may go out of commission. Whistles, bells, and gongs actuated by the motion of the sea may fail to function in smooth water.

Buoy Shape

There are five basic buoy shapes (fig. 6-17); namely, can, nun, spherical, pillar, and spar. With the exception of pillar and spar buoys, the shape of the buoy indicates the correct side on which to pass. Can buoys may sometimes be referred to as cylindrical, and nun buoys referred to as conical. The term *pillar* is used to describe any buoy that is smaller than a lighthouse buoy and has a tall, central structure on a broad base. Lighted buoys in the United States are referred to as pillar buoys.

Topmarks

The IALA Maritime Buoyage System makes use of can, nun, spherical, and X-shaped topmarks only. Topmarks on pillar and spar buoys are particularly important to indicate the side on which they will be passed and will be used, wherever practical.

Lights

Where marks are lighted, red and green lights are reserved for port and starboard or starboard and port lateral marks. Yellow lights are for special marks, and white lights are used for other types of marks, which will be discussed later in this chapter.

LATERAL MARKS

Lateral marks are generally used for well-defined channels. They indicate the route to be followed and are used in conjunction with a "conventional direction of buoyage." This direction is defined in one of two ways:

- Local direction of buoyage—the direction taken by the mariner when approaching a harbor, river estuary, or other waterway from seaward.
- General direction of buoyage—in other areas, a direction determined by the buoyage authorities, following a clockwise direction around continental landmasses, given in *Sailing Directions,* and, if necessary, indicated on charts by a symbol.

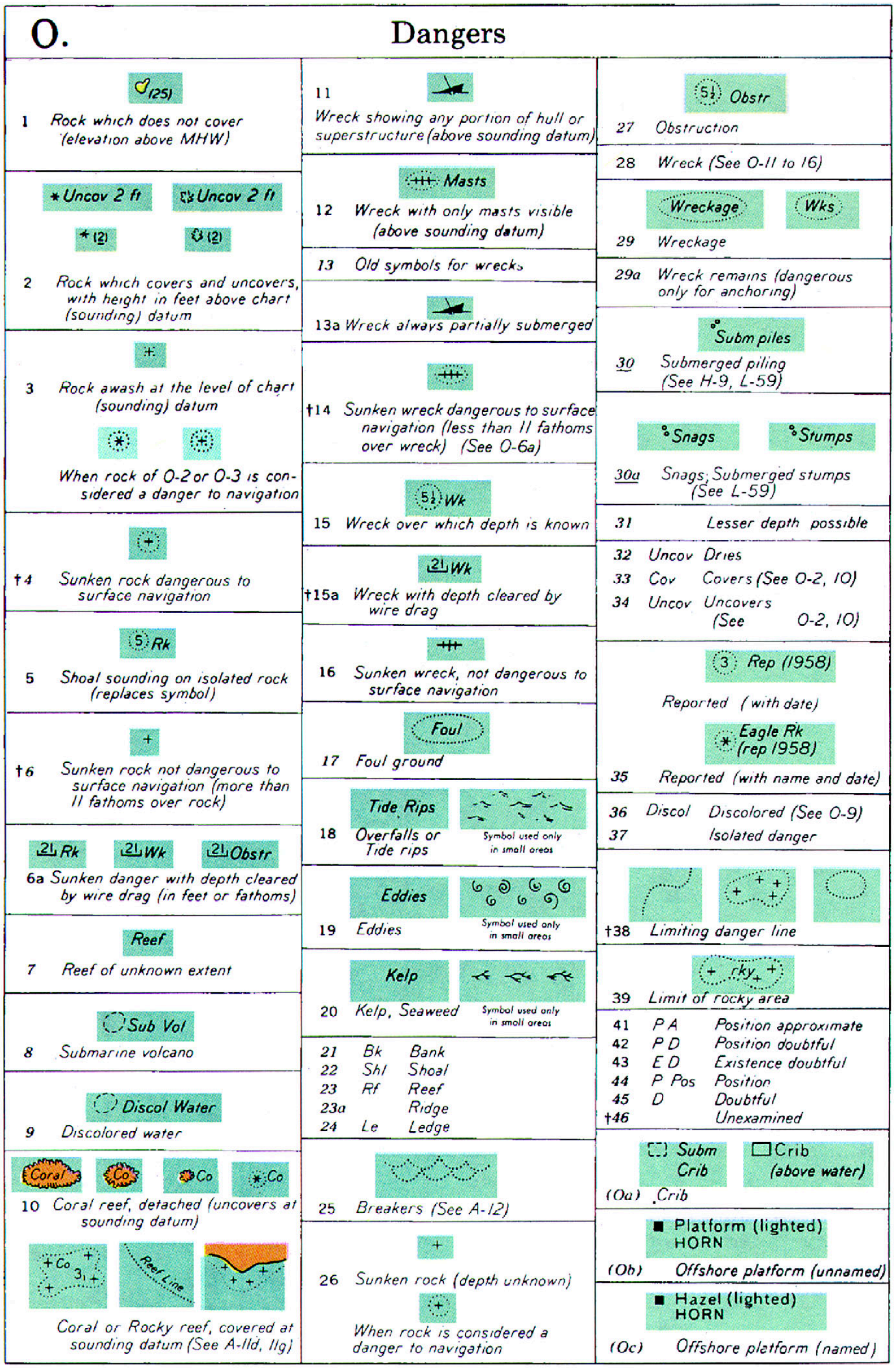


Figure 6-15.—Symbols used on charts to indicate changes to navigation.

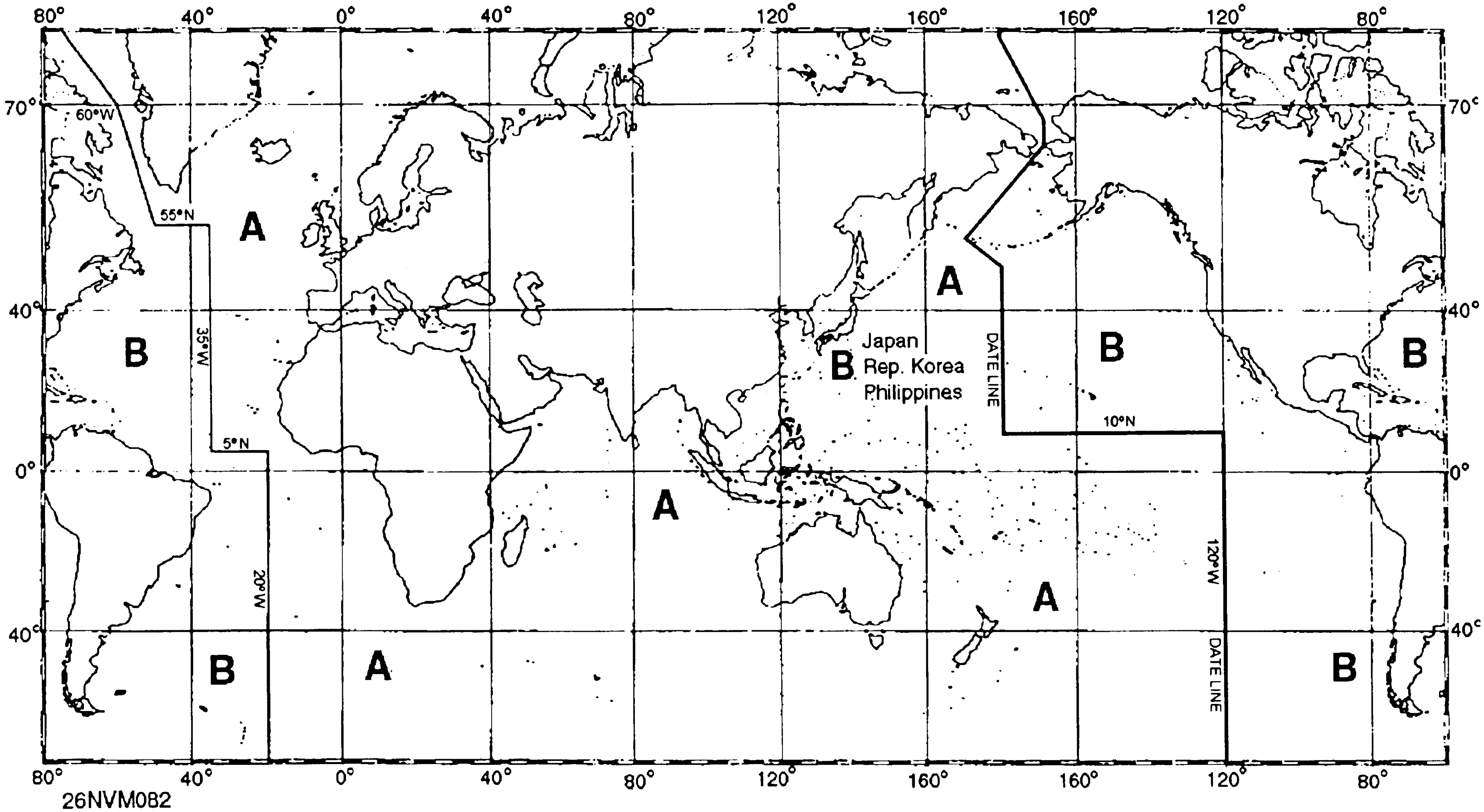


Figure 6-16.—IALA Maritime Buoyage System, buoyage regions A and B.

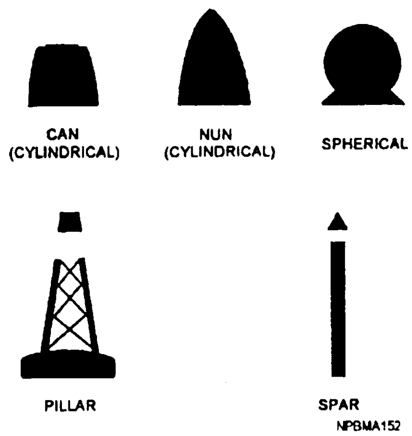


Figure 6-17.—Types of buoys.

The numbering or lettering of buoys is an optional feature. In the United States, fairway and channel buoys are always numbered odd to port and even to starboard, approaching from seaward.

BUOYAGE REGIONS

As previously mentioned, two International Buoyage Regions were established under IALA. Navigational charts produced and printed after 1983 will indicate the buoyage region to which a chart refers.

Lateral Marks Used in Region A

As shown in figure 6-16, International Buoyage Region A covers Europe and Asia with the exception of Japan, the Republic of Korea, and the Republic of the Philippines. The major rule to remember in this region is red to port when you are returning from seaward.

Port hand marks (fig. 6-18)

Color:	Red
Shape (buoys):	Can, pillar, or spar
Topmark (when required):	Single red can
Light (when fitted)	
Color:	Red
Phase characteristics:	Any except composite group flashing (2 + 1)

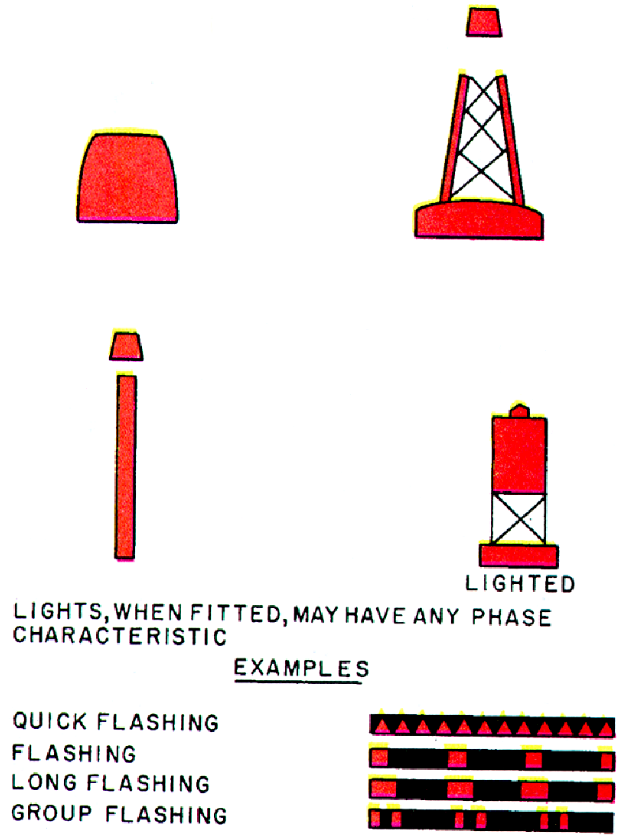


Figure 6-18.—IALA Maritime Buoyage System, International Buoyage Region A, port hand marks (buoys).

Starboard hand marks (fig. 6-19)

Color:	Green
Shape (buoys):	Nun, pillar, or spar
Topmark (when required):	Single green cone, point upward
Light (when fitted)	
Color:	Green
Phase characteristics:	Any except composite group flashing (2 + 1)

When a vessel is proceeding in the “conventional direction of buoyage,” a preferred channel is indicated by a modified port or starboard lateral mark at the point where a channel divides.

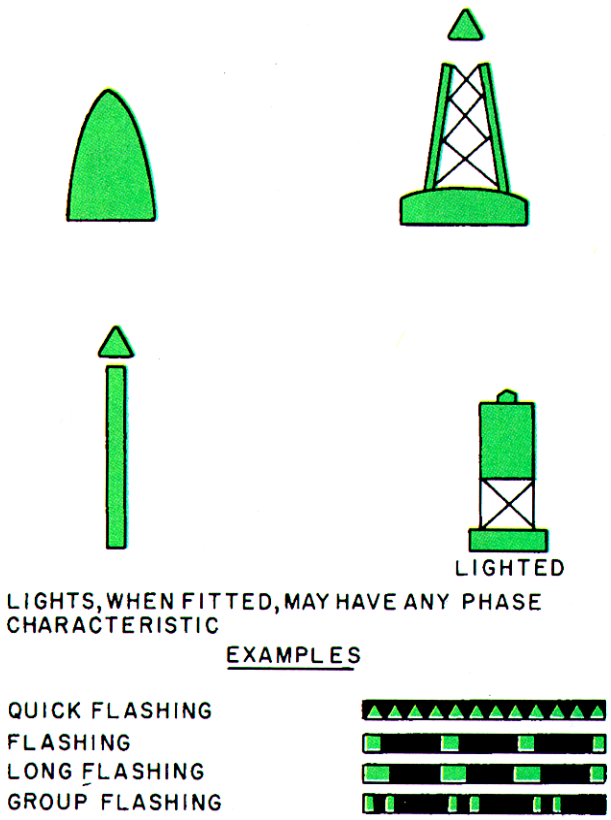


Figure 6-19.—IALA Maritime Buoyage System, International Buoyage Region A, starboard hand marks (buoys).

Preferred channel to port (fig. 6-20)

Color: Green with one broad red horizontal band

Shape (buoys):	Nun, pillar, or spar
Topmark (when required):	Single green cone, point upward

Light (when fitted)

Color:	Green
Phase characteristics:	Composite group flashing (2 + 1)

Preferred channel to starboard (fig. 6-21)

Color: Red with one broad green horizontal band

Shape (buoys):	Can, pillar, or spar
Topmark (when required):	Single red can

Light (when fitted)

Color:	Red
Phase characteristics:	Composite group flashing (2 + 1)

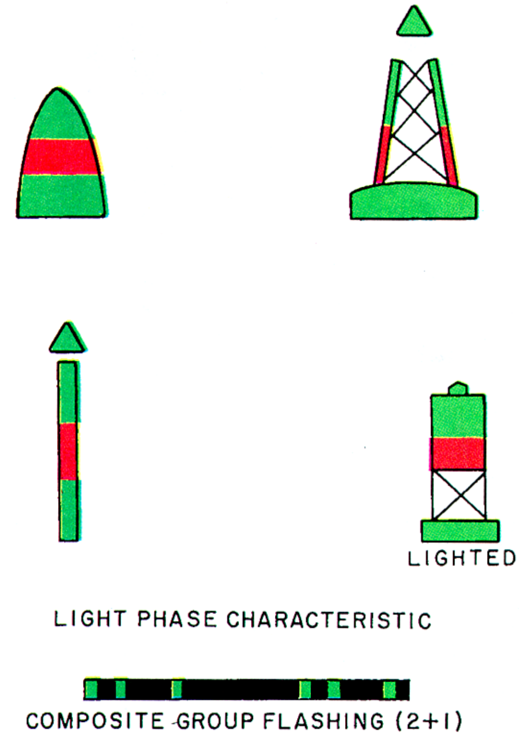


Figure 6-20.—IALA Maritime Buoyage System, International Buoyage Region A, preferred channel to port.

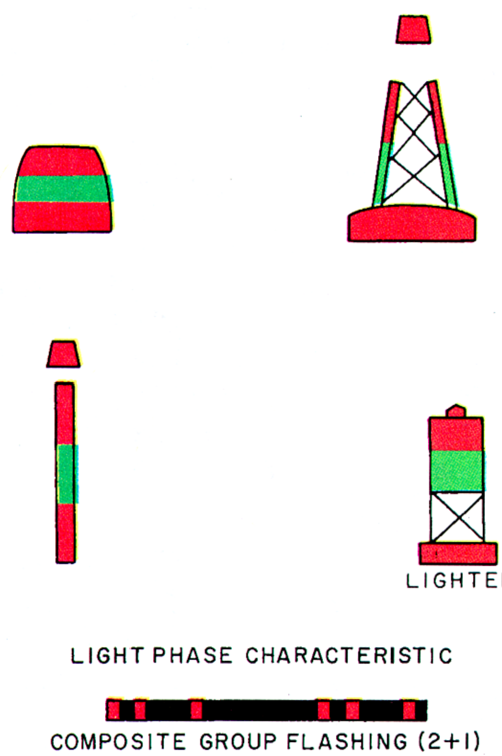


Figure 6-21.—IALA Maritime Buoyage System, International Buoyage Region A, preferred channel to starboard.

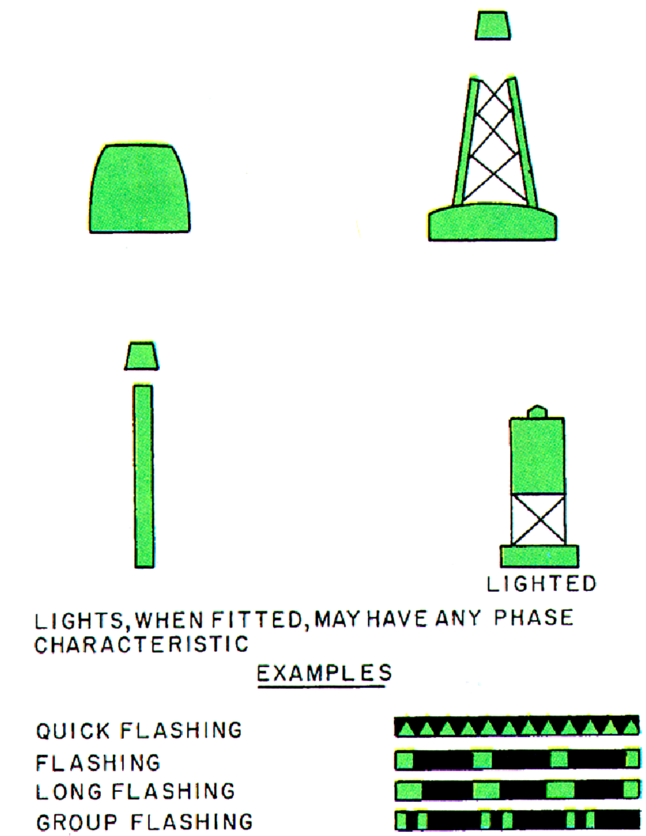


Figure 6-22.—IALA Maritime Buoyage System, International Buoyage Region B, port hand marks (buoys).

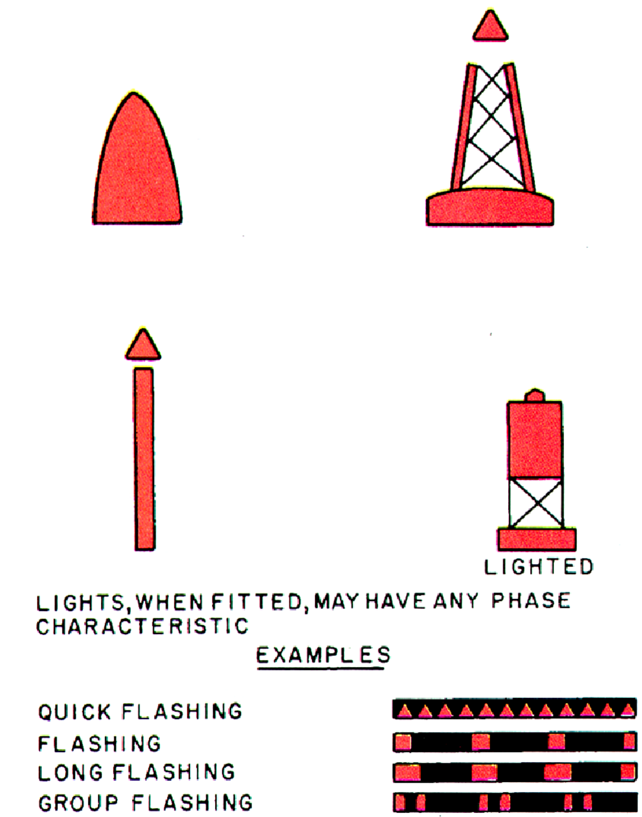


Figure 6-23.—IALA Maritime Buoyage System, International Buoyage Region B, starboard hand marks (buoys).

Lateral Marks Used in Region B

Basically, Region B covers the Western Hemisphere, Japan, the Republic of Korea, and the Philippines. The main rule to remember in this region is red right returning from seaward.

Port hand marks (fig. 6-22)

Color:	Green
Shape (buoys):	Can, pillar, or spar
Topmark (when required):	Single green can
Light (when fitted)	
Color:	Green
Phase characteristics:	Any except composite group flashing (2 + 1)

Starboard hand marks (fig. 6-23)

Color:	Red
Shape (buoys):	Nun, pillar, or spar
Topmark (when required):	Single red cone, point upward
Light (when fitted)	
Color:	Red
Phase characteristics:	Any except composite group flashing (2 + 1)

Preferred channel to port (fig. 6-24)

Color: Red with one broad green horizontal band

Shape (buoys):	Nun, pillar, or spar
Topmark (when required):	Single red cone, point upward
Light (when fitted)	
Color:	Red
Phase characteristics:	Composite group flashing (2 + 1)

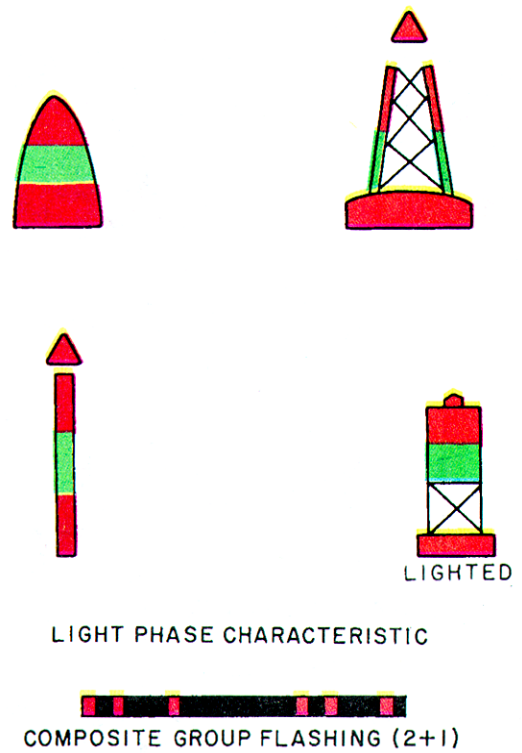


Figure 6-24.—IALA Maritime Buoyage System, International Buoyage Region B, preferred channel to port.

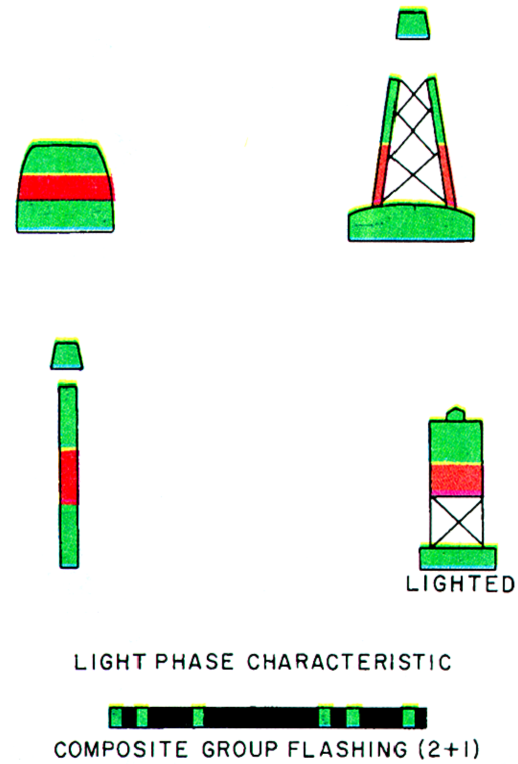


Figure 6-25.—IALA Maritime Buoyage System, International Buoyage Region B, preferred channel to starboard.

Preferred channel to starboard (fig. 6-25)

Color: Green with one broad red horizontal band

Shape (buoys):	Can, pillar, or spar
Topmark (when required):	Single green can
Light (when fitted)	
Color:	Green
Phase characteristics:	Composite group flashing (2 + 1)

> **NOTE**
>
> **In buoyage Regions A and B, if marks at the sides of a channel are numbered or lettered, the numbering or lettering will follow the "conventional direction of buoyage."**

CARDINAL MARKS

A cardinal mark is used in conjunction with the compass to indicate the best navigable water. It is placed in one of the four quadrants (north, east, south, or west) from the best water. A cardinal mark takes its name from the compass point in which it is placed. Figure 6-26 shows the IALA Maritime Buoyage System cardinal marks.

The mariner is safe if he/she passes north of a north mark, east of an east mark, south of a south mark, and west of a west mark. A cardinal mark may be used to do the following:

- Indicate that the deepest water is an area on the named side of the mark.
- Indicate the safe side on which to pass a danger.
- Draw attention to a feature in a channel, such as a bend, junction, branch, or end of a shoal.

Topmarks

By day, topmarks are the most important features of cardinal marks. The arrangement of the cones must be memorized. For north, the point of each cone is up. For south, the point of each cone is down. An aid to help you memorize the west topmark is its resemblance to a

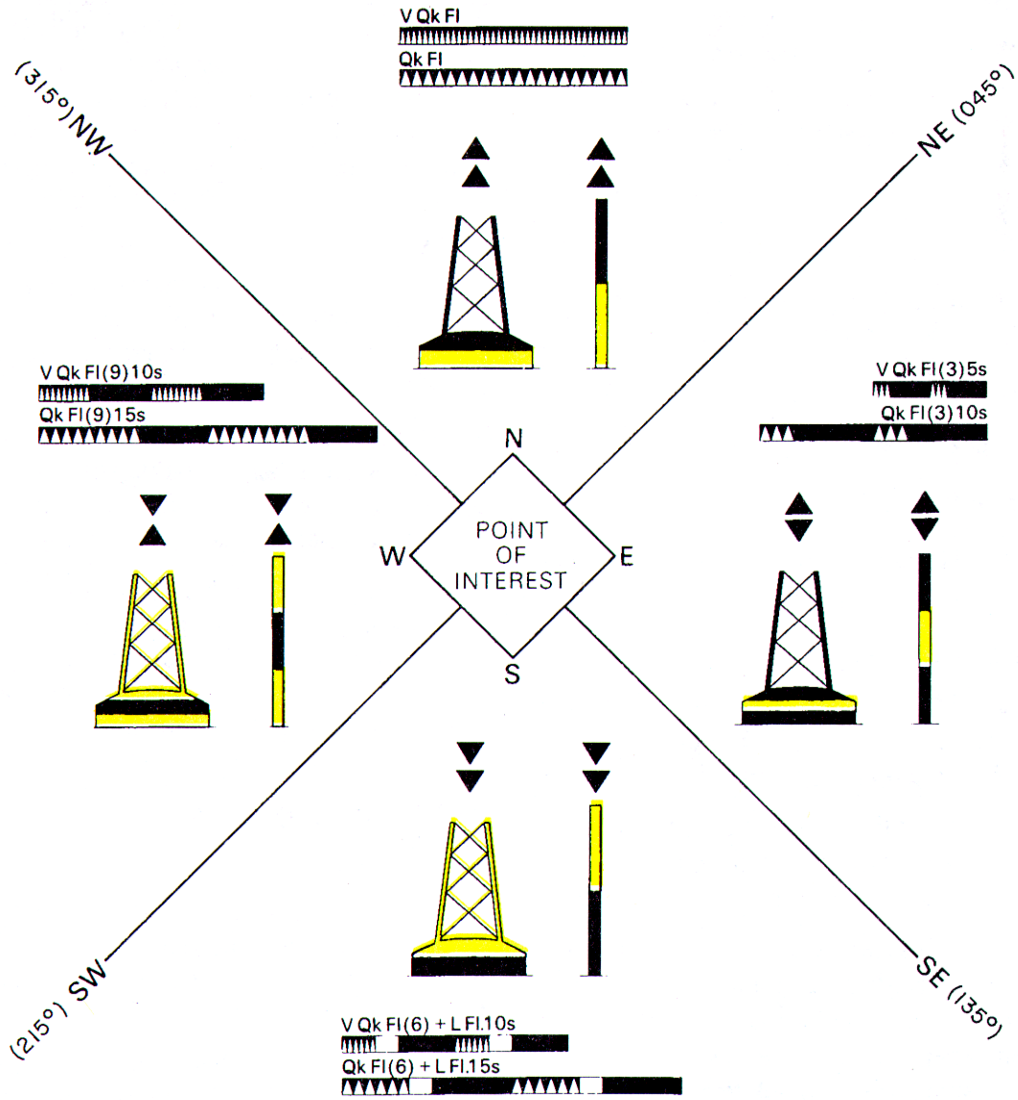


Figure 6-26.—IALA Maritime Buoyage System, cardinal marks.

wineglass. Cardinal marks carry topmarks, whenever practical, with the cones as large as possible and clearly separated.

Color

Black and yellow horizontal bands are used to color cardinal marks. The position of the black band, or bands, is related to the points of the black topmarks. The black and yellow horizontal bands are used as follows:

- North—black band above yellow band
- South—black band below yellow band
- West—black band with yellow bands above and below
- East—black band above and below yellow band

The shape of a cardinal mark is not important, but in the case of a buoy, it will be pillar or spar.

Light Characteristics

When lighted, a cardinal mark exhibits a white light. The characteristics are based on a group of quick (Qk) or very quick (VQk) flashes. These flashes distinguish it as a cardinal mark and indicate its quadrant. The distinguishing QK or VQK flashes are as follows:

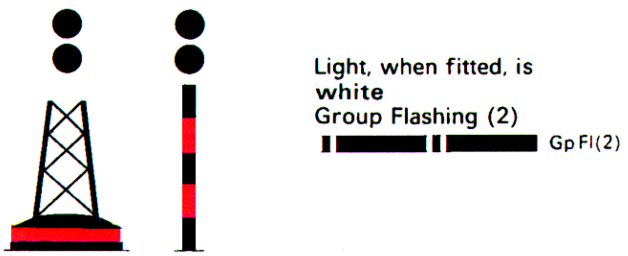


Figure 6-27.—IALA Maritime Buoyage System, isolated danger mark.

- North—uninterrupted
- East—three flashes in a group
- South—six flashes in a group followed by a long flash
- West—nine flashes in a group

As a memory aid, associate the number of flashes in each group with a clockface (3 o'clock—east, 6 o'clock—south, and 9 o'clock—west).

The long flash immediately following the group of flashes of a south cardinal mark is to ensure that its six flashes cannot be mistaken for three or nine.

Quick flashing lights flash at the rate of less than 79 but not less than 50 flashes per minute. Very quick flashing lights flash at the rate of less than 159 but not less than 80 flashes per minute. It is necessary to have a choice of quick flashing or very quick flashing lights to avoid confusion. Two north buoys that are placed near enough to each other to be mistaken is one example where the QK flashing and VQK flashing lights would be needed.

ISOLATED DANGER MARKS

An isolated danger mark (fig. 6-27) is erected on, or moored above, an isolated danger of limited extent. The isolated danger mark has navigable water all around it. The extent of the surrounding navigable water is not important. The isolated danger mark can, for example, indicate either a shoal that is well offshore of an islet separated by a narrow channel from the coast.

A black double-sphere topmark is, by day, the most important feature of an isolated danger mark. Whenever practical, this topmark will be carried with the spheres as large as possible, mounted vertically, and clearly separated.

Black, with one or more red horizontal bands, is used for isolated danger marks. The shape of an isolated danger mark is not significant, but, in the case of a buoy, it will be a pillar or spar.

When a spar buoy is lighted, a white flashing light showing a group of two flashes, is used to denote an isolated danger mark. The association of two flashes and two spheres in the topmark may be a help in remembering these characteristics.

SAFE WATER MARKS

A safe water mark (fig. 6-28) is used to indicate there is navigable water all around the mark. Such a mark may be used as a center line, midchannel, or landfall buoy.

Red and white vertical stripes are used for safe water marks. The vertical stripes are used to distinguish them from the black-banded danger marks. Spherical, pillar, or spar buoys may be used as safe water marks. Whenever practical, a pillar or spar buoy used as a safe water mark will carry a single red sphere topmark.

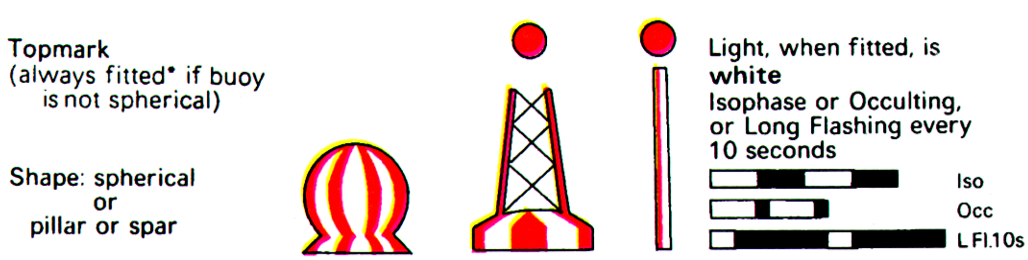


Figure 6-28.—IALA Maritime Buoyage System, safe water marks.

When lighted, a safe water mark exhibits a white light. The phase characteristics of the light will be occulting, equal interval (isophase), one long flash every 10 seconds, or Morse "A." The association of a single flash and a single sphere in the topmark may be a help in remembering these characteristics.

SPECIAL MARKS

A special mark (fig. 6-29) may be used to indicate to the mariner a special area or feature. The nature of the special area or feature may be found by consulting the chart, *Sailing Directions,* or *Notice to Mariners.* The uses of a special mark include the following:

- Ocean Data Acquisition System (ODAS), buoys carrying oceanographic or meteorological sensors
- Traffic separation marks
- Spoil ground marks
- Military exercise zone marks
- Cable or pipeline marks, including outfall pipes
- Recreation zone marks

Another function of a special mark is to define a channel within a channel (for example, a channel for deep-draft vessels in a wide-approach area where the limits of the channel for normal navigation are marked by red and green lateral buoys).

Yellow is the color used for special marks. The shape of a special mark is optional, but it must not conflict with a lateral or a safe water mark. For example, an outfall buoy on the port hand side of a channel could be can-shaped but not conical.

When a topmark is carried, it takes the form of a single yellow X. When a light is exhibited, it is yellow. The phase characteristics may be any except those used for the white lights of cardinal, isolated danger, and safe water marks.

NEW DANGERS

A newly discovered hazard to navigation, not yet shown on charts or included in *Sailing Directions* or sufficiently announced by *Notice to Mariners,* is called a "new danger," The term *new danger* covers naturally occurring obstructions, such as sandbanks or rocks, or man-made dangers, such as wrecks.

A new danger is marked by one or more cardinal or lateral marks following the IALA Maritime Buoyage System. When the danger is especially grave, it will be marked by marks that are identical until the danger has been sufficiently announced.

When a lighted mark is used for a new danger, it must exhibit a quick flashing or a very quick flashing light. When it is a cardinal mark, it must exhibit a white light. When it is a lateral mark, it must exhibit a red or green light.

The duplicate mark may carry a radar beacon (RACON), coded D (-..), showing a signal length of 1 nautical mile on a radar display.

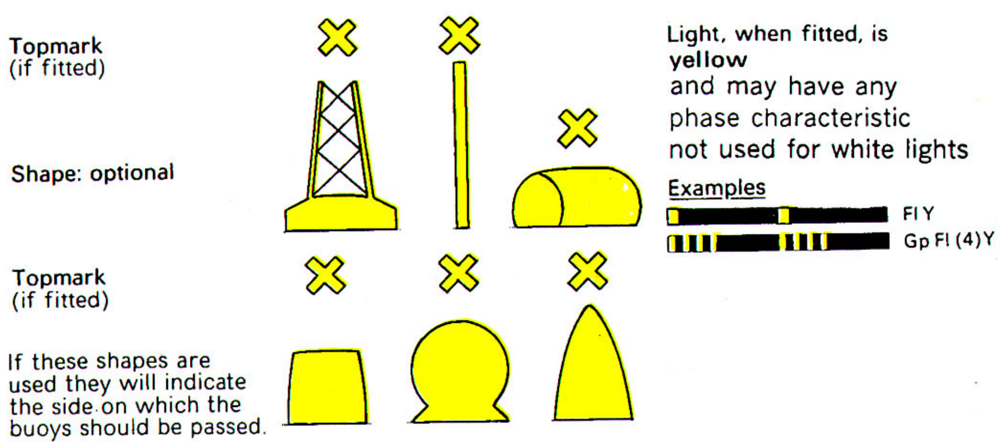


Figure 6-29.—IALA Maritime Buoyage System, special marks.

DAYMARKS

Unlighted aids to navigation (except unlighted buoys) are called daymarks (fig. 6-30). A daymark may consist of a single pile with a mark on top of it, a spar supporting a cask, a slate or masonry tower, or any of several structures.

Daymarks, like lighthouses and light structures, are usually colored, to distinguish them from their surroundings and make them easy to identify. Daymarks marking channels are colored and numbered like channel buoys. Many are fitted with reflectors that show the same colors a lighted buoy would show at night in the same position.

AIDS IN INTRACOASTAL WATERWAY

LEARNING OBJECTIVES: Explain aids in intercostal waterways and also how to navigate safely in these areas.

The Intracoastal Waterway, called the inland waterway, is a channel in which a light-draft vessel can navigate coastwise from the Chesapeake Bay almost to the Mexican border, remaining inside the natural or artificial breakwaters for almost the entire length of the trip.

Every buoy, daymark, or light structure along the Intracoastal Waterway has part of its surface painted yellow—the distinctive coloring adopted for this waterway. Somewhere on a lighted buoy is a band or a border of yellow.

Red buoys and daymarks are to the right, green to the left, as you proceed from the Chesapeake Bay toward Mexico. As in other channels, red buoys have even numbers; green buoys, odd numbers. Because the numbers would increase excessively in such a long line of buoys, they are numbered in groups that usually contain no more than 200 buoys. At certain natural dividing points, numbering begins again at one.

Lights on buoys in the Intracoastal Waterway follow the standard system of red lights on red buoys and green lights on green buoys. Lights on lighted aids besides buoys also agree with the standard rules for lights on aids to navigation.

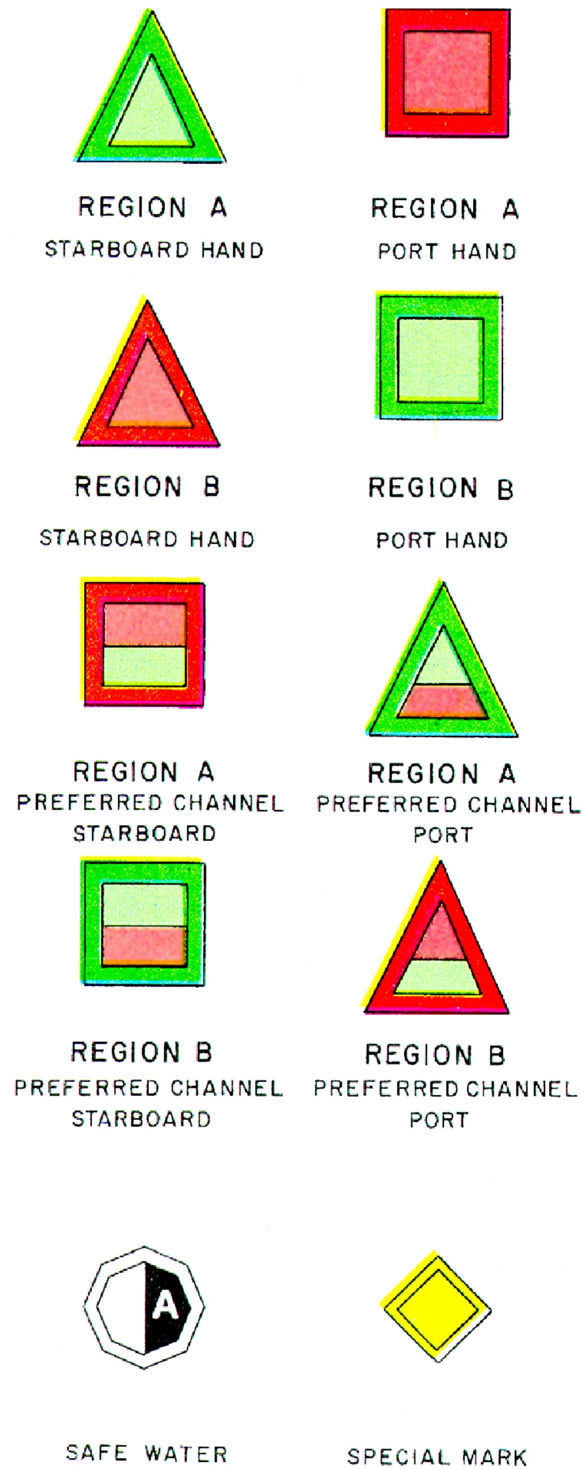


Figure 6-30.—IALA Maritime Buoyage System, lateral daymarks.

RANGES

Two day beacons located some distance apart on a specific true bearing constitute a day beacon range. When a ship reaches a position where the two lights, or beacons, are seen exactly in line, it is "on the range." Ranges are especially valuable for guiding ships along the approaches to or through narrow channels. Much of the steering through the Panama Canal is accomplished on ranges. Other examples of successive straight reaches marked by ranges are the channel entrances to the St. John's River, on the Atlantic coast, and to the Columbia River, on the Pacific coast.

Lights on ranges may show any of the four standard colors, and they may be fixed, flashing, or occulting. Most range lights appear to lose intensity rapidly as a ship diverges from the range line of bearing.

When you are steering on a range, it is highly important to ascertain the limit beyond which the range line of bearing cannot be followed safely. This information is available on the chart.

FOG SIGNALS

Most lighthouse and lightships are equipped with fog-signaling apparatus, ordinarily sounded automatically by mechanical and electrical means. For identification purposes, each station has its own assigned number of blasts, recurring at specified intervals. A definite time is required for each station to sound its entire series of blasts, and this timing provides another means of identification.

The various types of apparatus produce corresponding variance of pitch and tone, thus giving your ear a chance to compare the sound of a station with its description in the *Light Lists.*

DETERMINING A COURSE

One occupational standard for advancement requires you to use a chart to determine a compass course to a destination. For this purpose you need at least a pair of dividers and parallel rulers such as those shown in figure 6-31. The parallel rulers are simply two straightedges, usually of plastic, secured together by two short strips of plastic or metal. They may be opened or closed, but they always remain parallel to each other. To use them, place one edge along a course or bearing line, and walk them to the nearest compass rose. (Most charts have several compass roses conveniently located.) Make sure the rulers do not slip as you walk them across the chart. Place one edge at the center of the

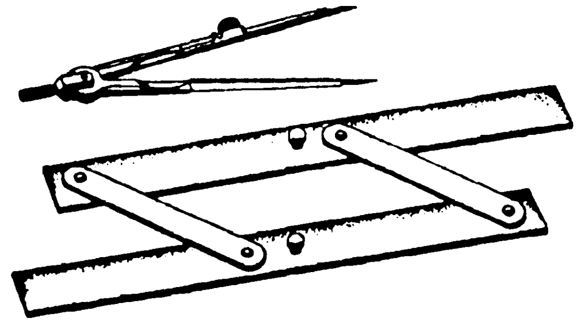


Figure 6-31.—Parallel rulers and dividers.

compass rose (marked by a cross). True course is read where the ruler crosses the outer ring. The inner ring gives a magnetic reading; variation (for the year indicated) is already applied. When using magnetic course, be sure you remember to apply the correction for annual rate of change. When you take true course, apply total variation. Deviation, if used, must be applied to either true or magnetic course.

Suppose your ship is in Berth 8, EX-1, Hampton Roads. (See fig. 6-32.) Fog is heavy, and visibility is less than 100 yards. You never have been in this port before, and you must make a trip to fleet landing.

You will want the largest scale chart available. First find your berth, then fleet landing, and plan a course between.

The safest and simplest way is to locate your position and your destination, and draw a straight line from one to the other. Then carefully examine both sides of the course, noting channels and depths of water. Make certain there are no hidden dangers, such as rocks, shoals, and sunken wrecks. When such dangers do exist, the course must be altered to give them wide berth. Choose a course that will put you at a point slightly up-current from your destination. By so doing, if your calculations are off slightly, you will not be swept past your landing. To avoid contacting ships, cross channels in the most expeditious manner possible. Remember that a small boat is not easily seen from a fogbound navigation bridge.

For purposes of this chapter, assume that all the areas where the DH berths are located is shallow water or contains other dangers and that you must go around that section. It is best to make as few course changes as possible, and for this reason you plan to head for the nearest channel buoy, cross the channel, and proceed in a straight line for the end of pier 2. On examining the chart, however, you discover the submerged pilings

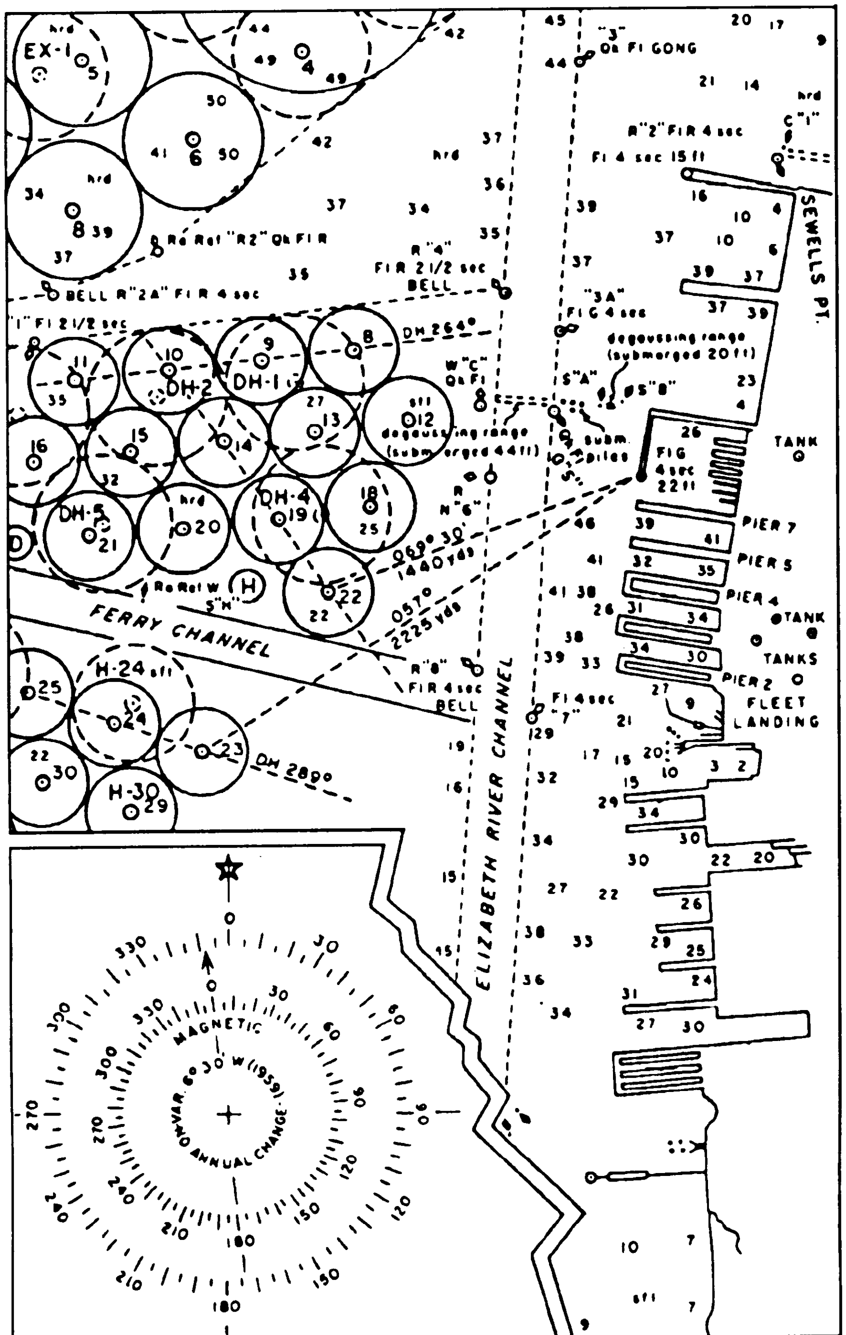


Figure 6-32.—Section from Coast and Geodetic Survey Chart No. 400. (sample).

indicated near channel buoy 5. They lie exactly on your course line, so you decide to skirt them by going down the channel until you pass buoy 5 and then head for pier 2. Now chart your course.

Write down on a piece of paper all pertinent information as you find it, including courses, numbers, and characteristics of buoys where you turn and buoys you pass, and any other details that may be useful. Do not ignore any data that could prove helpful. It is better to carry around material you do not use than to discover you have lost your way because you neglected to copy down some seemingly needless item. For simplicity, you can arrange your information in table form, if you wish.

Lay one edge of your parallel rulers on the dots marking the center of the berth and buoy 4. Walk the rulers to the nearest compass rose, and pick off your course. You can take either true course (outer ring) or magnetic course (inner ring). In our problem, we will select true and convert it as we go along. Variation is 6°30'W (we will call it 7°); there is no annual change. We are uncorrecting; therefore, we add the westerly error. Following the plan, we find and record each course from buoy to buoy. Always remember to lay the straightedge on the dots, because the dots mark the exact position of the buoys.

Your entry in the compass log should look something like this.

Berth 8, EX-1, Hampton Roads to fleet landing NorNav Base and return.

Berth 8 to channel buoy R"4" (F1 R 2 1/2 sec bell) 101°T, 108°M.

Passing R"2" (QkF1 R) close aboard to starboard.

R"4" to "3A" (F1 G 4 sec) C 129°T, 136°M. Turn right. Leave "3A" to port.

"3A" to G"5" (QkF1 G) C 184°T, 191°M. Keep G"5" to port (submerged piles on opposite side).

G"5" to end of pier 2, C 166°T, 173°M.

When you leave the ship in a situation like this, swing around to the bow, and use either the point where the anchor chain enters the water or, preferably, the anchor buoy as your point of departure.

Probably the easiest way to make the return trip would be to proceed from the end of pier 2, cross the channel to R"8," parallel the channel to R"4," and then to the ship. Thus your courses would be as follows:

Pier 2 to R"8" (F1 R 4 sec bell) C 259°T, 276°M.

R"8" to R"4" (F1 R 2 1/2 sec bell) C 004°T, 011°M.

Passing R N"6" and W"C" (QkF1) close aboard to starboard.

R"4" to Berth 8, C 281°T, 288°M. Passing R"2" (QkF1 R) close aboard to port.

All the foregoing information, plus the speed and time of run for each leg, should be entered in your compass log.

NOTE

Although we ignored tide and current to simplify our explanation, you should always be very careful to make due allowances for them when laying out your course.

COMPASS LOG

Navy regulations require that a compass log be kept in each boat. Magnetic courses to and from the various landings made are recorded in the compass log. To be of use, each entry should include the ship's berth, the landings, and the various courses, with the approximate running time for each leg at a certain number of revolutions per minute. The return trips also should be recorded in proper order.

In many ships, boat coxswains are provided with sketches of small-scale charts of familiar ports, showing the courses, distances, and running times. As a boat coxswain in a strange port, however, you would do well to record your own information on your first trip. When doing this, remember that speed must be reduced in foul weather and fog; make your entries accordingly.

You should record as much useful information as possible. Refer to it as necessary, and avoid the embarrassment and possible danger of becoming lost. Remember: The smart sailor makes use of all possible aids and does not trust anything to luck.

RULES OF THE ROAD

LEARNING OBJECTIVES: Describe the Rules of the Road for international, inland, crossing, meeting, and overtaking situations. Determine the applicability of various rules of safe navigation.

We will not discuss all the Rules of the Road in this chapter. Any rules mentioned in this manual are taken from the U.S. Coast Guard publication *Navigation Rules, International—Inland,* COMDINST M16672.2B. This publication lists both the International and Inland Rules in a convenient form. All Navy ships are required to have a copy aboard.

INTERNATIONAL RULES

International Rules apply to all vessels and seaplanes navigating on the high seas and the inland waters of foreign countries except for a limited number of areas where local laws prevail. International Rules are NOT applicable on the inland waters of the United States. On our inland waters, the Inland Rules are used.

INLAND RULES

The Inland Rules must be followed on all harbor, river, and other inland waters of the United States, with certain exceptions. These exceptions are the Great Lakes and their connecting and tributary waters as far east as Montreal; the Mississippi River above the Huey P. Long Bridge and all the Mississippi's tributaries and their tributaries; the Atchafalaya River above its junction with the Plaquemine-Morgan City alternate waterway; and the Red River of the North. The above waters have special rules duly made by local authority.

Specific lines marking the boundaries between high seas and inland waters have been laid down at the entrances to many harbors and bays. Where such lines of demarcation have not been laid down, the general rule is that the boundary is a line drawn through the outermost buoy, approximately parallel to the shoreline.

The Inland Rules parallel closely to the International Rules and, except where differences are cited, it may be assumed that the two are identical in meaning.

The Commandant of the U.S. Coast Guard has authority to promulgate *Pilot Rules.* These rules, referred to occasionally in this chapter, supplement and have cojurisdiction with local statutory rules and apply in inland waters.

GENERAL DEFINITIONS

For the purpose of these rules, except where the context otherwise requires, the following definitions apply:

- The word *vessel* includes every description of watercraft, including nondisplacement craft and seaplanes, used or capable of being used as a means of transportation on water.
- The term *power-driven vessel* means any vessel propelled by machinery.
- The term *sailing vessel* means any vessel under sail provided that propelling machinery, if fitted, is not being used.
- The term *vessel engaged in fishing* means any vessel fishing with nets, lines, trawls, or other fishing apparatus that restrict maneuverability, but does not include a vessel fishing with trolling lines or other fishing apparatus that do not restrict maneuverability.
- The word *seaplane* includes any aircraft designed to maneuver on the water.
- The term *vessel not under command* means a vessel that, through some exceptional circumstance, is unable to maneuver as required by the rules and is, therefore, unable to keep out of the way of another vessel.
- The term *vessel restricted in its ability to maneuver* means a vessel that, from the nature of its work, is restricted in its ability to maneuver as required by the rules and is, therefore, unable to keep out of the way of another vessel.
- The term *under way* means a vessel or seaplane on the water is not at anchor, made fast to the shore, or aground.
- The term *height above hull* means the height above the uppermost continuous deck (main deck).
- The word *visible,* when applied to lights, means visible on a dark night with a clear atmosphere.
- A short blast is a blast of about l-second duration.
- A prolonged blast is a blast of from 4 to 6 seconds.
- A whistle is a mechanical sound-producing appliance. A siren may be substituted.
- The word *tons* refers to gross tons; that is, the weight of the vessel plus the weight of the load.

MEETING, CROSSING, AND OVERTAKING SITUATIONS

Figure 6-33 shows various situations that arise when two vessels approach each other. The illustration and the following discussion apply only to the relationship existing between own ship, at the center of the diagram, and any of the other vessels.

A MEETING situation exists when, by day, the masts of each vessel, when viewed from the other, are in a line. At night, both sidelights of each vessel must be visible to the other.

A CROSSING situation exists if each vessel has the other any place forward of 2 points abaft either beam (when it is not a meeting situation).

An OVERTAKING situation exists if one vessel approaches the other from any place more than 2 points abaft either beam.

The unshaded vessels in figure 6-33 are stand-on vessels, and those with the crosshatched shading are give-way vessels. In practically all situations, a stand-on

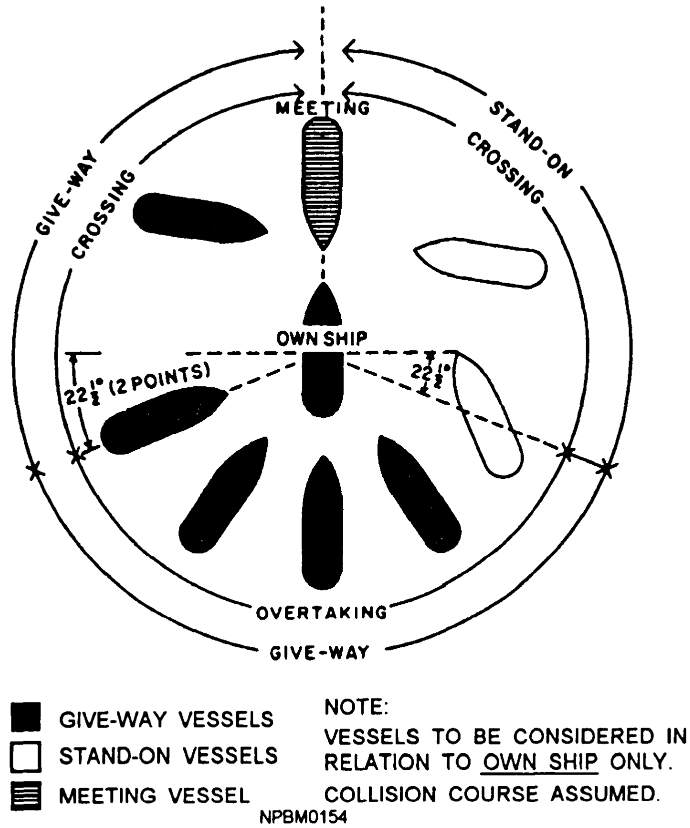


Figure 6-33.—Meeting, crossing, and overtaking situations.

vessel must maintain course and speed. The give-way vessel in a crossing situation is required to alter course and/or speed to pass astern of the other. Overtaking vessels, regardless of the method of propulsion, are always give-way vessels. A vessel on the starboard side in a crossing situation is the stand-on vessel, and one on the port side is the give-way vessel unless it is a sailing vessel crossing a power-driven vessel. Vessels driven by machinery are always required to stand clear of sailing vessels unless being overtaken. Inland Rules warn, however, that the privilege does not give a sailing vessel a right to hamper, in a narrow passage, the safe passage of a steam vessel that can maneuver only in that channel. (Rules governing sailing vessels are explained in COMDTINST M16672.2B.)

The relative bearing of the vessels from each other at the moment of first sighting determines what the situation is (crossing or overtaking), and no subsequent alteration of bearing relieves a give-way vessel of the duty to keep clear of a stand-on vessel.

In all of these situations, if the range is decreasing and the bearing does not change appreciably, the risk of collision is deemed to exist.

LIGHTS

LEARNING OBJECTIVES: Recognize and describe all lights as in navigation for all types of ships, buoys, and sound signals.

Lights are required on all vessels operating upon the high seas and the inland waterways of the world. The rules for these lights are covered under either the International Rules or the Inland Rules. The Great Lakes are covered under the Inland Rules, with a few exceptions covered by special rules made by local authorities. Certain rivers and tributaries in the United States abide by rules set by local authorities and deviate slightly from the Inland Rules of the Road.

MASTHEAD LIGHT

The masthead light is a white light placed over the fore and aft centerline of a vessel showing an unbroken light over an arc of the horizon of 225°, and so fixed as to show the light from right ahead to 22.5° abaft the beam on either side of the vessel.

SIDELIGHTS

The sidelights of a power-driven vessel are green on the starboard side and red on the port side, each showing an unbroken light over an arc of the horizon of 112.5° and so fixed as to show the light from right ahead to 22.5° abaft the beam on its respective side. If a vessel is less than 20 meters (65.5 ft) in length, the sidelights may be combined in one lantern carried on the fore and aft centerline of the vessel.

STERN LIGHT

The stem light is a white light placed as near the stem as possible, showing an unbroken light over an arc of the horizon of 135° and so fixed as to show the light 67.5° from right aft on each side of the vessel.

TOWING LIGHT

The towing light is a yellow light having the same characteristics as the "stern light" previously described.

ALL-AROUND LIGHT

The all-around light is a light showing an unbroken light over an arc of the horizon of 360°.

FLASHING LIGHT

A flashing light is a light that flashes at regular intervals at a frequency of 120 or more flashes per minute.

INTERPRETING LIGHTS CORRECTLY

During daylight hours, when visibility is good, it is fairly easy to recognize the situation that exists between two boats. But at night, with only the running lights to indicate relative positions, it is a little more difficult. This section is designed to teach you to interpret correctly the lights of motorboats and by them to determine what situation exists.

It would be impractical to try to describe or show every situation that could arise, but you can enlarge on the few typical ones presented. One way to do this is to whittle a rough boat hull from softwood and pin bits of colored and white paper or tufts of cotton in the approximate positions of the running lights. Screen the lights as necessary so that they are not visible where they should not be. For example, sidelights are not visible across the bow or more than 2 points abaft the beam. Place the boat on the table at various angles, and note the position of the lights in relation to each other. By doing this, you should learn to recognize a situation quickly, estimate the relative course of the other boat, and by your knowledge of Rules of the Road, determine the proper course of action.

For example, suppose you saw lights as shown in view A of figure 6-34 bearing down on you from dead ahead. The white light is about midway between the sidelights; therefore, the boat is heading straight at you.

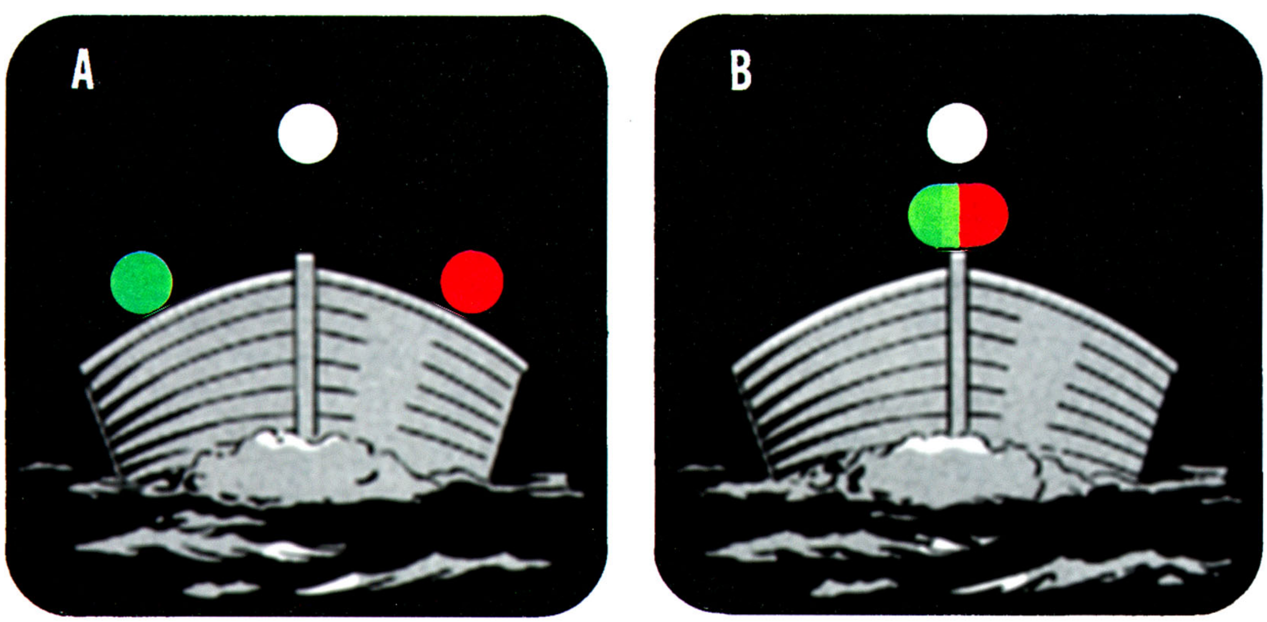


Figure 6-34.—Motorboat lights-meeting situation.

You know that sidelights are not visible across the bow and are not visible from aft. Your conclusion must be that this is a meeting situation, and the rules say that both of you must alter course to starboard and pass port to port.

The boat in view B is showing sidelights in a combination lantern, which is allowed for boats less than 20 meters (65.5 ft) in length, and is also bearing down on you from dead ahead, making this a meeting situation. We know this because the combination light is directly in line with the white light.

Now assume that you saw lights as shown in view A of figure 6-35 about 20° on the starboard bow. Of the sidelights, you can see only the port, so you know the boat is approaching port-side-to. If the bearing does not change appreciably, you are on collision courses. The other boat is on your starboard side and therefore, is the stand-on vessel. You must alter course and/or speed to pass astern of it; consequently, a change of course to starboard is in order. Make the change great enough to bring your course parallel to, or slightly away from, the course of the other boat.

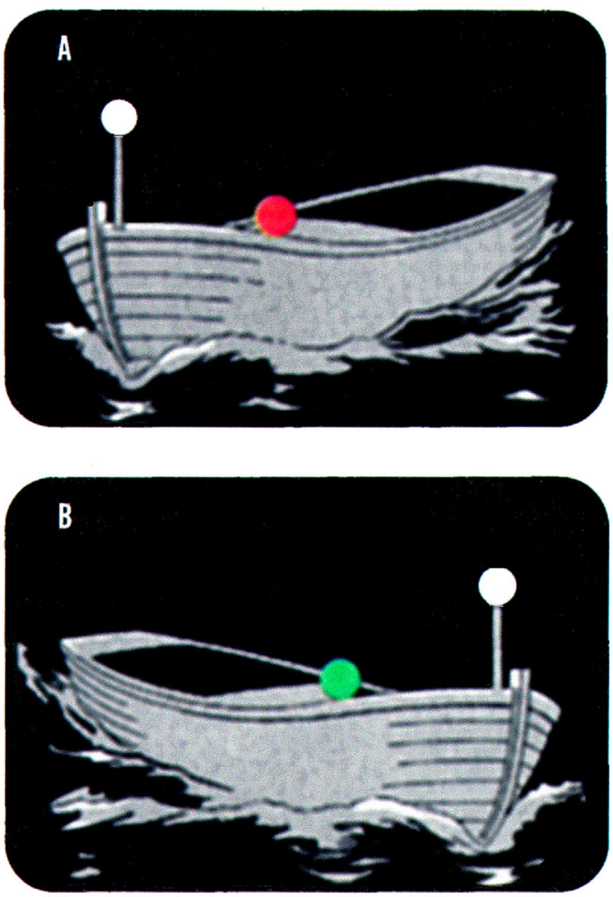


Figure 6-35.—Motorboat lights-crossing situation.

If you saw lights as they are shown in view B of figure 6-35 and they were on your port side, your boat would be the stand-on vessel, and you would be required to maintain your course and speed. Do not, however, go serenely on your way and forget the other boat. You know the situation; you know your boat is the stand-on craft; you know the Rules of the Road, and must follow them. But what about Petty Officer John Doe who is running the other boat? Does he know the rule governing this situation? Will he change course if necessary? Do not take a chance. You must take action if you think that a collision is possible and that the person running the other boat is not going to act in time. You must take steps to avoid the collision. In this case, you might be tempted to alter your course to the left, reasoning that this would involve the smallest change and, hence, the least loss of time. Resist this impulse. DO NOT swing to port in this circumstance. Why not?

First, even if you suspect that Petty Officer John Doe does not know the Rules of the Road, you must assume that he does know them and that he will act accordingly. Next, consider the situation as seen by the other coxswain. You are on his starboard hand. He knows that you are privileged and that he must reduce his speed, stop, reverse, or change course and pass astern of you.

For this discussion, let us suppose that the operator of the other boat, Petty Officer John Doe, waits until he is dangerously close to you and then comes right. Even so, he probably will pass safely under your stem (view A, fig. 6-36). If, however, you come left at about the same time, you will almost certainly cause a collision (view B, fig. 6-36).

Under the circumstances, your safest action is to make a sharp turn to starboard (view C, fig. 6-36), but do not wait too long before doing so. To prove to yourself that this movement is correct, try to figure out the results of various correct and incorrect actions by the coxswain of the other boat.

Suppose you see ahead of you a white light that is quite bright. You judge the distance to be less than a mile, and no red or green light is visible. You may be overtaking another vessel. If so, you are the give-way vessel and, therefore, must keep clear. It also could be a boat under oars, which is required to show a white light only in time to avert a collision. The rules do not specify boats under oars, but it is sensible, good manners, and

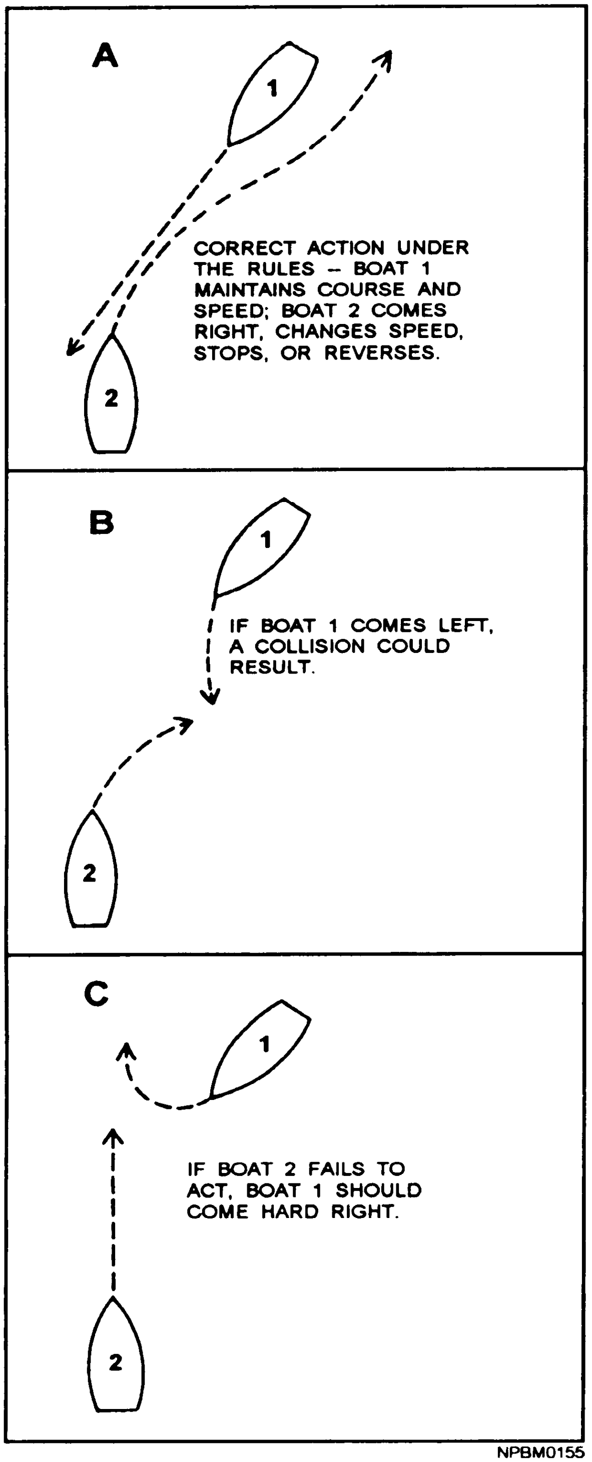


Figure 6-36.—Avoiding collisions.

seamanlike to avoid them—so reduce your speed and pass astern of them.

Consider a situation where you have a green sidelight on your starboard side or a red light on your port side and the opposite sidelight is not visible. Either case normally signifies a safe passing, and no change of course or speed for either boat is necessary.

If you spend much time running a boat, you will undoubtedly approach many ships under way, tugs with tows, and probably vessels showing lights, the meanings of which are unfamiliar to you, but we have purposely omitted any discussions about such situations. Regarding ships and tugs with tows, common sense should tell you that your boat is smaller and much more maneuverable than large vessels; therefore, do not insist on taking the right-of-way. As for the unfamiliar lights, the chances are good that such lights denote a vessel that is not able to maneuver freely, and you would be smart to avoid the lights, too.

Ferryboats intent on maintaining a schedule seem to be particularly stubborn to maneuver even when they are the give-way vessel. Give them a wide berth. A ferryboat carries the same sidelights and range lights required of other steam vessels under Inland Rules except that a double-ended ferry must carry a central range of clear, bright, white lights showing all around the horizon, placed at equal altitudes forward and aft.

SOUND SIGNALS

Sound signals are used in various situations and play a major part in the navigation of vessels. There are considerable differences between International and Inland rules concerning the type and meaning of sound signals; always know your situation so as not to confuse one with the other.

DISTRESS SIGNALS

When a vessel or seaplane on the water is in distress and requires assistance from other vessels or from the shore, the signals may be used or displayed by it, either together or separately.

INTERNATIONAL RULES

The following are recognized international distress signals. These signals are shown in figure 6-37.

- A gun or other explosive signal fired at intervals of about 1 minute

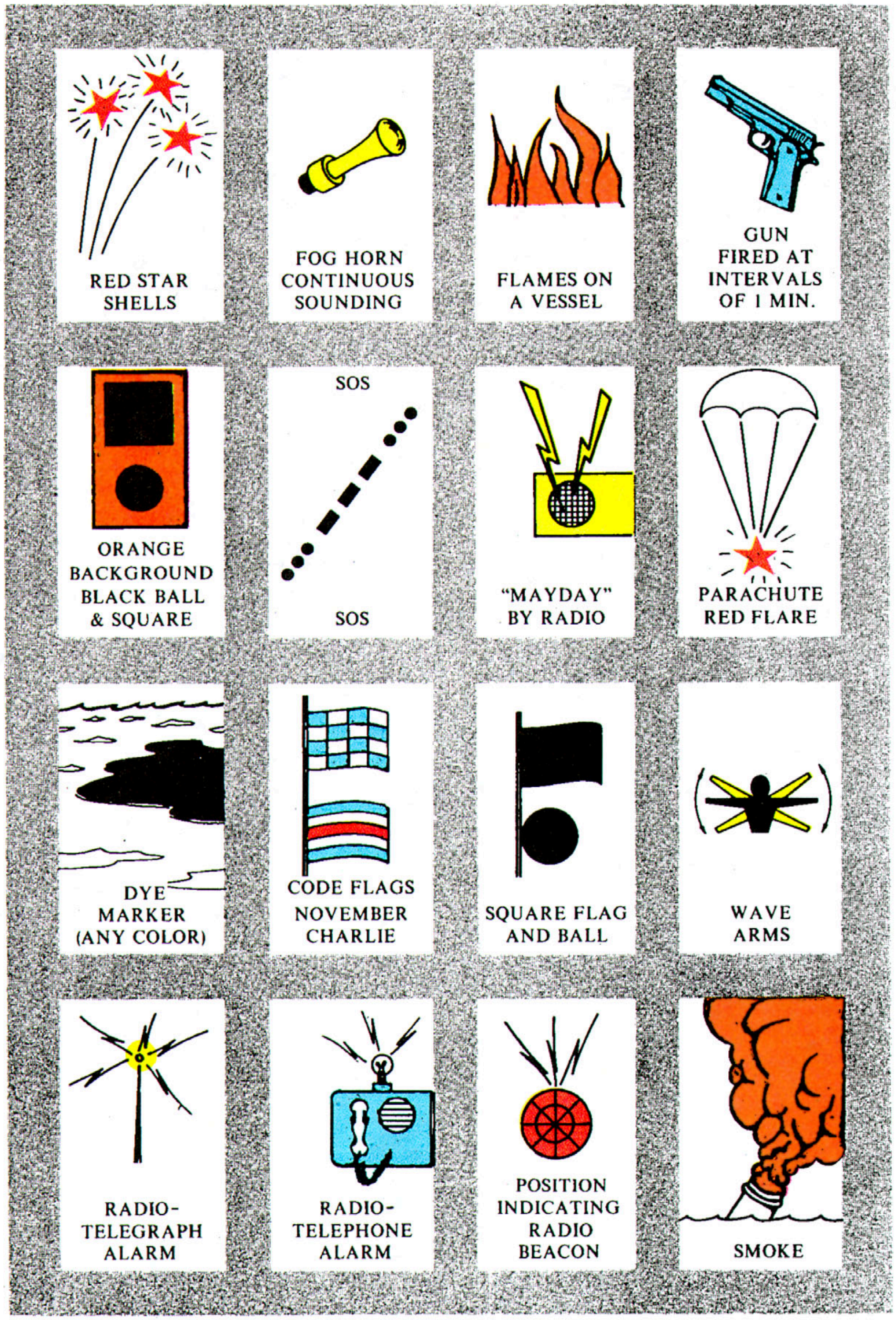


Figure 6-37.—International/Inland distress signals.

- A continuous sounding with any fog signal apparatus
- Rockets, or shells, throwing red stars, fired one at a time at short intervals
- A signal made by radiotelegraphy or by any other signaling methods, consisting of the group ...—... (SOS in Morse code)
- A signal sent by radiotelephone consisting of the spoken word *Mayday*
- The International Code signal of distress indicated by NOVEMBER CHARLIE (flag hoist)
- A signal consisting of a square flag having above or below it a ball or anything resembling a ball
- Flames on the vessel (as from a burning tar barrel, oil barrel, and so on)
- A rocket parachute flare showing a red light
- A smoke signal giving off a volume of orange smoke
- Slowly and repeatedly raising and lowering arms outstretched to each side
- Dye marker

A radio signal has been provided for the purpose of actuating the automatic alarms of other vessels and thus securing attention to distress calls or messages. The signal consists of a series of 12 dashes sent within 1 minute, the duration of each dash being 4 seconds, and the duration of the interval between two consecutive dashes being 1 second.

INLAND RULES

Under Inland Rules, distress signals are divided into daytime and nighttime signals. The continuous sounding with any fog signal apparatus or the firing of a gun is a signal for both day and night. In addition, at night, flames on the vessel, as from a burning tar barrel, oil barrel, and so on, may also be used.

Pilot Rules adds the daytime signal of slowly and repeatedly raising and lowering the outstretched arms. Boat crews of amphibious forces hold a life jacket aloft. We might add that no unusual signal or action should be ignored. Investigate to find out if the signaler needs assistance.

SUMMARY

Remember that nothing in the Rules of the Road will exonerate any vessel, the owner, master, or crew, from the consequences of any neglect to carry lights or signals, station lookouts, or neglect to take any precaution that may be required by good seamanship. You must take the ordinary precautions—carry the proper lights, use good judgment in your speed, and take any precautions necessary to avoid danger to your boat and its passengers. Be careful on the water at all times and be safe.

CHAPTER 7

COMMUNICATIONS

Communications is an age-old part of shipboard life. There are many phases of communications, and the Navy has ratings that handle these jobs day to day.

You, as a Boatswain's Mate, must have a working knowledge of flaghoists and voice radio procedures in your watch standing and duties on deck. When you complete this chapter, you should be able to recognize alphabet and numeral flags, as well as pennants and substitutes. You should be able to read a flaghoist and identify storm-warning signals. Finally, you should be familiar with voice radio procedures and how they are used in ship and boat operations.

FLAGHOIST SIGNALING

LEARNING OBJECTIVES: Recognize different flags and flaghoists. Explain the meaning of all flags and pennants.

Flaghoist signaling provides a rapid and accurate system of handling maneuvering and information signals of reasonable length, during daylight, between ships within sight of each other. In general, a flaghoist signal ensures a more uniform execution of a maneuver than does any other visual signaling system.

For signaling by flaghoist, the Navy uses the international alphabet flags and numeral pennants and, in addition, a set of numeral and special meaning flags and pennants.

PARTS OF A FLAG

Figure 7-1 shows the various types of flags and their parts.

- The **FLY** is the length of the flag as measured from the staff to the outside edge.
- The **HOIST** is the vertical width of the flag when it is flying free.
- The **TABLING** is the double thickness of bunting—taped, bound, and stitched—which is at the list of a flag.
- The **TAIL LINE,** carrying the snap hook, is a short length of halyard attached to the lower part of the tabling. It serves as a spacer, separating the flags of a hoist for clearness in reading signals.
- The **RING** is attached to the top of the tabling and snaps into the tail line of the preceding flag or hook of the halyard.
- The **TACKLINE** is a 6-foot length of braided signal halyard with a ring at one end and a snap hook at the other. The tackline is used to separate signals or groups of numerals that if not separated could convey a different meaning from that intended.

HOW TO READ FLAGHOISTS

The flags of a hoist are always read from the top down. When a signal is too long to fit on one halyard—when, in other words, it requires more flags than can be made into a single hoist—the signal must be continued

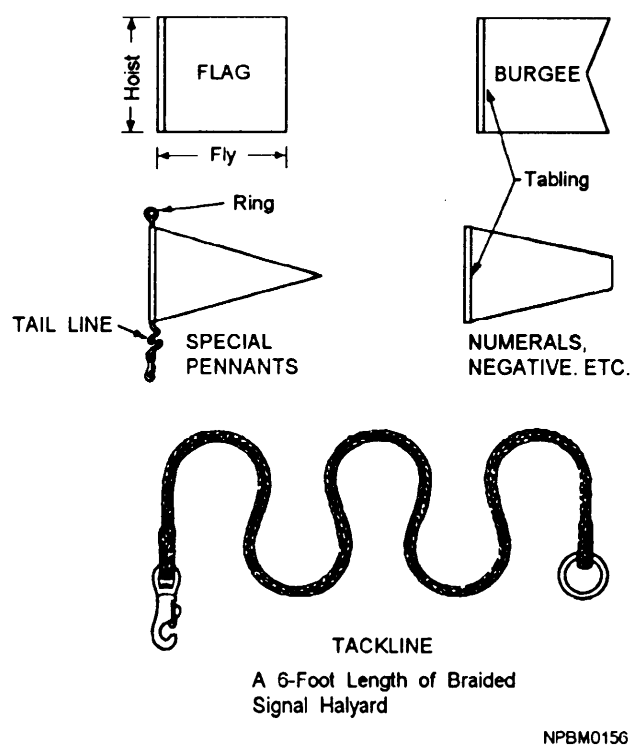


Figure 7-1 .—Parts of a flag.

on another halyard. When a signal is broken into two or more hoists, it must be divided at points where there can be a natural space without affecting the meaning of the signal.

A complete signal or group of signals—whether on one hoist or on two or more adjacent hoists flying at the same time—is called a display. When displays of more than one hoist are raised, the separate hoists are run up, one by one, in the correct order. Do not try to run them up simultaneously.

As a general rule, a signal too long to be shown completely on three halyards is made into two or more displays. When two or more displays are used, the heading must be hoisted on a separate halyard and kept flying while successive displays are made.

When two or more hoists are flying, they are read from outboard in or from forward aft. Figure 7-2 shows how to read a three-hoist display from the top down and from outboard in.

Flags may also be hoisted at the triatic stay. This is a line extending from the foremast to a stack or another mast. Such signals are read from forward to aft. A triatic stay is shown in figure 7-3. This illustration also shows hoists at two positions on a yardarm.

Signals hoisted at yardarms of different heights are read beginning at the highest yardarm. When several hoists are displayed simultaneously from different points, they are read in the following order: (1) masthead, (2) triatic stay, (3) starboard yardarm, and (4) port yardarm.

Terms used to describe the status of flaghoists are as follows:

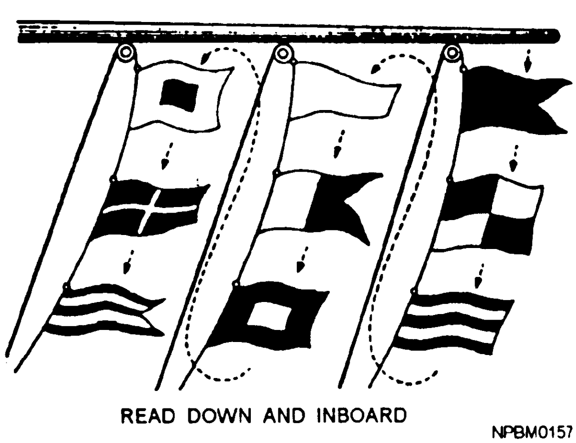


Figure 7-2.—Reading flaghoists.

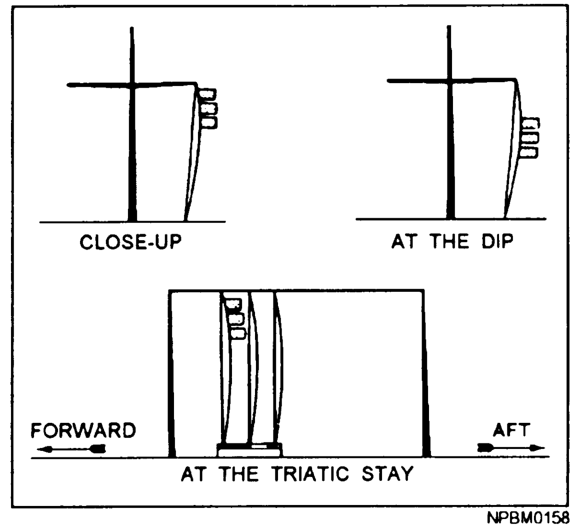


Figure 7-3.—Flaghoist positions.

- Close-up: A hoist is *close-up* when its top is touching the block at the point of hoist—that is, when the hoist is up as far as it will go.
- At the dip: A hoist is *at the dip* (or dipped) when it is hoisted three-fourths of the way up toward the point of hoist.
- Hauled down: A hoist is *hauled down* when it is returned to the deck.
- Superior position: Any hoist or portion of a hoist that is to be read before another hoist or portion of a hoist is said to be in a *superior position.*

FLAGSANDPENNANTS

You must learn all of the flags and pennants so well that you can recognize any one of them. (See figs. 7-4 and 7-5.) For you to be able to sketch each alphabet and numeral flag and each numeral pennant shown in the figures is desirable, but not absolutely necessary.

Memory aids are a big help in learning the flags. For example: CHARLIE, TANGO, and WHISKEY are the only flags that are *red, white,* and *blue.* You could also think of them as WTC—watertight compartment. CHARLIE has horizontal stripes—a berthing compartment has tiers of horizontal bunks. Anything watertight is completely enclosed—the blue square of WHISKEY completely encloses the white square, which completely encloses the red square. That leaves TANGO, the flag with the vertical stripes. TANGO could also be remembered as being similar to the flag of France (the stripes are in reverse order). You can make

FLAG and NAME	Spoken	Written	FLAG and NAME	Spoken	Written	FLAG and NAME	Spoken	Written
A	ALFA	A	M	MIKE	M	Y	YANKEE	Y
B	BRAVO	B	N	NOVEMBER	N	Z	ZULU	Z
C	CHARLIE	C	O	OSCAR	O	1	ONE	1
D	DELTA	D	P	PAPA	P	2	TWO	2
E	ECHO	E	Q	QUEBEC	Q	3	THREE	3
F	FOXTROT	F	R	ROMEO	R	4	FOUR	4
G	GOLF	G	S	SIERRA	S	5	FIVE	5
H	HOTEL	H	T	TANGO	T	6	SIX	6
I	INDIA	I	U	UNIFORM	U	7	SEVEN	7
J	JULIETT	J	V	VICTOR	V	8	EIGHT	8
K	KILO	K	W	WHISKEY	W	9	NINE	9
L	LIMA	L	X	XRAY	X	Ø	ZERO	Ø

Figure 7-4.—Alphabet and numeral flags.

PENNANT and NAME	Spoken	Written
1	PENNANT ONE	p1
2	PENNANT TWO	p2
3	PENNANT THREE	p3
4	PENNANT FOUR	p4
5	PENNANT FIVE	p5
6	PENNANT SIX	p6
7	PENNANT SEVEN	p7
8	PENNANT EIGHT	p8
9	PENNANT NINE	p9
Ø	PENNANT ZERO	pØ
TACK LINE	TACK	—

PENNANT or FLAG	Spoken	Written	PENNANT or FLAG	Spoken	Written
CODE or ANSWER	CODE or ANSWER	CODE or ANS	NEGATIVE	NEGAT	NEGAT
SCREEN	SCREEN	SCREEN	PREPARATIVE	PREP	PREP
CORPEN	CORPEN	CORPEN	PORT	PORT	PORT
DESIG-NATION	DESIG	DESIG	SPEED	SPEED	SPEED
DIVISION	DIV	DIV	SQUADRON	SQUAD	SQUAD
EMERGENCY	EMERGENCY	EMERG	STARBOARD	STARBOARD	STBD
FLOTILLA	FLOT	FLOT	STATION	STATION	STATION
FORMATION	FORMATION	FORM	SUBDIVISION	SUBDIV	SUBDIV
INTER-ROGATIVE	INTER-ROGATIVE	INT	TURN	TURN	TURN

SUBSTITUTES

1st. SUBSTITUTE	FIRST SUB	1st.	3rd. SUBSTITUTE	THIRD SUB	3rd.
2nd. SUBSTITUTE	SECOND SUB	2nd.	4th. SUBSTITUTE	FOURTH SUB	4th.

Figure 7-5.—Numeral pennants; special flags and pennants.

up any number of such things to jog your memory. They do not have to be logical. Often, the more exaggerated or silly they are, the easier they are to remember. Here's an example: "Gee, what a lot of stripes," for GOLF.

The numbered flags are easy. From 1 through 9, the basic colors, red, yellow, and blue, are repeated in that order. The first three have horizontal stripes, the next three have diagonal stripes, and 7, 8, and 9 have vertical stripes. Take one good look at zero. You are not apt to forget it.

Numeral flags are used along with alphabet flags and special pennants in flag signals, but numeral pennants are employed only in call signs. The special flags and pennants are used in tactical maneuvers to direct changes in position, speed, formation, and course; to indicate units; and to designate specific units.

SUBSTITUTES

Substitutes are used to prevent alphabet flags, numeral flags, or numeral pennants from appearing more than once in the same hoist. They are what their name implies—substitutes for other flags or pennants already used in the hoist.

- FIRST SUBSTITUTE repeats the first flag or pennant in the hoist.
- SECOND SUBSTITUTE repeats the second flag or pennant in the hoist.
- THIRD SUBSTITUTE repeats the third flag or pennant in the hoist.
- FOURTH SUBSTITUTE repeats the fourth flag or pennant in the hoist.

If you wanted to send the signal CHARLIE BRAVO BRAVO CHARLIE, it would read from the top down:

CHARLIE

BRAVO

SECOND SUBSTITUTE

FIRST SUBSTITUTE

The FIRST SUBSTITUTE has repeated the first flag in the hoist, and the SECOND SUBSTITUTE has repeated the second flag in the hoist.

Substitutes are not used to repeat other substitutes, but they can repeat the flag that a substitute represents, The tackline is not repeated. Therefore, when you count to determine which flag the substitute represents, do not include the tackline in the count.

Substitutes are also used as absentee pennants when a ship is not under way. They are flown from sunrise to sunset on the yardarms of the mainmast and indicate the absence of embarked officers and officials for less than 72 hours.

The FIRST SUBSTITUTE flown outboard at the starboard yardarm indicates the absence of the flag officer or unit commander whose flag or pennant is flying on the ship.

The SECOND SUBSTITUTE is the chief of staff's absentee pennant and is flown inboard at the port yardarm. When displayed with the THIRD SUBSTITUTE, it must be inboard.

The THIRD SUBSTITUTE is the captain's absentee pennant. It is flown outboard from the port yardarm. If the captain is absent over 72 hours, this pennant indicates the absence of the executive officer.

The FOURTH SUBSTITUTE indicates the absence of the civil or military official whose flag is flying on the ship. It flies from the inboard starboard yardarm. When displayed with the first substitute, it must be inboard.

NOTE

In the absence of a commanding officer who is acting as a temporary unit commander, both absentee pennants are displayed.

Ships' call signs are placed in two groups: international and visual.

International call signs are assigned according to international regulations. Call signs of U.S. naval ships are always four-letter groups, the first letter of which is N. These are the flaghoists you see flying from the yardarm each time your ship enters or leaves port.

Visual call signs are letters and numerals. A ship's call is made of numeral pennants, giving the ship's hull number, preceded by a letter designating the type of vessel. For example, cruiser 148 would be Cp1p4p8, and destroyer 563 would be Dp5p6p3. The first one or two numeral pennants may be dispensed with if there is no chance of confusion; that is, if no other ship of the same type in the area has the same second and third hull numbers. You should be able to recognize both the international and the visual call signs of your ship.

SINGLE FLAGS

Many one-flag signals are used in the Navy. Small vessels, which do not maintain a constant signal watch while in port, frequently rely on the PO of the watch to recognize some of these signals or to rouse out a QM or SM when needed. Of course, INDIA flying at the dip on an approaching vessel would require breaking out deckhands, not a Signalman, because INDIA shows that the ship is coming alongside. Every BM should know at least the few signals listed here. (Except where noted, these signals are flown where best seen.)

- ALFA: Divers or underwater demolition personnel are down. If a numeral group follows ALFA, the numbers indicate in hundreds of yards the radius within which the personnel are working.

- BRAVO: The BRAVO flag is hoisted whenever vessels are transferring fuel or explosives. During gunnery practice, it is flown on the appropriate side. It is also required in a boat (in the bow or where best seen) transporting fuel or explosives. While BRAVO flies, the smoking lamp is out.

- INDIA: In port, INDIA at the dip on an approaching ship indicates that it is preparing to come alongside. When the flag is hauled close up, it is ready to come alongside. INDIA is displayed on the side that the evolution is to take place. The receiving ship also flies INDIA on the appropriate side, at the dip to show that it is making preparations, and close up to show that it is ready to receive the approaching vessel. When the first line is secured, INDIA is hauled down on both ships. At sea, ROMEO serves as this signal.

- JULIETT: Your ship's call followed by JULIETT displayed on another ship indicates that the other ship has a semaphore message for your ship. JULIETT followed by DESIG indicates a priority message. The hoist remains flying during transmission and is hauled down when the message has been sent.

- MIKE: The ship having medical guard duty flies MIKE.

- OSCAR: OSCAR indicates man overboard and is made up ready to break.

- PAPA: PAPA calls all personnel attached to that ship to return to the ship.

- QUEBEC: QUEBEC is the boat recall. When flying alone, it orders all boats to return immediately. QUEBEC plus one or more numeral pennants recalls the boat addressed.

- ROMEO: In port, ROMEO is flown by the ship having the ready duty. At sea, it is flown by ships preparing for and ready for replenishing. It is hauled down when the first messenger is in hand (alongside method) or when the hose is in hand (astern method).

- SIERRA: SIERRA is flown while a ship is holding signal drill.

- YANKEE: In port, YANKEE is flown by the ship with the visual communications duty.

- EIGHT flag: The EIGHT flag is used when a boat is being directed by a ship during man overboard.

- EIGHT flag: The EIGHT flag hoisted alone means <u>steer straight away from the ship</u>. The EIGHT flag hoisted with the port or starboard flag means <u>steer to the left (or right)</u>.

- EIGHT flag: The EIGHT flag hoisted with SCREEN (BLACK PENNANT) means <u>steer straight to the ship</u>.

- FIVE flag: The FIVE flag is the breakdown flag and is usually carried at the foretruck and made up ready to break. Every sailor should be able to recognize and know the meaning of the FIVE flag and the OSCAR. Both flags are always carried ready to break.

You will need practice if you are to remember the flags and pennants. Probably the best time for you to practice reading hoists is during slack periods while standing BM watches. During these periods, there usually will be a Signalman nearby who can check you. You will soon become quite proficient at reading flags and will learn the meanings of many maneuvering and other signals.

UNITED STATES STORM-WARNING SIGNALS

The combinations of flags and pennants shown in figure 7-6 are hoisted at the National Weather Service and other shore stations in the United States to indicate

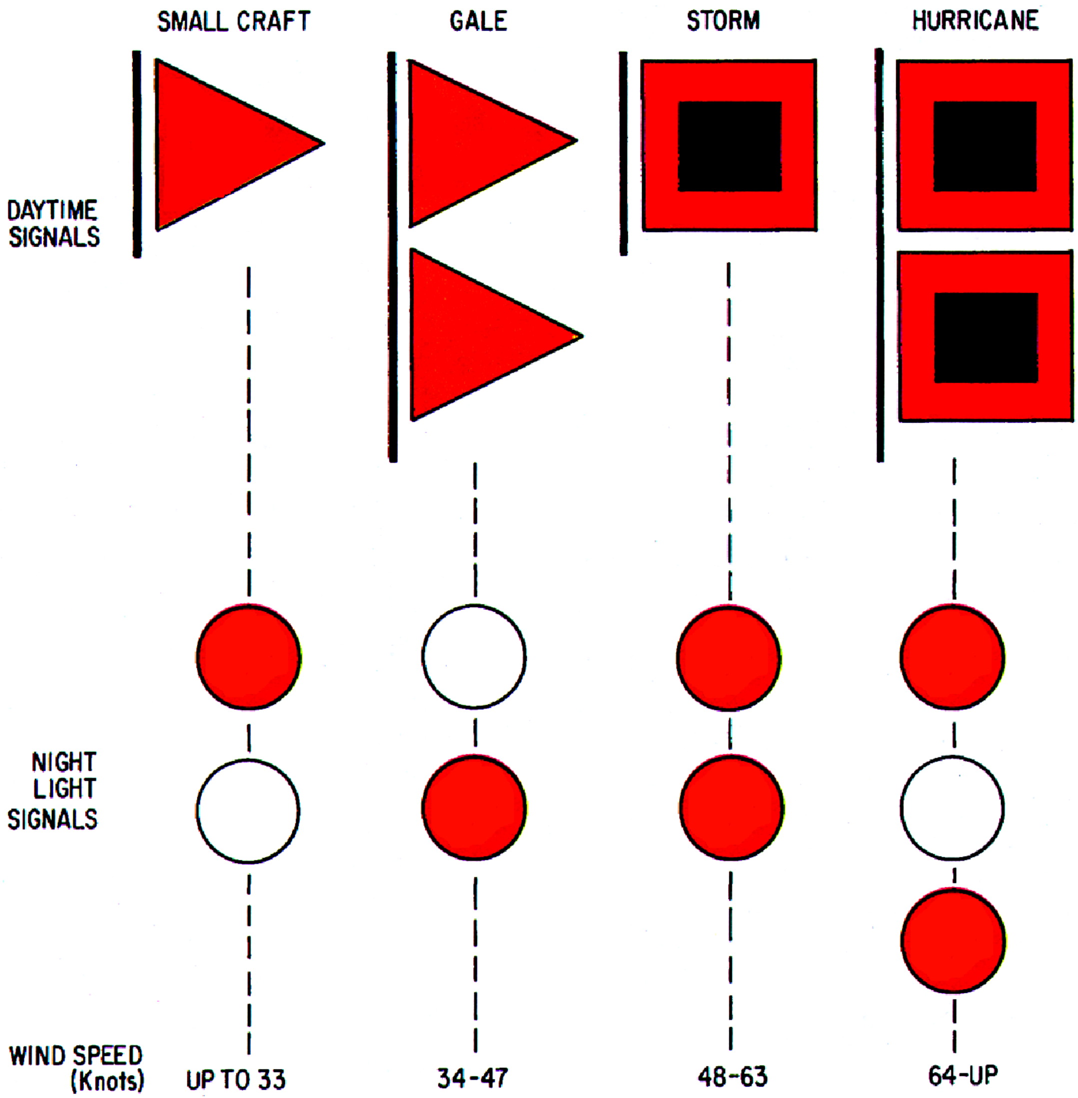


Figure 7-6.—Small-craft, gale, storm, and hurricane warnings.

existing or predicted unfavorable winds. The meanings of the various displays are given as follows:

- Small-craft warning: One red pennant displayed by day or a red light over a white light at night indicates that winds up to 38 miles an hour (33 knots) and/or sea conditions dangerous to small-craft operations are forecast for the area.

- Gale warning: Two red pennants displayed by day or a white light above a red light at night indicates that winds ranging from 39 to 54 miles an hour (34 to 47 knots) are forecast for the area.

- Storm warning: A single red flag with a black square center displayed by day or two red lights at night indicate that winds 55 miles an hour (48 knots) or above are forecast for the area. If the winds are associated with a tropical cyclone (tropical storm), the storm-warning display indicates that winds ranging from 55 to 73 miles an hour (48 to 63 knots) are forecast.

- Hurricane warning: Two red flags with black square centers displayed by day or a white light between two red lights at night indicates that winds of 74 miles an hour (64 knots) or above are forecast for the area.

VOICE RADIO

LEARNING OBJECTIVES: Describe the proper procedures for voice radio transmitting over the net. Explain the proper procedures for security over the net.

R/T, commonly known as voice radio, is an effective and convenient method of naval communications. It is used extensively for ship-to-ship tactical communication, convoy work, control of airborne aircraft, and countless tasks requiring rapid short-range communications. Small vessels such as district craft rely entirely upon R/T.

Voice radio supplements both radiotelegraph and visual methods of communications; it does not replace either. It has the advantages of simplicity of operation and direct transmission of the spoken word, but ease of operation has led to abuse. Careless use of voice procedure, and overloaded circuits, has at times led to much confusion when good communications were imperative. It is essential that you know the proper voice procedures and use them correctly.

RADIOTELEPHONE (R/T) SECURITY

Voice radio is considered the least secure means of communication. A message sent by radio is open to interception by anyone who has the proper equipment and is within reception range. Voice radio transmissions are much less secure than radiotelegraph transmissions on the same frequency, because anyone can understand them even without a knowledge of Morse code.

Careless and excessive use of voice radio is a serious hazard to communication security. Often, the problems of correct procedure and circuit discipline are complicated by the fact that the equipment can be and frequently is operated by untrained personnel. Circuit discipline is every bit as important on the voice radio as in radiotelegraph. Poor circuit discipline slows communications, causes confusion, and may give information to the enemy.

The following practices are serious violations and are strictly forbidden:

- Violating radio silence
- Unofficial conversation between operators
- Transmitting in a directed net (nets are described later) without permission
- Excessive tuning and testing
- Transmitting an operator's name or personal sign
- Using unauthorized procedure words (prowords)
- Using plain language in place of applicable prowords or operating signals
- Linking or compromising classified call signs and address groups by plain language disclosures or association with unclassified call signs
- Using profane, indecent, or obscene language

Security precautions required for the use of the voice radio include the following:

- Use the circuit only for its intended purpose.
- Keep the number of transmissions to a minimum.
- Write the message before transmission, if possible.
- Keep transmissions brief, concise, and clear.
- Transmit no classified information in plain language.
- Avoid linkage between voice radio call signs and other types of call signs.
- Follow prescribed voice radio procedures at all times.

TRANSMITTING TECHNIQUE

The following is a guide for developing a good voice radio transmitting technique.

ALWAYS;

- Listen before transmitting. Unauthorized breaking in causes confusion. Often, neither transmission gets through.
- Speak clearly and distinctly. Slurred syllables and clipped speech are difficult to understand.
- Speak slowly. Give the recorder a chance to write the entire message the first time. You will save time and repetition.

- Avoid extremes of pitch. A high voice cuts best through interference, but if too high, it is shrill and unpleasant.

- Speak naturally. Maintain a normal speaking rhythm. Transmit the message by phrases rather than word by word.

- Use standard pronunciation. Speech with sectional peculiarities is difficult for persons from other parts of the country to understand.

- Speak in a moderately strong voice. This technique overrides unavoidable background noises and reduces requests for repeats.

- Keep the correct distance (about 2 inches) between lips and microphone.

- Shield your microphone from noise-generating sources while transmitting.

- When practical, release the microphone button and pause momentarily between phrases. This procedure allows other stations with higher precedence traffic to break in.

- Adhere strictly to prescribed procedures as contained in ACP 125.

- Transact your business and get off the air. Preliminary calls waste time when communications are good and the message is short. It is unnecessary to blow into a microphone to test it or to repeat portions of messages unless repetition is requested.

<u>NEVER</u>:

- Never transmit near persons engaged in loud discussions. Extraneous noises cause confusion at receiving stations.

- Never hold the microphone button in the push-to-talk position until you are ready to transmit. Depressing the button blocks communications on the net.

- Never hold the handset loosely. A firm pressure on the microphone button will prevent unintentional release and signal interruption.

- Never send test signals for longer than 10 seconds.

PROCEDURE WORDS

Procedure words (prowords) are words and phrases used to speed the handling of RFT messages. They perform the same function and are used in the same manner as prosigns. Most prosigns and prowords have the same meaning.

A complete list of prowords and their prosign equivalents, where applicable, is contained in table 7-1.

PHONETIC ALPHABET

When necessary to identify any letter of the alphabet, the standard phonetic alphabet must be used. This following list contains this alphabet:

LETTER	PHONETIC	SPOKEN AS
A	ALFA	AL FAH
B	BRAVO	<u>BRAH</u> VOH
C	CHARLIE	<u>CHAR</u> LEE or <u>SHAR</u> LEE
D	DELTA	<u>DELL</u> TAH
E	ECHO	<u>ECK</u> OH
F	FOXTROT	<u>FOKS</u> TROT
G	GOLF	GOLF
H	HOTEL	HOH <u>TELL</u>
I	INDIA	IN DEE AH
J	JULIETT	<u>JEW</u> LEE ETT
K	KILO	<u>KEY</u> LOH
L	LIMA	<u>LEE</u> MAH
M	MIKE	MIKE
N	NOVEMBER	NO <u>VEM</u> BER
O	OSCAR	<u>OSS</u> CAH
P	PAPA	PAH <u>PAH</u>
Q	QUEBEC	KEH <u>BECK</u>
R	ROMEO	<u>ROW</u> ME OH
S	SIERRA	SEE AIR RAH
T	TANGO	<u>TANG</u> GO
U	UNIFORM	YOU NEE FORM
V	VICTOR	<u>VIK</u> TAH
W	WHISKEY	<u>WISS</u> KEY
X	XRAY	<u>ECKS</u> RAY
Y	YANKEE	YANG KEY
Z	ZULA	<u>ZOO</u> LOO

(**NOTE:** Syllables underlined carry the accent.)

Table 7-1.—Radiotelephone Prowords and Their Prosign Equivalents (page 1 of 2)

Proword	Explanation	Proword Equivalent
ADDRESS GROUP	The group that follows is an address group.	
ALL AFTER	The portion of the message to which I have reference is all which follows ________________.	AA
ALL BEFORE	The portion of the message to which I have reference is all that precedes ________________.	AB
AUTHENTICATE	The station called is to reply to the challenge which follows.	
AUTHENTICATION IS	The transmission authentication of this message is __________.	
BREAK	I hereby indicate the separation of the text from other portions of the message.	$\overline{\text{BT}}$
CALL SIGN	The group that follows is a call sign.	
CORRECT	You are correct, or what you have transmitted is correct.	C
CORRECTION	An error has been made in this transmission. Transmission will continue with the last word correctly transmitted.	EEEEEEEE
	An error has been made in this transmission (or message indicated). The correct version is ____________.	C
	That which follows is corrected version in answer to your request for verification.	C
DISREGARD THIS TRANSMISSION-OUT	This transmission is in error. Disregard it. This proword shall not be used to cancel any message that has been completely transmitted and for which receipt or acknowledgment has been received.	EEEEEEEE $\overline{\text{AR}}$
DO NOT ANSWER	Stations called are not to answer this call, receipt for this message, or otherwise to transmit in connection with this transmission. When this proword is employed, the transmission shall be ended with the proword "out."	F
EXECUTE	Carry out the purport of the message or signal to which this applies. To be used only with the Executive Method.	$\overline{\text{IX}}$ (5 sec dash)
EXECUTE TO FOLLOW	Action on the message or signal which follows is to be carried out upon receipt of the proword "EXECUTE." To be used only with the Delayed Executive Method.	$\overline{\text{IX}}$
EXEMPT	The addressees immediately following are exempted from the collective call.	XMT
FIGURES	Numerals or numbers follow.	
FLASH	Precedence FLASH.	Z
FROM	The originator of this message is indicated by the address designator immediately following.	FM
GROUPS	This message contains the number of groups indicated by the numeral following.	GR
GROUP NO COUNT	The groups in this message have not been counted.	GRNC
I AUTHENTICATE	The group that follows is the reply to your challenge to authenticate.	
IMMEDIATE	Precedence IMMEDIATE.	O
IMMEDIATE EXECUTE	Action on the message or signal following is to be carried out on receipt of the word EXECUTE. To be used only with the Immediate Executive Method.	$\overline{\text{IX}}$
INFO	The addressees immediately following are addressed for information.	INFO
I READ BACK	The following is my response to your instruction to read back.	
I SAY AGAIN	I am repeating transmission or portion indicated.	$\overline{\text{IMI}}$
I SPELL	I shall spell the next word phonetically.	
I VERIFY	That which follows has been verified at your request and is repeated. To be used only as a reply to VERIFY.	
MESSAGE	A message which requires recording is about to follow. Transmitted immediately after the call. (This proword is not used on nets primarily employed for conveying messages. It is intended for use when messages are passed on tactical or reporting nets.)	

Table 7-1.—Radiotelephone Prowords and Their Prosign Equivalents (page 2 of 2)

Proword	Explanation	Proword Equivalent
NET NOW	All stations are to net their radios on the unmodulated carrier wave which I am about to transmit.	
NUMBER	Station Serial Number.	NR
OUT	This is the end of my transmission to you and no answer is required or expected.	
OVER	This is the end of my transmission to you and a response is necessary. Go ahead; transmit.	K
PRIORITY	Precedence PRIORITY.	P
READ BACK	Repeat this entire transmission back to me exactly as received.	G
REBROADCAST YOUR NET	Link the two nets under your control for automatic rebroadcast.	
RELAY (TO)	Transmit this message to all addressees immediately following.	T
ROGER	I have received your last transmission satisfactorily.	R
ROUTINE	Precedence ROUTINE.	R
SAY AGAIN	Repeat all of your last transmission. Followed by identification data means "Repeat ___________ (portion indicated)."	
SERVICE	The message that follows is a service message.	SVC
SIGNALS	The groups which follow are taken from a signal book. (This proword is not used on nets primarily employed for conveying signals. It is intended for use when tactical signals are passed on nontactical nets.)	
SILENCE (Repeated three or more times)	Cease transmissions on this net immediately. Silence will be maintained until lifted. (When an authentication system is in force the transmission imposing silence is to be authenticated.)	$\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$
SILENCE LIFTED	Silence is lifted. (When an authentication system is in force the transmission lifted silence is to be authenticated.)	
SPEAK SLOWER	Your transmission is at too fast a speed. Reduce speed of transmission.	
STOP REBROADCASTING	Cut the automatic link between the two nets that are being rebroadcast and revert to normal working.	
THIS IS	This transmission is from the station whose designator immediately follows.	DE
TIME	That which immediately follows is the time or date-time group of the message.	
TO	The addressees immediately following are addressed for action.	TO
UNKNOWN STATION	The identity of the station with whom I am attempting to establish communication is unknown.	$\overline{\text{AA}}$
VERIFY	Verify entire message (or portion indicated) with the originator and send correct version. To be used only at the discretion of or by the addressee to which the questioned message was directed.	J
WAIT	I must pause for a few seconds.	$\overline{\text{AS}}$
WAIT-OUT	I must pause longer than a few seconds.	$\overline{\text{AS}}$ $\overline{\text{AR}}$
WILCO	I have received your signal, understand it, and will comply. To be used only by the addressee. Since the meaning of ROGER is included in that of WILCO, the two prowords are never used together.	
WORD AFTER	The word of the message to which I have reference is that which follows _____________.	WA
WORD BEFORE	The word of the message to which I have reference is that which precedes ___________.	WB
WORDS TWICE	Communication if difficult. Transmit(ting) each phrase (or each code group) twice. This proword may be used as an order, request, or as information.	
WRONG	Your last transmission was incorrect. The correct version is ___________.	

In naval communications, when the signals from the naval signal books are transmitted by R/T, the spoken (voice) equivalents of the flags that appear in the books must be used.

Difficult words or groups within the text of plain text messages may be spelled out using the phonetic alphabet and preceded by the proword I SPELL. If the operator can pronounce the word to be spelled, he/she will do so before and after the spelling to identify the word.

Example A:

CATENARY— I SPELL CHARLIE ALFA TANGO ECHO NOVEMBER ALFA ROMEO YANKEE— CATENARY

Example B:

RENDEZVOUS POINT IS— I SPELL UNIFORM NOVEMBER INDIA MIKE ALFA KILO

PRONUNCIATION OF NUMERALS

To distinguish numerals from words similarly pronounced, you may use the proword FIGURES preceding such numbers.

When numerals are transmitted by R/T, the following rules for their pronunciation will be observed:

NUMERAL	SPOKEN AS
0	ZE-RO
1	WUN
2	TOO
3	TREE
4	FOW-ER
5	FIFE
6	SIX
7	SEV-EN
8	AIT
9	NIN-ER

Numbers will be transmitted digit by digit except that exact multiples of thousands may be spoken as such. However, there are special cases, such as antiair warfare reporting procedures, when the normal pronunciation of numerals is prescribed and this rule does not apply. For example, 17 would then be "seventeen."

NUMERAL	SPOKEN AS
44	FOW-ER FOW-ER
90	NIN-ER ZE-RO
136	WUN TREE SIX
500	FIFE ZE-RO ZE-RO
1478	WUN FOW-ER SEV-EN AIT
7000	SEV-EN TOU-SAND
16000	WUN SIX TOU-SAND
812681	AIT WUN TOO SIX AIT WUN

The decimal point is to be spoken as DAY-SEE-MAL. For example, 123.4 is to be spoken WUN TOO TREE DAY-SEE-MAL FOW-ER.

Dates must be spoken digit by digit, with the months in full. For example, 20 August is spoken TOO ZE-RO AUGUST.

Roman numerals must be transmitted as the corresponding Arabic numerals preceded by the word *ROMAN.*

VOICE CALLS

A voice call is assigned to each ship, administrative commander, and tactical commander, as well as to the collective units that they command. Call signs, which are tactical in nature, usually consist of spoken words that can be transmitted and understood more rapidly and effectively than the actual names of ships or afloat commands.

There are two types of calls: unit and collective. A unit call is one used to call the commander of a task force, group, unit, squadron, or division, or an individual ship.

Collective calls over a net can best be shown graphically, as in figure 7-7. Four destroyers, USS *Brown,* USS *Black,* USS *Green,* and USS *White,* make up the administrative organization of Destroyer Division 121 and are temporarily assigned to a tactical organization, Task Group 28.2. Each ship and command is assigned a prescribed voice call as follows:

USS *Brown*	ADAM
USS *Black*	DITTYBAG
USS *Green*	SATAN
USS *White*	FOXFIRE

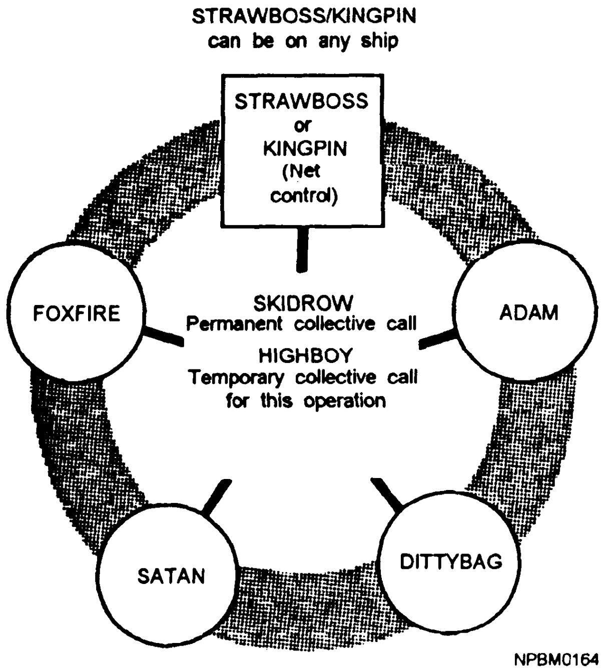


Figure 7-7.—Radiotelephone net.

DESDIV 121	SKIDROW (collective call for ships in DESDIV 121)
COMDESDIV 121	STRAWBOSS
TG 28.2	HIGHBOY (collective call for ships while assigned to TG 28.2)
CTG 28.2	KINGPIN

A typical collective call-up would be SKIDROW— THIS IS STRAWBOSS, followed by the message. When the officer in tactical command (OTC) uses the collective call of a group of ships, the ships answer in alphabetical order corresponding to their voice call signs. If one ship fails to answer in proper sequence, the next ship due to report waits about 5 seconds before answering. The ship that missed its turn then comes in at the end. For brevity, answering ships omit the voice call of the originator and start with THIS IS ____.

There are occasions when tactical calls may be eliminated and the ship's name used as a call. This normally is done, for example, by ships in port over what is known as the harbor common net. This circuit is used for passing weather information, instructions from the senior officer present afloat (SOPA), berthing instructions for ships entering port, and other like matters.

RADIO NETS

A radio net consists of two or more stations capable of direct communication on a common circuit, as in figure 7-7. Each net is under the control of a net control station, which is a ship designated by the OTC to direct and control the operation and flow of traffic on that net. Normally the flagship is net control, but it may be any station on the net that can best exercise circuit discipline and expedite traffic.

The method of operating on a net is determined by operational factors involved.

In a free net, the net control station authorizes member stations to transmit traffic to other stations in the net without obtaining prior permission from the control station. The latter, however, remains responsible for maintaining circuit discipline.

When on a directed net (transmissions made only as directed by net control), stations obtain permission before communicating with other stations unless this is done according to predetermined schedules. Permission is not required for the transmission of FLASH messages, which will be sent direct.

Radio (including R/T) nets are classified into three types according to their mission (purpose): (1) command, (2) common, and (3) functional.

A command net is one linking a commander with immediate subordinates in the chain of command and other units as may be designated. A task force command net, for example, is activated by the task force (TF) commander and guarded by the group commander.

A common net is one linking all ships and/or troop units of the same task organization. For instance, a task group common net is activated by the task group commander and guarded by all ships or troop units in the task group (TG).

A functional net is one normally used to connect directly those personnel delegated control of a specified function for which the net is provided, such as a picket reporting net.

VOICE RADIO OPERATING PROCEDURES

For purposes of illustration, the R/T transmissions in the remainder of this chapter are assumed to pass over the net shown in figure 7-7. Dashes in the examples indicate natural pauses between words and phrases.

Calling and Answering

Communication is established by a preliminary call and answer. The call-and-answer procedure takes one of three forms: full call, collective call, and abbreviated call.

The full call takes the following form:

FOXFIRE—	Call sign of station called.
THIS IS	From.
STRAWBOSS—	Call sign of station calling.
OVER	Go ahead; transmit.

The reply is in the same form: STRAWBOSS—THIS IS FOXFIRE—OVER. If two or more stations had been called, they would reply in alphabetical order of voice call signs.

A collective call may be used when all, or most, stations on the net are addressed. When necessary, the collective call may contain the proword EXEMPT, followed by the call sign(s) of the station(s) exempted from the collective call.

SKIDROW—	Collective call.
EXEMPT	Exempt.
DITTYBAG—	Call sign of exempted station.
THIS IS	From.
STRAWBOSS—	Call sign of station calling.
OVER	Go ahead; transmit.

ADAM, FOXFIRE, and SATAN answer in that order.

In an abbreviated call, the call sign of the station called is omitted when the call is part of an exchange of transmissions between stations and when no confusion is likely to result.

Example:

THIS IS ADAM—OVER

Repetitions

When words are missing or are doubtful, a repetition is requested by the called station. For this purpose the proword SAY AGAIN is used alone or with the proword ALL BEFORE, ALL AFTER, WORD BEFORE, or WORD AFTER. In complying with such requests, the transmitting station identifies that portion to be repeated. For example, DITTYBAG sent a message to SATAN, but SATAN missed the word following ship. SATAN transmits:

DITTYBAG—THIS IS SATAN—SAY AGAIN—WORD AFTER SHIP—OVER

DITTYBAG then transmits:

SATAN—THIS IS DITTYBAG—I SAY AGAIN—WORD AFTER SHIP—SIGHTED—OVER

After receiving the doubtful portion, DITTYBAG receipts for the entire message with ROGER.

You may give repetitions in plain language messages by natural phrases or by individual words.

Correcting an Error

When an error is made by a transmitting operator, he/she sends the proword CORRECTION. The operator then repeats the last word, group, proword, or phrase correctly sent, corrects the error, and proceeds with the message.

Example:

ADAM—THIS IS STRAWBOSS——TIME ONE ZERO ONE TWO ZULU—BREAK—CONVOY ROMEO THREE—CORRECTION—CONVOY SIERRA ROMEO THREE—SHOULD ARRIVE—ONE SIX THREE ZERO LIMA—OVER

If the error is not discovered until the operator is some distance beyond it, the correction may be made at the end of the message. The operator must be careful to identify the exact portion that is being corrected.

Example:

ADAM—THIS IS STRAWBOSS—TIME ZERO SIX THREEZERO ZULU—BREAK—ARE YOU RIGGED FOR HEAVY WEATHER—CORRECTION—TIME ZERO SIX FOUR ZERO ZULU—OVER

Canceling a Message

Before the ending proword OVER or OUT is transmitted, a message may be canceled by sending DISREGARD THIS TRANSMISSION—OUT at any time during the transmission. For example, STRAWBOSS discovers the message being sent is to the wrong station and cancels it accordingly:

FOXFIRE—THIS IS STRAWBOSS—TIME ZERO SIX ZERO TWO ZULU—COMMENCE UNLOADING AT—DISREGARD THIS TRANSMISSION—OUT

A message already transmitted can be canceled only by another message.

Do Not Answer

When it is imperative that called stations do not answer a transmission, the proword DO NOT ANSWER is transmitted immediately following the call. The complete transmission is sent twice.

Example:

SKIDROW—THIS IS STRAWBOSS—DO NOT ANSWER—OPERATIONAL IMMEDIATE—TIME ONE SIX THREE ZERO ZULU—BREAK—NOVEMBER YANKEE DELTA PAPA—I SAY AGAIN—SKIDROW —THIS IS STRAWBOSS—DO NOT ANSWER—OPERATIONAL IMMEDIATE —TIME ONE SIX THREE ZERO ZULU— BREAK—NOVEMBER YANKEE DELTA PAPA—OUT

Verifications

When verification of a message is requested, the originating station verifies with the originating person and sends the correct version.

Example A:

STRAWBOSS—THIS IS ADAM—VERIFY MESSAGE—TIME ONE ZERO ZERO EIGHT ZERO ONE ZULU—ALL BEFORE TEXT—OVER

STRAWBOSS transmits:

THIS IS STRAWBOSS—ROGER—OUT

STRAWBOSS, after checking with the originating officer, finds the heading correct as transmitted previously. STRAWBOSS sends:

ADAM—THIS IS STRAWBOSS—I VERIFY—MESSAGE—TIME ONE ZERO ZERO EIGHT ZERO ONE ZULU—ALL BEFORE TEXT—ADAM—THIS IS STRAWBOSS—PRIORITY—TIME ONE ZERO ZERO EIGHT ZERO ONE ZULU—FROM STRAWBOSS—TO ADAM—INFO DITIYBAG—GROUPS ONE SEVEN—BREAK—OVER

ADAM receipts for the transmission:

THIS IS ADAM—ROGER—OUT

Example B:

STRAWBOSS—THIS IS SATAN—VERIFY MESSAGE TIME ZERO EIGHT FOUR FIVE ZULU—WORD AFTER PROCEED—OVER

STRAWBOSS transmits:

THIS IS STRAWBOSS—ROGER—OUT

STRAWBOSS' operator finds that the originating officer meant Hong Kong rather than Shanghai as the word after PROCEED. STRAWBOSS transmits:

SATAN—THIS IS STRAWBOSS—CORRECTION ——TIME ZERO EIGHT FOUR FIVE ZULU—WORD AFTER PROCEED—HONG KONG—OVER

SATAN transmits:

THIS IS SATAN—ROGER—OUT

Read Back; Words Twice

Further checks on transmission accuracy can be obtained with the prowords READ BACK and WORDS TWICE.

Send READ BACK when you want the message repeated back to you exactly as received. Transmit the proword immediately after the call. If an addressee repeats a message incorrectly, the originator transmits the proword WRONG, followed by the correct version.

When communication is difficult, you may use the proword WORDS TWICE to indicate that each phrase (or code group) will be repeated. The call sign first is made twice, followed by WORDS TWICE and the message.

Example:

FOXFIRE—FOXFIRE—THIS IS STRAWBOSS—STRAWBOSS—OVER

FOXFIRE replies:

STRAWBOSS—STRAWBOSS—THIS IS FOXFIRE—FOXFIRE—OVER

STRAWBOSS sends the message:

FOXFIRE—FOXFIRE—THIS IS STRAWBOSS—STRAWBOSS—WORDS TWICE—WORDS TWICE—ROUTINE—ROUTINE—TIME ONE SIX THREE ZERO ZULU—TIME ONE SIX THREE ZERO ZULU—BREAK—BREAK—MAIL FOR YOU—MAIL FOR YOU—RECEIVE AT FIRST LIGHT—RECEIVE AT FIRST LIGHT—OVER

FOXFIRE receipts:

STRAWBOSS—STRAWBOSS—THIS IS FOXFIRE—FOXFIRE—ROGER—ROGER-OUT

Radio Checks, Signal Strength, and Readability

A station is understood to have good signal strength and readability unless otherwise notified. Strength of signals and readability will not be exchanged unless one station cannot clearly hear another station.

A station that wishes to inform another of his/her signal strength and readability will do so by means of a short and concise report of actual reception, such as "Weak, but readable," "Loud but distorted," or "Weak with interference."

The following prowords are for use when an operator is initiating and answering queries concerning signal strength and readability:

- General

RADIO CHECK	What is my signal strength and readability; that is, how do you hear me?
ROGER	I have received your last transmission satisfactorily. The omission of comment on signal strength and readability is understood to mean that reception is loud and clear. If reception is other than loud and clear, it must be described with the prowords from subparagraphs. Report of signal strength and report of readability.
NOTHING HEARD	To be used when no reply is received from a called station.

- Report of Signal Strength

LOUD	Your signal is very strong.
GOOD	Your signal strength is good.
WEAK	Your signal strength is weak.
VERY WEAK	Your signal strength is very weak.
FADING	At times your signal strength fades to such an extent that continuous reception cannot be relied upon.

- Report of Readability

CLEAR	Excellent quality.
READABLE	Quality is satisfactory.
UNREADABLE	The quality of your transmission is so bad that I cannot read you.
DISTORTED	Having trouble reading you because your signal is distorted.
INTERFERENCE	Having trouble reading you due to interference.
INTERMITTENT	Having trouble reading you because your signal is intermittent.

Relay

The proword RELAY, used alone, indicates that the station called is to relay the message to all addressees.

Example:

FOXFIRE—THIS IS STRAWBOSS—RELAY—PRIORITY—TIME ZERO NINER ONE ZERO ZULU—FROM—STRAWBOSS—TO—ADAM—SATAN—BREAK—REPORT NUMBER ROUNDS EXPENDED LAST RUN—OVER

After FOXFIRE receipts for the message, the relay is as follows:

ADAM—SAXiN—THIS IS FOXFIRE—
PRIORITY—TIME—ZERO NINER ONE ZERO
ZULU—FROM—STRAWBOSS—TO—
ADAM—SATAN—BREAK—REPORT
NUMBER ROUNDS EXPENDED LAST
RUN—OVER

The proword RELAY TO followed by an addressee means that the station called is to relay the message to the station indicated. When more than one station is called, the call sign of the station to relay precedes the proword RELAY TO.

Example:

DITTYBAG—SATAN—THIS IS
STRAWBOSS— SATAN—RELAY TO
FOXFIRE—MESSAGE FOLLOWS—
ROUTING—TIME ZERO ONE TWO TWO
ZULU—FROM STRAWBOSS—TO
FOXFIRE—INFO—DITTYBAG—SATAN—
BREAK—PROCEED ON MISSION
ASSIGNED—OVER

SATAN receipts and relays as instructed:

FOXFIRE—THIS IS SATAN—MESSAGE
FOLLOWS—ROUTINE—TIME ZERO ON
TWO TWO ZULU—FROM STRAWBOSS—TO
FOXFIRE—INFO—DITTYBAG—SATAN—
BREAK—PROCEED ON MISSION
ASSIGNED—OVER

Authentication

A R/T message must be authenticated if there is any chance it might be of enemy origin. Be alert and quick to be suspicious. Sometimes you can spot an enemy deceptive message by the operator's mistakes in procedure or in English grammar or pronunciation. One of the best informal (but not foolproof) authenticators is to be able to recognize the other operator's voice.

Authentication is mandatory when any of the following conditions exists:

- Any station suspects imitative deception on a circuit
- Any station is challenged or requested to authenticate
- Making contact and amplifying reports in plain language or brevity code
- Directing radio silence or requiring a station to break an imposed radio silence

Good judgment sometimes dictates that an operator accept a message rather than argue over authentication, even though doubt of its legitimacy exists. Such a message should be delivered promptly to the addressee with the operator's notation that it was authenticated improperly. The decision governing its authenticity is made by the addressee.

SUMMARY

In this chapter you were shown the different types of communication between a small boat and the ship. You have also been shown the different types of flags and their uses. You will need to be able to identify all flags by sight and know what they stand for. Always remember, if you do not know something when dealing in communications, ask before you make a mistake over the net.

CHAPTER 8

RIGGING

In this chapter, you will learn about standing rigging and running rigging. You will study the formulas for finding the safe working loads (SWLs) and breaking strengths (BSs) of line and wire rope. You will also learn how to compute area and volume, so that you may estimate weights intelligently. When studying the sections concerning computations, you would be wise to work each of the examples and make sure you completely understand how to work them.

The word rig is loosely derived from the Scandinavian word *rigga,* which means to *bind or to wrap around.* Through usage, however, rig has come to mean many more things to a sailor. It means, for instance, the arrangement of masts, yards, and ropes of sailing ships; assembling and arranging gear for handling heavy weights and cargo; preparing for, such as rigging a ship for heavy weather. It also means adjusting and can even mean the outfit of clothing you wear.

You will become familiar with the expression *jury* rig. Originally, this meant the temporary arrangement of spars and sails to bring a dismasted vessel into port. Today, the term refers to temporary rigging erected to handle weights.

The rigging of a ship is broken down further into standing and running rigging. Standing rigging comprises the stays and shrouds that support the mast. Running rigging includes all movable lines or wires rove through blocks.

STANDING RIGGING

LEARNING OBJECTIVES Identify standing rigging and blocks and tackles. Describe how running rigging works on board a ship.

Standing rigging, usually of 6 x 19 galvanized improved-plow-steel (IPS) wire rope, is used to support the masts. The fore-and-aft supports are called stays, and the supports running arthwartships are shrouds. Stays and shrouds are set up at the lower end with turnbuckles, and those in the line of fire of the guns are also fitted with pelican hooks so that they may be moved quickly. Vibration often causes turnbuckles to back off. Keepers are installed on most turnbuckles in standing rigging to prevent backing off.

All standing rigging is grounded to the ship's structure with a bonding strap (fig. 8-1) to eliminate the effects of charges in rigging induced by electromagnetic radiation. When making any adjustments to the shrouds and stays, you must disconnect the bonding straps to preclude damage and/or breaking. Upon completion of adjustments, you must reconnect them.

When shrouds and stays are allowed to become slack, their effectiveness is reduced. Standing rigging should, therefore, be inspected periodically and tightened when necessary. The following procedures MUST be observed when considerable adjustments are required:

- Disconnect the bonding straps. Loosen the turnbuckles to slacken all shrouds and stays so that no unbalanced forces are applied to the mast.
- Take up the slack as uniformly as possible until sag is substantially eliminated from all stays and shrouds, and turnbuckles are hand-tight. Measure the distance between the ends of the tumbuckle bolts.
- Tighten each tumbuckle so that the distance is shortened 1 inch for each 60 feet of stay length. Reconnect the bonding straps.

All metallic standing rigging is wormed, parceled, and served at splices and thimbles and in places where chafing is likely. Coverings, however, could conceal rust and other defects; therefore, they should be cut off and the splices and eyes carefully inspected when specified by the Planned Maintenance System (PMS).

Before wire rope is served, it should be clean and bright, free from rust. Insulators on rigging should present clean surfaces. They should not be painted, tarred, varnished, or coated in any way.

All electrical bond straps on standing rigging should be inspected for damage, broken or missing fittings, and excessive deterioration at points of contact between dissimilar metals as specified by the PMS periodicity

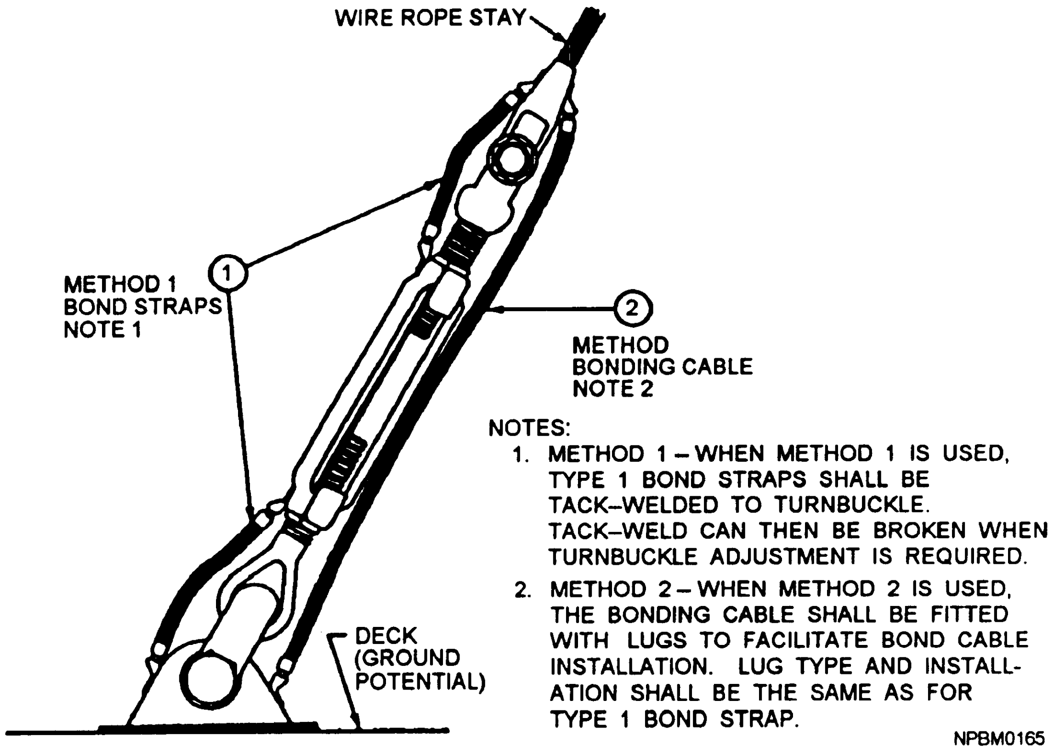


Figure 8-1.—Bonding straps on standing rigging.

and procedures. Report deficiencies to the work center supervisor and/or the division officer.

RUNNING RIGGING

Running rigging consists of hoists, topping lifts, vangs, guys, preventers, and associated blocks involved in the lifting and supporting of heavy weights and cargo. Running rigging also includes all of the movable gear associated in underway replenishment (UNREP) rigs.

Each ship or class of ship has a rigging plan. The rigging plan contains exact descriptions of the blocks and indicates their uses. A similar rope list is included for the lines and wires used in a ship's rigging.

Problems can be avoided and the rig made safer by strict adherence to the rigging diagram when placing running rigging.

Inspection, preventive maintenance, and tests of all booms and their rigging and associated fittings are conducted by a responsible officer of the weapons or deck department at regularly scheduled intervals as indicated and according to the appropriate maintenance requirement cards (MRCs).

Whenever a boom is to be used for hoisting or lowering a load equal to its rated capacity, shown on the label plate on the boom, the head of the weapons or deck department should be notified. The head of the department will assign a senior Boatswain's Mate to make a thorough inspection of the boom and its associated fittings and rigging before the lift is made.

Whenever signs of deterioration are found, defective components should be replaced or renewed at the earliest opportunity. When the inspection indicates a dangerous condition or weakness of any component, this condition should be reported without delay, and the boom in question should not be operated until repair or replacement of the component is effected. Unusual conditions and repeated failures must be reported to Naval Sea Systems Command.

More detailed information concerning the use, care, and testing of cranes, booms, and rigging is contained in *Naval Ships' Technical Manual (NSTM),* chapters 573 and 589.

BLOCKS AND TACKLES

LEARNING OBJECTIVES: Explain the uses of blocks and tackles as used by a Boatswain's Mate. Explain the difference between fiber blocks and wire blocks.

A block consists of one or more sheaves fitted in a wood or metal frame. Each block has one or more straps of steel that support the center pin on both sides of each sheave. By means of a hook or shackle inserted in the strap, the block itself may be suspended or a load applied to the block. When the block has a becket to which the fall is spliced, the becket is also secured to the strap.

A block with a line led over the sheave is convenient in applying power by changing the direction of the pull. Used in conjunction with line and another block, the block, with line, becomes a tackle (pronounced TAY-kul) and increases the power applied on the hauling part. The parts of a fiber rope block are shown in figure 8-2. The size of a block, designated in inches, is found by measuring the length of the cheek.

Since blocks are designed for use with a certain size of line, they should NEVER be used with line of a larger size. Line bent over a small sheave will be distorted, and any great strain applied will injure it and may even result in the line wearing on the frame. The proper block sizes for the various sizes of fiber line follow. A safe rule of thumb, to find the size of block to use, is to multiply the size of line by 3.

Block Size (Inches)	Line Size (Inches)
4	1 1/2
6	2 1/4
8	3
10	3 3/4
12	4 1/2
14	5

It is impossible to give an absolute minimum size for wire rope sheaves because of the number of factors involved. Experience has shown, however, that the diameter of a sheave should never be less than 20 times the diameter of the wire rope.

COMMON CARGO BLOCKS

The three types of cargo blocks most frequently seen on naval ships are the diamond, oval, and roller bearing. An example of the diamond block is shown in figure 8-3. The figure shows a single-sheave block, but

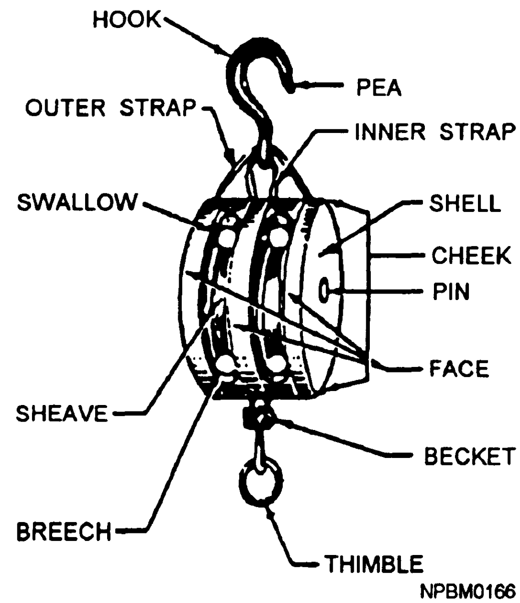


Figure 8-2.—A fiber rope block.

there may be more sheaves, depending on how the block will be used. Sheave bushings for this type of block are usually of a high-grade bronze alloy; the pins are equipped with grease fittings (see item 14 in fig. 8-3). Oval blocks are built to the same specifications as diamond blocks except that the cheeks are oval instead of diamond-shaped. The most common use of these two blocks is for topping lifts of cargo booms.

Head, heel, and many fairlead blocks are of the roller bearing type, shown in figure 8-4. These blocks have cast steel cheeks and sheaves, and the sheaves are equipped with roller bearing assemblies. The pin, of course, is provided with a grease fitting. These blocks, when manufactured for the Navy, have the following information stamped or cast on the shell: USN, working load, proof test, and the size of rope to be used with the block. Roller bearing blocks are used where high-speed operation is essential.

Regardless of type, a cargo block is usually named for its location in the cargo rig. The block at the head of the boom through which the whip runs is called the head block. That at the foot, which fairleads the wire to the winch, is the heel block. A small single-sheave block in the middle of most booms is called the slack wire block because it prevents slack in a whip from hanging down in a bight. Blocks in the topping lift are the upper and the lower topping lift blocks. A fairlead block, called a cheek block, is permanently fixed by welding or bolting one cheek to a bulkhead, davit, and so forth. Another fairlead block is a snatch block, which is hinged on one

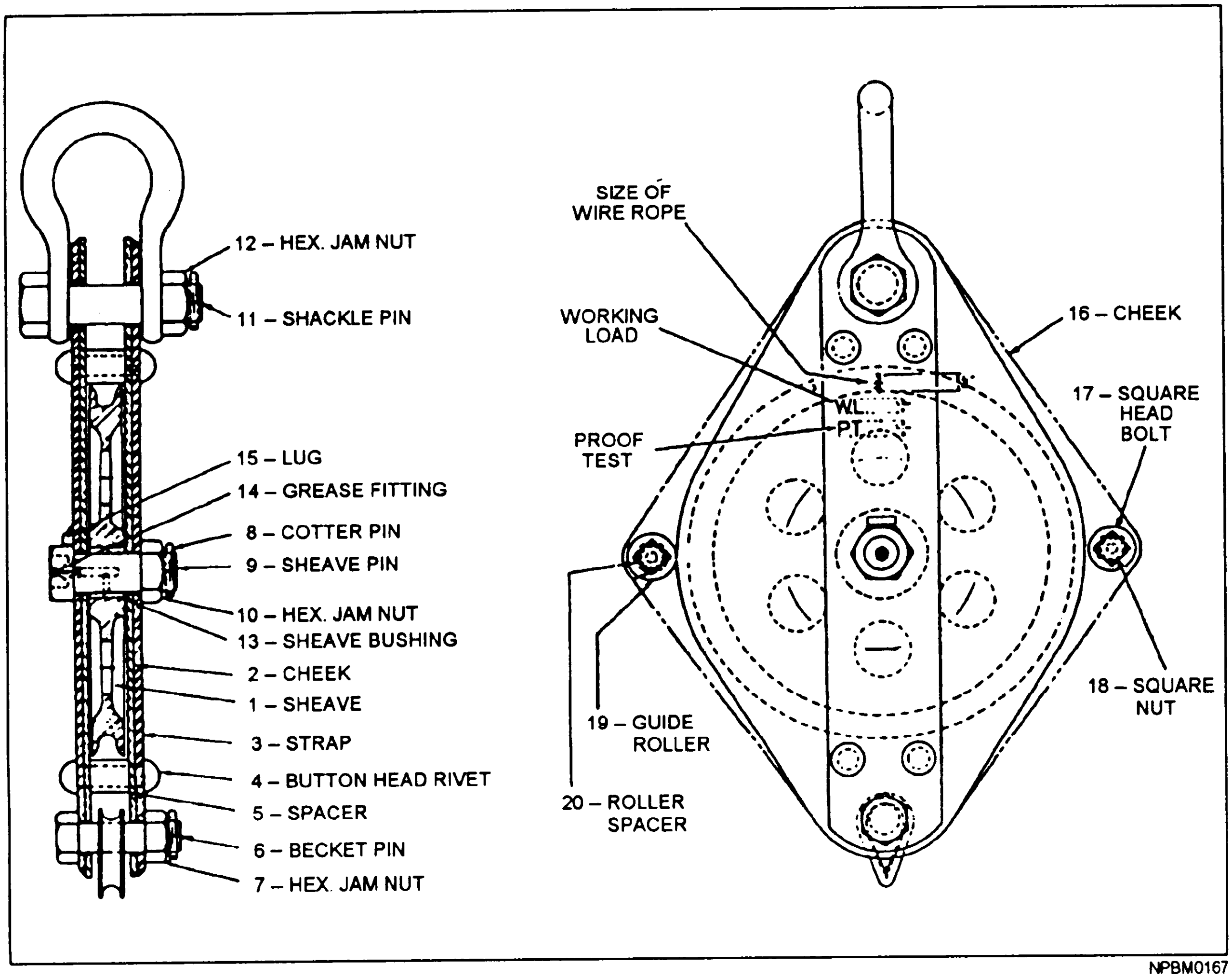


Figure 8-3.—Diamond block.

side and fitted with a hasp on the other. This permits the block to be opened and a line dropped in, rather than reeving the end of the line through. Tail blocks are single blocks usually used alone with a whip or as a runner.

Blocks may be single, double, treble, and so on. That is, they may be fitted with one sheave, two sheaves, three, or more, respectively. When used in a tackle, one of the blocks must be fitted with a becket, to which one end of the line is spliced.

The hook, shackle, swivel, and other fittings on each block are called the rig, which is identified by a number. The rigs in figure 8-5 are for fiber rope blocks only. Rigs for wire rope blocks are shown in figure 8-6.

Every quarter you have to inventory all the blocks on the ship, and occasionally you may have to order a block. When ordering blocks, you must give the following information:

- Type and size of rope (natural, synthetic fiber, or wire) as required
- Block shell material (wood or metal)
- Block size (sheave diameter or cheek length)
- Number of sheaves (single, double, triple, or as required)
- Block shape (oval, diamond, snatch, or as required)
- Type of bearings (journal, roller, self-lubing, or as required)
- Rig number or special fittings as required

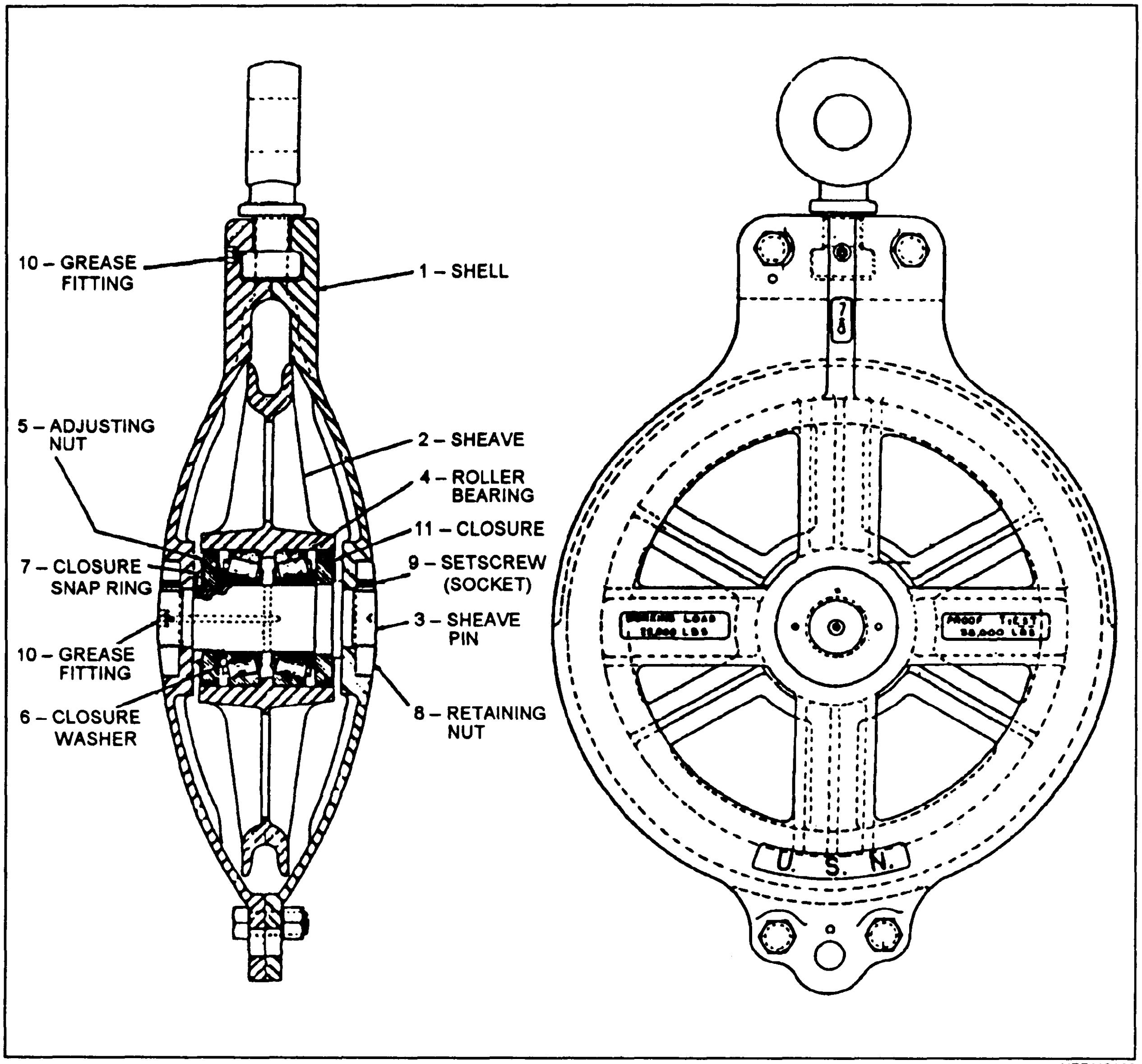


Figure 8-4.—Roller bearing block.

> **NOTE**
>
> **Becket parts should be requisitioned only when a becketed block is required.**

COMBINATIONS OF BLOCKS IN TACKLES

Tackles are designated according to (1) the number of sheaves in the blocks that are used to make the tackle-single whip, gun tackle, or twofold purchase—or (2) the purpose for which the tackle is used—yard tackles, stay tackles, or fore-and-aft tackles. In this section, the most commonly used combinations (fig. 8-7) are described.

- SINGLE WHIP: A single whip consists of one single-sheave block fixed to a support with a line passing over the sheave (view 1, fig. 8-7).
- RUNNER: This, too, consists of a single block, but the block is free to move; one end of the line is secured to the support; and the weight is attached to the block (view 2, fig. 8-7).

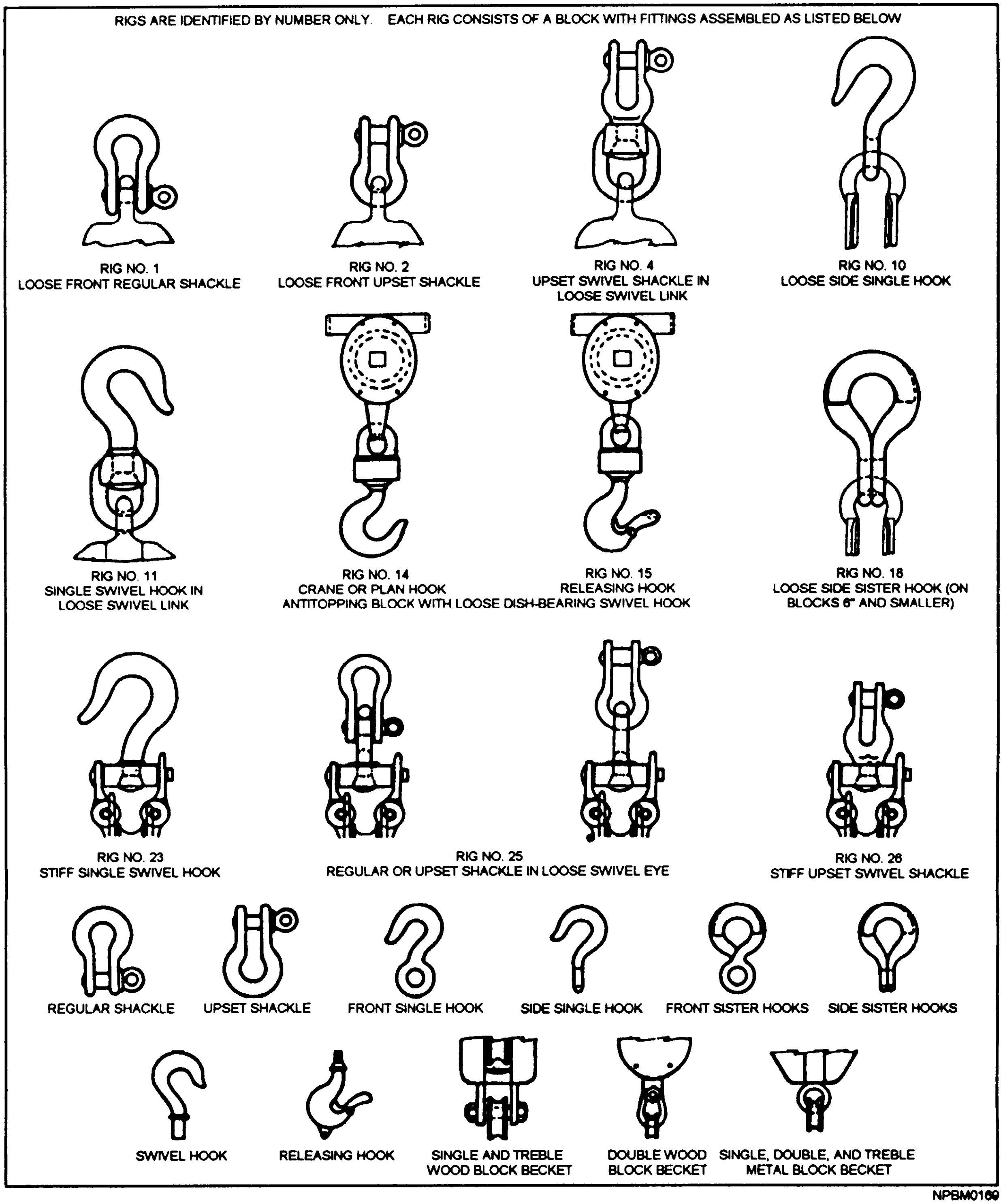


Figure 8-5.—Rigs and fittings for wood and metal fiber rope blocks.

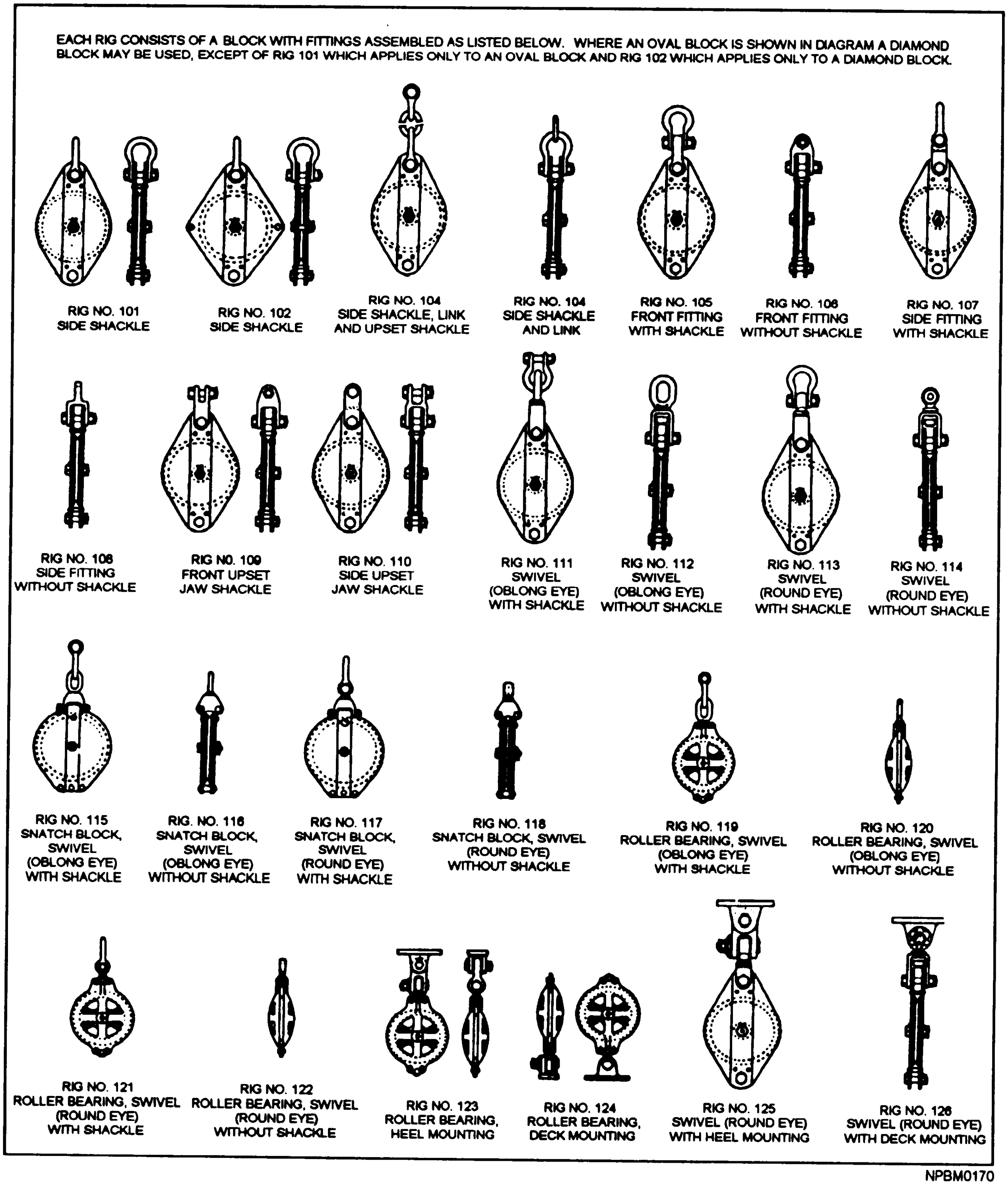


Figure 8-6.—Rigs and fittings for standard wire rope blocks.

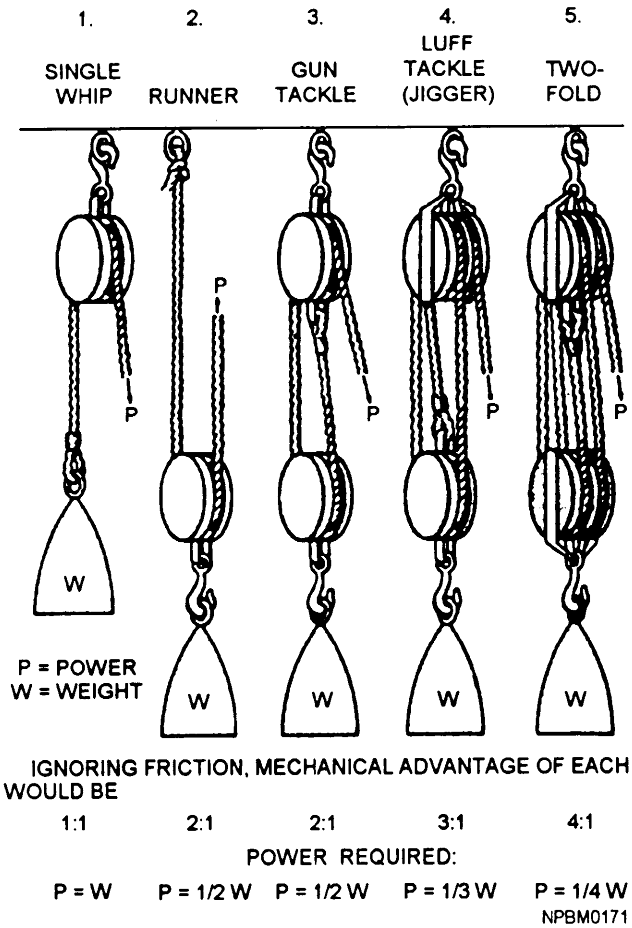


Figure 8-7.—Blocks and tackles.

- GUN TACKLE: This tackle is made up of two single blocks, as shown in view 3, fig. 8-7. It takes its name from the use made of it in hauling muzzle-loading guns back into battery after they have been fired and reloaded.
- LUFF TACKLE (JIGGER): A double and a single block make up this tackle (view 4, fig. 8-7).
- TWOFOLD PURCHASE: A twofold purchase, which is made up of two double blocks, is shown in view 5, fig. 8-7.
- DOUBLE-LUFF TACKLE: This tackle consists of a treble block and a double block. The right-angle method of reeving it is shown in figure 8-8.
- THREEFOLD PURCHASE: The right-angle method of reeving a threefold purchase is shown in figure 8-9. This method of reeving is

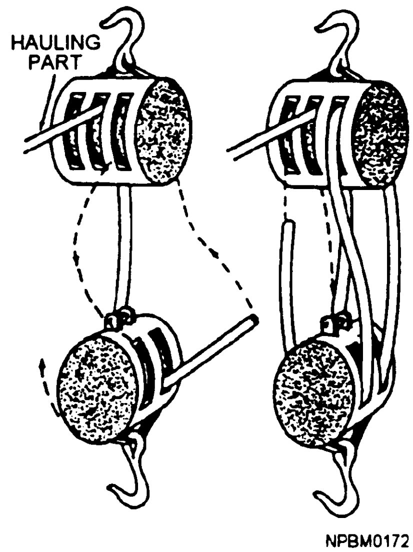


Figure 8-8.—Reeving a double-luff tackle.

considered the best for this purchase, as it reduces the chances of the various parts of lines chafing each other.

- BOAT FALLS: Boat falls may be twofold, double luff, or threefold and are reeved as shown in figures 8-7, 8-8, and 8-9. Boat falls should be reeved by the right-angle method.

MECHANICAL ADVANTAGE OF TACKLES

The *mechanical advantage* (MA) of a tackle is the term applied to the relationship between the load being

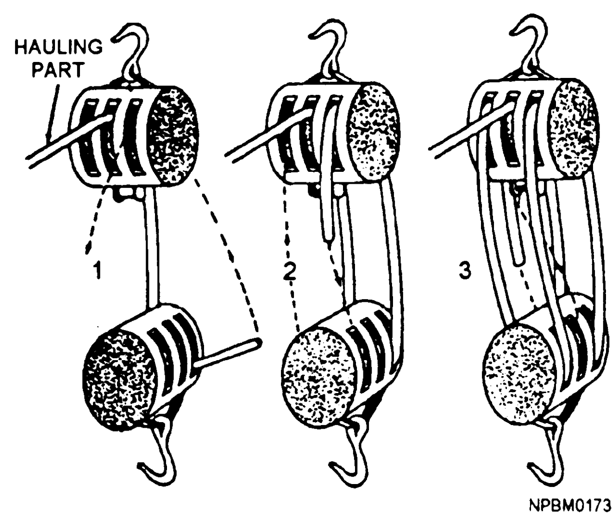


Figure 8-9.—Reeving a threefold purchase.

lifted and the power required to lift the load. In other words, when a load of 10 pounds requires 10 pounds of power to lift it, the mechanical advantage is 1. If a load of 50 pounds requires only 10 pounds of power to lift it, then the mechanical advantage is 5 to 1, or 5 units of weight lifted for each unit of power applied.

The mechanical advantage of a simple tackle is determined by counting the number of parts of the falls at the movable block. Therefore, a gun tackle has a mechanical advantage of 2 because there are two parts of the falls at the movable block.

To ascertain the amount of power required to lift a given load by means of a tackle, you determine the weight of the load to be lifted and divide that by the mechanical advantage.

For example, when it is necessary to lift a 600-pound load by a single-luff tackle, you first determine the mechanical advantage gained by using this type of tackle. You count the parts of the falls at the movable block and determine that you have a mechanical advantage of 3. Therefore, by dividing the weight to be lifted (600 pounds) by the mechanical advantage in this tackle (3), you find that 200 pounds of force is required to lift a weight of 600 pounds when a single-luff tackle is being used.

ALLOWANCE FOR FRICTION

A certain amount of the force applied to a tackle is lost through friction. Friction in a tackle is the rubbing of ropes against each other or against the frame or shell of a block, the passing of the ropes over the sheaves, and the rubbing of the pin against the sheaves. When the power required to lift a given load is being figured, this loss in efficiency of the block and tackle must be added to the weight being lifted. Roughly, 10 percent of the load must be added to the load for every sheave in the tackle. The following example is for a load of 600 pounds lifted with a single-luff tackle:

> Ten percent of 600 pounds is 60 pounds, times 3 (the number of sheaves) equals 180 pounds, which must be added to the load.
>
> The total load, 780 pounds, is divided by 3 (the mechanical advantage of a single-luff tackle).
>
> The answer, 260 pounds, is the power required to lift the load.

COMPUTING BREAKING STRENGTH AND SAFE WORKING LOAD

LEARNING OBJECTIVES: Calculate the breaking strength (BS) and safe working load (SWL) for lifting a given weight. Explain the BS and the SWL for plain-laid line and for braided lines.

When working with line, you must not overload it, because doing so is dangerous and costly. An overloaded line may part and injure someone in the vicinity, and even if it does not part, its useful life is shortened every time it is overloaded. For these reasons, you must know a line's breaking strength (BS) and safe working load (SWL).

The manufacturer's data gives the BS of a line; however, to learn the line's SWL, you must apply a safety factor (SF).

NOTE

The Navy has many commercial suppliers of line. In many cases, the manufacturers disagree on the BS and SWL of comparable line. For a more complete overview of line, look in *NSTM,* chapter 613, which has a complete listing of the accepted BS by type, construction, and size of line.

The SF for working loads on fiber line is as follows:

Working Conditions	Safety factor
Non-Critical	6
Critical	10

Critical lifts are defined as those lifts performed at sea or under adverse weather conditions, lifts involving or conducted over ordnance; lifts overhead, and lifts warranting precision or extra care.

LIFTING A GIVEN WEIGHT

To find the size of line to use for lifting any given weight, you first identify the type and construction of line to be used. Next, you multiply the load by the safety factor to determine breaking strength. The formula for determining breaking strength is as follows:

BS = L x SF

Then, you refer to tables 8-1, 8-2, and 8-3 to find the circumference of line safe to use. In the following examples, C = circumference, in inches; D = diameter, in inches; L = load, in pounds, BS = breaking strength; and SF = safety factor. Example 1 uses a safety factor of 6, and example 2 uses a safety factor of 5.

Example 1: (This example is for a single part of three-strand nylon, a safety factor of 6, and a load of 4,000 pounds.)

BS = L x SF

BS = 4,000 pounds x 6

BS = 24,000 pounds

Refer to table 8-1; when the breaking strength is between sizes, use the next larger size of line-in this

Table 8-1.—Plain-Laid Rope Construction

SIZE CIRCUMFERENCE INCHES	MINIMUM BREAKING STRENGTH (LB)[1]				
	SISAL	MANILA	POLYPROPYLENE	NYLON[2]	POLYESTER
5/8	360	405	700	950	800
3/4	480	540	1,000	1,500	1,200
1	800	900	1,700	2,600	2,000
1 1/8	1,080	1,215	2,150	3,300	2,800
1 1/4	1,400	1,575	2,500	4,800	3,800
1 1/2	2,120	2,385	3,700	5,800	5,000
1 3/4	2,760	3,105	4,800	7,600	6,500
2	3,520	3,960	6,000	9,800	8,000
2 1/4	4,320	4,860	7,000	13,200	10,000
2 1/2	5,200	5,850	9,000	15,300	13,000
2 3/4		6,930	11,000	19,000	15,000
3		8,100	13,000	23,200	18,500
3 1/2		10,800	16,500	32,000	25,000
3 3/4		12,150	19,500	36,500	
4		13,500	21,500	41,300	31,000
4 1/2		16,650	26,000	50,000	
5		20,250	32,000	60,000	48,000
5 1/2		23,850	38,000	72,000	
6		27,000	44,000	90,000	68,000
6 1/2			50,000	100,000	
7		36,900	60,000	127,000	88,000
8		46,800	75,000	164,000	110,000
9		57,600	94,000	209,000	140,000
10		69,300	115,000	265,000	165,000
11		81,900		316,000	240,000
12		94,500		375,000	285,000

[1]Comparative strengths of various ropes.

[2]The minimum breaking strength of nylon when wet is reduced approximately 15 percent.

Table 8-2.—Braided Rope Construction

SIZE CIRCUMFERENCE INCHES	MINIMUM BREAKING STRENGTH (LB)[1]		
	DOUBLE BRAIDED		PLAITED
	NYLON[2]	POLYESTER	NYLON
3/4	1,700	1,730	1,500
1	2,700	2,670	2,500
1 1/8	3,900	3,860	3,700
1 1/4	5,100	5,210	5,000
1 1/2	6,900	6,820	6,400
1 3/4	9,000	8,590	8,000
2	12,000	10,600	11,000
2 1/4	15,000	15,100	17,000
2 1/2	18,400	17,800	20,000
2 3/4	22,500	20,600	24,000
3	26,500	26,800	31,000
3 1/2	36,000	33,900	38,000
3 3/4	42,000	41,700	46,000
4	48,000	46,000	53,000
4 1/2	60,000	59,900	63,000
5	73,000	69,900	73,000
5 1/2	90,000	81,200	78,000
6	102,500	106,000	95,000
6 1/2	123,000	119,000	106,000
7	140,000	133,000	125,000
7 1/2	160,000	164,000	137,000
8	180,000	181,000	165,000
9	225,000	236,000	200,000
10	273,000	277,000	250,000
11	325,000	343,000	300,000
12	385,000	417,000	360,000
13	440,000	470,000	380,000
14	508,000	527,000	441,000
15	576,000	649,000	507,000
16	650,000	715,000	572,000
17	726,000	784,000	
18	808,000	931,000	
19	893,000	1,012,000	
20	980,000	1,091,000	
21	1,070,000	1,263,000	

[1]Comparative strengths of various fiber ropes. For current minimum breaking strength of each type, consult the MIL-SPEC.

[2]The minimum breaking strength of nylon when wet is reduced approximately 15 percent.

Table 8-3.—General Purpose 6 x 19 and 6 x 37 (Single Operating Strand) Wire Rope

ROPE DIAMETER	IPS FIBER CORE	IPS WIRE CORE	EIPS WIRE CORE
INCHES	LB	LB	LB
1/4	5,340	5,740	6,640
5/16	8,300	8,940	10,280
3/8	11,900	12,800	14,720
7/16	16,120	17,340	19,900
1/2	20,800	22,400	26,000
9/16	26,400	28,200	32,800
5/8	32,600	35,000	40,200
3/4	46,400	50,000	57,400
7/8	62,800	67,400	77,600
1	81,600	87,600	100,800
1 1/8	102,600	110,200	126,800
1 1/4	126,000	135,400	155,800
1 3/8	151,600	162,800	187,200
1 1/2	179,400	192,800	222,000
1 5/8	208,000	224,000	258,000
1 3/4	242,000	260,000	298,000
1 7/8	274,000	296,000	340,000
2	312,000	336,000	386,000
2 1/8	350,000	374,000	431,000
2 1/4	390,000	420,000	482,000
2 1/2	476,000	511,000	589,000
2 3/4	570,000	612,000	704,000
3	668,000	722,000	828,000
3 1/4	778,000	836,000	960,000
3 1/2	892,000	958,000	1,100,000

case, the next larger is C = 3 1/2. Thus, a three-strand nylon line 3 1/2 inches in circumference is needed to do the job.

Example 2: (This example is for a single part of wire rope, 6 x 37 IPS w/fiber core; a load of 10,000 pounds, and a safety factor of 5.)

BS = L x SF

BS = 10,000 pounds x 5

BS = 50,000 pounds

Refer to table 8-3; when the breaking strength is between sizes, use the next larger size—in this example, D = 7/8. Thus, a 7/8-inch-diameter wire rope 6 x 37 IPS with fiber core is needed to do the lift.

PROPER SIZE OF LINE AND TACKLE TO LIFT A GIVEN WEIGHT

To find the size of line and tackle to lift a given weight (GW), first find the total load, which includes allowance for friction in the tackle. This is done by multiplying the GW by 10 percent to obtain the amount of friction per sheave. Next, multiply the amount of friction by the number of sheaves (NS) in the tackle you are going to use. This gives you the total allowance for friction. Add the total allowance for friction to the load to obtain the total weight of the load including friction. Next, divide the total load by the mechanical advantage (MA) of the tackle. This gives you the load (L) in pounds required to lift a given weight with a given tackle. The formula for determining load is as follows:

GW x 10% x NS + GW ÷ MA = L

Then, by using the formula for determining breaking strength, BS = L x SF, compute for the size of line needed. For our purposes here, we will use a safety factor of 6, for a non-critical operation.

Example: (Weight to be lifted, 4,000 pounds; tackle to be used, twofold purchase; safety factor, 6)

GW x 10% x NS + GW ÷ MA = L

4,000 x 10% = 400 x 4 sheaves = 1,600 (total allowance for friction, which must be added to GW)

1,600 + 4,000 = 5,600 ÷ 4(MA) = 1,400 (load (L) in pounds to lift GW)

BS = L x SF

BS = 1,400 x 6

BS = 8,400 pounds

Go to table 8-1; find a nylon line having a breaking strength of 8,400 pounds or more. In this case, a 2-inch, three-strand nylon line is required.

Now that the line size has been established, remember the safe rule of thumb to find the size of block to use: Multiply the size of the line by 3. In the previous example, at least a 6-inch block is required.

WEIGHT A GIVEN TACKLE WILL LIFT

To find the weight a given tackle will lift safely, first find the SWL of the line rove in the tackle. Then, multiply the SWL by the number of parts at the movable block. Multiply that value by 10, and divide by 10 plus the number of sheaves used.

Example, using a twofold purchase rove with 2 1/2-inch three-strand nylon line:

$$SWL = \frac{BS}{SF}$$

Table 8-1 shows 2 1/2-inch nylon to have a breaking strength of 15,300 pounds. Convert the pounds to tons by dividing 15,300 by 2,000 pounds. Then, using a safety factor of 6, work the previous formula.

$$SWL = \frac{7.65 \text{ tons}}{6} = 1.275 \text{ tons}$$

Now multiply the SWL by the number of movable parts, which is 4.

$$\begin{array}{r l} 1.275 & \text{tons} \\ \underline{\times\ 4} & \text{parts} \\ 5.10 & \text{tons} \end{array}$$

Multiply that value by 10.

$$\begin{array}{r} 5.10 \\ \underline{\times\ 10} \\ 51.00 \end{array}$$

Then, divide by 10 plus the number of sheaves.

10 + 4 = 14

$$\frac{51.00}{14} = 3.64 \text{ tons}$$

Thus, 3.64 tons is the load a twofold purchase rove with 2 1/2-inch, three-strand nylon will handle safely.

CHAIN HOISTS

LEARNING OBJECTIVES: Understand how to use chain hoists or chain falls and their advantages for handling different types of lifts. Explain the difference in safety shackles types, grades, and classes.

Chain hoists, or chain falls as they are often called, provide a convenient and efficient method for hoisting loads by hand. The chief advantages of chain hoists are that one person can raise a load of several tons and that the load can remain stationary without being secured. The slow-lifting travel of a chain hoist permits small movements, accurate adjustments of height, and gentle handling of loads. For these reasons, chain hoists are particularly useful in machinery spaces, and you will find they come in handy on deck, too. There are three general types of chain hoists: the differential, the spur

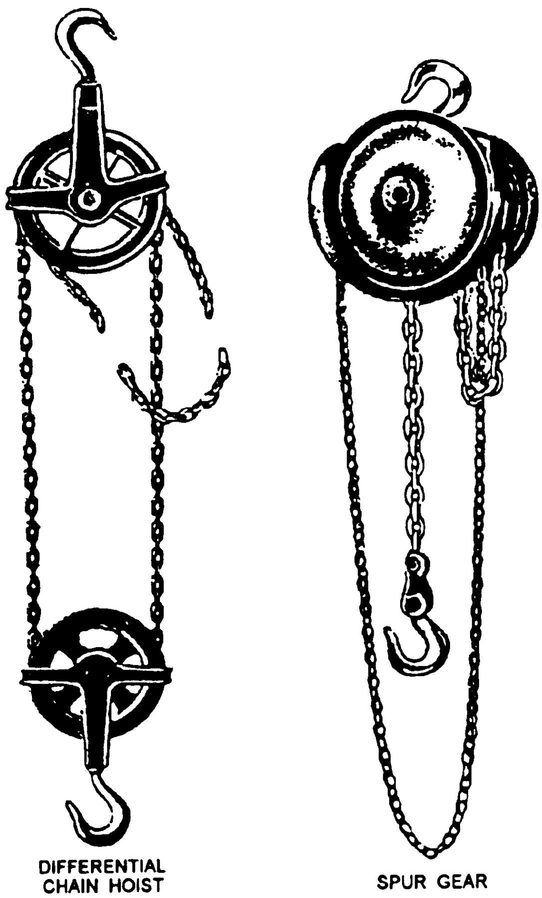


Figure 8-10.—Chain hoists.

gear, and the screw gear. Figure 8-10 shows two of these types, which range from 1/2 ton to 40 tons.

Ordinarily, chain hoists are constructed with their lower hook as the weakest part of the assembly. This is a precaution so that the lower hook will start to spread open before the chain hoist itself is overloaded. Under ordinary circumstances, the pull exerted on a chain hoist by one or two crew members will not overload the hoist.

Chain hoists must be inspected at frequent intervals. Any evidence of spreading or excessive wear on the hook is sufficient cause to require its replacement. When the links of the chain are distorted, it is an indication that the chain hoist has been heavily overloaded and is probably unsafe for further use. Under such circumstances, the chain hoist should be surveyed and replaced.

Table 8-4.—Safety Shackle Types, Grades, and Classes

TYPE 1– ANCHOR SHACKLES
GRADE A– REGULAR
Class-1– Round pin
Class-2– Screw pin
Class-3– Safety bolt and nut
GRADE B– HIGH STRENGTH
Class-1– Round pin
Class-2– Screw pin
Class-3– Safety bolt and nut
TYPE 2– CHAIN SHACKLES
GRADE A– REGULAR
Class-1– Round pin
Class-2– Screw pin
Class-3– Safety bolt and nut
GRADE B– HIGH STRENGTH
Class-1– Round pin
Class-2– Screw pin
Class-3– Safety bolt and nut

SHACKLES

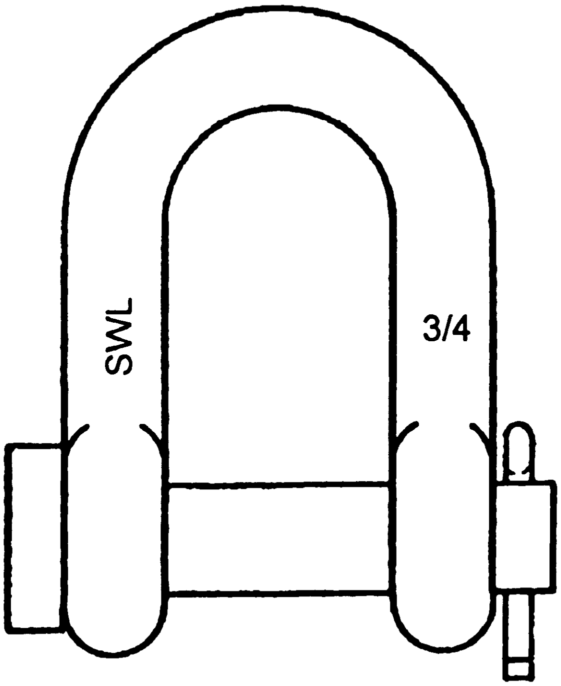
Shackles are of two types, each with two grades of three classes each. Table 8-4 shows the classes and types of shackles available. Since MIL-S-24214 requires that shackles be readily identifiable, they are marked in raised or indented lettering with the manufacturer's name, the safe working load, and the shackle size. Fins for grade B shackles are marked HS, for high strength, in raised or indented letters.

Tables 8-5 through 8-10 give a visual description and the safe working load of the Grade A and Grade B shackles used in the Navy.

MAINTENANCE AND OVERHAUL OF BLOCKS

LEARNING OBJECTIVES: Describe the proper maintenance and overhaul of all blocks. Explain the difference between fiber rope blocks and wire rope blocks.

Table 8-5.—Round Pin Chain Shackle, Regular Strength (A) and High Strength (B)



SIZE (INCHES)	SAFE WORKING LOAD (POUNDS)	
A & B	A	B
1/2	1,987	6,500
5/8	3,050	10,000
3/4	4,475	13,800
7/8	6,000	18,700
1	7,950	24,400
1 1/8	10,812	28,600
1 1/4	13,750	36,000
1 3/8	16,700	41,400
1 1/2	20,625	48,800
1 5/8	24,950	57,400
1 3/4	29,675	65,000
2	35,875	85,040
2 1/2	52,750	121,400
3	79,500	150,000

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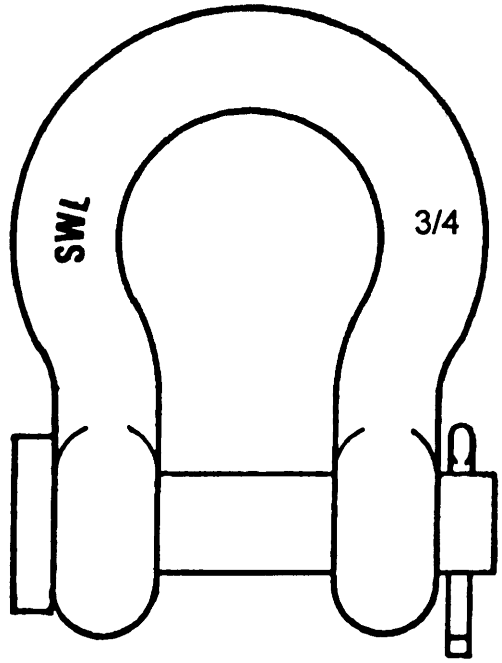
Table 8-6.—Round Pin Anchor Shackle, Regular Strength (A) and High Strength (B)



SIZE (INCHES)	SAFE WORKING LOAD (POUNDS)	
A & B	A	B
7/16	1,375	5,180
1/2	1,987	6,500
5/8	3,050	10,000
3/4	4,475	13,800
7/8	6,000	18,700
1	7,950	24,400
1 1/8	10,812	28,600
1 1/4	13,750	36,000
1 3/8	16,700	41,400
1 1/2	20,625	48,800
1 5/8	24,950	57,400
1 3/4	29,675	65,000
2	35,875	85,040
2 1/2	52,750	121,400
3	79,500	150,000
3 1/2	107,500	209,000

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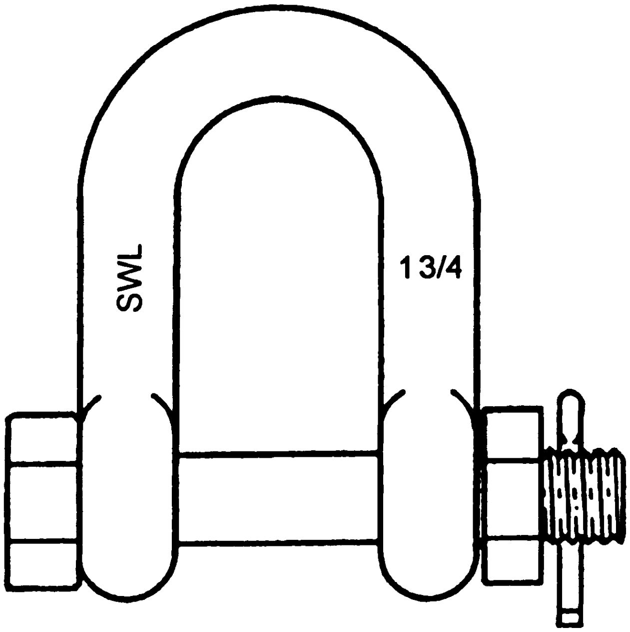
Table 8-7.—Safety Chain Shackle, Regular Strength (A) and High Strength (B)



SIZE (INCHES)	SAFE WORKING LOAD (POUNDS)	
A & B	A	B
1/2	1,987	6,500
5/8	3,050	10,000
3/4	4,475	13,800
7/8	6,000	18,700
1	7,950	24,400
1 1/8	10,812	28,600
1 1/4	13,750	36,000
2 3/8	16,700	41,400
1 1/2	20,625	48,800
1 5/8	24,950	57,400
1 3/4	29,675	65,000
2	35,875	85,040
2 1/2	52,750	121,400
3	79,500	150,000
3 1/2	107,500	200,000
4	140,000	260,000

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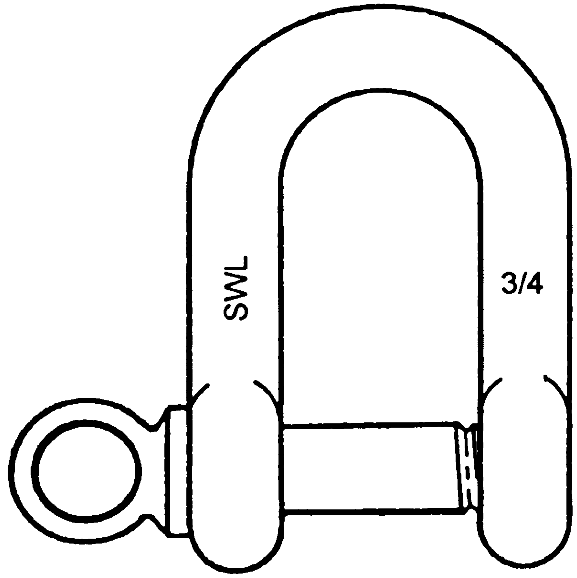
Table 8-8.—Safety Anchor Shackle, Regular Strength (A) and High Strength (B)



SIZE (INCHES)	SAFE WORKING LOAD (POUNDS)	
A & B	A	B
3/16	–	900
1/4	450	2,000
5/16	650	3,520
3/8	1,000	3,800
7/16	1,375	5,180
1/2	1,987	6,500
5/8	3,050	10,000
3/4	4,475	13,800
7/8	6,000	18,700
1	7,950	24,400
1 1/8	10,812	28,600
1 1/4	13,750	36,000
1 3/8	16,700	41,400
1 1/2	20,625	48,800
1 5/8	24,950	57,400
1 3/4	29,675	65,000
2	35,875	85,040
2 1/2	52,750	121,400
3	79,500	150,000
3 1/2	107,500	290,000

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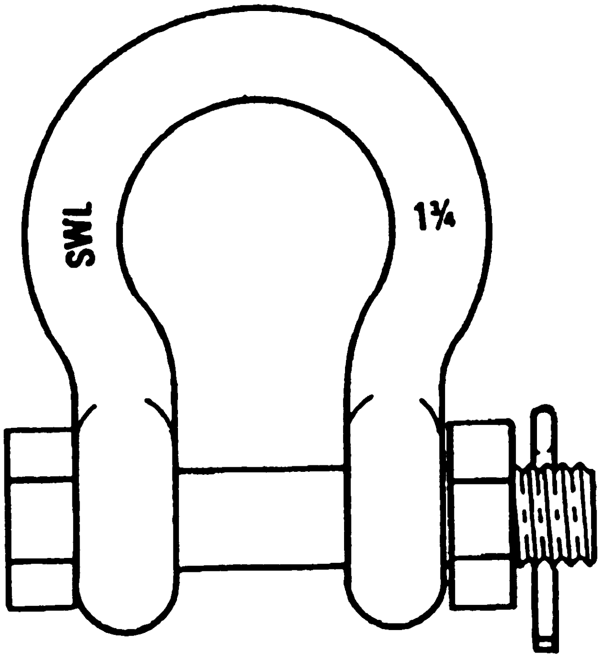
Table 8-9.—Screw Pin Chain Shackle, Regular Strength (A) and High Strength (B)



SIZE (INCHES)	SAFE WORKING LOAD (POUNDS)	
A & B	A	B
1/2	1,987	6,500
5/8	3,050	10,000
3/4	4,475	13,800
7/8	6,000	18,700
1	7,950	24,400
1 1/8	10,812	28,600
1 1/4	13,750	36,000
1 3/8	16,700	41,400
1 1/2	20,625	48,800
1 5/8	24,950	57,400
1 3/4	29,675	65,000
2	35,875	85,040
2 1/2	52,750	121,400
3	79,500	150,000
3 1/2	107,500	209,000
4	145,000	260,000

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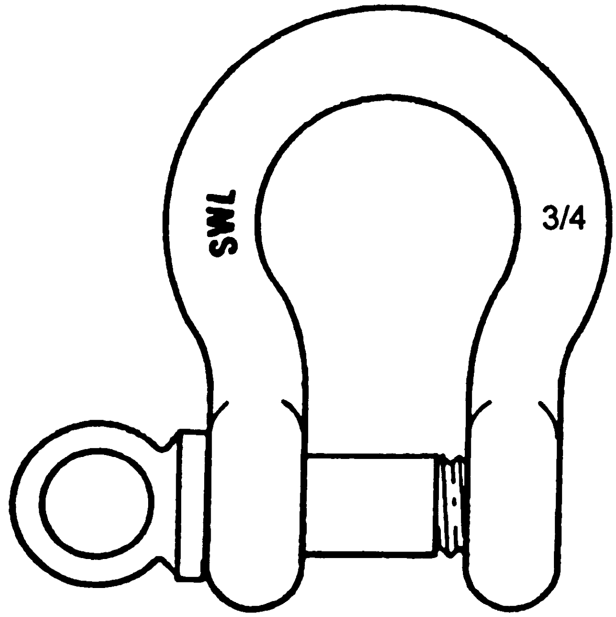
Table 8-10.—Screw Pin Anchor Shackle, Regular Strength (A) and High Strength (B)



SIZE (INCHES)	SAFE WORKING LOAD (POUNDS)	
A & B	A	B
1/2	1,987	6,500
5/8	3,050	10,000
3/4	4,475	13,800
7/8	6,000	18,700
1	7,950	24,400
1 1/8	10,812	28,600
1 1/4	13,750	36,000
1 3/8	16,700	41,400
1 1/2	20,625	48,800
1 5/8	24,950	57,400
1 3/4	29,675	65,000
2	35,875	85,040

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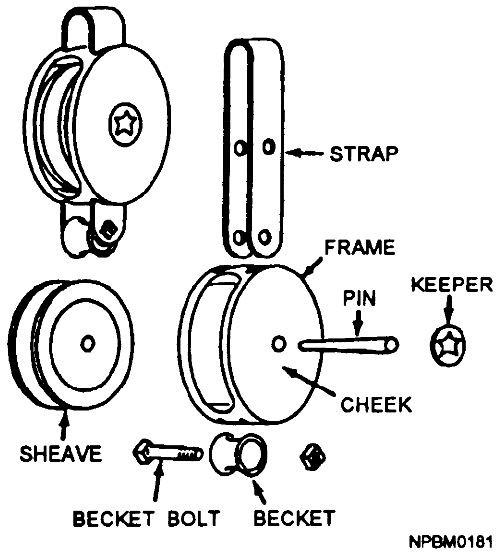


Figure 8-11.—A disassembled block.

Blocks, like other equipment exposed to the elements, will become useless quickly if they do not receive proper maintenance. The bearing and bushing will wear if they are not properly lubricated. The shells and accessories will deteriorate if they are not properly preserved.

FIBER ROPE BLOCKS

Fiber rope blocks should be disassembled periodically, inspected, and lubricated with grease. Consult the PMS card for the appropriate grease.

To disassemble a block, first remove the becket bolt and becket, pry off the keeper, and drive out the pin. Then, loosen the strap in the frame by tapping the bottom of the frame with a hammer. If you cannot pull the strap out by hand, insert a marlinespike in the U of the strap and drive it out by tapping on the marlinespike with a hammer. Figure 8-11 shows a disassembled block

Inspect the frame of the block for any cracks or splits and for any indication that the sheave is wearing on the frame. If there are any worn spots on the inside of the frame, check the pin to see if it is bent. Check the hooks or shackles for any sign of distortion. A bent pin or a distorted hook or shackle is a sure sign that an overload was placed on the block at some time, and that it no longer is safe.

Dropping a wooden block can split its frame very easily, and a coat of paint can hide that split; so NEVER paint a wooden block. Use clear shellac or varnish or several coats of linseed oil.

Metal in constant use is subject to fatigue; therefore, blocks in running rigging should be inspected frequently and carefully for any signs of distortion or wear. Any doubtful block should be replaced immediately.

Suspected wooden blocks should be surveyed and replaced.

Many parts for blocks are available separately; for example, rigs for wire rope blocks. Before replacing an entire block, consult the supply officer to see if it is possible to get a replacement for any part that is defective.

WIRE ROPE BLOCKS

Wire rope blocks in cargo-handling rigs and others in continuous use should be disassembled frequently and inspected for wear. Those blocks used only occasionally, however, seldom need to be disassembled if they are kept well lubricated.

Diamond and Oval Blocks

To remove the sheave from a diamond or oval block (fig. 8-3), take out the cotter pin (8), and remove the hexagon nut (10) from the sheave pin (9). Drive out the sheave pin. For a diamond block, you have to loosen all bolts holding the cheeks together and remove one before the sheave will slide out. With an oval block, you only have to loosen the bolts.

Roller Bearing Blocks

To disassemble a roller bearing block (fig. 8-4), loosen the setscrews (9) and remove the retaining nuts (8). Take out the bolts holding the shell together and remove the shell. Remove the closure snap rings (7), adjusting nut (5), closure washer (6), and closure (11). Now, remove the pin, then the bearings from the sheave.

ESTIMATING WEIGHTS

LEARNING OBJECTIVES: Explain how to estimate weight in hoisting cargo, and determine how much material there is in various shapes using weight tables and simple geometry

Many times throughout your naval career, you will be required to rig for hoisting a piece of equipment or other material. As was pointed out earlier in this chapter, you must know the weight of the load to be lifted before you can compute the size of gear needed for the job.

Normally, the weight of machinery or other equipment may be found on its label plate. Cargo boxes or crates for shipment usually are clearly stenciled with the gross weight and the cubic feet of the crate or box. Occasionally, however, the label plate is missing or the markings are obliterated on Iron wrought plate and it is necessary to estimate the weight.

Table 8-11 gives the weights of various materials per cubic foot or per square foot of material 1 inch thick. You should memorize the weight of a few of the most common materials.

> **NOTE**
>
> **Weight of wood varies as much as 50 percent with moisture content. Those listed are for building grade of the woods and for wood that is comparatively dry. Ample allowance should be made for wood that is wet. When in doubt, always overestimate weights.**

The rest of this section is devoted to explaining how to determine the amount of material in various shapes.

FINDING AREA

To estimate weights intelligently, you must know how to find the area or volume of the articles in question. The following section will refresh your memory of a few simple rules that you probably learned in school. The symbols used and their meanings follow:

A = area
B = base
C = circumference
D = diameter
H = height
L = length
R = radius
W = width
V = volume
π = pi (which is approximately 3.1416 or 3 1/7)

Table 8-11.—Weights of Various Materials

METAL	POUNDS PER CU FT
Aluminum, cast	160
Aluminum, sheet	166.5
Brass, rolled	533.8
Brass, sheet	513.6
Iron, cast	448.9
Lead, sheet	710.8
Steel, cast	492.6
Steel, wrought	489.6
WOOD	
Fir, Douglas	37
Oak, red	37-52
Oak, white	56
Pine, white	27
Pine, yellow	43
MISCELLANEOUS	
Bricks, common	120
Bricks, fire	150
Cement, Portland, solid	197
Gravel, dry	112
Gravel, wet	125
Oil, lubricating	(320 lb per bbl of 42 gal)
Water, fresh	62.5
Water, sea	64
The following weights are for 1 square foot of material 1 inch thick.	
Brass, sheet	43
Iron, cast	38
Iron, wrought	40
Steel, wrought	41

Squares and Rectangles

In squares and rectangles, opposite sides are parallel and equal; so to find the area, simply multiply the length by the width.

$$A = L \times W$$

Triangles

To find the area of a triangle, multiply half the base length by the height.

$$A = 1/2\ B \times H$$

Example: Using the dimensions of the triangle in figure 8-12, find the area.

$A = 1/2(3) \times 4$

$A = 6$ square feet

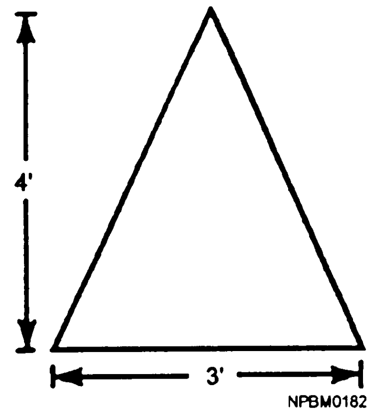


Figure 8-12.—Area of a triangle.

Circles

The area of a circle is found by squaring the radius and multiplying by pi. To square a number, multiply the number by itself.

$$A = \pi\ R^2$$

Given: A circle with a diameter of 6 feet. Find the area as follows:

$R = 1/2\ D = 3$ feet

$A = \pi\ (3)^2$

$A = 3.1416 \times 9$

$A = 28.27$ square feet

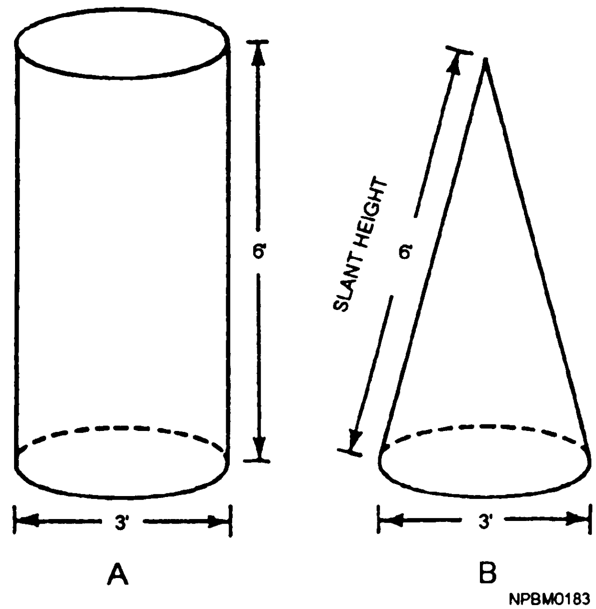


Figure 8-13.—Areas of cylinders and cones.

Cylinders

To find the area of the side of a cylinder, multiply the circumference of the base by the height.

$$A = C \times H$$

Example: Find the area of the side of the cylinder in view A of figure 8-13.

$X = \pi\ D$

$C = \pi\ 3$

$A = C \times 6$

$A = 56.55$ square feet

Cones

The formula for finding the area of the side of a cone uses a new dimension—slant height (SH)—which is the distance from the edge of the base to the apex of the cone. See view B of figure 8-13. The area may be found by multiplying half the slant height by the circumference of the base.

$$A = 1/2\ SH \times C$$

Example: Using the dimensions in figure 8-13, find the area of the cone.

$A = 1/2(6) \times 3\ \pi$

$A = 28.27$ square feet

Polygons

A polygon is a figure having many sides and many angles (the term is usually used in reference to a figure with more than four sides). Polygons may be irregular (having at least one angle or side unequal to its opposite angle or side, as shown in views A, B, and D of fig. 8-14)

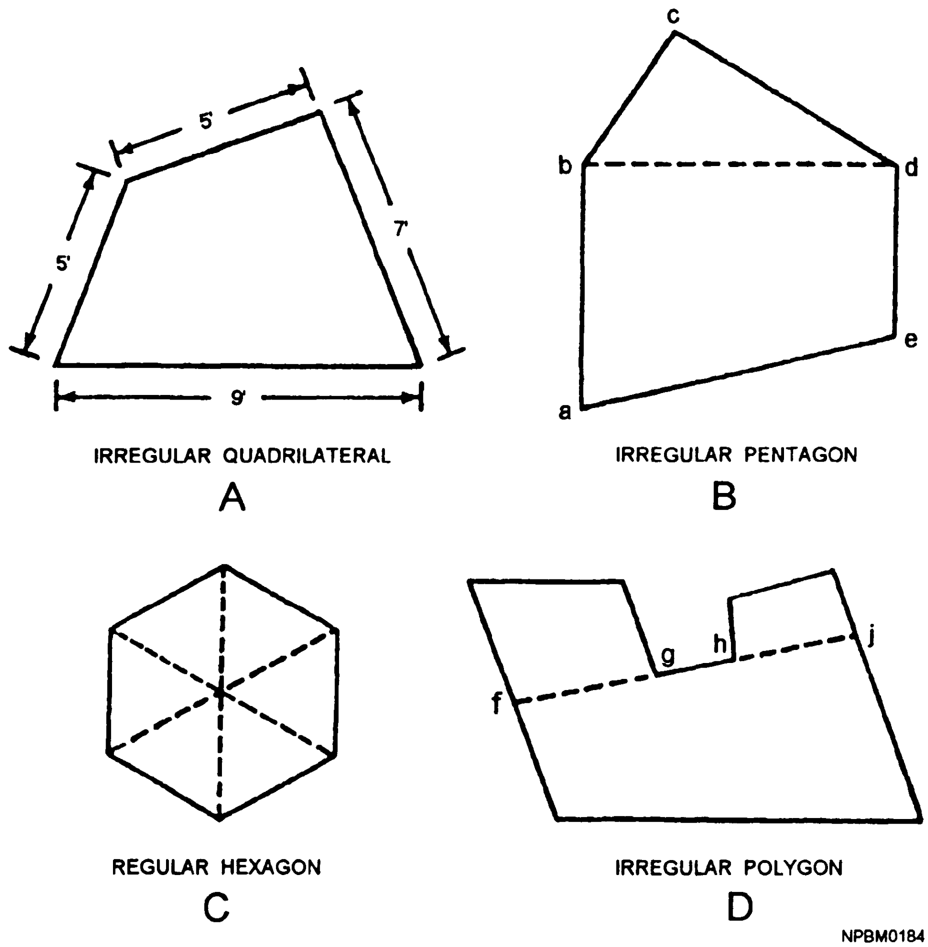


Figure 8-14.—Areas of polygons.

or regular (having all opposite sides and angles equal, as the hexagon shown in view C of fig. 8-14).

To find the area of an irregular quadrilateral, such as that shown in view A, figure 8-14, determine the means of the opposite sides and multiply them together. A mean is found by adding any number of quantities together and dividing by the number of the quantities added. (A synonym for mean is average.) Area equals the mean of the lengths times the mean of the widths.

A = mean L X mean W

Example: Using the dimensions in view A, figure 8-14, find the area.

5 feet + 9 feet = 14 feet ÷ 2 = 7 feet (mean length)

5 feet + 7 feet = 12 feet ÷ 2 = 6 feet (mean width)

A = 7 feet x 6 feet

A = 42 square feet

The process for finding the area of other irregular shapes can be simplified by dividing the shape into two or more simple forms for which you know the formulas. This method can be used on almost any shape having straight sides. Examples of this are shown in views B and D of figure 8-14. The irregular pentagon (view B of fig. 8-14) may be divided by drawing the line bd (shown as a dotted line). Then, the area of the quadrilateral, abde, and the area of the triangle, bcd, can be found and the two areas added together.

The area of the irregular polygon (view D of fig. 8-14) may be found by dividing the figure into three quadrilaterals by drawing lines fg and hj. Then, those three areas are found and added together.

A regular hexagon (view C of fig. 8-14) has all sides and all angles equal; therefore, the triangles formed by drawing the dotted lines are all equal. Thus, the total area

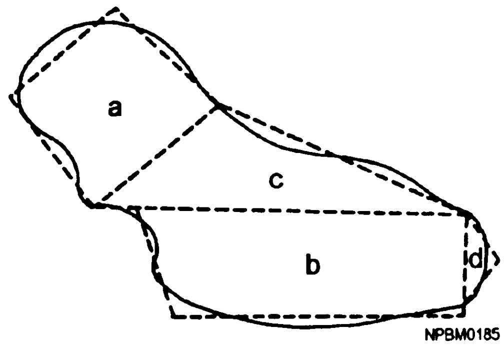


Figure 8-15.—Area of an oddly shaped form.

can be determined by finding the area of one of the triangles and multiplying by 6 (number of triangles):

Area of one triangle x 6 = area of hexagon

An oddly shaped form, such as that shown in figure 8-15, is not any more difficult if you superimpose recognizable geometric figures on the odd shape and sum up the areas. An example of this is shown by the dotted lines in the figure 8-15, which form equilaterals a and b and triangles c and d. The result obtained by this process is only an approximation, but the answer is close.

FINDING VOLUME

Volume can be defined as mass or bulk or, more precisely, as space occupied. It is measured by cubic inches, cubic feet, or cubic yards.

Cubes and Rectangular Prisms

A cube is a solid body having six faces, all of which are perfect squares of equal areas. A rectangular prism is a solid body bounded by six sides, all of which are rectangles with the ends and opposite sides, respectively, equal to each other. The volume of either of these two shapes is found by multiplying length times width times height:

$$V = L \times W \times H$$

Spheres

You probably will seldom need to find either the area or the volume of a ball, but these formulas and examples are included for your convenience.

The area of a sphere is found by multiplying the square of the radius by 4 pi:

$$A = 4\pi\ R^2$$

Example: Find the area of a sphere having a diameter of 4 inches.

$$A = 4p\ (2)^2$$

$$A = 50.27 \text{ square inches}$$

To find the volume of a sphere, cube the radius, multiply by 4 pi, and divide by 3. To cube a number, multiply the number by itself two times (2 X 2 X 2).

$$V = \frac{4}{3} = \pi R^3$$

Example: Find the volume of a sphere having a diameter of 4 inches.

$$V = \frac{4\pi \text{ x } 2^3}{3}$$

$$V = 4\pi \text{ x } 8 \div 3$$

$$V = 33.51 \text{ cubic inches}$$

Wedges

To find the volume of a rectangular wedge, as shown in figure 8-16, multiply the area of the base by half the height.

$$V = A \text{ (of base) x } 1/2\ H$$

Example: Find the volume of the wedge in figure 8-16.

$$V = L \text{ x } W \text{ x } 1/2\ H$$

$$V = 10 \text{ feet x } 8 \text{ feet x } 1/2(5)$$

$$V = 200 \text{ cubic feet}$$

Pyramids and Cones

To find the volume of a pyramid, multiply one-third the area of the base by the height. This formula holds true for any pyramid, regardless of the shape of the base. Thus, the same formula is used to find the volume of a cone, which is a form of pyramid.

$$V = 1/3\ A \text{ (of base) x } H$$

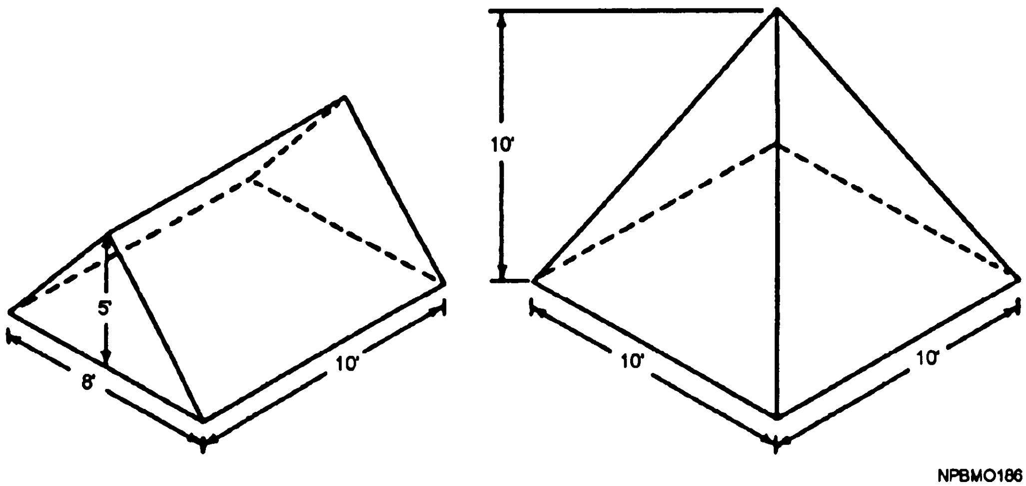


Figure 8-16.—Volume of wedges and pyramids.

Example: Find the volume of the pyramid in figure 8-16.

$$V = \frac{L \times W}{3} \times H$$

$$V = \frac{10 \text{ feet} \times 10 \text{ feet}}{3} \times 10 \text{ feet}$$

$$V = 333.3 \text{ cubic feet}$$

The volume of various other shapes of solids may be found by dividing them as explained for finding areas of irregular polygons.

PRACTICAL APPLICATION

Let us see how we can make a practical application of some of the formulas and information given in this chapter. Suppose there are six drums, three-fourths full of dry gravel, on a pallet on the pier. You must determine if you can hoist the pallet load aboard with your crane, which has a rated capacity of 10 tons. You measure the drums and find that all are 3 feet in diameter and 4 feet high. For this example, ignore the weight of the drums themselves; but in many problems of this sort, you will have to calculate the weight of the containers, too, if they are heavy or if the load is too close to the SWL.

The first thing to do to solve a problem of this sort is to write down the things you know, as follows:

There are six drums, each 3 feet in diameter and 4 feet high.

The drums are three-fourths full; therefore, effective height, H, is 3 feet.

Dry gravel weighs 112 pounds per cubic foot (from table 8-11).

The capacity of the crane is 10 tons.

Then, apply the formula for finding the volume of a cylinder:

$$V = A \text{ (of base)} \times H$$

$$V = \pi(1.5)^2 \times 3$$

$$V = 21.21 \text{ cubic feet}$$

21.21 cubic feet x 6 drums = 127.26 cubic feet

127.26 cubic feet x 112 pounds of gravel per cubic foot = 14,253.12 pounds of gravel = 7.1 tons of gravel

Go ahead and hoist the load aboard.

SUMMARY

This chapter has explained very little about rigging and finding volume and weight. Once you become more familiar in this role of doing rigging, you will be able to do this with ease. You must always remember that this area of the Boatswain's Mate rating is just as dangerous as most areas and you must be very cautious when trying to do rigging. **KEEP IT SAFE!**

CHAPTER 9

CARGO HANDLING

Cargo handling and stowage require many skills and items of equipment. In this chapter you will study various cargo rigs. You will learn how they are set up and gain knowledge of their operation. This chapter will explain the function of winches and how to load or discharge cargo. You will learn how to secure cargo and vehicles aboard ship and should be able to explain safety as it applies to cargo handling evolutions.

The Navy is continuously studying and experimenting to make all phases of cargo handling faster, safer, easier, and more economical. There are many ships designed for specific tasks that have rigs peculiar to those types. For example, new replenishment ships are not equipped with cargo booms and the large hatches typical of ordinary cargo ships. Instead, cargo elevators are installed at one or both ends of the cargo holds; the hatches are just large enough to accommodate the elevators. King posts and booms are replaced by M-frames and outriggers that support the transfer rigs. Cranes are installed for handling cargo on carriers, amphibious ships, and auxiliaries. These cranes are used for handling aircraft, boats, weapons, palletized cargo, submersible vehicles, trucks, and other cargo. The number of cranes per ship depends on the specific ship requirements. Consult Naval Ships' Technical Manual, chapter 589, for information concerning cranes. Where rigging of a particular ship differs from that explained here, consult the ship's plans.

YARD-AND-STAY METHOD

LEARNING OBJECTIVES: Identify and explain the yard and stay method of handling cargo.

In the yard-and-stay method of cargo handling, two booms are used. One, called the hatch boom, plumbs the hatch; and the other, called the yard boom, is rigged out to one side so that the head of the boom is over the dock or pier. (See fig. 9-1.)

Upon examining the rigging in figure 9-1, you will find two major differences. One set of booms has a midship guy (23) between the boom heads; the other set uses an inboard guy (22) for each boom. For clarity, some details in figure 9-1 have been omitted (for example, the inboard guy of the yard boom). Guys are backed up by preventers (27), which are made fast around the heads of the booms, independent of all other fastenings. Strains on preventers and guys are equalized.

The other difference is in the topping lifts. The booms to the right of the mast have multiple topping lifts; the other two have single topping lifts. Which type of topping lift a rig may have depends on design, but when a boom alone is being used as a swinging derrick, the multiple type is preferable because it is easier to top the boom up and down.

The cargo whips come from different winches, are rove through their respective heel and head blocks, and are shackled to the same cargo hook. This hook is usually a triple swivel hook as shown in figure 9-2.

The winches are located in such a position that operators have an unrestricted view of the hatch area. On most ships, one person can operate both winches.

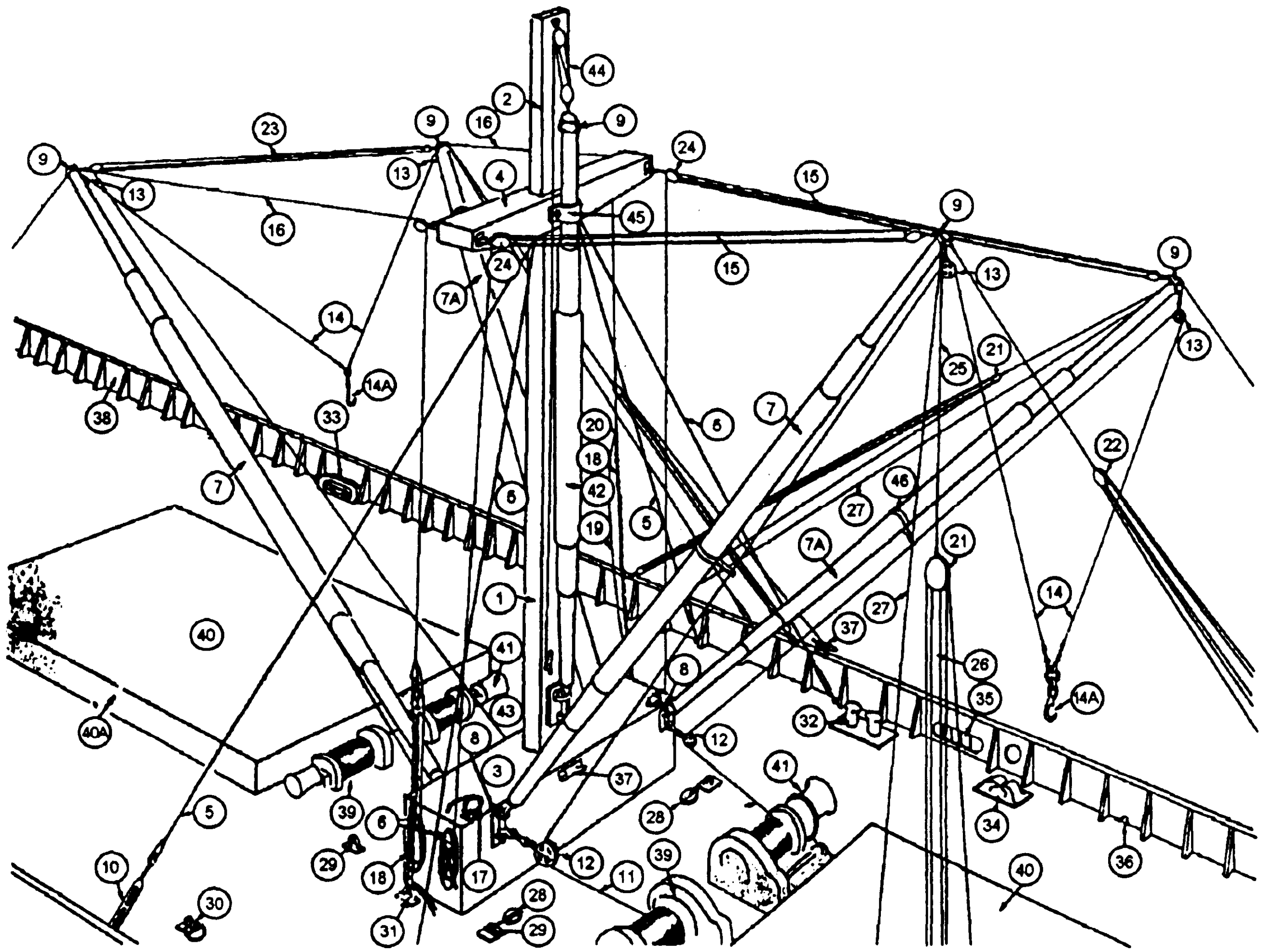
With the yard-and-stay rig you can move a load from the hold to a pier in the following manner. Allow the yard whip to hang slack as the hatch whip hoists the load out of the hold and clear of the coaming. Then, heave around on the yard whip and pay out on the hatch whip, rack (swing) the load across the deck and over the side. When the load is plumbed under the yard boom, slack the hatch whip and have the yard whip lower the load to the pier.

Most Navy installations have multiple topping lifts with their hauling parts made fast to the winch drums at all times. These drums may be part of the cargo winches, but usually are on special winches. One type of yard-and-stay rig (fig. 9-3) has the topping lift winches mounted on the king posts.

RIGS WITH TOPPING LIFT WINCHES

In rigs with topping lift winches, topping procedures are less complicated, safer, and you can accomplish them much more swiftly. Use the following procedures:

- Request power for winches.



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1. Mast
2. Topmast
3. Mast table
4. Crosstree
5. Shroud
6. Topping lift cleat
7. Hatch boom

7A. Yard boom

8. Gooseneck
9. Linkband
10. Turnbuckle
11. Cargo whip
12. Heel block

13 Head block

14. Cargo whips

14A. Cargo hook

15. Topping lift (multiple)
16. Topping lift (single)
17. Stopper chain
18. Bull chain
19. Bull line
20. Flounder
21. Outboard guy
22. Inboard guy
23. Midship (schooner, lazy) guy
24. Topping lift block
25. Guy pendant
26. Guy tackle
27. Preventer
28. Snatch block
29. Padeye
30. Padeye and ringbolt
31. Shackle
32. Bitts
33. Closed chock
34. Open chock
35. Freeing port
36. Scupper
37. Cleat
38. Bulwark
39. Hatch winch
40. Cargo hatch

40A. Hatch coaming

41. Yard winch
42. Jumbo boom
43. Gooseneck and step of jumbo boom
44. Breasting-up tackle
45. Boom gate collar
46. Slack wire fairlead

Figure 9-1.—Yard-and-stay rig.

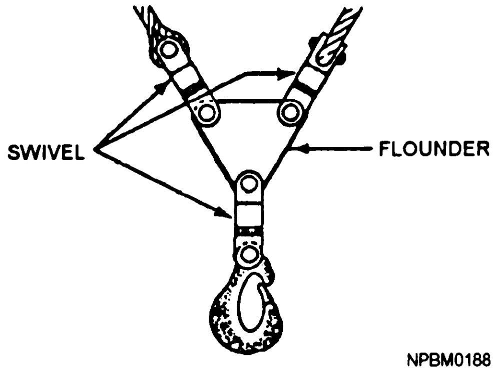


Figure 9-2.—Triple swivel hook.

- Assign personnel to winches, guys, whips, and gypsy heads.
- Test winches.

> **CAUTION**
>
> **Winches with clutches should be disengaged before being tested. Do not test winches that do not have clutches. To do so could result in danger to either the winch, wire, or cargo boom.**

- Lay out guys and preventers to proper fittings.
- Assign one person to overhaul the whip as the boom is topped.
- Raise the boom to the desired height.
- Secure the topping lift winch. If a dog is provided, dog the winch.

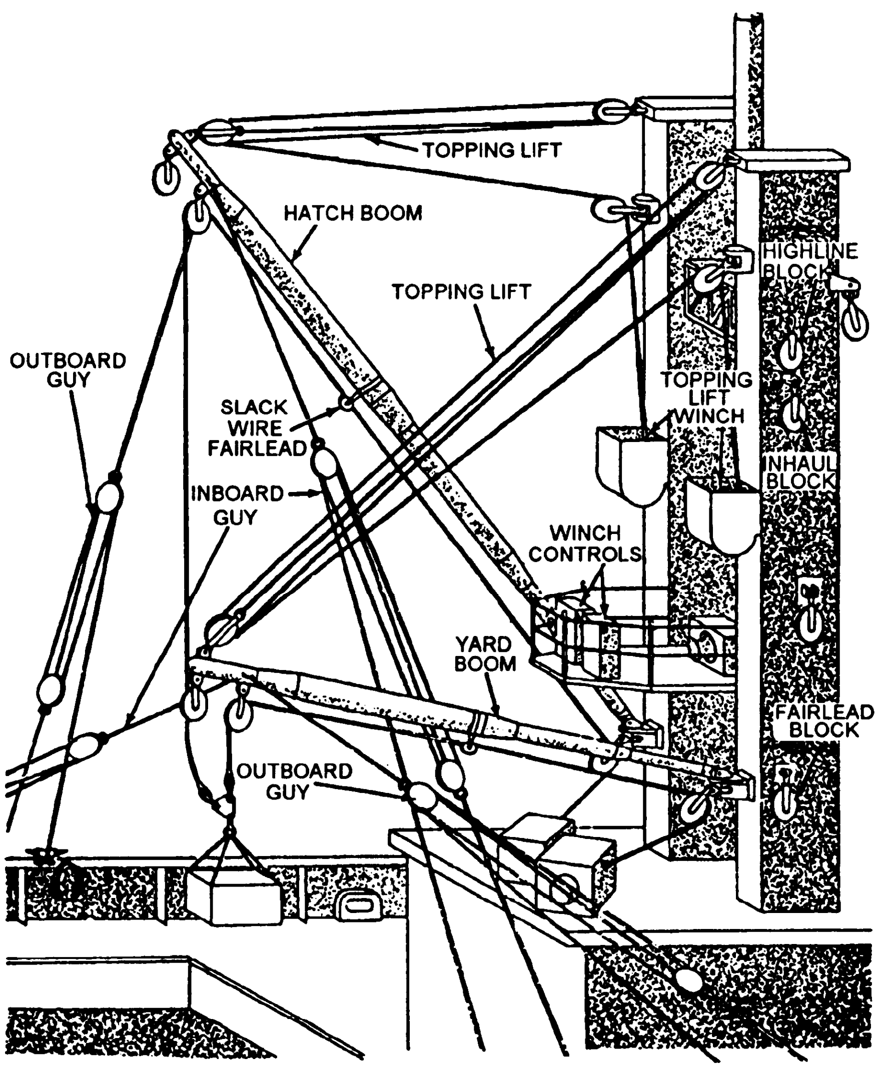


Figure 9-3.—Yard-and-stay rig with topping lift winches on king post.

- Spot booms in working position by hauling on the guys. Position the yard boom over the pier, clear of the ship's side. Spot the hatch boom slightly past the centerline of the hatch.

- Equalize guys and preventers. Set the outboard guys and preventers by lifting a draft equally between the booms until the angle formed by the span (cargo whips) is about 120°. Equalize the strain on the outboard guys and preventers by slacking off the guy tackles as needed. As this is being done, take in all the slack in the midship or inboard guys. When originally spotting the booms, swing them slightly wider than desired so that they ease into the desired position as you lift the load and equalize the guys.

DOUBLING UP A CARGO WHIP

Nearly all methods of rigging yard-and-stay cargo-handling gear for heavy lifts require that the cargo whip be doubled up and a runner used. Doubling up the whip accomplishes two things: it doubles the load that may be lifted by the whip and it reduces the load on the winch by half.

Most yard-and-stay rigs use 3/4-inch, 6 x 37 wire; therefore, use a block with a 15-inch sheave for a runner. Larger whips, of course, require larger blocks.

If the whip has a thimble spliced in the end in the usual manner, it may be impossible to reeve the whip through the block, making it necessary to remove the whip from the winch drum so that the winch end may be reeved through. The Navy, consequently, has adopted the method shown in figure 9-4 for securing the thimble in the eye. A large eye is spliced in the whip and the thimble is held in place by a wire rope clip. It is then an easy matter to remove the thimble, reeve the whip through the block, and replace the thimble.

The end of the whip may be secured in several ways. The best method is to shackle the eye of the whip to a padeye on the boom or to the becket of the head block. If the head block has no becket, it can be rerigged with parts ordered from supply. There is no danger in rerigging a block to include a becket, as far as overloading is concerned.

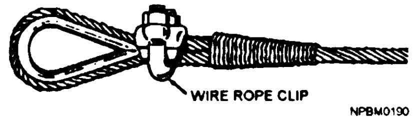


Figure 9-4.—Method of securing thimble in eye of cargo whip.

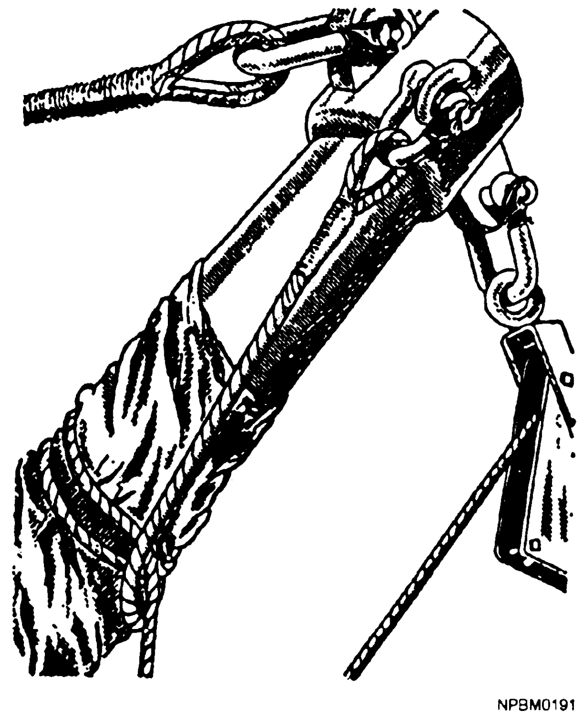


Figure 9-5.—An emergency method of doubling up a cargo whip.

An emergency method of doubling up a cargo whip is shown in figure 9-5. About 4 feet down from the head of the boom, two round turns are taken and the eye is shackled to the link band at the head of the boom. This method produces a sharp bend in the whip that will injure the wire, so its use should be discouraged. A much better arrangement is to make a special strap of wire that is a bit larger than the whip. The strap is secured in the same way as shown in figure 9-5 and the eye of the whip is shackled to the bitter end of the strap.

If either of the above methods is used, the turns around the boom must be started from the inside to prevent chafing against the whip or strap.

YARD-AND-STAY DOUBLE PURCHASE

The chief advantage of the yard-and-stay double purchase is that lifts as heavy as the safe working load of the cargo booms can be handled at nearly the same rate as ordinary 1-or 1 1/2-ton drafts. Light filler cargo encountered during the operation can be handled with scarcely any loss of time.

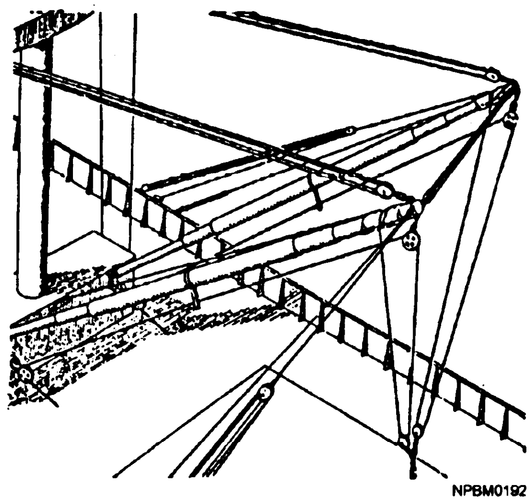


Figure 9-6.—Yard-and-stay double purchase.

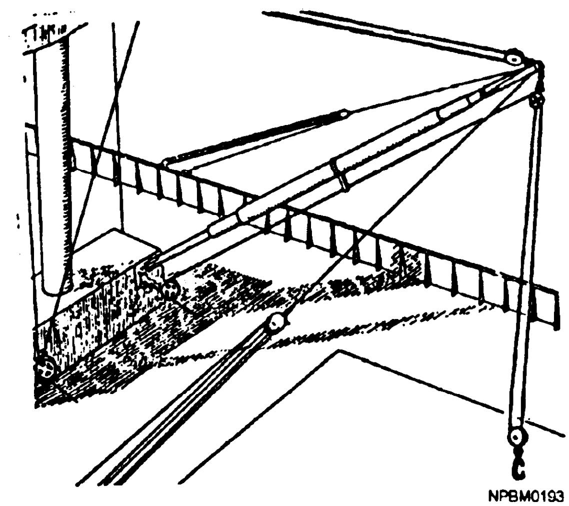


Figure 9-7.—The single swinging boom with double purchase.

The only difference between this rig and the ordinary yard-and-stay rig is that both cargo whips are doubled up and runners are shackled to the head of the boom as shown in figure 9-6. A short length of small chain between the blocks will keep the slack block from tumbling.

COMBINATION RIGS

There are many different variations of rigs for handling cargoes; we will only discuss a few here. When rigging, consult the ship's plans.

SINGLE SWINGING BOOM WITH DOUBLE PURCHASE

The single swinging boom with double purchase is considered one of the best methods of rigging for handling loads beyond the capacity of a single whip up to the capacity of a single boom. You can rig it quickly and easily, and it has the added advantage of flexibility. It can place drafts at any point in the square of the hatch or on the deck.

You rig the yard boom so the hatch boom can be topped up and secured out of the way. (See fig. 9-7.)

You use the following procedure for rigging the boom:

- Strip the hatch whip from its drum and replace it by the yard boom's topping lift wire. Make sure the topping lift wire has a fairlead.
- Make sure the yard whip is long enough to permit doubling up (250 to 300 feet).
- Double up the whip.
- Remove the preventers from the yard boom and lead the guys to proper fittings.

You top up the boom and swing it into position by hauling on the guy tackles. Fairlead the hauling part of the guys to winches at adjacent hatches, or assign personnel to haul on the guys when the load is being swung.

Some authorities claim that the single swinging boom requires too many deckhands and is slow. However, its extreme flexibility can save you time in placing heavy lifts at any desired point.

BLOCK-IN-BIGHT

When the lift exceeds the SWL of a single boom, you use the block-in-bight because it divides the weight of the draft between both booms. This is a jury rig and should be used only when other means of handling the cargo are not available.

You use the following rigging and operation procedures:

- Check the whips for length. If not long enough, reeve a longer whip on at least one boom, preferably the yard boom. Reeve the longer whip through the proper size of block. This block will be the runner.

- Shackle the whips together and turn the eyes up to within a foot or so from the head block of the hatch boom (fig. 9-8).

- Heave around on the yard whip until the runner is clear of the deck.

- Assign personnel to tend the guys and remove the preventers. Swing both booms over the draft, which we will assume is to be loaded in the hold.

- Hoist the load high enough to clear the bulwarks and coaming. Swing both booms inboard. This is difficult, so proceed slowly. Often it is necessary to take the hauling part of the guy to the winch of an adjacent hatch to swing the booms in.

- When the load is over the desired spot, lower it away by paying out on the yard whip. Always keep at least four turns of the whip on the drum of the winch.

The difference in the reaches of the yard and hatch boom makes this rig cumbersome and difficult to operate. The load has a tendency to strike and drag up the sides of the ship, but you can correct this by working the hatch boom 4 or 5 feet lower than the yard boom.

Capacity of the block-in-bight rig is slightly less than the sum of the SWL of the two whips used, and it must not exceed the combined SWL of the booms being used.

NOTE

Capacity is less than the sum of the SWL of the two whips because of the added strain on each whip caused by the angle of pull (angle of force). This angle of force increases the load on each whip as each, in effect, is opposing the other.

TWO SWINGING BOOMS

You can handle a load greater than the capacity of a single boom by using two booms working together as a single swinging boom. In this case, fasten the whip of the two booms to opposite ends of a lifting bar as shown in figure 9-9. The lifting bar serves to equalize any difference in winch operation.

To move a load from the hold to the pier, you hoist it clear of the coaming first. Using the guys, swing both booms in unison until the load is over the pier. Then lower the draft to the pier.

Swinging the load is a difficult operation, so it may be necessary for you to set the load on the deck to change the position of the booms. Because this rig is cumbersome and difficult to handle, you use it only in an emergency.

BLOCK-IN-BIGHT METHOD OFRIGGING A DOUBLE-GANGED HATCH

Many ships have double-ganged hatches; that is, they are equipped with two pairs of ordinary cargo

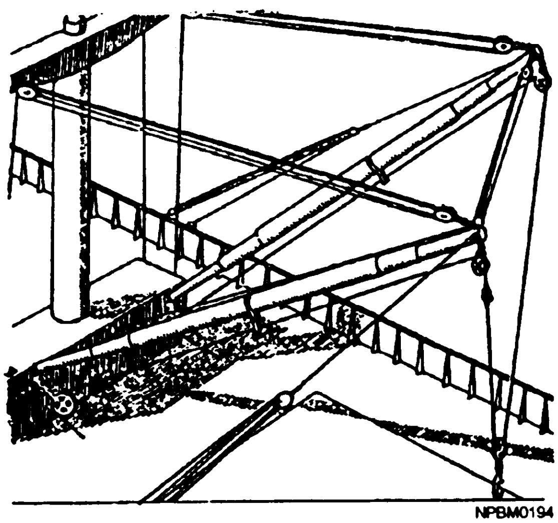


Figure 9-8.—Block-in-bight.

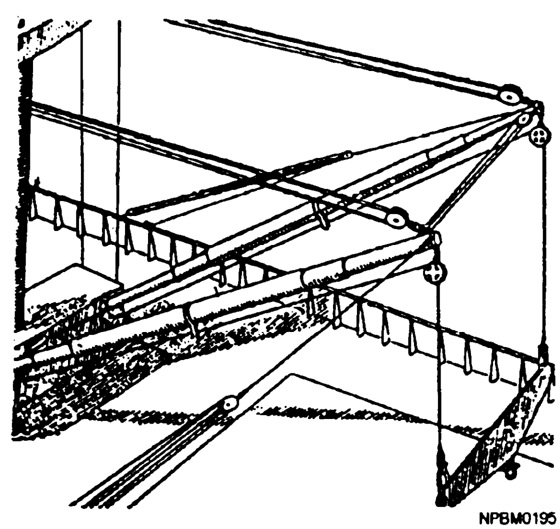


Figure 9-9.—Two swinging booms.

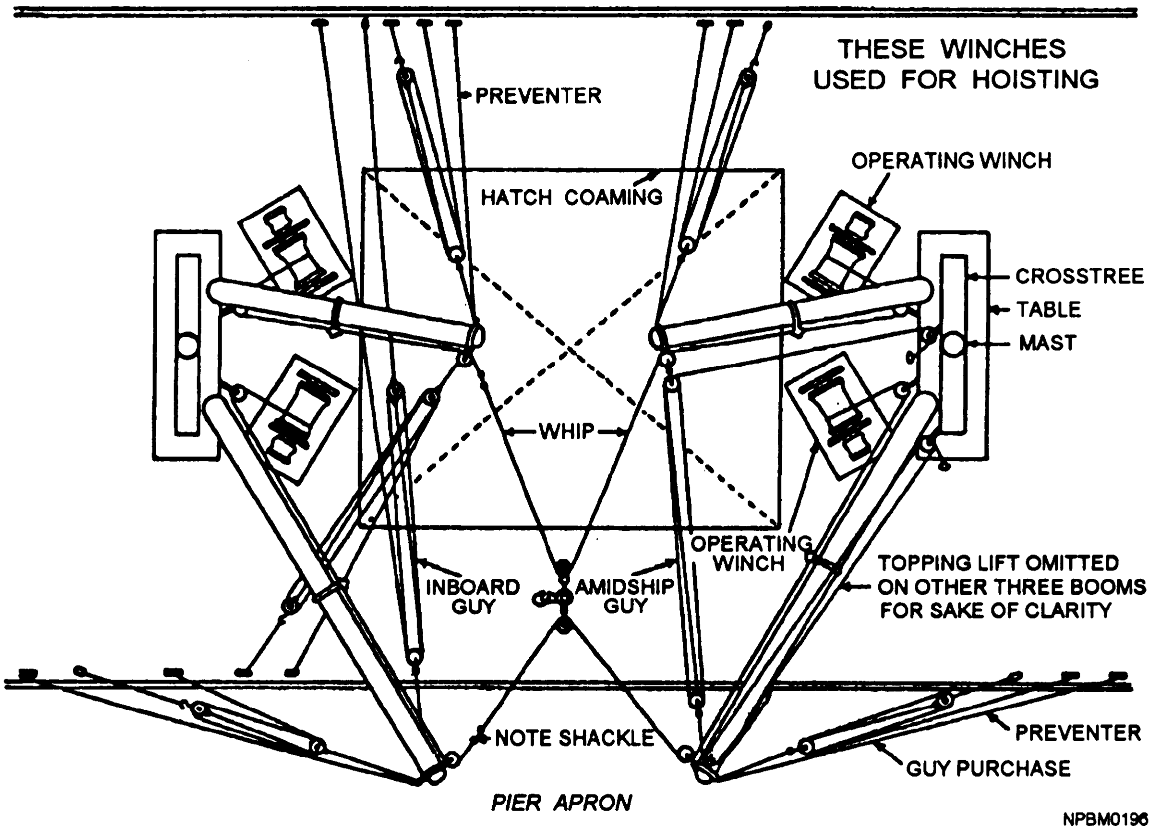


Figure 9-10.—Block-in-bight method of rigging a double-ganged hatch.

booms. Handling heavy lifts at a hatch rigged in this manner is facilitated by rigging all four booms as shown in figure 9-10.

You use the following rigging procedure:

- Reeve the forward hatch whip through a runner, and shackle the eye to the eye of the after hatch whip. Reeve the forward yard whip through a runner, and shackle it to the after yard whip.
- Run the shackles joining the two sets of whips to within a few feet of the head blocks of the after booms.
- Shackle the two runners to the cargo hook.

Now you load or discharge heavy lifts slightly less than the sum of the SWL of two parts of the cargo whips by the usual yard-and-stay method.

The rig has the advantage of being quickly rigged without the necessity of lowering the booms, and only two manned winches are required for its operation. In addition, the gear may be readily singled up for ordinary light drafts.

HEAVY-LIFT BOOMS

LEARNING OBJECTIVES: Describe the need and usefulness of the heavy lift booms, include the disadvantages in operations. Identify handling guys used on a heavy lift boom and describe there uses.

Tanks, landing craft, harbor boats, crash boats, locomotives, and other extremely heavy cargo required by our forces in the field present difficult problems in stevedoring operations at advanced bases. At ports in this country, loading a heavy lift is a simple matter; however, the problem does not end at these ports. At overseas bases, these heavy lifts must be off-loaded, although shoreside equipment or floating cranes are not always available. Often the ship's gear must be used for this purpose.

Many ships used in task force operations are provided with heavy-lift gear at practically all hatches for the quick discharge of heavy equipment. Personnel in practically all cargo-handling divisions operating in the field will have occasion to work heavy-lift rigs, and for this reason must understand rigging and operating procedures of heavy-lift booms.

METHOD OF RIGGING

Most heavy-lift booms are carried in an upright position, collared to the mast, and fully rigged with topping lift, load purchase, and guy tackles already secured.

Your first step in rigging a heavy-lift boom (fig. 9-11) is to lead all purchases to power. Four sources of power are required. You lead the load purchase and the topping lift wire through heel blocks to the winches at the hatch to be worked. You lead the guy tackles out to proper fittings, and the hauling parts of the guys to adjacent sources of power. Although it is preferable to use the anchor windlass or the after warping winch, you may use the winches at the next hatch, depending on the location of the boom. If the hatch equipped with the heavy-lift boom is also double ganged, you use the other two winches for the guys. To free the boom for use, send personnel aloft to release the collar that secures the boom to the mast. On some ships, you can take the weight of the boom off the collar by heaving around on the topping lift wire, but on other vessels it is necessary for you to use a tackle or a special breasting-up line (commonly called a bull rope). Hitch this line to the boom, clap it in a snatch block on the mast, and lead it up to a gypsy. Take a strain on the breasting-up line and hold until the collar can be released, then slack off the line until the weight of the boom is on the topping lift. At this point, you remove the breasting-up line, and the boom is ready to operate.

Before making a hoist with a heavy-lift boom, you check all the gear thoroughly to make sure that all blocks are running free and that none of the lines are chafing. Lay turns on the drums of winches tightly and evenly around the drum. Free guy tackles of twists and fairlead the hauling parts of the guys to sources of power. Mouse the hasps and hooks of snatch blocks securely with seizing wire. Check the stays, shrouds, and preventers and tighten if necessary. This is extremely important because it is possible to bring down a mast in attempting to handle a heavy lift.

Before operating a heavy-lift boom, swing ordinary cargo booms at the hatch clear of the working area, Generally, it is sufficient to swing these booms outboard against the shrouds and secure them with the guys. In working deck cargo, however, you might have to top the booms very high to clear the deck space.

OPERATING A HEAVY-LIFT BOOM

You plumb the head of the boom directly over the load and sling, then shackle the slings carefully to the lower purchase block. Next, hoist the load a few inches off the deck and check all gear carefully for any indication of undue strain. You hoist the load carefully

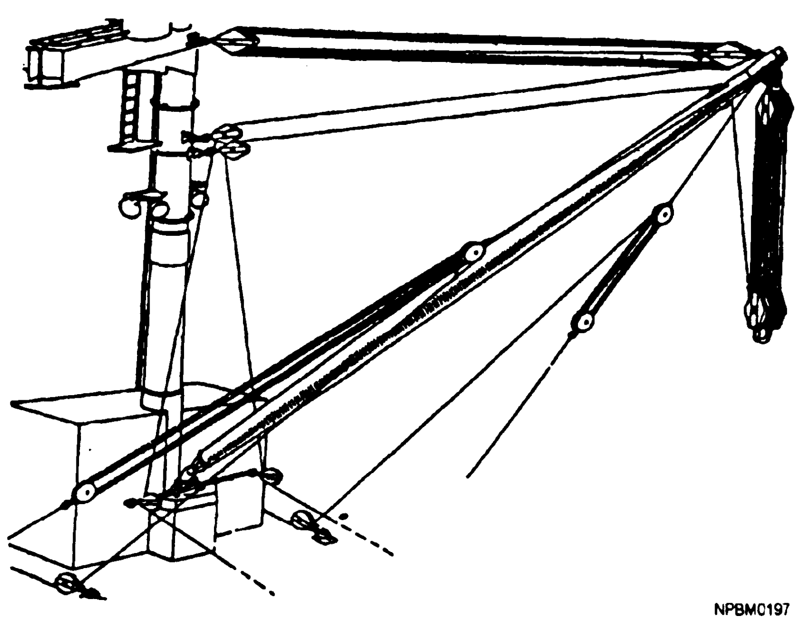


Figure 9-11.—Heavy-lift boom.

until it is clear of the hatch coaming. By heaving around on the guy tackles, you swing the boom over the ship's side, and set the load on the pier.

HANDLING GUYS OF A HEAVY-LIFT BOOM

One of the greatest difficulties in working a heavy-lift boom is handling the guys. Every change in position of the boom must be accompanied by an adjustment of the guys. When a boom is topped, slack off the guys; when it is lowered, take in the guys. To swing a boom, you heave on one guy and pay out the other. This requires coordination between the personnel handling the guys.

When a boom is swung outboard or inboard, one guy may be considered as a "hauling" guy; the other as the "following" guy. The latter is generally the troublemaker. Green hands often fail to ease off on this guy smartly enough and it parts with disastrous results. Allow a small amount of slack in a following guy, but never enough to permit the boom to slap about.

A heavy lift suspended outboard from the head of a boom may cause the ship to develop considerable list. This inclination places a great deal of added strain on the guys. The boom has a natural tendency to swing outboard in the direction of the list, and, if this is not controlled properly, a guy tackle may carry away easily.

PRECAUTIONS

Rigging and operating cargo booms used for heavy lifts require skill, care, and common sense. There are many precautions to be observed, and to neglect any is to invite trouble.

Do not overload. You make certain that the rig will make the lift safely. Rig carefully and check each piece of gear as it is rigged. Check the stays and shrouds.

You plumb the load directly under the boom head. Sling carefully and use dunnage or other suitable chafing gear at points where there may be chafing.

You check every part of the rig before you pick up the load. Hoist the load a few inches off the deck and check the rig for indications of undue strain.

You hoist, swing, and lower the load slowly and smoothly. Jerking causes terrific strain in the rig and can easily part something. Hoist loads only high enough to clear the coaming and bulwark. A particularly heavy load raised too high will affect the stability of the ship and may cause a considerable list. Listing increases the strain on the guys and preventers and, therefore, the danger of parting. If something does part when a load is raised high, the effect will be worse than if the load were lower.

You watch while a load is being moved, and keep every part of the rig under constant observation. Listen for any change in sound. Normally, a wire or natural fiber rope will hum under strain, but when it starts to squeak or squeal, LOOK OUT A faulty block may give warning by squeaking or groaning.

You keep unnecessary personnel out of the area; make sure those concerned with the operation keep alert. LOOK ALIVE AND STAY ALIVE.

BURTON METHOD

Some piers in the United States are equipped with cargo masts or beams erected at intervals along the pier edge or near the outer face of the warehouse. These masts are 60 to 80 feet high, and the tops are secured together by girders. Near the top of the masts, running the length of the pier, are catwalks from which workers can shackle snatch blocks in holes spaced every 2 or 3 feet along the girders. Whips are rove through these blocks and one end is shackled to a whip of the ship. The other end is secured to an electric cargo winch on the pier. By using this arrangement, you can handle loads in the same fashion as in the burton method of transfer at sea. See chapter 10 of this manual.

The button method of handling cargo has several advantages. It increases the usable landing area on the pier. It uses only one of the ship's booms at each hatch, freeing the other to work cargo from a lighter or barge on the outboard side. If the pier warehouse is two-storied, you can land cargo on either level. It facilitates handling cargo having long length, such as pipes, beams, and rods. Cargo can be transferred even if the ship is separated from the pier by a lighter.

HOUSEFALL METHOD

The housefall method of cargo handling requires the same arrangement of the pier as the burton method except that there are no cargo winches on the pier. You remove the cargo whip from the inboard winch on the ship. Reeve a special whip through a block on the pier, and then fairlead the whip (usually through the heel block) to the inboard winch. Spot the outboard boom over the hatch and shackle its whip to the special whip; do not use the inboard boom. Handle cargo as described in chapter 10 in the section on the housefall method of transfer at sea.

The housefall method has all the advantages of the burton method with one exception; the outboard boom is not free to be used separately.

WINCHES

LEARNING OBJECTIVES: Describe the types of winches, their operation, and precautions to be observed while working with them. Identify the different types of winches and describe there uses.

All winches consist of a rugged bedplate and side frames upon which are mounted a horizontal drum shaft, drum(s) and/or gypsy head(s), reduction gearing, and (usually) the motor or engine that drives the winch. Figure 9-12 shows an arrangement of the components of a typical winch.

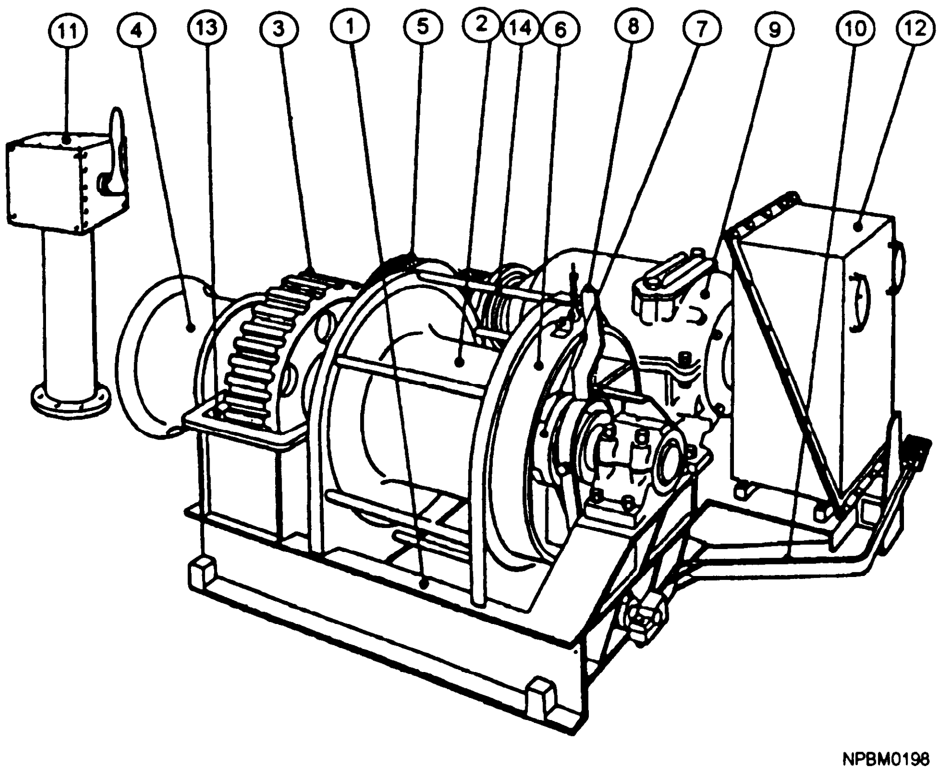
Winches are classified by types and by drives. Types are drum winches, gypsy winches, and combinations of the two. Drives are electric, electrohydraulic, and diesel engine.

TYPE OF WINCHES

Drum winches are those with drums on which rope is wound for raising, lowering, or pulling loads. Depending on their purpose, they may have from one to four drums.

Gypsy winches, also known as warping or snaking winches, have one or two horizontally mounted gypsy heads around which several turns of rope can be taken to pull or hoist a load.

Combination winches are simply drum winches with shafts extended far enough to take gypsy heads on either side or both sides.



1. Bedplate	**6. Drum brake**	**11. Speed control**
2. Drum	**7. Drum clutch**	**12. Electric brake**
3. Drum gear	**8. Clutch lever**	**13. Oil bath**
4. Gypsy head	**9. Drive motor**	**14. Rope guard**
5 Reduction gearing	**10. Drum brake lever**	

Figure 9-12.—A typical winch.

WINCH DRIVES

Drum winches may be powered by any of the means discussed previously, but gypsy winches in the Navy are powered only by electricity.

Electric

Electric drives consist of a motor, either alternating current (ac) or direct current (dc), that actuates a drive shaft through reduction gearing.

The dc drives can be built with an indefinite number of speeds, but normally only three to five in each direction are provided.

Electric-Hydraulic

When a winch with wide speed range, fine control, and smooth acceleration is required for installation in an ac-powered ship, an electrohydraulic winch is used.

Drive equipment for these winches is comprised of a constant speed electric motor that drives a variable displacement pump and a hydraulic motor that, through reduction gears, drives the shaft of the winch. A manual control regulates the stroke of the pump and its output and thereby determines the speed of the motor.

Diesel

Although there are few diesel engine winches installed aboard ship, the Navy has found many uses for them. For example, diesel winches are used in salvage work and are used in the amphibious forces for a variety of tasks.

The prime mover is the engine, which actuates the shaft through a torque converter and reduction gearing. The torque converter provides for an infinite number of speeds. The speed also can be controlled by increasing or decreasing the revolutions of the engine.

Usually, these winches are designed as a unit, with the engine and the winch mounted on the same bedplate. Frequently, as in the case of the salvage winches, they are portable.

WINCH BRAKES

Drum winches have friction brakes designed to hold or control a drum under load or to hold the drum when disengaged. The brake is a steel band lined with an automotive type of brake lining that acts on a flange (brake drum) on the winch drum, A positive locking foot pedal, hand lever, or handwheel provides the necessary pressure to the brake band.

In addition to the friction brake, many winches have positive locking devices known as pawls or dogs that engage ratchets welded or bolted to the winch drum. The paw1 (dog) either is spring-loaded or heavily counterbalanced so that is falls out of engagement when the load on it is relieved. Normally, some means is provided for locking the dog in a disengaged position, and if the dog is not to be used, it should be locked out as a safety precaution.

Electric winches also have electric brakes that are applied automatically when the current is turned off or the control lever is moved to the OFF position.

CLUTCHES

Clutches for winches are of two types: drum and speed. Drum clutches provide the means for engaging the drum to the shaft. Speed clutches provide the means for selecting the gearing that will give the desired speed. Both types of clutches have a device—locking pin or spring-loaded pawl—to lock the clutch lever in position.

When a speed clutch is in neutral or a drum clutch is disengaged, the winch drum can “free wheel.” It is mandatory, therefore, that the drum brake be set before disengaging a drum or shifting a speed clutch to neutral. The drum brake should not be released unless the drum clutch lever is locked in the engaged position or the speed clutch lever is locked in the high- or low-speed position.

GENERAL OPERATING INSTRUCTIONS

LEARNING OBJECTIVES: Describe the hand signals used in the controlling of the winch operations. Identify the proper procedures in using a winch during operations.

Instructions in this section apply generally to all winches. For instructions for specific installations, you consult the manual supplied with the winch.

- Inspect the area around the winches, making sure there is a safe place for the winch operator to stand. If the deck is slippery, lay down some dunnage on which the operator can stand.

- Inspect the rigging, making certain that the standing rigging is taut and that the running rigging is not foul. Check to see that cargo whips are free to run and are not loose on their drums. A loose whip may cause the winch to reverse itself by allowing the whip to bind and wind back in the wrong direction. It also may cause a load to drop if the slack runs out, endangering rigging and personnel in the vicinity.

- Inspect the equipment. Check the action of pawls, brakes, and clutches; make certain they are engaged. See that clutch levers are locked in place. Note the amount of play in the brake pedal and make certain there is not too much slack.

- Test the winch. Energize the winch motor, disengage the pawl and lock it out, release the brake, and run the winch in both directions. With no load on the whip, have one person overhaul the whip when lowering or paying out.

Changing Speed Gear

The following instructions must be followed when you are changing the speed gear:

- Engage the pawl and drum brake.

- Unlock the gear shift lever and move the lever to the NEUTRAL position.

- Slowly rotate the shaft in the hoist direction and move the gear lever in the desired direction. When the gears engage, relock the lever. When ready in other respects, disengage the dog, lock it out, release the brake, and continue operations.

Using the Gypsy Head

When using the gypsy head, you follow the instructions in the following list:

- Set the drum brake and engage the pawl in the ratchet.

- Disengage the drum from the shaft, or shift the speed clutch to neutral. Lock the lever in place.

- Move the control lever in the desired direction.

When you secure a winch, lock the drum brake to prevent the rope from unspooling from the drum and engage the pawl in the ratchet. Make certain that the power is secured.

NOTE

Although the engineering department is responsible for maintaining winches, the winch operator and the petty officer in charge must make certain that required maintenance actually is carried out. Winches in constant operation should be lubricated about once every 4 hours.

OPERATING HINTS

Coordination is essential for good winch operation. After sufficient practice, you, as a winch operator, should be able to pick a draft from the hold, or ‘tween deck, and deposit it on the pier in one smooth, constant motion. However, during the early stage of training, handle the draft with three distinct movements—hoisting, racking, and lowering. In hoisting, you have one winch support the entire load and the other maintain the slack. When the draft is clear of the rail, or coaming, carry it across the deck by both winches. This is called "racking." When you have a draft in position to be lowered, have the other winch support the entire load and slack the first whip. It is vitally important that you leave the right amount of slack in the nonworking whip during the hoisting and lowering phases of the load's cycle. If you keep the whip too tight, the draft will strike against the side of the ship or the coaming of the hatch. If you allow the whip excess slack, loose turns will pile up on the drum of the winch and must be rewound before resuming operations.

When you hoist or lower cargo, avoid swinging if possible. A wildly swinging draft often results in damaged cargo and endangers the lives of personnel working in the hold, on deck, or on the pier. You can usually prevent swinging in the hold or on the pier by dragging or "touching" the draft until it is directly under the head of the boom before hoisting it. Occasionally, a draft will start to swing athwartships while you carry it across the deck. You stop this swinging before landing the load. It can be done easily with a little practice as follows: When moving outboard, wait until the draft is at the highest point of its arc swinging outboard, then slack the hatch whip quickly so that the slings supporting the draft assume the usual perpendicular position. To be safe, practice with a load of cargo nets.

You attach at least two steadying lines to heavy or unwieldy loads. Have these lines handled by personnel in the hold until the load is hoisted above the coaming, then have them passed simultaneously to the personnel on deck.

SIGNALS TO WINCH OPERATORS

Signals to winch operators must be distinct so they can easily be understood. The winch operator and the signalman must be thoroughly familiar with the system of signals to be used.

Since BMs experienced in cargo handling have drawn attention to the fact that if the signal of the same hand always controls the hook (whip) and the signal of the other hand controls the boom, there is less chance of a signal being misunderstood. The following set of signals is presented here. (See fig. 9-13.)

- **RAISE THE HOOK (WHIP)**—The right forefinger is extended, pointing up and circling. For faster speed, extend two or more fingers, depending on the speed desired and speeds available. (The more fingers, the faster the speed.)
- **LOWER THE HOOK**—Same as for raise the hook, except a finger or fingers point down.
- **RAISE (LOWER) THE BOOM**—Left fist closed, thumb extended, pointing in the direction desired.
- **RAISE (LOWER) THE HOOK, SWING THE BOOM (LOAD)**—With your right hand giving proper signal for the hook; your left hand, with fingers extended and together, points in direction the boom or load is to be moved. If the hook is not to be raised or lowered, keep your right hand at your side while the left hand points.

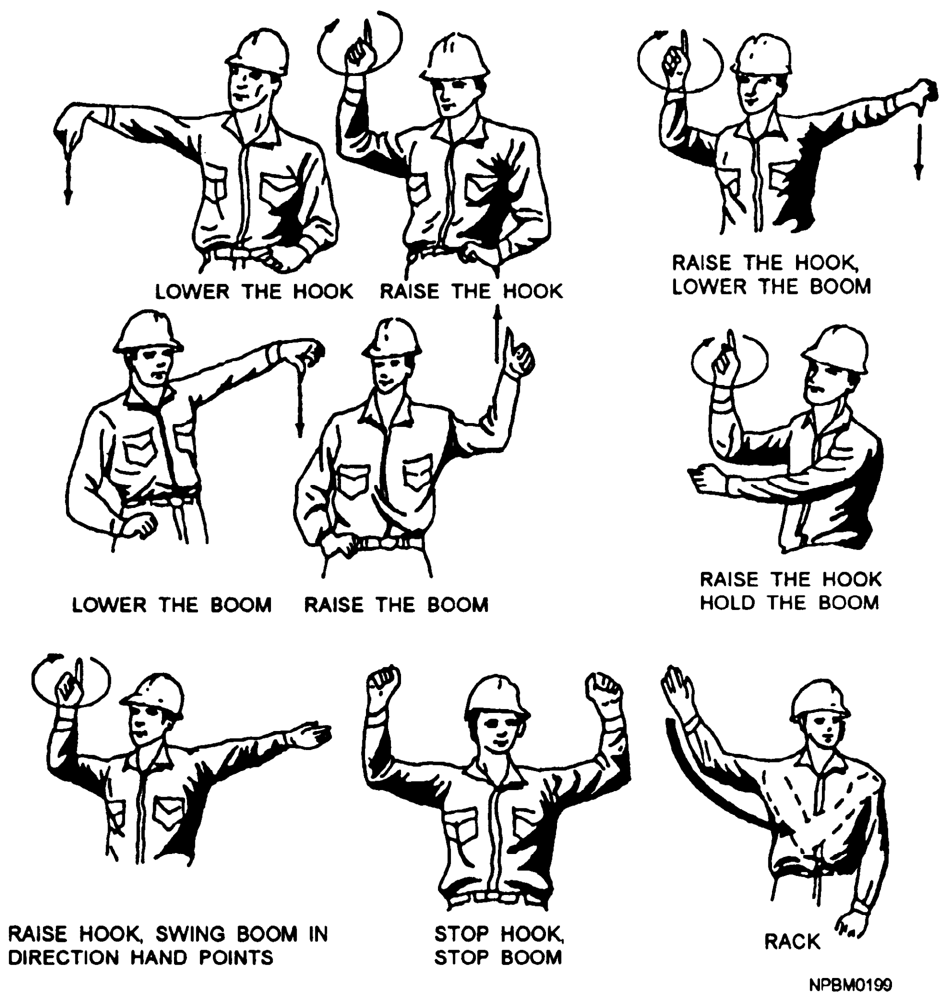


Figure 9-13.—Hand signals for operating booms and winches.

- **STOP**—Proper arm held with upper arm shoulder high, forearm straight up, fist clenched.
- **EMERGENCY STOP**—Fist swung rapidly back and forth, or rapidly pumped up and down.
- **RAISE (LOWER) HOOK, HOLD (STOP) BOOM** —Right hand giving proper signal for the hook, left hand giving stop signal.
- **RACK**—Arm extended on side of body to load. Swing arm across body in direction load is to be moved.

> **NOTE**
>
> **Winchmen have authority to move the load at their discretion only when the RACK signal is given. This authority terminates when the signalman gives another signal.**

Although all signals are not described or shown, you should be able to figure out the correct combination for any signal if you remember that in this system the right hand controls the hook and the left hand controls the boom. However, in a rig where the boom cannot move (yard-and-stay, for example) and there are two whips, each hand controls the corresponding whip.

CARGO-HANDLING EQUIPMENT

LEARNING OBJECTIVES: Describe the various equipment used in cargo handling operations and explain how to use them properly in everyday use.

Equipment used for handling cargo is varied to meet the situation. Here you will learn the equipment, its description, and its use in cargo-handling evolutions.

GENERAL EQUIPMENT

Pallets are platforms on which you place cargo so you can move both platform and cargo as a unit. Stack cargo on pallets in uniform loads and securely strap the loads to the pallets by steel or fiber bands. The most common pallet is the double platform type shown in figure 9-14. It is used in conjunction with forklift trucks and trailers. The figure also shows a pallet bridle with

Figure 9-14.—Pallet and bridle.

spreaders. Preventers (like the one shown) hooked at each end of the bridle keep the bridle from slipping from under the load.

Sled pallets were developed for beach operations. Bridles are attached to the padeyes provided, and the sleds or skids are towed up the beach by trucks or tractors.

The box pallet has sides, as indicated by its name, and is employed for small items or cargo that may be subject to damage by crushing.

Cargo nets are used to advantage when nonuniform packages are being handled. The nets may be made of manila, wire rope, or nylon bands. In replenishment-at-sea operations, transfer palletized cargo in cargo nets, although the net load is limited to one pallet per draft. In this case, nylon band nets are particularly advantageous. You have the pallet trucks run over the net, pick up the pallet, and quickly move it from the landing area. Figure 9-15 shows a nylon cargo net in use.

At times, you will find the beckets of cargo nets are too short for large, bulky loads. It is difficult to get the beckets over the hook and your chances of crushing something are increased. For these reasons, many ships keep cargo net shorteners at hand (fig. 9-16).

Usually, you hoist large crates and odd-shaped cargo by means of slings. In general, a sling is one or more lengths of rope or chain passed around a draft of cargo and attached to the cargo hook. The terms sling and *strap* are often interchangeable, but to avoid confusion, you use them as described in this chapter.

A sling is a length of rope, either fiber or wire, with the two ends spliced together. It is looped around the item to be hoisted, and one end is passed through the other and over the hook.

Figure 9-17 shows an ordinary sling. Figure 9-18 shows one of many special slings—the barrel sling. You use barrel slings for hoisting steel drums and barrels of standard size by hooks (chines) placed over each end. You may use these slings singly or in conjunction with a spreader bar or frame to hoist as many as six or eight drums at a time. Barrel slings are not recommended for wooden barrels.

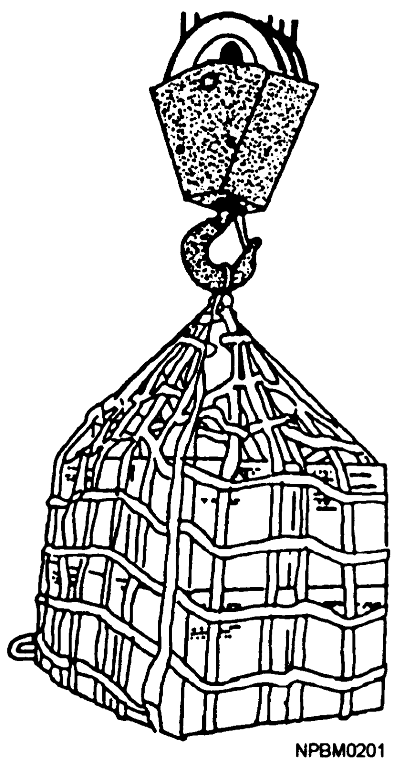


Figure 9-15.—Nylon cargo net.

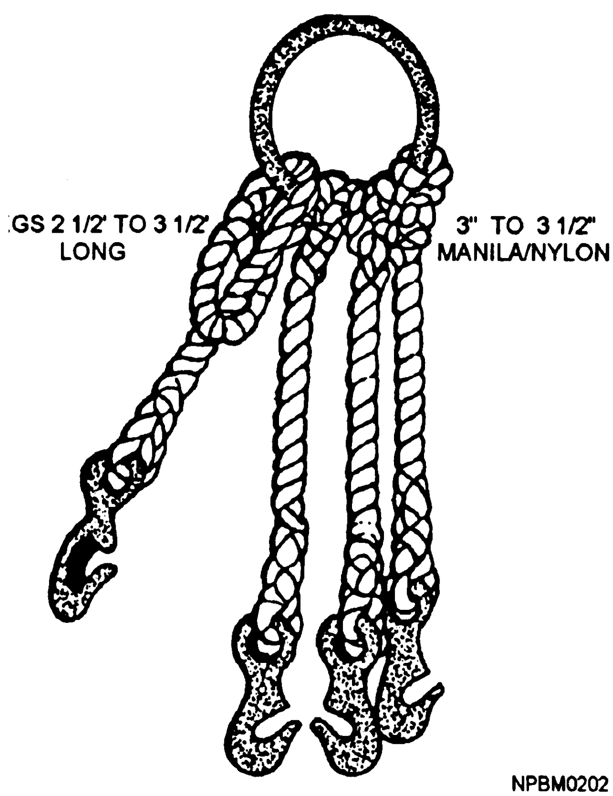


Figure 9-16.—Cargo net shortener.

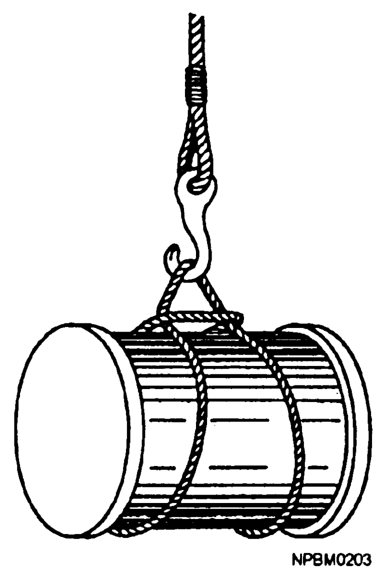


Figure 9-17.—A sling.

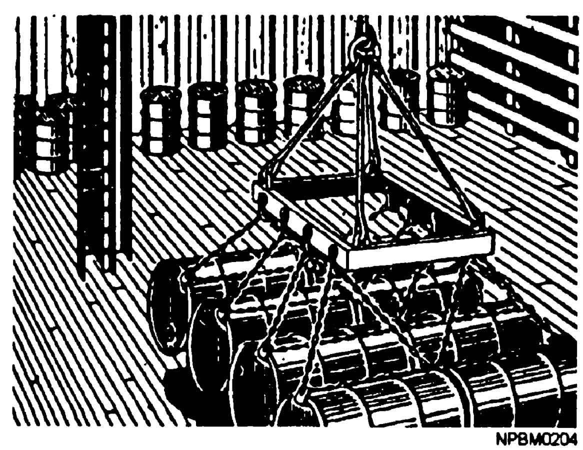


Figure 9-18.—Barrel slings.

A strap is a length of line or wire with an eye spliced at each end. Usually, you should loop the strap around the article to be lifted, and pass one eye through the other and over the hook. Frequently, however, you can use two straps of equal length to hoist a heavy or bulky load. Place the straps under the ends of the load, and put both eyes of each strap in the hook. Because two straps are so often used together, make them in pairs of equal length and paint the eyes a distinctive color to designate the length. This saves you time in searching for a matched pair.

You pay considerable attention to the condition of slings and straps. Since they are subject to stress and abuse, inspect them frequently for wear and distortion. Your inspection of wire rope should include the following areas:

- Reduction of wire rope diameter because of loss of core support or internal or external corrosion or wear of individual outside wires
- Number of broken outside wires and degree of distribution of broken wires
- Corroded, pitted, or broken wires
- Severe kinking, crushing, or distortion of rope structure
- Evidence of heat damage from any cause

One or more of the following conditions is sufficient reason for questioning the straps' or slings' safety and are cause for replacement:

- Reduction of the nominal rope diameter by more than the amount shown in table 9-1
- Six broken wires in one rope lay length
- Wear of one-third the original diameter of outside individual wires
- Evidence of pitting caused by corrosion
- Evidence of heat damage from any cause
- Kinking, crushing, or any damage resulting in distortion of the rope structure

View A of figure 9-19 shows a choker, which is very effective for handling pipe, dunnage, steel items, or anything requiring good gripping action. When used in pairs, the hooks of the chokers and straps pull from opposite sides of the load as shown in view B.

Table 9-1.—Wire Rope Allowable Diameter Reduction

ROPE DIAMETER (Inches)	MAXIMUM ALLOWABLE NOMINAL DIAMETER REDUCTION (Inches)
5\16 and smaller	1\64
3\8 to 1\2	1\32
9\16 to 3\4	3\64
7\8 to 1-1\8	1\16
1-1\4 to 1-1\2	3\32
1-9\16 to 2	1\8
2 to 2-1\2	5\32

Chain slings are used mainly for hoisting steel items such as rails, beams, angles, and pipe. You always place dunnage between the chain and the draft to provide a gripping surface, as shown in figure 9-20. One disadvantage of the chain sling is that the links may crystallize and snap without warning. Handle chain slings carefully and do not expose them to cold temperatures for long periods.

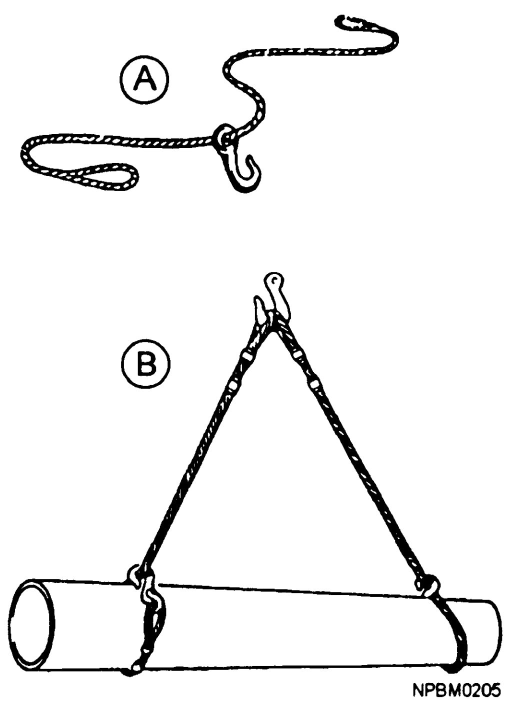


Figure 9-19.—Choker and straps.

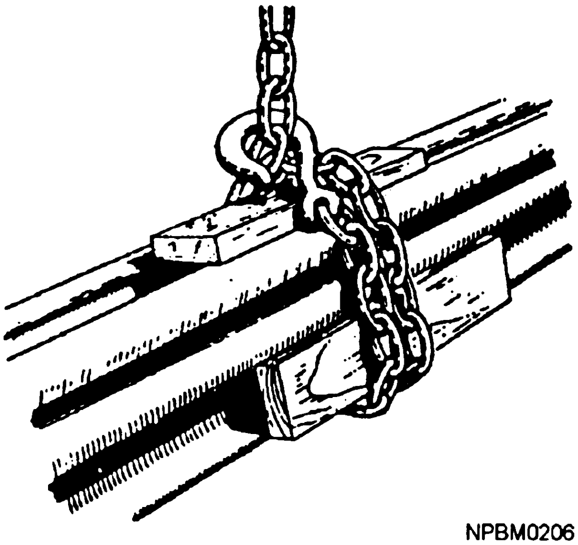


Figure 9-20.—Use of chain slings.

You hoist unloaded military vehicles by attaching bridle legs directly to the padeyes provided (fig. 9-21). You handle uncased automobiles by means of bridles with special hooks that fit under the wheels.

A salmon board is a rectangular wooden platform, approximately 4 by 6 1/2 feet, with a 2 by 3-inch beading around the edges of the upper side. You use it in conjunction with a cargo net for handling ammunition and crated bombs. The beading prevents stacked powder tanks or other containers from rolling off the platform.

A hand hook has a hardwood handle fastened at a right angle to a highly tempered steel shaft. The shaft is curved at the end to form a hook that is tapered to a sharp point. The primary purpose of the hand hook is to move or turn crates and bales. Use the following precautions when you use the hand hook. You hold the hand hook in the most comfortable position. When breaking out or turning a crate over, have your knuckles turned away

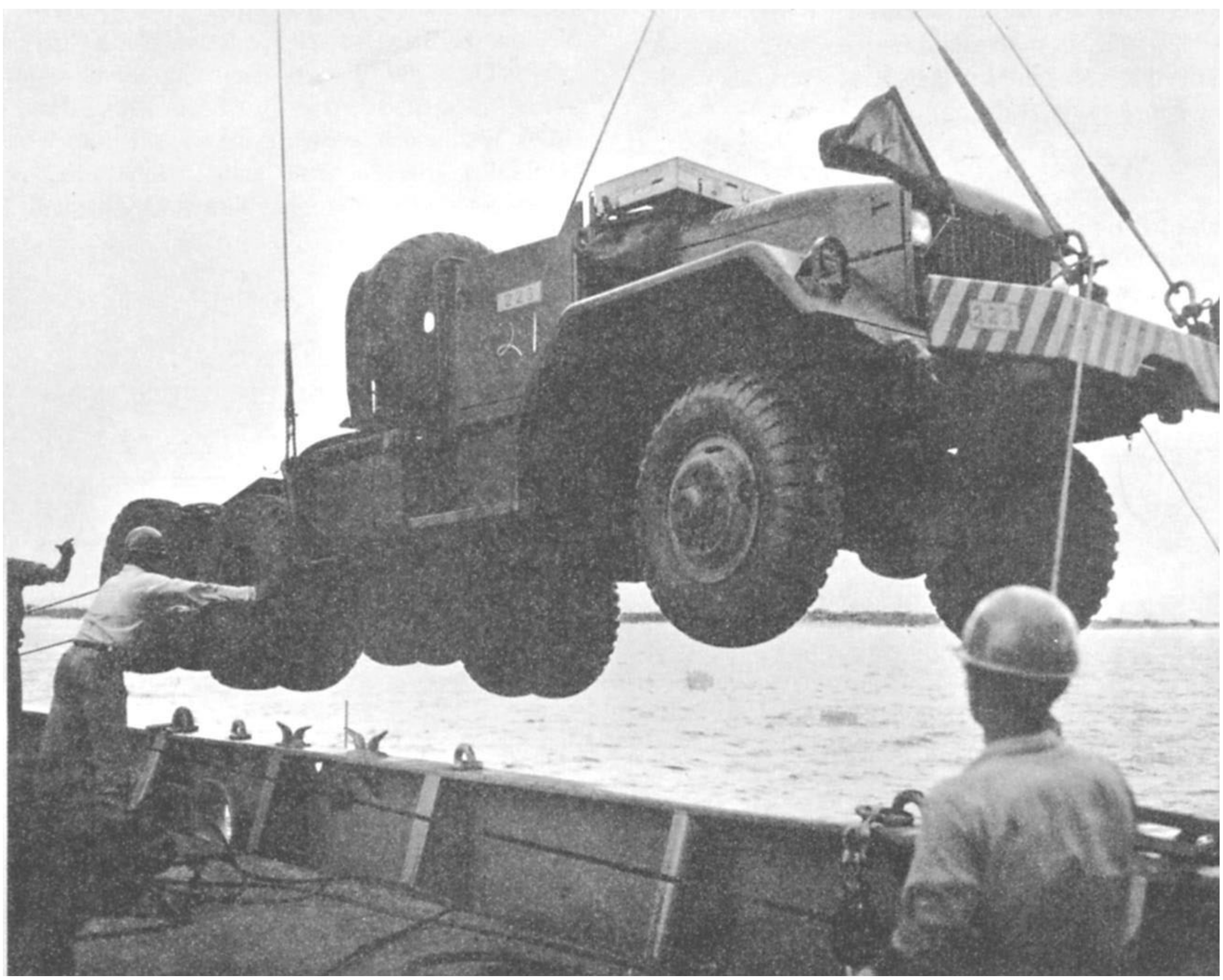


Figure 9-21.—Bridle legs may be attached to hoisting padeyes of unloaded military vehicles.

from the crate; this will give you better control over the hook when securing a bite. (See view A of fig. 9-22.) To lift a crate, however, turn the back of your hand toward the crate to prevent pinching your fingers between the handle of the hook and the crate (view B, fig. 9-22). When rolling a crate, sink the point of the hook lightly into the top edge opposite you. Place the heel of the other hand on the top edge nearest you. Then, by pressing down with the heel of one hand and lifting up and pulling on the hook, you can start the crate rolling.

The "Use No Hooks" warning, which frequently appears on cartons and packages, means exactly what it says. Obey this admonition, because using a hook on cases containing such items as cigarettes, cereals, and canned goods could easily damage or ruin the contents.

You never use the hand hook on metal unless there are holes in which the point of the hook can be inserted. Do not tip over barrels or drums, nor remove hatch boards with a hand hook. NEVER use it for handling ammunition.

Keep crowbars and pinchbars handy when you are working cargo. They are useful for tearing out dunnage, breaking out cases, and in many other situations where a lever is necessary.

Rollers are ideal for moving cases that are too heavy to lift. Rollers may be lengths of pipe, or they may be fashioned from hardwood. They must be long enough to pass completely under the load to be moved. Place several under the case and several more in front of it. As you roll the case forward, pick up the rollers passed over and position them ahead of the load. Turn the case by placing the rollers at an angle or angling those already under the load by striking one end of them with a sledge hammer or maul.

Dragline

Cargo too heavy to be moved by manpower is difficult to shift to its stowage place. Palletized cargo, of course, can be handled by forklift truck, but it may be necessary to rig a dragline to move an exceptionally heavy or bulky item from the hatch to its stowage place. (See fig. 9-23.)

To rig a dragline, fairlead a wire pendant through snatch blocks (DO NOT USE THE CARGO WHIP) to the gypsy head of a cargo winch. If possible, put rollers under the load to be moved. If the load is too heavy for the winch, you may have to improvise a tackle or extra snatch blocks, as shown in the inset of figure 9-23.

Beam clamps, such as those in figure 9-24, will facilitate securing snatch blocks in place where it is impossible to pass a strap. The clamp in view A of the figure is designed for use on a beam with a flat flange (I-beams); the one in view B may be secured on beams of circular cross-sectional area (bulb beams). Beam clamps are also useful for hanging a tackle or chain hoist

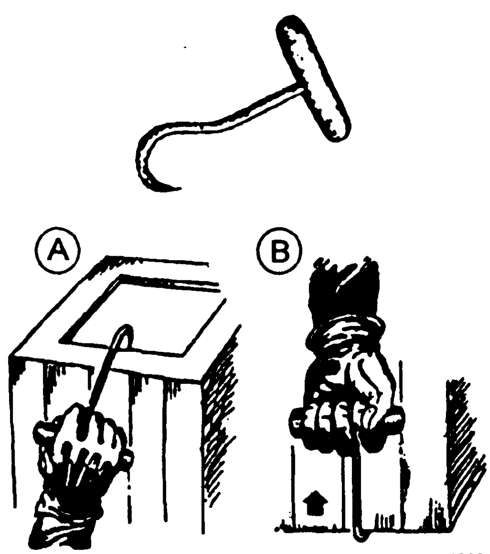


Figure 9-22.—Use of hand hook.

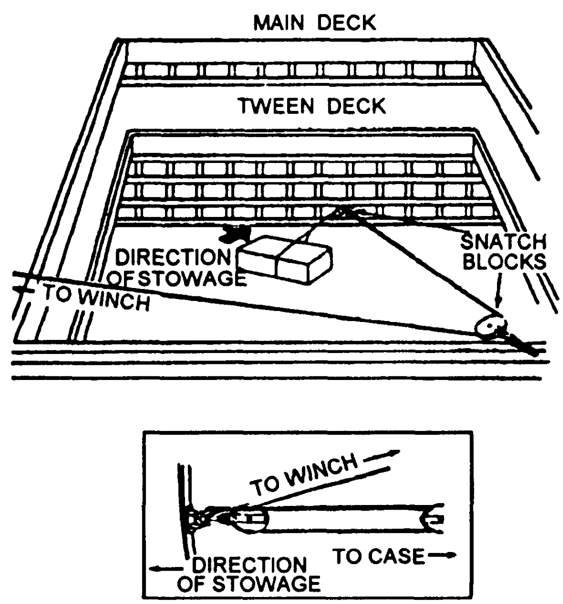


Figure 9-23.—Use of dragline.

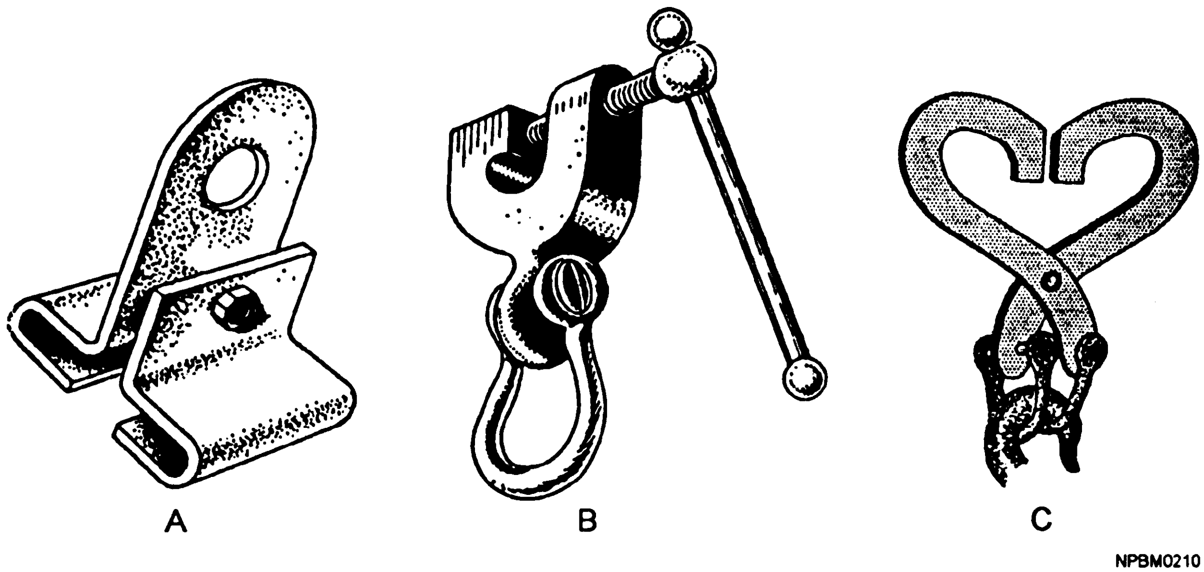


Figure 9-24.—Beam clamps.

from the overhead. The clamp in view C, particularly, is good for this purpose because it operates like a pair of ice tongs and can be moved easily from place to place.

Save-All

A save-all is a device to prevent the loss of cargo overboard during loading or discharging operations. The most common type of save-all is a rope or nylon web net approximately 15 by 20 feet or larger (fig. 9-25). Wire rope nets and wooden platforms may also serve as save-alls. You should rig a save-all at each working hatch, and also beneath each brow, skid, or conveyor if the ship is loading or discharging through sideports.

The easiest way for you to rig a save-all is to hook into the center of one edge with the cargo whip, hoist it up, and secure that edge to the bulwark or to cleats on deck. Then, stretch it out and secure the opposite edge to the stringer on the pier. Be sure to allow for the rise and fall of the tide.

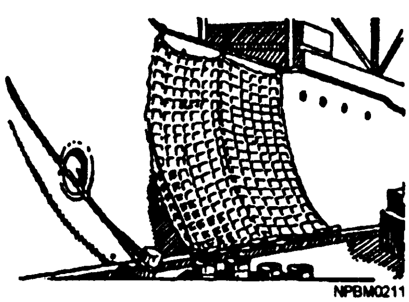


Figure 9-25.—The save-all.

You can improvise a save-all by lashing together several cargo nets. If light cargo is being worked, substitute a tarpaulin.

HATCH TENTS

A hatch tent is a large shelter of canvas suspended from the heads of booms to cover a hatch opening. Its purpose is to protect cargo and personnel, thus permitting operations to continue during bad weather. Hatch tents provide cover not only from rain and snow but also from the hot sun.

You will find there are many different types of hatch tents. The New York or hut type resembles a pyramidal tent and is suspended from the hatch boom. The Seattle type, considered the best all-purpose hatch tent, resembles a shelter tent and is rigged from the heads of both booms. It is equipped with reef points and laced openings so that it is adaptable to any size hatch You can unlace openings on the sides of the tent to form a protective flap over the heads of the winchmen, or to clear shrouds, guys, stays, or other obstacles. (See fig. 9-26.)

To rig the Seattle hatch tent, suspend 10-inch wooden blocks from the link bands at the head (on the offshore side) of each boom. Reeve gantlines

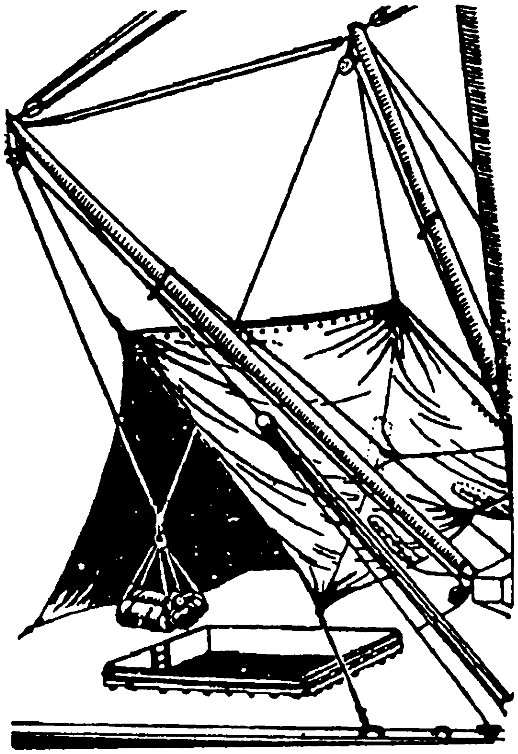


Figure 9-26.—Seattle hatch tent.

3 1/2 inches in circumference through these blocks. Hoist the tent aboard by the cargo whips, and tie the hatch gantline to the large shackle of the metal shoe in the rear peak of the tent.

Next, you run the tent up by the hatch gantline about halfway to the head of the boom. Assign personnel to spread out the tent while is it being raised. At this point the hatch whip is inserted between the ridges of the tent. Then, you haul up the hatch gantline until the bottom of the tent is above the deck. Pull taut the heavy backstay of the tent and secure the hatch gantline. Lash the yard gantline to a short bridle on the front peak of the tent, and hoist the front of the tent by this gantline and the yard whip. Raise the tent until the ridge is parallel to the deck; secure the gantline and spread out the bottom to completely cover the hatch opening. Tighten and secure the heavy guy lines, located at the corners and at the center of the back and sides. Now, adjust the intermediate lanyards to keep the tent straight and prevent sagging.

The hatch tent at best is only a temporary protection. When work at a hatch is discontinued, secure the hatch tent.

CONVEYORS

Conveyors described in this section are used primarily for replenishment-at-sea operations, but may be employed for normal cargo operations.

Horizontal Conveyors

Most of you are familiar with the skate wheel type of horizontal conveyors shown in figure 9-27. These are ideal for moving small boxes and crates. They are made in 5- and 10-foot straight lengths and angles of 45° and 90°. The straight lengths may be laid end to end to extend for any distance desired; the angled sections form the comers. Another piece of equipment that can be used at a comer is the turntable shown in the figure. It is unnecessary to use either the angled sections or the turntable, however, because the straight lengths can be overlapped at the corners.

These conveyors may be laid on deck as shown, but the Navy also provides three-legged T-bar supports that can be used when the conveyors must clear objects on deck or pass through watertight doors.

Another type of horizontal conveyor has a broad, endless belt running the length of the conveyor. This belt is powered by an electric motor, making it unnecessary to have personnel stationed along the conveyor to push the boxes.

Vertical Tray-Lift Conveyor

The vertical tray-lift conveyors shown in figure 9-28 were designed for installation on combatant ships

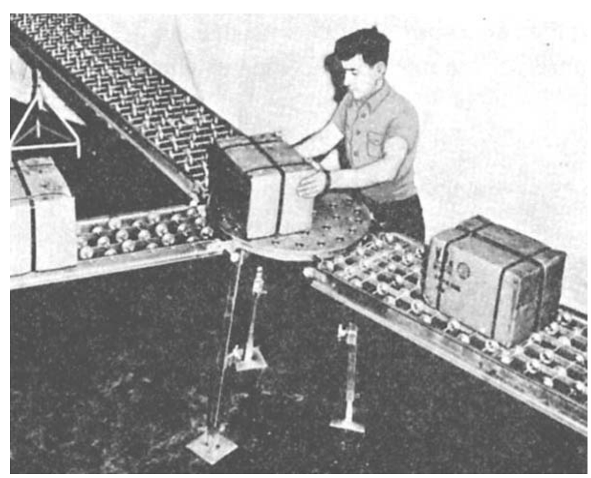


Figure 9-27.—Horizontal conveyors and turntable.

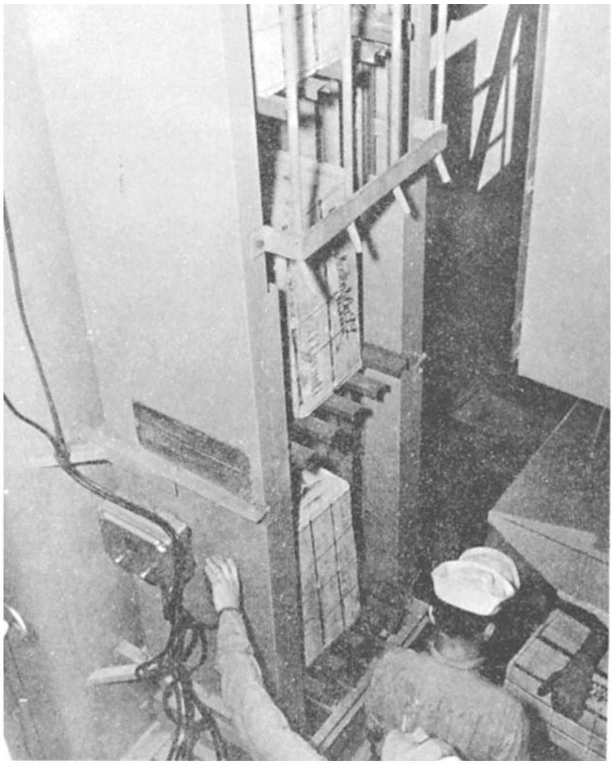


Figure 9-28.—Vertical tray-lift conveyor.

to speed striking down provisions while replenishing at sea.

Strikedown Chutes

Various strikedown chutes are in use in Navy ships. One type of chute is a simple ramp formed by laying a plank or strip of sheet metal on a ladder. Another innovation is the folding-leaf ladder chute, which consists of planks hinged to each side of a ladder. When not in use, the leaves stand upright on the ladder rail. In use, they lie flat on the outer edges of the treads. An abrasive on the surface of the leaves slows the rate of descent of the boxes.

WHEELED CARGO-HANDLING EQUIPMENT

Wheeled cargo-handling equipment may be either manually- or power-operated vehicles.

Hand Trucks and Trailers

A hand truck is a two- or four-wheeled vehicle, operated by one person, and used for transferring cargo. Two common types of two-wheeled hand trucks are shown in figure 9-29. The one on the left is a lightweight

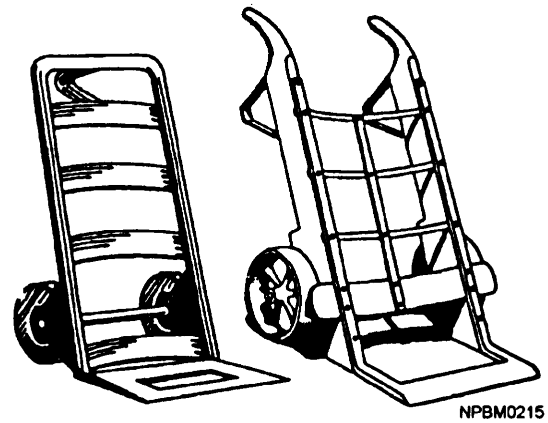


Figure 9-29.—Two-wheeled hand trucks.

model used aboard ship; the other is commonly used in warehouses ashore. Hand trucks range in size and weight from light models weighing approximately 25 pounds with a carrying capacity of 800 pounds to heavy-duty models weighing approximately 155 pounds with a capacity up to 1 ton. There also is available for use aboard ship an aluminum two-wheeled, 500-pound capacity hand truck.

To break a hand truck over after it has been loaded, place one foot on the second crosspiece of the bed and pull down on the handles.

A hand truck also may serve as a pry or lever. Wedge the nose under a heavy object, chock the wheels, then bear down on the handles. Often, very heavy loads may be lifted a foot or more off the ground by the combined leverage of several hand trucks.

Pallet Trucks

You can use pallet trucks for picking up and transporting palletized loads. Use them primarily for situations where space is limited and handling operations are so small that forklift trucks are not justified from the standpoints of efficiency and economy.

Low-lift pallet trucks furnished by replenishment ships are used on the receiving ships to move pallet loads of stores and ammunition from landing point to strikedown hatches.

The frame of the low-lift truck (fig. 9-30) is constructed as a fork and so arranged that it can enter between the top and bottom decks of a pallet. A hydraulic-lift mechanism, which may be operated manually or electrically, is provided to raise the forked frame sufficiently for the load to clear the floor and be moved. The low-lift pallet truck may be powered by a

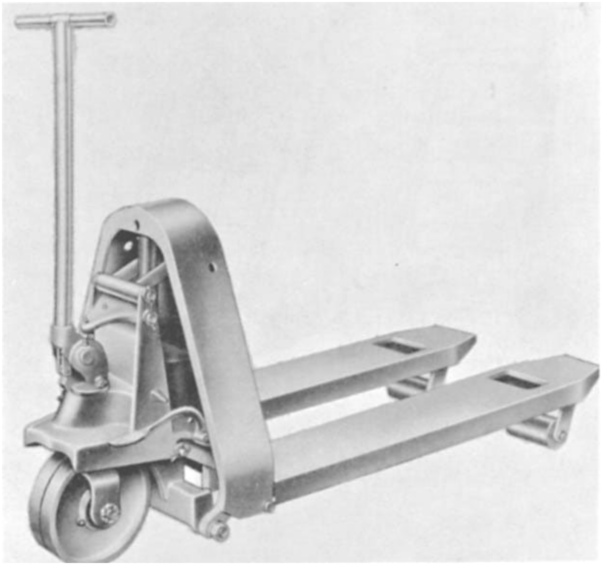


Figure 9-30.—Low-lift pallet truck.

battery-electric motor or moved manually. It usually is steered by a tow handle that also operates the mechanical brakes. However, some self-propelled low-lift pallet trucks have automobile-or lever-type steering. Their usual capacity is 2 to 3 tons.

The high-lift pallet truck is designed to pick up, transport, and lift to different heights a load supported on a two-tined fork (See fig. 9-3 1.) The fork is attached to a vertical mast that may or may not telescope and does not tilt. An electrically operated hydraulic-lift mechanism is provided to raise or lower the fork on the vertical mast. The frame of the truck extends beyond the vertical mast in a manner similar to the fork tines. The two leg extensions of the frame act as outriggers in supporting the load. One type of frame construction has the leg extensions approximately coinciding with the fork tines; that is, the leg extensions are wider apart than the fork tines. This truck may be used with single- or double-faced pallets because the frame of the truck straddles the load. The drive wheels are positioned under the steering mechanism at the other end of the frame.

CARGO STOWAGE

LEARNING OBJECTIVES: Identify the methods used in stowing and securing cargo aboard ship. Describe the difference in wooden dunnage and metal dunnage and describe what they are used for.

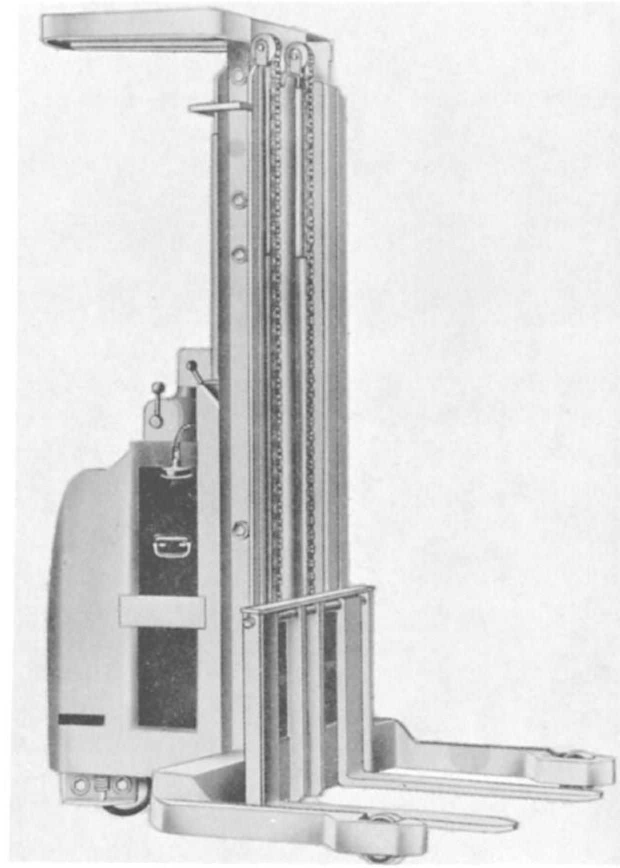


Figure 9-31.—High-lift pallet truck.

You stow cargo according to a plan made up by the cargo officer or another designated officer. How the plan is worked up depends on the amount and type of cargo and the way the ship is to be loaded; that is, whether the ship is loaded for an amphibious operation, for underway replenishment, or for supplying an advance base.

If the ship is loaded for an amphibious operation, load the articles of equipment that will be needed first last. Stow articles and supplies that will not be needed until later in the bottom of the hold. Stow vital equipment where it can be off-loaded first.

You load underway replenishment ships in such a way that there are passageways to all items in the holds.

You load a ship carrying a load to an advance base to its maximum capacity; that is, use all available space with little regard to providing access to various items. The cargo officer thus has more leeway in planning, but must follow certain basic principles and rules of common sense.

When you are loading cargo, follow the loading plan and keep alert to make sure that nothing is stowed in violation of these basic principles and rules. Before discussing the methods of stowing cargo, however, it is essential that you understand the use of dunnage.

DUNNAGE

Dunnage is any material used to protect both the ship and the cargo. The most common materials are rough-finished boards and other pieces of wood. Other materials used are bamboo, battens, cardboard, heavy paper, burlap, and so forth. The main function of dunnage is to ensure that the cargo is delivered in good condition and does not damage the ship.

Use dunnage for the following:

- To prevent movement and chafing by blocking off and securing containers, and filling spaces that cannot be filled with cargo.
- To separate cargo so that only the proper amount will be discharged at each port. Burlap or heavy paper ordinarily is used for this purpose.
- To allow for drainage and ventilation by laying dunnage athwartships or fore and aft, permitting air to circulate and preventing the accumulation of moisture by allowing condensation and leakage to flow into the drainage system. Whether the dunnage is laid athwartships or fore and aft depends on where the scuppers in the hold are located. If they are at the sides of the hold, dunnage is laid athwartships. If the scuppers are at the forward or after ends of the hold, dunnage is laid fore and aft. The idea, of course, is to expedite drainage of water to the scuppers.

Contaminated dunnage or green lumber can do considerable damage to cargo. Never reuse wet, dirty, greasy, oil-soaked, or chemically fouled dunnage without thoroughly cleaning it first.

It is impossible to lay down hard-and-fast rules governing the use of dunnage, but remember the following pointers. The dunnage must be sufficient and of proper type to protect the cargo not only under ordinary conditions but under extreme operating conditions. Dunnaging must be done in such a way as to allow for air circulation and drainage of moisture. Dunnage must be clean and reasonably free of knots and cracks.

Before beginning to stow cargo you will find it usually is a good idea, and frequently necessary, to lay a floor of two or more layers of dunnage. The boards in the first layer may be placed up to 12 inches apart, and they must line in a direction that will allow moisture to flow toward the drains. Lay the second layer at right angles to the first, and if there is a third layer, lay it at right angles to the second. The top layer may be solid, or the boards in it may be several inches apart, depending on the cargo and its container. For cardboard cartons, for example, the spacing of the top layer may be up to 4 inches.

CASES AND CARTONS

Much of the cargo in cases and cartons that you will load will be palletized, but general cargo usually is made up of an assortment of wooden and fiberboard boxes and cases constructed in various sizes and shapes. Stowing all these mixed sizes and shapes requires careful planning and skillful placement and dunnaging. Generally, stow the largest and heaviest cases in the lower hold, and pack the smaller cases between and around them. In addition to providing a degree of protection for the smaller and lighter cartons, this stowage method helps to keep the tiers level and cuts down on the amount of dunnage necessary.

When stowing, start either at the centerline and work outboard in both directions, or start at one side and work toward the other. Keep each tier perfectly level. In ships the deck of the lower hold rises a little in the wings as the deck approaches the turn of the bilge; do not stow boxes on this rise because succeeding tiers above will put extra pressure on the tilted edge of the wing boxes and crush them. Fill the space with dunnage, and place dunnage vertically against the sweat battens to prevent cartons from becoming hung on the battens as the ship works.

Figure 9-32 shows how to use dunnage at the turn of the bilge and also the brick method of stacking cartons of the same size. Figure 9-33 shows the block method of stacking regular-sized boxes and cartons.

You always lay dunnage between tiers of boxes as shown in view A of figure 9-34. This method of handling

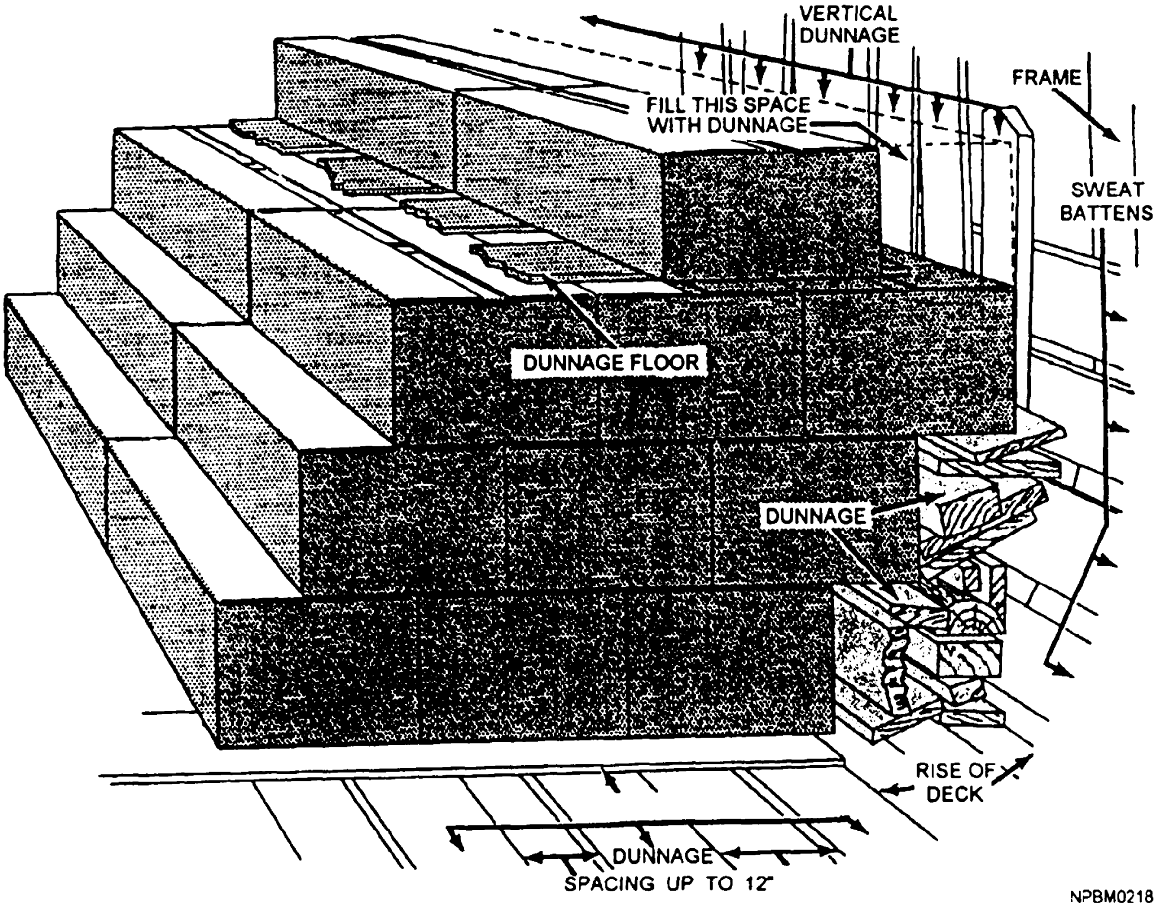


Figure 9-32.—Brick stacking cardboard cartons.

boxed cargo protects the boxes on the bottom. Without the use of dunnage (view B of fig. 9-34), the boxes may lie inside the edges of the bottom layer and crush their contents.

On the third tier of cardboard cartons, a floor of dunnage should be laid, and on the sixth tier, another floor. After this, it is only necessary to lay a floor on every sixth tier. No more than four floors will be needed. By taking part of the strain, these floors prevent a chain reaction of sagging, crushing, and breaking in case a bottle should break or a can should be crushed in one of the bottom tiers.

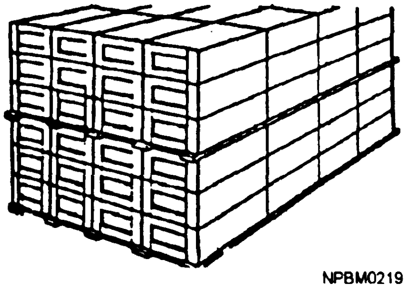


Figure 9-33.—Block stacking.

Like cartons, cases (tight wooden boxes) may be stowed brick fashion; but being stronger, they do not need the dunnage floors between tiers. Dunnage may be used, however, to give greater stability to a stack. Cases also may be stowed on their ends or edges.

With both cartons and cases, when the length is twice as great as the width, the boxes in the first tier might be placed with the long dimension running fore and aft, those in the second tier with the long dimension running athwartships, those in the third tier like those in the first, and so on, The same effect can be obtained by altering the directions of the boxes in the two rows at the edges of a stack, as shown in figure 9-35.

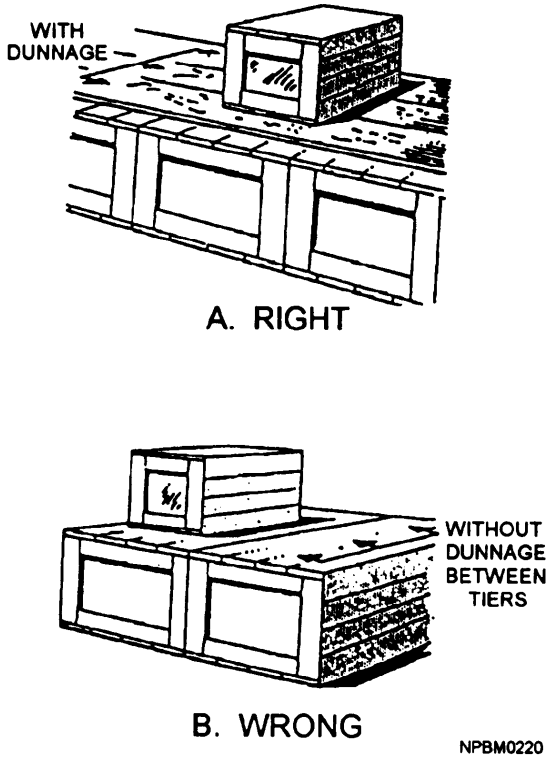


Figure 9-34.—Wrong way and right way to stack boxes.

CRATES

Crates are framework containers, sometimes with open sides and ends and sometimes with sides and ends enclosed by cardboard or thin plywood. Crates for ocean shipment should be strengthened with diagonal braces, and those not so strengthened must receive special care in stowage. The best place to stow crates is in between deck spaces or in the top tiers of the lower hold. Only light cargo should be stowed on top of crates. Dunnage must be placed between every tier of crates; therefore, the crates need not be stowed brick fashion.

DRUMS

Drums may be deck loaded or placed in the hold. If struck below, a single layer of dunnage should be laid down to provide drainage and friction against rolling.

Stow drums on end, with bungs up and packed together as closely as possible. If a row of drums does not completely fill the athwartship spaces, spread the drums evenly, and set those in the second row in the intervals between. This eliminates the need for additional bracing or dunnaging to fill the extra space at the end of the row and may make room for more rows in the hold. However, dunnage must be stacked between the outboard drums and the flare of the sides, as shown in figure 9-36.

To spread the weight and prevent bending the chines, you put two strips of dunnage over every row in each tier.

BAGS

Before you can load bags, a dunnage floor of two or more layers must be spread to keep the bags off the steel deck and to provide drainage. If ventilation is not a problem, make the top layer solid. In any event, the spacing of the top layer should not be more than 1 inch, otherwise the weight of the top tiers will cause the bags in the bottom tier to split. Vertical dunnage must be used to keep the bags from the sweat battens and from steel stanchions, bulkheads, ladders, and so on. Normally, no other dunnage will be needed.

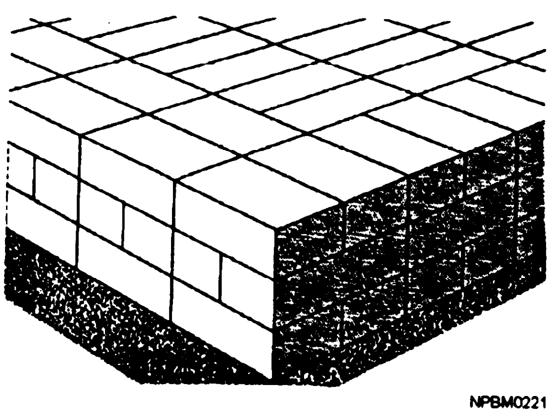


Figure 9-35.—Alternating directions of boxes in edge row.

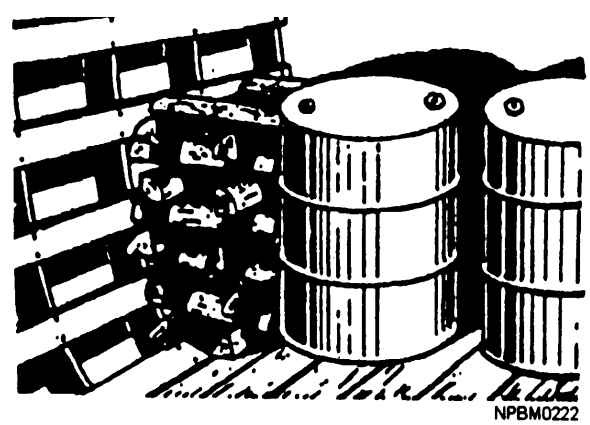


Figure 9-36.—Dunnage between end drums and the flare of the side.

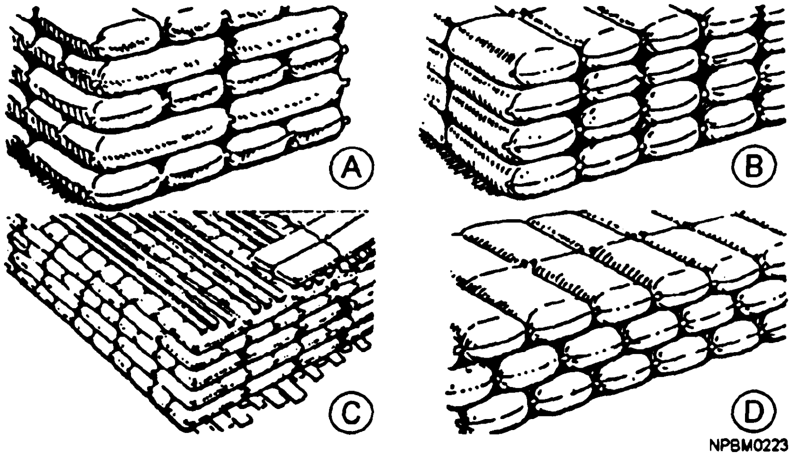


Figure 9-37.—Stacking bagged goods.

Bags may be stowed in any of the ways shown in figure 9-37. Alternating them, as in view A, or using strips of dunnage, as in view C, makes a secure stack, but piling the bags, as in view D, makes better use of the space. The method of stacking shown in view B provides fair ventilation, but some commodities, such as rice and onions, require circulation of air throughout the cargo. This circulation can be obtained by the use of venetian vents (fig. 9-38).

You erect venetian vents vertically at the four corners of the hatch and below the cargo hold ventilators. Lay others fore and aft and athwartships from the vertical vents to form a system that allows air to circulate through them. Vents laid athwartships should extend from side to side so that the spaces between the sweat battens and the ship's sides become a part of the system. The number of vents required depends on the cargo, but in any case, they need not be closer together than every 5 feet.

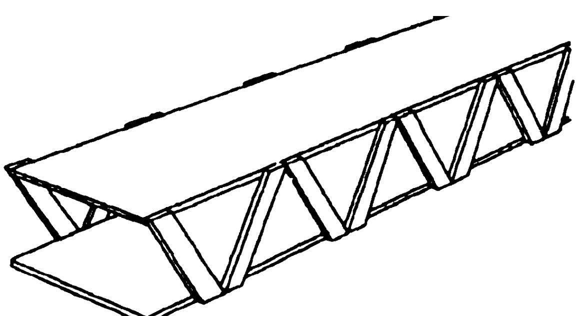


Figure 9-38.—Use a venetian vent to promote circulation of air through bagged goods.

REELS

Many reels containing sheathed cable have special handling instructions stenciled on their sides. These instructions must be complied with, lest careless handling ruin the cable. Generally, large, heavy reels should be stowed in the lower hold with their axes athwartships. They should be chocked with 8 by 8 timbers cleated together by 2 by 6s and lashed and stored as securely as possible. Preferably, the reels should be blocked in by other cargo, such as rags, lumber, or other items that can stand a little chafing. Otherwise, construct dunnage bulkheads about 6 inches from the reels to protect adjacent cargo from them.

You tip small reels on their sides and, depending on their contents, brace and dunnage them if necessary.

VEHICLES

Vehicles pose peculiar stowage problems because of their size and mobility. It is not difficult to picture the havoc an unsecured heavy tank would have during a heavy sea. Therefore, it is extremely important that you give close attention to the job your crew is doing when stowing vehicles. Take great care to avoid blocking off bitts, chocks, sounding tubes, valves, and other equipment that must be accessible. Outline in chalk those spaces to be left clear.

Whenever possible, you roll a wheeled vehicle into place with someone doing the steering. If this is not

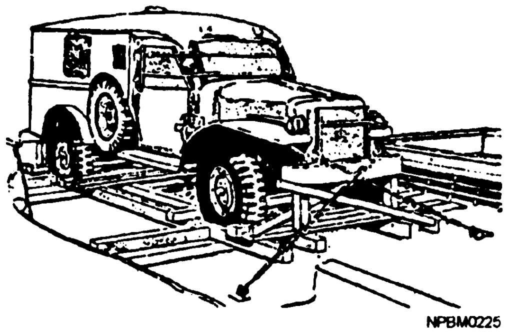


Figure 9-39.—Securing vehicles on deck.

feasible, use a rolling car jack to cut either end around; or use winch power to pull it into place, placing the wheels on a dolly. Stow the vehicles in a fore-and-aft position with 4 to 6 inches between them to prevent their rubbing against each other. Chock the wheels on all four sides to prevent movement in any direction. Brace individual chocks. At times it may be necessary to lash each vehicle with wire rope and put blocks under the frame to prevent sideways movement (fig. 9-39).

Vehicle stowage aboard amphibious ships is somewhat different. Since these vessels are more concerned with vehicle transportation, they are outfitted to handle such equipment as efficiently as possible. For example, they have a number of cloverleafs in their holds and on deck. These cloverleafs are so situated that vehicles, including tanks, may be run aboard and stowed between them. Gripes are then secured to the cloverleafs and to the vehicle. A turnbuckle in the center of the gripe is used to take up the slack and secure the vehicle firmly. Normally, two gripes forward and two aft will be adequate. They must be crossed like spring mooring lines to prevent sideways movement. Heretofore, gripes of this type were made of chain, but now there is available a cable-type lashing with an improved lightweight quick-release hook. Although this Peck and Hale cable (fig. 9-40) is used primarily for securing vehicles, a similar cable is incorporated into a net used to secure cargo on deck and in the holds. If such gear is unavailable, wire rope and turnbuckles or Spanish windlasses can be used to prevent sideways movement. Fiber line should never be used for this operation. Wheels are chocked, but chocks are not braced as they are when the vehicle is not secured by gripes. Thus, through the use of cloverleafs, a small working party can secure in short order a number of vehicles that would present a major problem aboard a ship not so equipped.

Cloverleafs eliminate the elaborate bracing and use of dunnage necessary when cloverleafs are not available. Dunnage is used, however, when the gripes are secured over a tank to cloverleafs on either side. In such cases dunnage is placed under the gripes at those

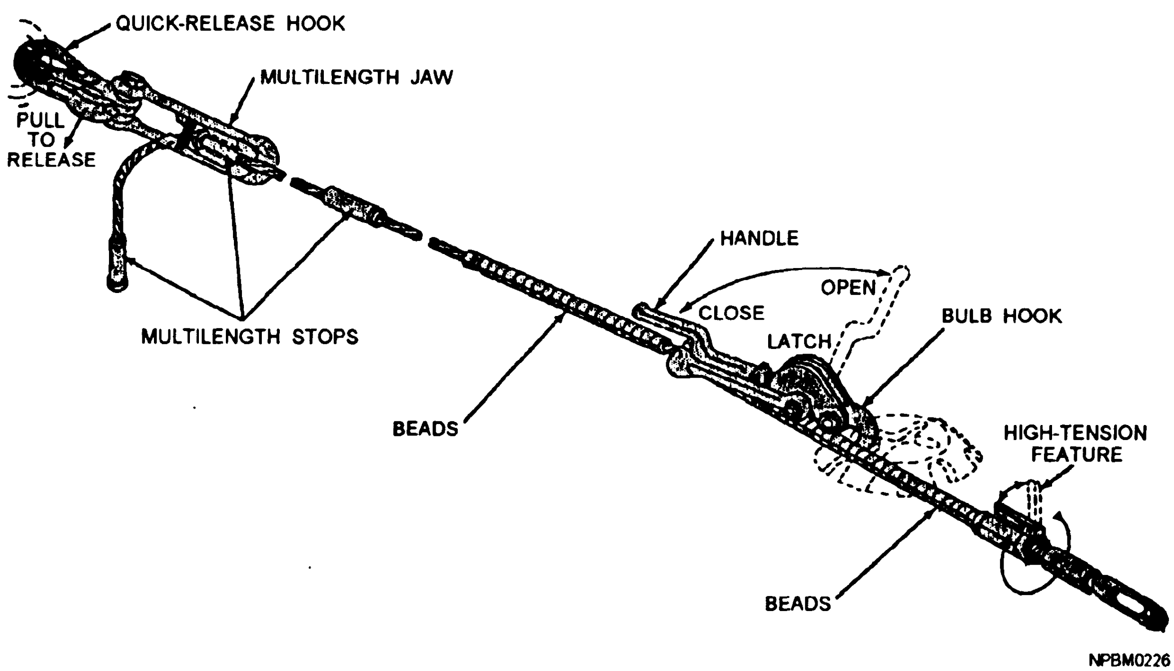


Figure 9-40.—Peck and Hale adjustable cable.

points where they come into contact with the tank. This eliminates chafing that could result in a gripe parting during particularly heavy weather.

Before leaving the subject of vehicle stowage, one more point is worth mentioning. Normally, vehicles to be stowed below decks should have all fuel removed from their tanks and any lingering fumes removed by a ventilator. One of the cables should be removed from the battery, and the vehicle should be grounded to bleed off any static electricity charges. (Ordinarily, the gripes will serve as grounds.)

There is one exception to the rule about draining fuel tanks. Tanks of vehicles that are to take part in an amphibious operation are filled to 75 percent capacity, and a reserve supply of fuel and lubricants in 5-gallon cans is secured to the vehicle. The space left in the tanks allows for expansion of the fuel.

DECK CARGO

LEARNING OBJECTIVES: Discuss when you would secure cargo on deck and list the safety precautions to be followed.

Deck cargo consists of miscellaneous gear for which there is no room below, or which, because of its nature or size, cannot be stowed below decks.

Because of the varying sizes and shapes of commodities stowed on deck, few specific rules for their stowage can be given. This section, however, presents such material as is generally applicable to the stowage of all deck cargo.

When you are stowing a large quantity of cargo on deck, take care to avoid blocking off bitts and chocks, sounding pipes to the bilges and ballast tanks, handles or valves controlling the opening of watertight bulkheads or piping systems, or other equipment essential to the operation or safety of the vessel. You might find it helpful to mark off, with chalk, the spaces to be kept clear.

You stow deck cargo in three separate blocks, one on the square of the hatch and one on either side. The height to which cargo may be loaded is limited by the size and construction of the ship because a great deal of weight high above the waterline adversely affects the ship's ability to right itself after a roll. However, there are times when the specified safe deckload height must be exceeded; for example, when small boats, landing barges, unboxed aircraft, and the like are being hauled. Nevertheless, where stowage requires more than one tier, deck cargo should not be stowed over 12 feet above deck.

CARGO LIGHTERS

Often, it is necessary to off-load cargo into a barge or lighter. Before starting to load the lighter, cover its deck with one or two layers of dunnage. Load from both ends and work toward the middle; do not overload. Take great care not to load the lighter unevenly. Uneven loading will cause it to list or to go down by the head or stern and thereby increase the difficulty of towing. If the lighter is to be towed a great distance or through rough water, make up a cargo plan and follow it carefully. Always make sure the cargo is well secured and protected from the weather.

Wooden lighters not in constant use tend to develop open seams above the waterline. Therefore, post a watch on these lighters, during loading operations and when loaded, to check constantly on the amount of leakage. Several hours usually are required for the planks to swell enough to stop the leaks; hence, it may be necessary occasionally to pump out the lighters.

SECURING CARGO

When a ship is loaded to capacity, the cargo is packed in tightly, and securing it is a minor problem. Frequently, all that is necessary is to wedge it with dunnage and to tom it down in some way. Tomming down is the process of securing cargo to prevent its vertical movement, usually by wedging timbers between overhead beams and the cargo. Ships loaded for an amphibious operation or for underway replenishment, however, have securing problems complicated by the necessity for providing access to the various items in each hold. Two systems, metal dunnage and wire net shoring, facilitate stowing cargo in blocks with passageways between.

Metal Dunnage System

The metal dunnage system consists of portable metal stanchions or battens that fit into sockets overhead and in plates inserted in channels welded to the deck. (See fig. 9-41.) Hinged latches lock battens in their sockets. An end view of the battens resembles two I-beams welded together. They can be set with either the long or the short dimension to the cargo, making a difference in space of about 3 inches.

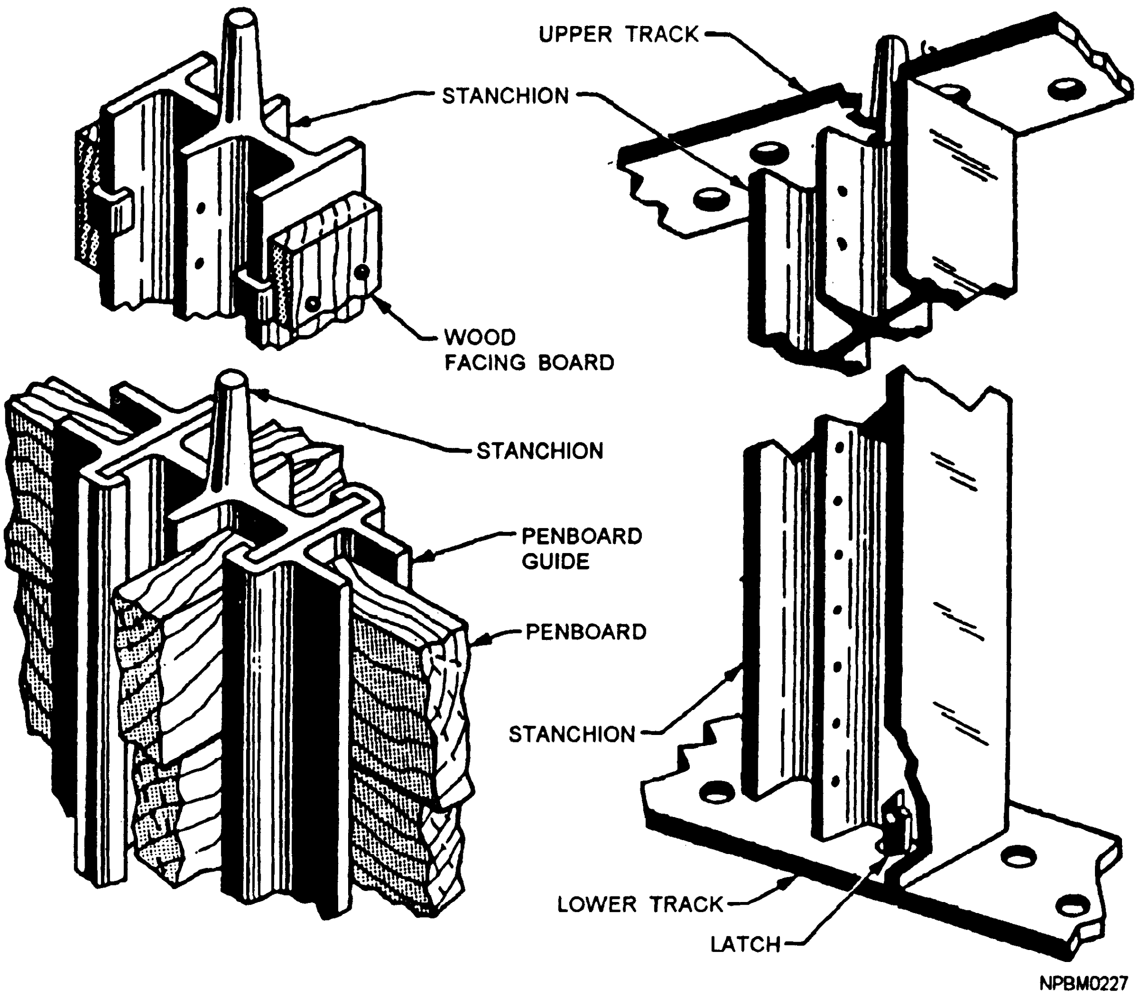


Figure 9-41.—Metal dunnage and penboards used on replenishment ships.

The metal dunnage system can be used with both palletized and loose cargo. With loose cargo (powder cans, for example), penboards are slipped between the battens to form pens or bins in which cargo is placed. Tomming is done by means of cotton web straps of three types. The extension strap assembly is a long strap with a V-ring at one end and a hook at the other. Other V-rings also are secured to two short tabs sewn at points equally distant from each end and from each other. The spreader strap assembly is a short strap with a hook at either end and a V-ring in the middle. The adjustment strap assembly has a hook at each end. In the middle is a device for shortening the strap. In this system, a combination of straps making up the proper length is laid over the cargo, and each end is hooked in the deck channels or to the battens. The cargo is tommed by setting up on the adjustment strap. Figure 9-42 shows a typical tomming down arrangement with metal dunnage and penboards.

Wire Net Shoring System

The wire net shoring system consists of wire nets and ratchet tensioning devices for securing them. Nets are about 6 feet wide and long enough to reach from the overhead to the deck (fig. 9-43). They hook into holes spaced a few inches apart in angle irons welded athwartships every 2 feet on the overhead. Thus, the nets hang fore and aft, providing support for cargo against the roll of the ship. Numerous holes in the angle irons permit nets to be moved inboard or outboard and brought as close as possible to the vertical face of the cargo.

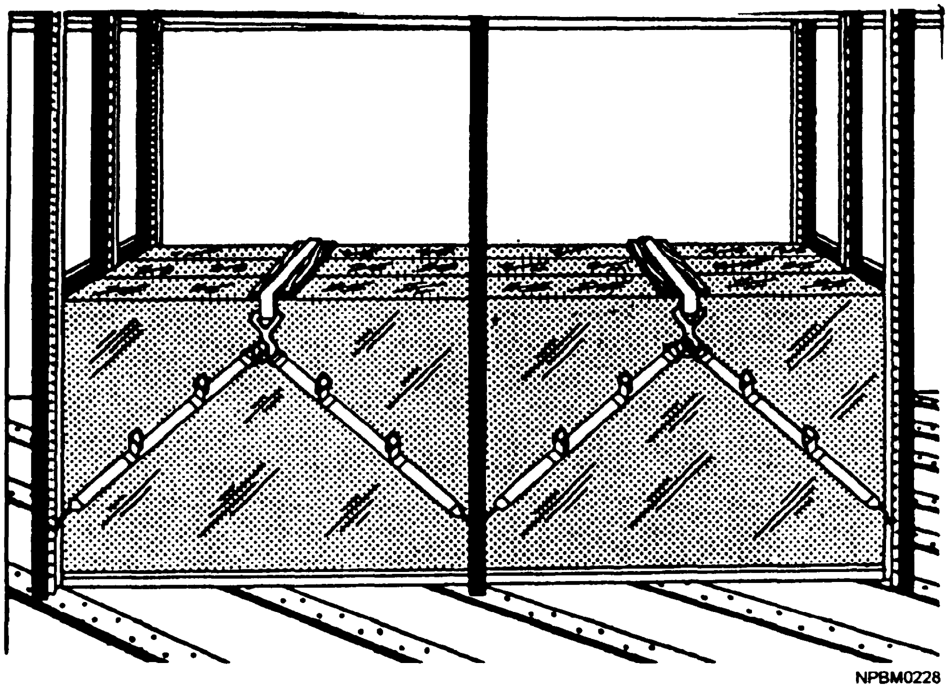


Figure 9-42.—Typical tomming down arrangement with metal dunnage and penboards.

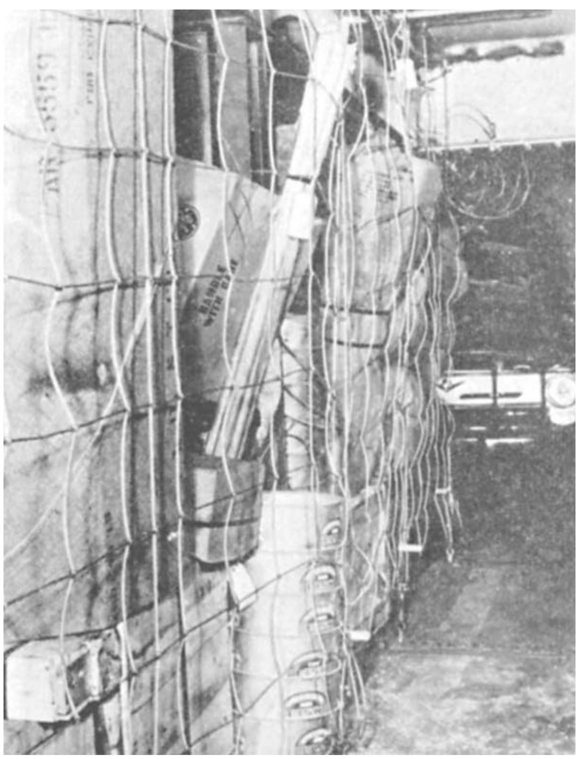


Figure 9-43.—Wire net shoring system.

In the wire net shoring system, as in the metal dunnage system, add wood dunnage as necessary to fill void spaces, to provide extra support, and for flooring.

Securing Deck Cargo

The primary problem in securing anything on deck is the lack of padeyes, cleats, and other fittings to which one can attach securing wires and lines. Sometimes it is necessary to weld special padeyes and braces to decks, bulkheads, or bulwarks.

Secure small boxes and cases as shown in figure 9-44. Run the line from one securing point around the box to a securing point on the opposite side. If the line is light or the box is heavy, run the line back and forth

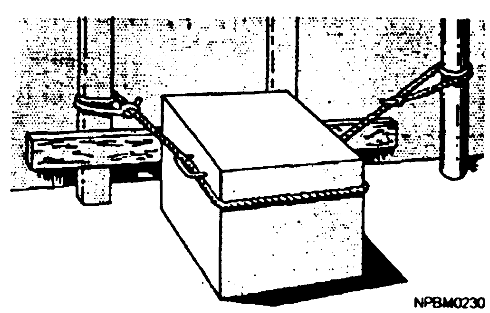


Figure 9-44.—Proper way to secure small boxes.

two or three times. Lash the boxes tight against something solid, such as a bulkhead. When this is not possible, place planks or dunnage across two or more stanchions or beams and lash the box against them.

Never make fast your lashings to electric cables or small, lightly secured pipes, lagged pipes, doors and hatches, dogs or hinges, electric motors, lifeline stanchions, nor to anything not solidly secured.

Notice some of the principles of securing large and heavy crates and boxes, as shown in figure 9-45. Place perishables stowed on deck on pallets and cover with a tarp. Fold the comers of the tarp aft or away from the weather and lash them in place by a light line. Place boards or even pallets between the load and the lashings to serve as chafing gear or to support the load. Pass two or more lashings around the load. For extremely heavy or bulky loads, add lashings across the top and down under the load. See dotted lines in figure 9-45. Tie one end of the lashing as shown at point A, run it around the load to B, and back around to C. Before securing the lashing at C, work all possible slack out of it and tie a single bowline on a bight in the standing part of the lashing. Pass the bitter end of the lashing around the securing point, through the bight of the knot, and back around the stanchion as in figure 9-46. This method gives a mechanical advantage of three, making it possible to get the lashing much tighter. You tighten the lashing further by using a Spanish windlass on one or both sides, as shown in figure 9-45. Put chafing gear between the lashings and all rough or sharp edges.

One method of stowing and securing large amounts of cargo is pictured in figure 9-47. The top edges of the

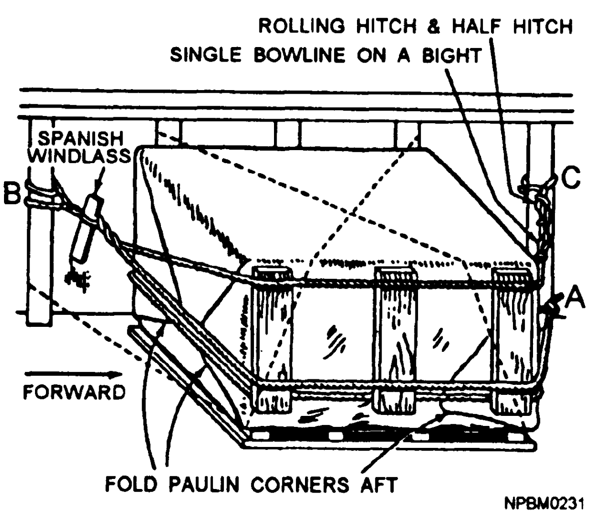


Figure 9-45.—Securing large and heavy loads.

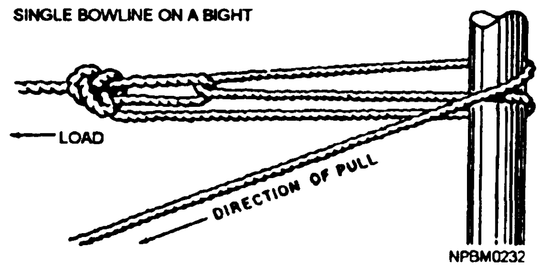


Figure 9-46.—Tightening a lashing.

cargo are held in place and protected by caps made of at least 2 by 6 lumber (not dunnage). Angle irons (see insert) protect the caps. Wire straps fitted with turnbuckles at each end and spaced at equal intervals might be enough to secure some loads, but large and high stacks, such as those shown, also require both athwartship and fore-and-aft shoring.

The methods of securing cargo described here must not be construed as being the only ones. The important things to remember are that the load must not be allowed to move in any direction, and that it must be secured in such a way that it will not be worked loose by boarding seas nor by the pitching and rolling of the ship. How this is accomplished will depend on such factors as shape and position of the load, lashing being used, securing points available, and so on. Sometimes, it pays to construct fences, bins, or other structures. Common sense must guide you on such jobs, but never underestimate the force of the sea. Secure all cargo, equipment, and gear in such a manner and with lashings strong enough so that it will be unnecessary to go back and relash it if the word is passed to rig ship for heavy weather. Nevertheless, periodically check all lashings and retighten if necessary.

SAFE CARGO-HANDLING SAFETY PRACTICES

Cargo handling is full of dangers for careless personnel. It is your job as a petty officer to see that all safety precautions are strictly observed by all hands at all times. The following list contains some commonsense precautions that all cargo handlers must observe. Otherwise, they will endanger themselves and their shipmates.

- Wear properly color-coded safety helmets and steel-toed safety shoes. Do not wear trousers that

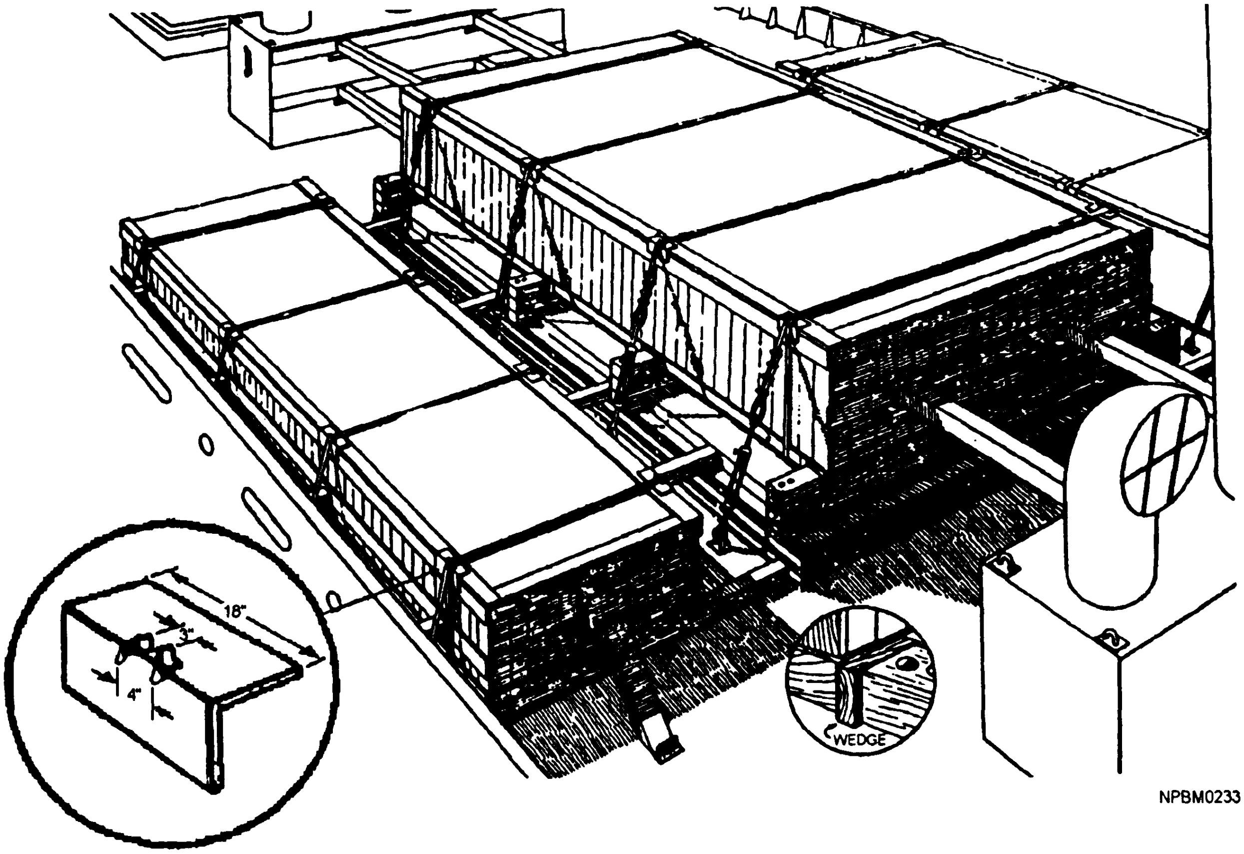


Figure 9-47.—Stowing and securing deck cargo.

are too long. Do not wear rings. Gloves must be worn by personnel handling objects having sharp or rough edges.

- Use the accommodation ladder or brow for boarding and leaving the ship.
- Climb ladders in the hold only when the hoist is not in motion.
- Use the walkway on the ship's side away from the side on which the hoist is operating.
- Make sure working areas on board ship and on the pier are properly roped off and supervised.
- Secure hatch tent lashings to permanent deck fastenings. Never depend upon movable objects lying on deck, such as strongbacks, dunnage, hatch covers, and so forth.
- Secure hatch rollers properly.
- Lower blocks, crowbars, chain slings, bridles, and so forth, into the hold by cargo falls or other lines.
- Pile hatch boards in an orderly manner, no higher than the hatch combing. Sloppy piles create tripping and stumbling hazards. If piles are higher than the combing, a board may be dragged into the hatch.
- Lay strongbacks flat so they will not tip over on persons or be dragged into hatches or overboard by slingloads.
- When handling strongbacks, keep them between you and the open hatch.
- Stand in the clear when strongbacks and hatch covers are being handled on the deck above,
- Stand in the clear away from suspended loads.
- When steadying a load, do not stand between the load and any fixed object. Always face the load and keep feet and hands in the clear.
- Stand clear of slings being pulled from under loads by cargo falls.

- When using a dragline to move cargo, stand out of the bight and clear of the throw of the block and hook.
- Be especially attentive when handling objects with sharp or rough edges.
- Keep your hand hook pointed properly and the handle tight.
- Learn to lift properly to prevent strains and sprains.
- Always use a light when entering dark places.
- Never walk backwards.
- Step down from elevations-never jump down.
- Bend over projecting nails to prevent puncture wounds.
- Report to your petty officer in charge any defect in tools, materials, appliances, and gear.
- When short pieces of dunnage are required, use only the proper cutting tools. All breaking methods are dangerous.
- Report all injuries (even scratches, cuts, and splinters) to your leading petty officer and get immediate first aid or medical attention.
- Know the location of fire alarm boxes and fire-fighting equipment.
- Do not engage in horseplay, practical jokes, or arguments. They are shortcuts to the hospital.
- Never enter a compartment that has been secured for a long time until it has been determined that it is safe to do so.
- Never stand on deck machinery.
- Never stand in or near the square of the hatch when the hoist is in motion.
- Do not smoke in holds where there is cargo or dunnage.

In addition to the foregoing safety precautions, the leading petty officer should do the following:

1. Make frequent inspections of the gear; check—

a. cargo whips for wear in the eye and on that length coiled on the drum.

b. blocks for wear and to see that they are properly lubricated and turn freely.

c. shackles to see that those with screw pins are tight and moused and that nuts on safety shackles are tight.

d. booms to see that goosenecks are not bent or cracked and that they are lubricated and turn easily.

e. guys for worn spots and twisted thimbles that might cut into the line.

f. topping lifts for kinks and worn spots. Topping lifts should be long enough to permit the boom to be lowered to the deck. If a topping lift is not that long, securely clamp its end to the drum so that the boom will not drop if all turns are run off the drum.

2. Report immediately to your superior any conditions or defective gear that cannot be corrected by your own efforts.

3. Supervise the raising and lowering of booms.

4. Inspect to see that boom topping lifts, guys, and preventers are secured properly.

5. Check the save-all to see that it is in place when required and is properly made fast.

6. Supervise opening and closing the hatch.

7. See that hatch covers, tarpaulins, and strongbacks are stowed in a safe, orderly manner and that there is a clear space for a walkway between the hatch coaming and the ship's side.

8. Make sure that good housekeeping is observed in the ship's holds and on decks at all times and that bridles, blocks, slings, and so on, are not permitted to remain where personnel can fall over them or where they may be damaged.

9. See that lines, topping lift pendants, and other pendants are not allowed to remain needlessly on deck where they may be damaged if a strongback or slingload falls on them, or where they may cause personnel to trip or to fall.

10. Make certain that oil, water, and other slipping hazards are cleaned up, sanded, or covered with dunnage.

11. See that all slingloads are built safely and slung properly before they are lifted.

12. Make sure that adequate hatch lighting is provided.

13. Tell and show personnel how to work safely and insist that they do so.

14. Instruct personnel in how to break down or build piles or slingloads and break out and stow cargo in a safe manner.

15. Instruct personnel on how to lift properly.

16. Never permit personnel to stand or work below suspended slingloads.

17. Know what to do in the event of injury.

18. Learn the location of fire axes, hose, and other fire-fighting equipment, and how to use them.

19. Know how to remove personnel quickly from the vessel and pier when necessary.

20. Make sure that guys, fairlead blocks, and other items to be put under heavy strain are not attached to untested padeyes.

SUMMARY

This chapter by no means covers ALL areas of cargo handling and it is possible that there may be easier methods of cargo handling found in the fleet. Just remember that a senior BM has more experience in cargo handling, and if you do not know how to do something ask before someone gets injured. THINK SAFETY!!!

CHAPTER 10

UNDERWAY REPLENISHMENT

Underway replenishment (UNREP) is a broad term applied to all methods of transferring fuel, munitions, supplies, and personnel from one vessel to another while under way. The term *replenishment at sea,* formerly used in this sense, now applies to all methods except those for fueling at sea.

Before the techniques of UNREP were developed, a ship that ran low on fuel, supplies, or ammunition had to return to port, or the fleet had to lie to while the ship was partially replenished by small boats. If several or all of the ships were in need, the whole fleet had to return to port. The disadvantages were obvious. The effectiveness of a fleet was reduced by every ship that had to leave, and a ship or small group of ships detached from a fleet were in greater danger of being sunk or captured. A fleet lying to in order to replenish was more vulnerable to attack, and a fleet heading back to port left the way open for an enemy fleet to accomplish its mission. With UNREP, a whole fleet can be resupplied, rearmed, and refueled in a matter of hours while proceeding on its mission.

CONNECTED AND VERTICAL REPLENISHMENT

LEARNING OBJECTIVES: Discuss the importance of the replenishment operation between the USS *Marcellus* and the USS *Massachusetts.* Give a general description of connected and vertical underway replenishment.

The first significant replenishment operation ever performed at sea by the U.S. Navy was in 1899 when the U.S. Navy collier *Marcellus,* while towing the USS *Massachusetts,* transferred coal to it. Since that time, many methods have been tried and abandoned. Those described in this chapter have been adopted as the most feasible and are currently used in the fleet.

Two general methods of UNREP are used: connected (CONREP) and vertical (VERTREP). They may be used singly or at the same time. In CONREP, two or more ships steam side by side, and the hoses and lines used to transfer fuel, ammunition, supplies, and personnel connect the ships. VERTREP is carried out by helicopters. The ships may be in close proximity or miles apart, depending on the tactical situation and the amount of cargo to be transferred. CONREP concerns two processes—refueling and resupply. In fueling at sea (FAS), fuel is pumped from a delivering ship, which may be a replenishment oiler (AOR), oiler (AO), fast combat support ship (AOE), or a large combat ship. Other replenishment ships such as the combat store ship (AFS) and the ammunition ship (AE) can deliver lesser amounts of fuel, but their primary purpose is to deliver solid cargo—that is, supplies and ammunition—by the methods now referred to as replenishment at sea (RAS).

The most common refueling rigs are the span-wire and the close-in rigs. The span-wire rig has several variations—single hose, double hose, and probe. The span wire may be either tensioned or untensioned. The span wire is tensioned by a ram tensioner. A tensioned span wire, or highline as it is called in RAS, is also employed when the standard tensioned replenishment alongside method (STREAM) of transfer is used. STREAM transfer consists of an all-tensioned rig, highline, outhaul, and inhaul. The method of fairleading the outhaul is a traveling standard UNREP fixture (traveling SURF). The SURF is used with two STREAM rigs, the regular traveling SURF, and the SURF, traveling—actuated remotely (STAR) rig. STREAM with tensioned highline has an alternate method when the UNREP ship experiences difficulties with the outhaul winch. This rig is called a burton outhaul and is sent to ships having burton whip capabilities.

Other common methods of RAS include highline, burton, housefall, and modified housefall.

You must be familiar with the various equipment and procedures used during replenishment. It might help you to remember the various rigs if you make rough sketches of them and label the various parts.

The illustrations in this chapter and the procedures described are representative only. For example, many items of rigging, such as guys and preventers, have been omitted from illustrations for purposes of clarity. *Standard Organization and Regulations of the U.S. Navy* (commonly called the SORM), OPNAVINST

3120.32, NWP 14 (Series), and *Underway Replenishment Hardware and Equipment Manual* should be consulted to determine the details of rigging and the personnel and tools required for each rig. Ship's plans show rigging details, while the SORM affixes responsibility for the various functions to be performed.

Underway Replenishment Hardware and Equipment Manual provides a catalog of the equipment used in the transfer of solid cargo and bulk fluids and a description of the methods used in UNREP. The manual will permit the user to identify the equipment, to establish the intended use, and to locate additional detailed technical information related to the configuration, operation, maintenance, safety features, installation, and procurement of UNREP equipment.

Your worth as a BM will be judged largely on how you and your crew conduct yourselves during evolutions, such as fueling at sea. Make sure that every piece of gear required is on your station. Do not forget such things as buckets and drip pans, rags for wiping up spilled oil, buckets of sand to spread on slippery decks, spare stops, and an extra cotter pin or two in case the cotter pin is missing from the pelican hook.

COMMON REPLENISHMENT FEATURES

LEARNING OBJECTIVES: Describe four features common to all replenishment operations.

Many features are common to all replenishment operations, and they will be discussed first.

It is the responsibility of the officer in tactical command (OTC) to select a suitable course and speed, taking into consideration the mission of the group and the condition of the sea.

Generally, the delivering ship takes station, and the receiving ship maneuvers to come alongside and maintain position during the operation. When large CVs are being replenished, however, replenishment ships may complete the final phase of the approach because of obstructions to view from the bridge of the aircraft carriers. During replenishment, individual flaghoists are displayed, as shown in figure 10-1.

Because of the danger of hitting aircraft on deck, CVs, LPHs, LHAs, and other ships with aircraft on deck fire the shot lines to the delivering ships.

Except for gear actually rigged on the receiving ship (such as fairlead blocks and riding lines) and for the distance line and burton whips, the delivering ship furnishes all the equipment. An exception to this practice is when carriers and cruisers are alongside replenishment ships and personnel are to be transferred. In this case, the combatants must furnish and tend the synthetic highline.

BRIDGE-TO-BRIDGE PHONE/DISTANCE LINE

The bridge-to-bridge (B/B) phone/distance line provides both a sound-powered (S/P) phone circuit and a distance-between-ships visual indicating system. This line is required on all ships. See figure 10-2.

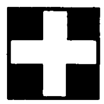
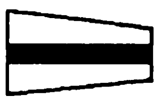
DISTANCE MARKERS

Distance markers on the B/B phone/distance line are arranged as shown in figure 10-3. You make the line up for use as follows:

- Day: These markers are colored cloth, nylon-coated fabric, or painted-canvas markers, each 8 inches (20.3 cm) by 10 inches (25.4 cm), spaced at 20-foot (6.0-m) intervals from 0 to 300 feet (0 to 91.4 m). The distance is shown in numerals 5 inches (12.7 cm) high. The markers must be sewn, lashed, or otherwise stopped off in such a way that they will not slide along the line. You must provide grommets, as appropriate, to lash chemical lights for night replenishment.
- Night: You will rig chemical lights by using two blue chemical lights, one on each side of the 60-, 100-, 140-, and 180-foot (18.2-, 30.4-, 42.6-, and 54.8-m) markers. Lash one red chemical light on the approach-ship side of the other markers. (One-cell, pin-on-type red flashlights may be used instead of red chemical lights.)

The zero end of the distance line (fig. 10-3) is secured at or near the outermost rail of the delivering ship, and the other end is hand tended on the receiving ship. Embedded in the polypropylene distance line are the conductors for the S/P telephone line, which provides the communication link between the bridges of the two ships.

Each replenishment station has a S/P telephone line to the corresponding station on the other ship. Necessary commands are transmitted by S/P telephone, and a

VISUAL FLAGHOIST		
 ROMEO DISPLAYED ON FORE YARDARM ON SIDE RIGGED	**CONTROL SHIP**	
	AT THE DIP:	AM STEADY ON COURSE AND SPEED AND AM PREPARING TO RECEIVE YOU ON SIDE INDICATED.
	CLOSE UP:	AM READY FOR YOUR APPROACH.
	HAULED DOWN:	WHEN MESSENGER IS IN HAND.
 ROMEO DISPLAYED ON FORE YARDARM ON SIDE RIGGED	**APPROACH SHIP**	
	AT THE DIP:	AM READY TO COME ALONGSIDE.
	CLOSE UP:	AM COMMENCING APPROACH.
	HAULED DOWN:	WHEN MESSENGER IS IN HAND.
 PREP DISPLAYED AT THE OUTBOARD YARDARM	**RECEIVING SHIP**	
	AT THE DIP:	EXPECT TO DISEGAGE IN 15 MINUTES.
	CLOSE UP:	REPLENISHING COMPLETED; AM DISENGAGING AT FINAL STATION.
	HAULED DOWN:	ALL LINES CLEAR.
 BRAVO	**BOTH SHIPS**	
	WHERE BEST SEEN:	FUEL OR EXPLOSIVES ARE BEING RECEIVED.
	APPROACH SHIP	
	AT THE DIP:	HAVE TEMPORARILY STOPPED SUPPLYING.
	CLOSE UP:	FUEL OR EXPLOSIVES ARE BEING RECEIVED.
	HAULED DOWN:	DELIVERY IS COMPLETED.
	RECEIVING SHIP	
	AT THE DIP:	HAVE TEMPORARILY STOPPED TRANSFERRING.
	CLOSE UP:	FUEL OR EXPLOSIVES ARE BEING TRANSFERRED.
	HAULED DOWN:	DELIVERY IS COMPLETED.

NOTE: AT NIGHT, ROMEO CLOSE-UP MUST BE SIGNALED BY FLASHING LIGHT.

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Figure 10-1.—Replenishment flaghoists.

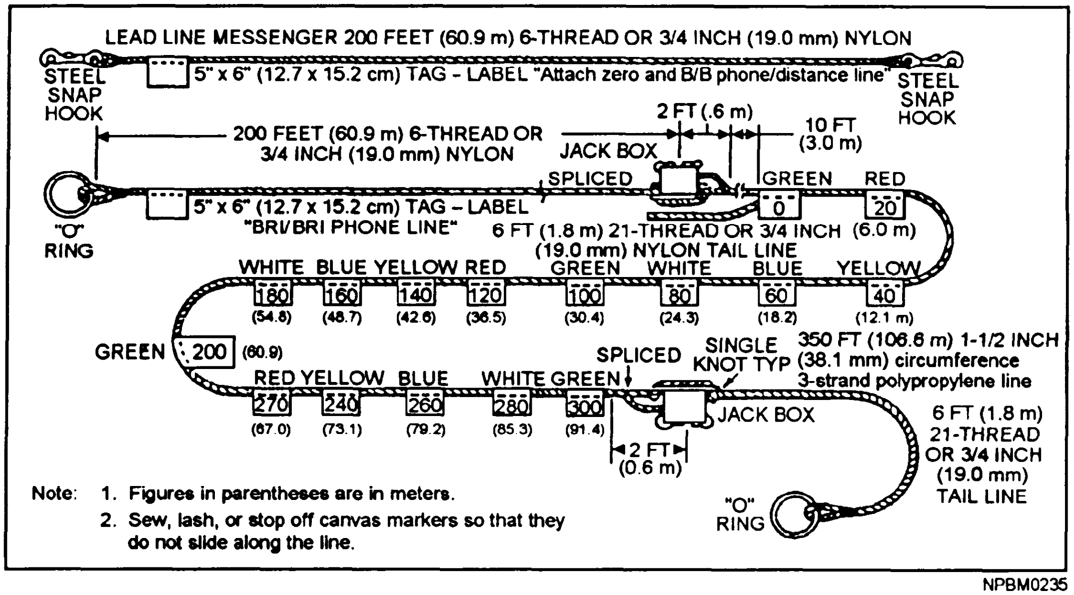

Figure 10-2.—Bridge-to-bridge (B/B) phone/distance line.

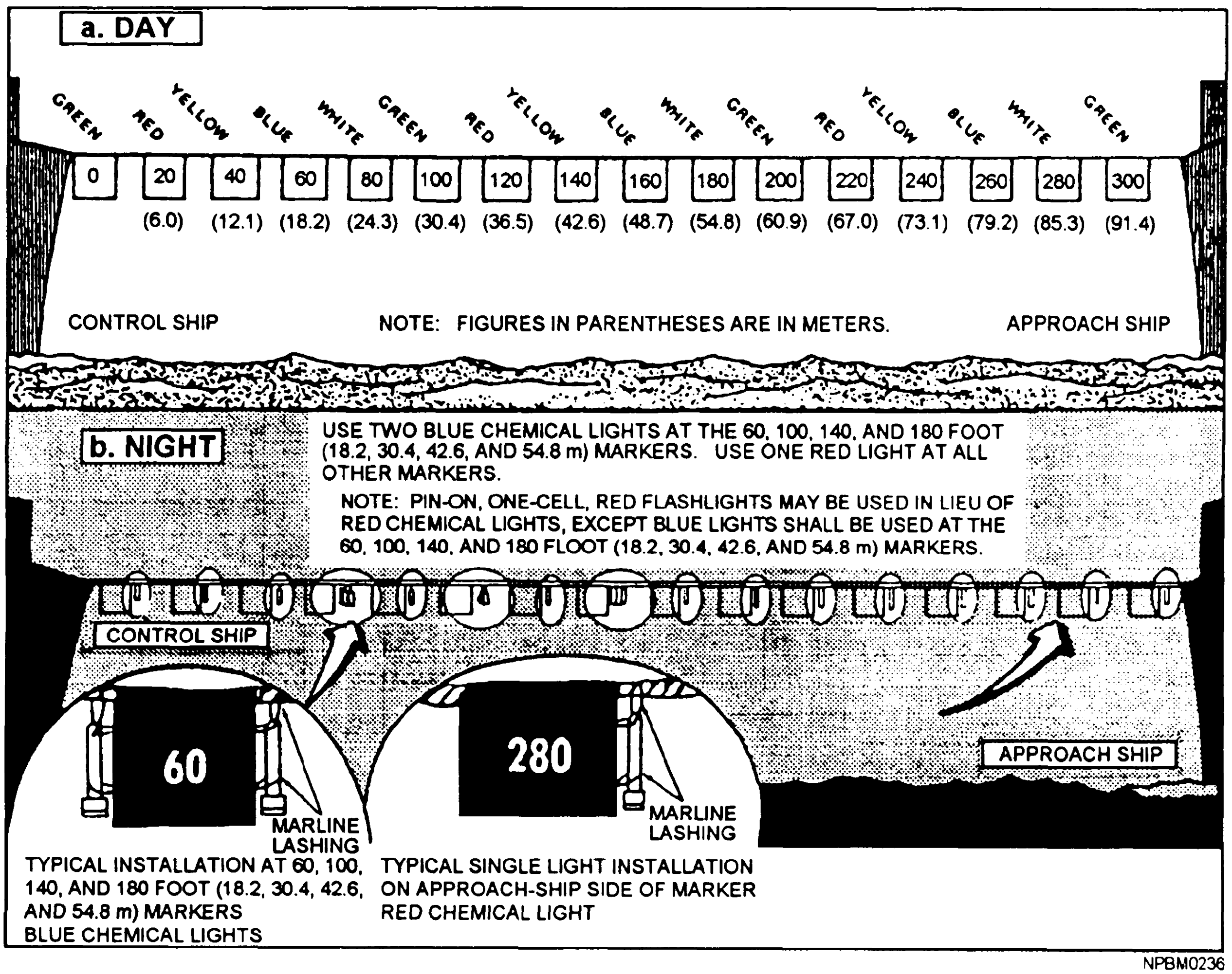

Figure 10-3.—B/B phone/distance line markings.

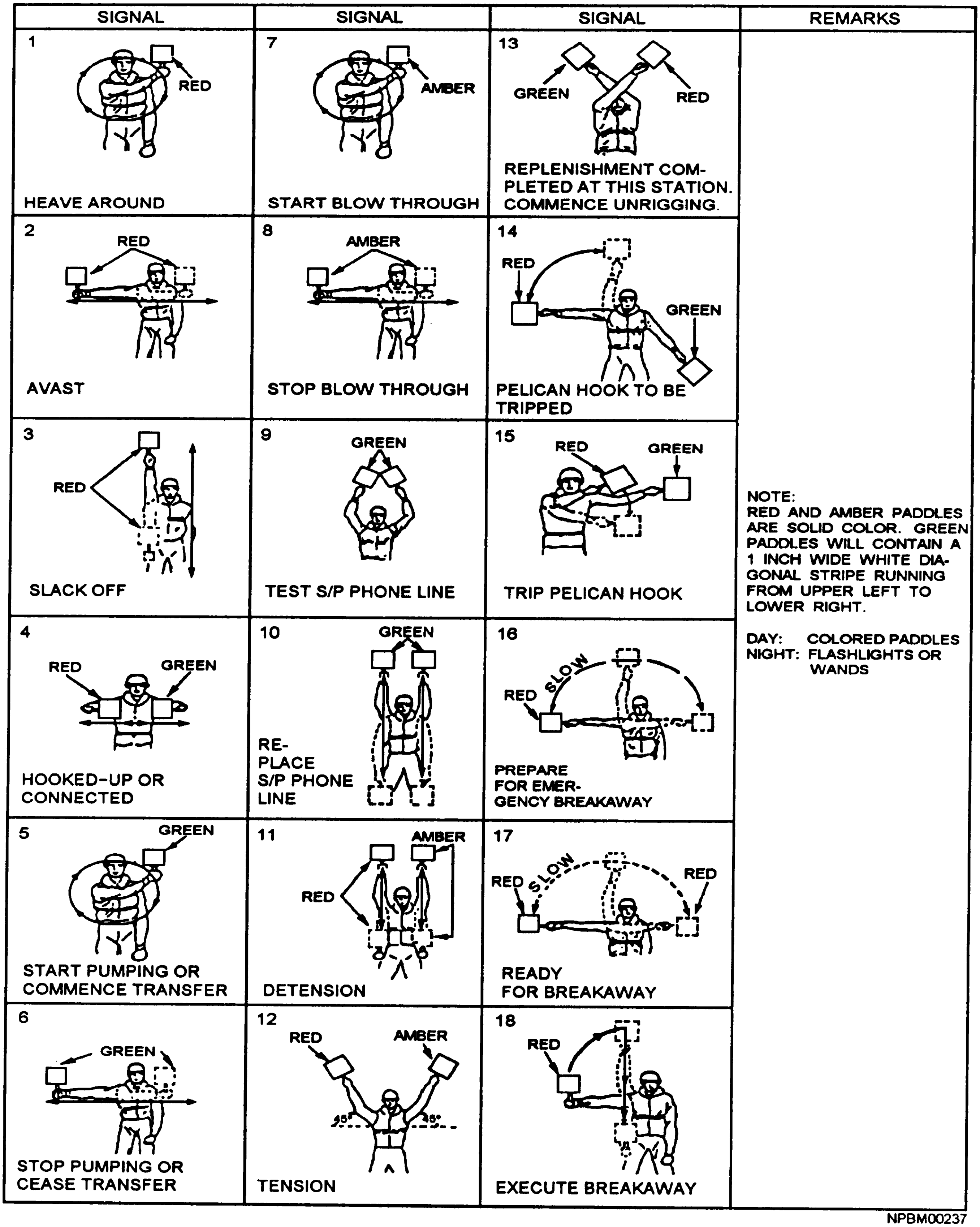

Figure 10-4.—Alongside hand signals, standard procedures.

signalman also gives them by hand or light signals, as shown in figure 10-4. It is a good idea to post these hand signals at the replenishment stations or, better yet, to stencil them on the backs of the paddles.

As the receiving ship completes its approach and steadies alongside, bolos or line-throwing gun lines are sent over from each station on the delivering ship to the opposite stations on the receiving ship. Telephone lines and messengers are sent over by means of these first lines.

Line-throwing gunners and bolo heavers must be well-trained, and they must be outfitted in red helmets and red jerseys or vests and life jackets. Before the shot line is fired or the lines heaved, the word is passed on both ships over the 1MC and/or by electric megaphone (bullhorn) as follows:

FIRING SHIP: "ON THE (name of receiving ship), STAND BY TO RECEIVE SHOT LINES. ALL HANDS TOPSIDE TAKE COVER."

RECEIVING SHIP: "ON THE (name of own ship), STAND BY TO RECEIVE SHOT LINES AT (stations concerned). ALL HANDS TOPSIDE TAKE COVER."

Before the shot line is fired, each station on the delivering ship sounds one blast on a police whistle. When ready to receive the shot line, each station on the receiving ship replies with two blasts. The above two signals must be sounded each time the shot is fired.

When the delivering ship has difficulty getting its shot lines across, the receiving ship uses its own line-throwing guns when it is requested to do so by the delivering ship. The shot or bolo lines are used to haul over the messengers and then passed back at the earliest convenience to the ship furnishing them.

MESSENGER

The messenger is the main line used to haul any basic rig across between ships. See figure 10-5. The preferred location for handling the messenger and other lines is forward of the rig. Rigging the messenger aft of the rig is acceptable when there is no room available forward. Your other lines, such as the station-to-station phone line and the lead line messenger for the B/B phone/distance line, are attached to beckets on the basic messenger at a minimum distance of 200 feet (60.9 m) from the smaller soft eye or clip end. The span wire or

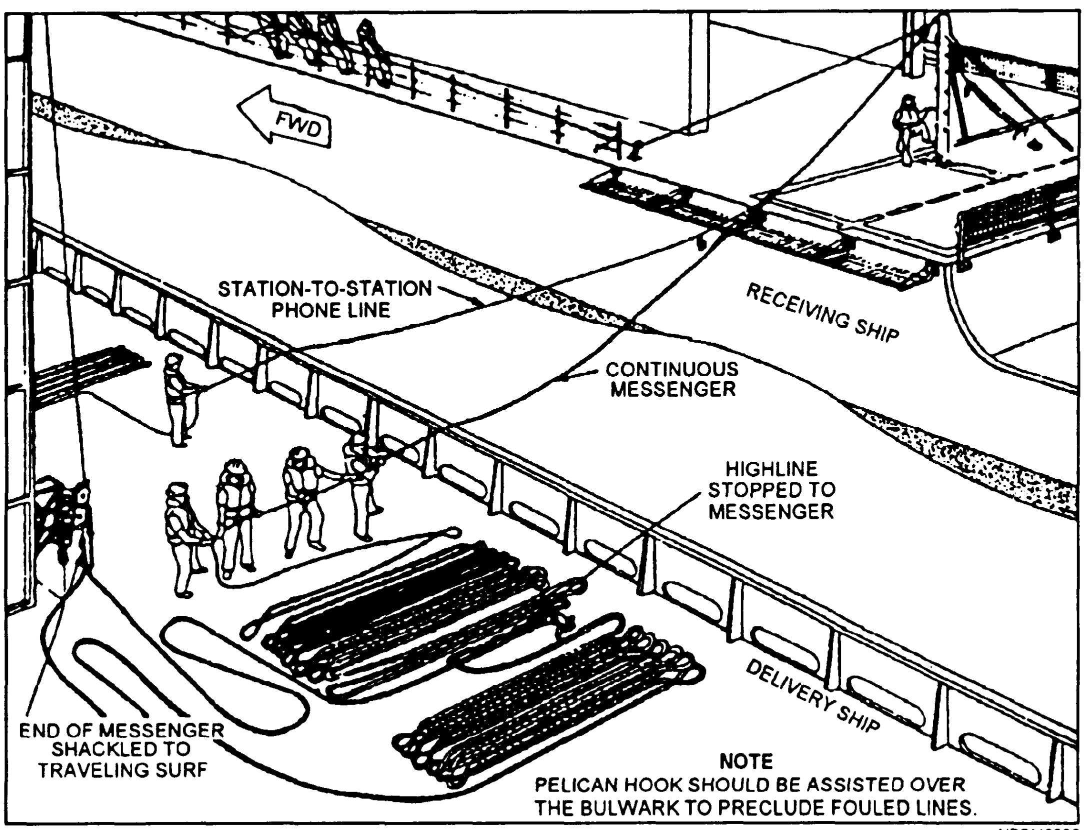

Figure 10-5.—Replenishment-at-sea messenger.

highline is stopped off to beckets on the messenger at a minimum distance of 350 feet (106.5 m) from the large soft eye end.

STAR MESSENGER

The STAR messenger is made up as shown in figure 10-6. It is 800 feet (243.8 m) of graduated plaited polyester or three-strand nylon with tapered splices as follows:

- 200 feet (60.9 m) of 1 1/2-inch (38.1-mm) line
- 534 feet (162.8 m) of 3-inch (76.2-mm) line
- 6 feet (1.8 m) of 2 1/4-inch 57.1-mm) line
- a pair of Brummel hooks
- 60 feet (18.2 m) of 2 1/4-inch (57. l-mm) line.

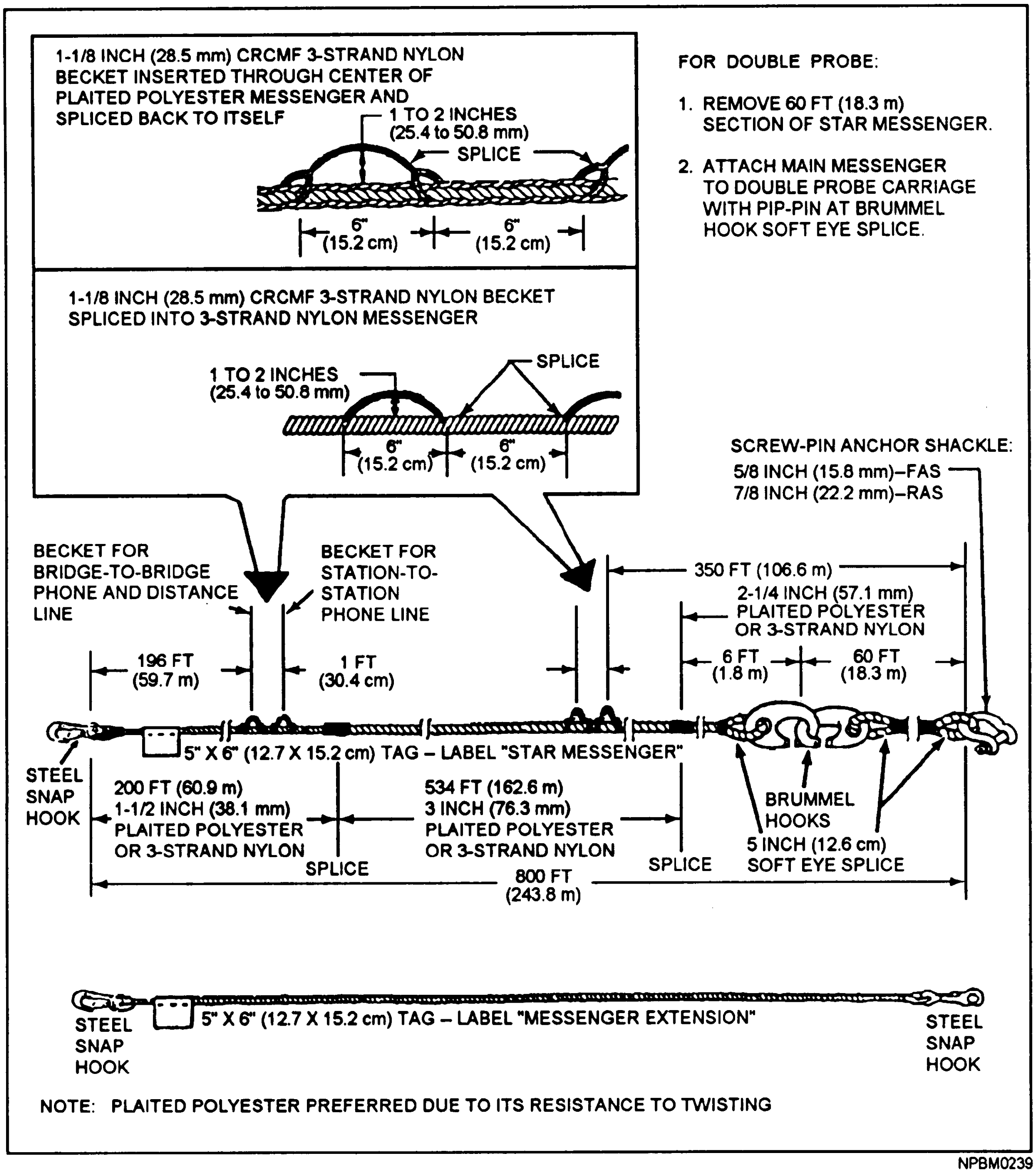

Figure 10-6.—STAR messengers.

TRANSFER STATION MARKERS

Display transfer station markers (bunting, metal, or painted area markers for day, and red lights for night) to indicate the type of commodity that is to be transferred at the station. See figures 10-7 and 10-8.

WIRE ROPE

The wire ropes used in UNREP are of varying lengths and sizes, but they must conform to Federal Specification RR-W-410, which lays down the requirements for most of the wire rope used in the Navy.

	CODE	
COMMODITY TRANSFERRED	DAY 3 ft^2 (91.4 cm^2) BUNTING OR PAINTED AREA	NIGHT LIGHT BOX
MISSILES	INTERNATIONAL ORANGE	
AMMUNITION	GREEN	
FUEL OIL	RED	
DIESEL OIL	BLUE	
F76	RED & BLUE TRIANGLES	
F44	YELLOW & BLUE TRIANGLES	
LUBE OIL	BLACK, YELLOW QUARTERS	
FEEDWATER	WHITE	
POTABLE WATER	WHITE WITH BLUE LETTER "P" CENTERED	
STORES	GREEN WITH WHITE VERTICAL STRIPES	
PERSONNEL AND/ OR LIGHT FREIGHT	GREEN WITH WHITE LETTER "P" CENTERED	
FUEL OIL AND F44	RED/YELLOW & BLUE TRIANGLES	
F76 AND F44	RED/BLUE & YELLOW/ BLUE TRIANGLES	
BRIDGE-TO-BRIDGE PHONE DISTANCE LINE	GREEN WITH WHITE LETTER "B" CENTERED	

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Figure 10-7.—Transfer station markers.

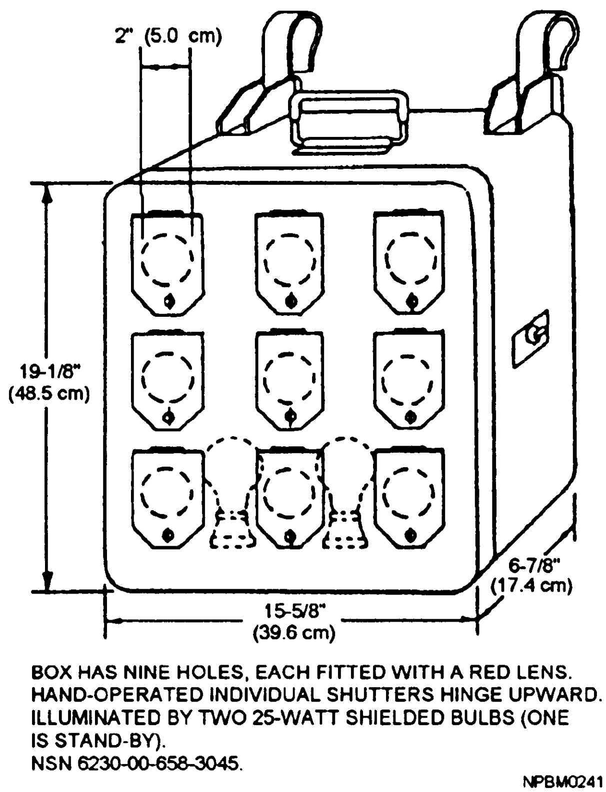

Figure 10-8.—Station marker light box.

Specifically, the rope must be type 1, class 3, and construction 6. In plain language, this is a general-purpose, preformed, right regular lay, 6 x 37 rope with an independent wire rope core. The sizes and lengths for the various rigs are listed in NWP 14 and *Underway Replenishment Hardware and Equipment Manual.*

Every ship is required to have on station for use at replenishment stations certain tools of appropriate sizes. While all tools need not be at each station, a list of all replenishment tools and their locations must be posted at each station. This list is located in NWP 14 *Replenishment-at-Sea Manual.*

Emergency breakaway tools are required at each station during UNREP These requirements are in the NWP 14 *Replenishment-at-Sea Manual.* These tools are not to be used for any other purpose.

SAFETY REQUIREMENTS

LEARNING OBJECTIVES: Describe safety precautions that must be observed at the transfer station, during fueling, regarding personal safety equipment, and regarding transferring combustible materials.

You must make sure that the main considerations in every shipboard evolution are safety precautions and the proper use of safety equipment.

GENERAL PRECAUTIONS

All personnel assigned to transfer stations must be thoroughly briefed in safety precautions. Safety precautions have to be reviewed immediately before each replenishment operation, and it is your duty to see that they are observed. The following safety precautions apply:

- Only essential personnel will be allowed at a transfer station.
- Lifelines will not be lowered unless they are absolutely necessary; if they are lowered, temporary lifelines must be rigged. Temporary lifelines must be no smaller than 2 1/4 inches in circumference, three-strand, nylon line.
- Personnel assigned to a transfer station, including line and cargo handlers, should not wear rings, watches, key chains, or any other jewelry that could be caught in the rigs, blocks, lines, and cargo.
- Personnel must stay out of the bights of line. Instruct all line handlers to work the lines from the inboard side and keep at least 6 feet from blocks through which the lines pass.
- Make sure that you use the correct cotter pins in pelican hooks. Do not spread the cotter pins excessively. A sharp bend on a cotter pin leg will make it difficult to insert or remove.
- Keep personnel clear of suspended loads and rig attachment points. Do not let personnel get between a load and the rail or side of the ship.
- Each transfer station must be equipped with a life ring that has a distress marker light attached.
- Span wires, whips, and wire highlines will be secured to winch drums by one wire clip or specially designed clamp—this minimizes the possibility of damage in an emergency breakaway.

> **NOTE**
>
> **All personnel involved in cargo-handling operations on both transfer and receiving ships must wear safety shoes.**

- Deck space in the vicinity of the transfer stations must be covered with nonskid paint to provide secure footing.
- Both delivering and receiving ships must station a life-buoy watch well aft on each engaged side. The watch must have S/P phone communications with the bridge and must be equipped with two smoke floats and with a 24-inch (60.9-cm) ring buoy fitted with a float light.
- All hands must be instructed on the hazards of emergency breakaway. See NWP 14(E) for more information on emergency breakaway.
- Phone talkers on the intership phone lines must not fasten their neck straps to their phone talker helmets.
- Cargo handlers should not be allowed to step on or in cargo nets that are attached to a cargo hook.
- Personnel involved in VERTREP must wear protective gear as indicated in NWP42 and safety devices that are covered in NWP42.
- Make sure that personnel who are rigging aloft or who must work outboard of bulwarks use safety harnesses with DYNA-BRAKE assemblies and safety and working lines.
- Easing-out lines must be rigged immediately upon rig hook-up to prepare for a possible emergency breakaway.

SAFETY DURING FUELING

The following precautions are mandatory during fueling operations:

- Personnel handling petroleum must be aware of the constant danger of fire and explosion. They must be thoroughly trained in the use of fire-fighting equipment.
- Cigarette lighters and safety matches are permitted only in authorized smoking areas.
- During fuel transfer, the smoking lamp is out except in authorized spaces. (The lamp should NEVER be lighted on an oiler's weather decks.)
- Necessary protective and fire-fighting equipment must be kept on hand during the transfer, ready for instant use.
- All hands must be indoctrinated in the requirements for emergency breakaway. The following items must be checked prior to each replenishment:

  a. Check use of a single wire clip to secure the span wire and saddle whips to the winch drums.

  b. Check the span wire weak link, end fitting.

  c. Check that UNREP working and repair tools are on station.

Personnel Safety Equipment

It is your responsibility as a deck petty officer to make sure all hands involved in an UNREP evolution follow the following personal safety rules:

- Personnel in the immediate area of the transfer station must wear construction-type safety helmets, equipped with quick-acting breakaway devices. Chin straps must be fastened and worn under the chin. Safety helmets are color-coded as shown in figure 10-9.

SAFETY HELMET - COLOR-CODED AS FOLLOWS:

WHITE	OFFICER/CPO
WHITE with GREEN CROSS	SAFETY OFFICER
WHITE with RED CROSS	CORPSMAN
YELLOW	RIG CAPTAIN
GREEN	SIGNALMAN/PHONE TALKER
RED	LINE-THROWING GUNNER/BOLD HEAVER
BROWN	WINCH OPERATOR
PURPLE	WINCH WATCHER/ REPAIRMAN
BLUE	LINE HANDLER/ DECK RIGGER
ORANGE	CHECKER/SUPPLY PERSONNEL
GREY	ALL OTHERS

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Figure 10-9.—Safety helmets.

> **NOTE**
>
> **Battle helmets must NOT be worn at UNREP stations.**

- Except for forklift truck operators and winch repair personnel, topside personnel who are engaged in handling stores or lines or who are in the transfer area must wear properly secured, orange-colored, inherently buoyant, vest-type life jackets with collars. Forklift truck operators and winch repair personnel will wear inflatable life jackets fully ready for use—life jackets in front, opened, with yoke over the head (except for actual inflation). Colored jerseys or vests over life jackets are not required.
- Personnel who are rigging aloft or working outboard of bulwarks or safety chains must wear a properly secured, orange-colored inherently buoyant, vest-type life jacket with a buttonhole in the back cover to permit concurrent use of the safety harness with DYNA-BRAKE assemblies and safety and working line. (See *Naval Ship's Technical Manual,* chapter 077, for details for use with a safety harness.)
- Personnel at transfer stations must wear a one-cell flashlight (or green chemical light) and a whistle on the outside of their life jacket during night replenishment. Flashlights need not be lighted except at the discretion of the commanding officer. Chemical lights must be lighted. Chemical lights are not to be discarded over the side during hours of darkness or until completely extinguished. The ship or lifeguard station may mistake a discarded chemical light for a man overboard.
- Personnel involved in cargo-handling operations on both the delivery and receiving ships must wear safety shoes.
- Personnel handling messenger, distance, and inhaul lines should use the "hand-over-hand" grip and may wear gloves.
- Personnel handling wire-bound or banded cases must wear work gloves.
- Personnel assigned to each transfer station must carry an appropriate knife for use in routine work and in an emergency.

Transfer of Dangerous Combustible Materials

Prior to transfer of dangerous material, such as acids, compressed gases, or hypochlorites, the delivery ship will identify the load to the receiving ship. The safety officer on the receiving station must verbally acknowledge that the receiving station is prepared to receive the material.

Potentially dangerous materials, such as acids, compressed gases, inflammable material, material that will support combustion, and hypochlorites, must NOT be transferred together in the same net or cargo load, and they must be kept segregated from each other in the loading and receiving areas. The inadvertent mixture of calcium hypochlorite-base materials and liquid hydrocarbon-base materials will produce an explosive fire within seconds.

Most containers of inflammable solids and oxidizing materials are identified by a 4-inch (10.2-cm), yellow, diamond label and other special hazardous warnings conspicuously displayed on the containers.

REPLENISHMENT CHECKOFF LISTS

LEARNING OBJECTIVES: State the purpose of replenishment-at-sea checkoff lists and name the references that contain these lists.

The success of a replenishment operation is determined in part before a line is passed; it is determined by how well you are prepared for the job ahead. Indeed, proper preparation is so important that you should not trust memory alone in getting ready. To prevent oversight, follow a carefully prepared checkoff list. These lists vary, depending upon the ship and the replenishment method or methods to be employed, but the following lists can be used as guides. There are checklists in NWP 14, appendix D.

GENERAL PREPARATIONS

Rig appropriate station markers.

Have two bolos ready for use. Test line-throwing guns and examine firing pins. Have projectiles and shot lines on hand.

Test S/P phones.

- When necessary, rig in the lifeboat and sea painter.
- Make sure that personnel assigned to replenishment stations are outfitted as we have described in the safety precautions.
- Have CO_2 extinguishers available and fire hoses run out. Have personnel standing by the main CO_2 system.
- Have sand available for use on oily or icy areas. When practicable, in freezing weather, remove ice from replenishment areas.
- Check emergency repair and working tools at each station.
- Review pertinent safety precautions.

FUELING STATIONS (OILERS)

- Place the hose rig in position, fitted on its outboard end with the appropriate fitting for the ship to be refueled. Test the operation of the end fitting.
- Make sure that only properly tested hoses are used in the rig.
- When rigged with a pigtail, make sure that the connecting male Robb operating lever (if used) is lashed in the OPEN position.
- Stop off the messenger to the hose; fake the messenger down on deck for running, rigged for the method being employed.
- Test winches. Have the span-wire drum engaged.
- Make sure that inboard saddle whips and retrieving lines are clear for running and are led to gypsy heads or winches.
- Make sure that the topping lift brake is set on the topping lift and that preventer stoppers are in place or that pawls are engaged.

FUELING STATIONS (RECEIVING SHIP)

- Rig the necessary blocks. Reeve light lines through the messenger and outer bight line snatch blocks and through any associated fairlead blocks. Rig easing-out lines.
- Make sure that the proper terminal fitting is on the hose to the riser or that the fuel trunk is open and clear of rags or other debris.
- Provide chafing gear at the point where the hose comes aboard. Lash shores over structures that might interfere with lines.
- If required, provide shores to position the end of the hose off deck.
- Fake down the distance/telephone line.
- Make sure that rigs, drip pans, buckets of sand, and a canvas tarpaulin to cover the fueling trunk are on hand.
- Provide the necessary tools for making connections, opening valves, and cutting the lines and breaking the rigs in case of emergency breakaway.
- Detail personnel to their tasks and make sure that all know their jobs.
- Make sure that all signalmen are familiar with the signals for all evolutions. See that these signals are posted or are stenciled on the backs of the signal paddles.
- Have available one or two spare cotter pins.

HIGHLINE TRANSFERS (SHIP SUPPLYING RIG)

- Have the highline rigged and ready for use, and make sure that all lines are faked down clear for running.
- Break out transfer bags and have them ready.
- Have a light line with a canvas bag ready for transfer of small articles, movies, or guard mail.
- If a transfer chair is to be used, make sure that it is ready, and have extra orange-colored life jackets available for personnel to be transferred.

FUELING AT SEA

LEARNING OBJECTIVES: Identify the span-wire, close-in rig, and double hose methods for fueling at sea; describe their setups and features.

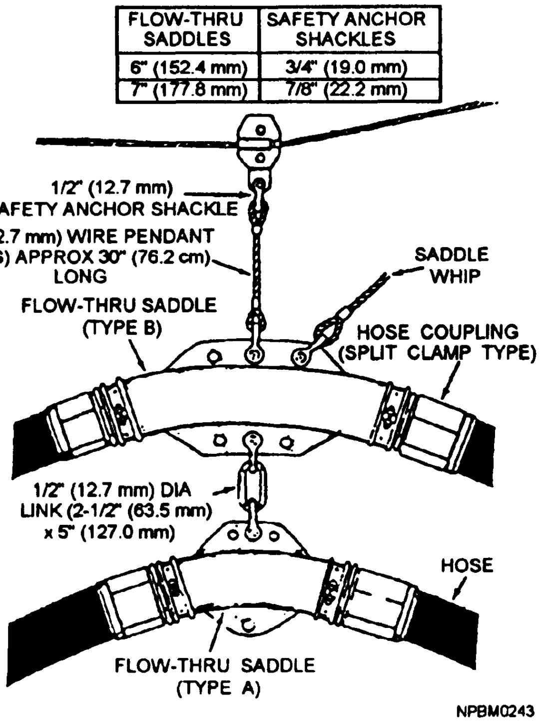


Figure 10-10.—Hose saddles.

Fueling at sea normally is conducted by using a span wire to support the fuel hose rig between the two ships. The span wire may be either tensioned or untensioned. An alternate method, the close-in rig, is used occasionally when the delivering ship is not equipped with a span wire or when the receiving ship cannot receive the wire, due, for example, to lack of a padeye that will stand the strain. Another method that you may use when fueling ships smaller than DDs and when operating with NATO ships is the astern rig.

COMMON FEATURES OF FUELING RIGS

Like replenishment in general, a few features are common to two or more refueling rigs; notably, hoses, hose saddles, terminal fittings, and riding lines.

The Navy uses a collapsible, lightweight hose that comes in 35-foot sections of 4-, 6-, or 7-inch diameters. The hose-end couplings are of a split-clamp type that permits joining sections together and joining sections to flow-through riding line fittings, to terminal fittings, and to flow-through hose saddles (fig. 10-10). The saddles are used to support bights of hose from the various rigs. Two types of saddles are used: type A (19 inches long) is found in single-hose rigs and in the lower hose in double-hose rigs; type B (32 inches long) is found in the upper hose in double-hose rigs.

Terminal Fittings

Three types of terminal fittings, all designed for quick release, are used. They are the breakable-spool quick-release coupling (NATO), the combined quick-release (Robb) coupling and valve, and the fueling probe.

BREAKABLE-SPOOL QUICK-RELEASE COUPLING.—The breakable-spool quick-release coupling (fig. 10-11) is used in fueling operations with NATO and MSC ships. It is also used with the Robb coupling. It consists of an A end and a B end. The A end, rigged on the receiving ship, is a cast-iron spool with a standard hose flange on one end and a slotted flange on the other. It is weakened by a groove machined around the spool. The groove is easily broken in an emergency by a blow from a sledge hammer.

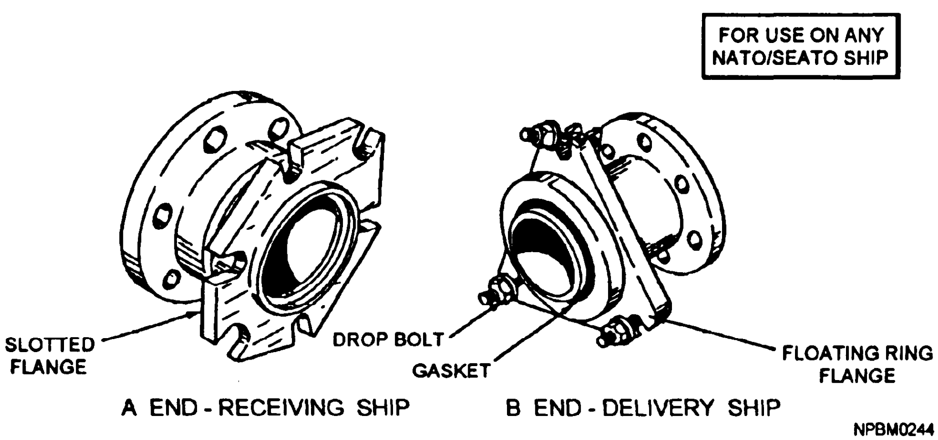


Figure 10-11.—Breakable-spool quick-release coupling.

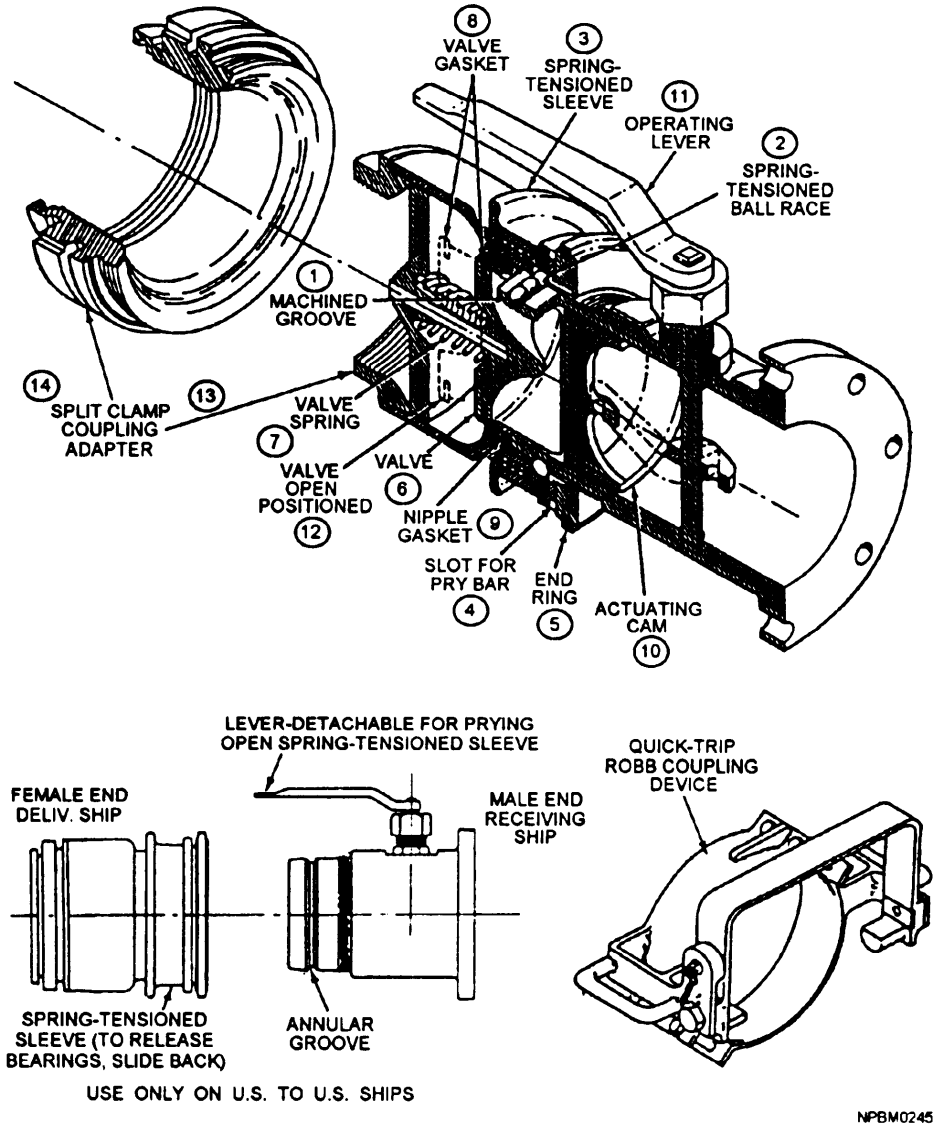


Figure 10-12.—Combined quick-release coupling and valve (Robb coupling).

The B end is a similar spool with a standard hose flange on one end and a special floating-ring flange with drop bolts on the other. The floating-ring flange can be rotated to quickly bring the drop bolts in line with the slots in the A end. A gasket mounted in the outboard end of the B end ensures an oiltight fit. A blank flange is attached to the B end to prevent oil from spilling and water from entering the hose when the hose is being passed.

COMBINED QUICK-RELEASE COUPLING AND VALVE.—The combined quick-release (Robb) coupling and valve (fig. 10-12) consists of a female end and a male end. The male end, rigged on the receiving ship, is a slightly tapered tube with a flange at one end. Near the other end is a machined groove (1). A spring-tensioned ball race (2) in the female end lines up with the groove, and a spring-tensioned sleeve (3) on the outside forces the balls down into the groove, holding the two ends together. When the sleeve is forced back by hand or, as usually is necessary, by pry bars, tension on the ball race is released and the male end can be withdrawn. Slots (4) are cut into the sleeve to permit the insertion of pry bars between the sleeve and the end ring (5).

A valve located in the female end (6) is normally closed and held in place by a heavy spring (7). A gasket (8) ensures a tight seal. Another gasket (9) provides a tight joint when the two ends are joined. A ring-shaped actuating cam (10) in the male end is linked to an

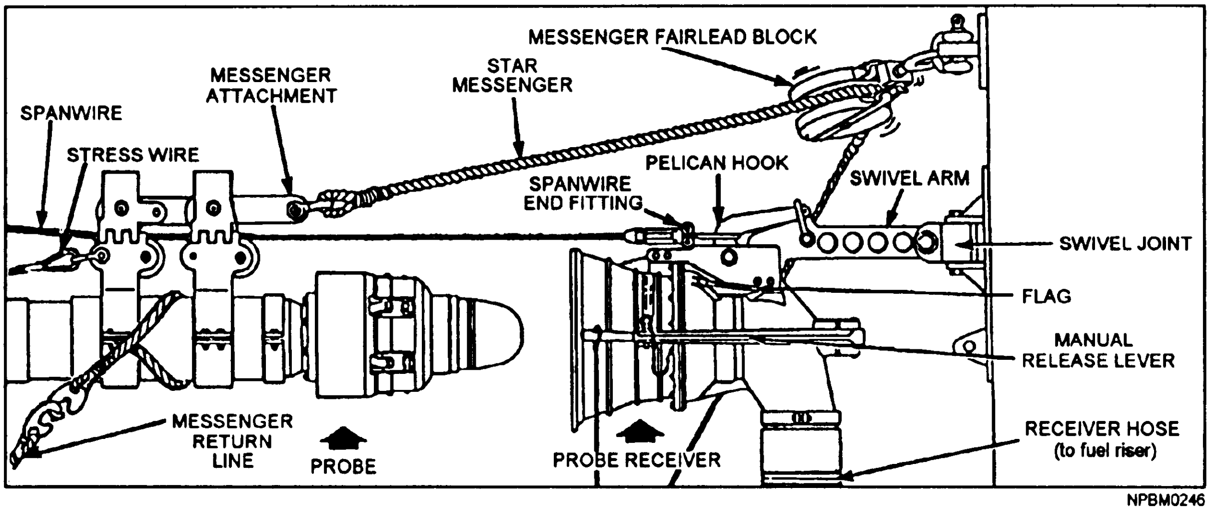


Figure 10-13.—Single probe and receiver.

operating lever (11). When the lever is turned to the OPEN position, the cam is thrust forward, opening the valve (12).

Both 6-inch and 7-inch adapters (13 and 14) are available for the female end. Therefore, the coupling can be used with either size of hose.

Despite the name, the Robb coupling does not qualify as a quick-release device, because uncoupling is virtually impossible when the fitting is under strain. For this reason, any strain must be taken by the riding line; and to connect or disconnect, the ends must be lined up perfectly. To provide for emergency breakaway, a breakable spool is inserted between the receiving ship's manifold and the male end.

Only U.S. ships are outfitted with the Robb coupling.

PROBE AND RECEIVER.—The probe fueling method was inspired by the method used to refuel aircraft in flight. The probe itself was modeled after that used by the aircraft. Preferably, the probe (fig. 10-13) is supported by a tensioned span wire by means of a hinged trolley block assembly, which can be attached to the span wire without disassembling the trolley. The probe contains a spring-tensioned latching mechanism that holds the probe in the receiver. A sliding sleeve valve opens when the probe seats properly, and closes automatically when disengaged.

The receiver hangs from a swivel arm that pivots in a swivel joint. The span wire also hooks to the swivel arm; thus, regardless of the relative position of the ships, the receiver is kept aligned with the probe. Visual indicators mounted on either side of the receiver show when the probe is seated. As the probe mates, the indicators rise to the vertical, then drop back to a position approximately 30° above the horizontal. See figure 10-14. When the probe is engaged properly, the latch mechanism prevents its being withdrawn under

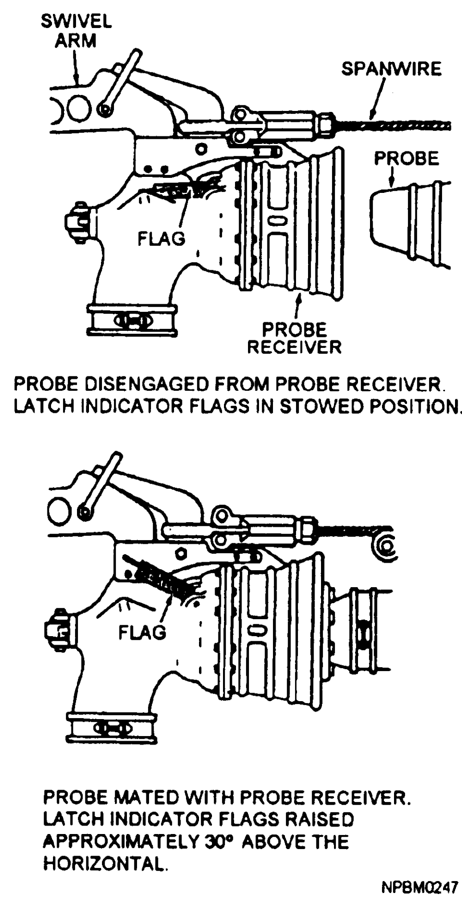


Figure 10-14.—Latch indicator flags.

normal circumstances until it is disengaged. The usual way to disengage the probe is to pull on a manual release lever mounted on the receiver; however, a pull of about 2,500 pounds on the inhaul also will disengage it.

A remating line, furnished by the receiving ship, is dropped over the hook on the trolley block and provides means for manually engaging the probe, or reengaging it should it be disengaged for any reason. A hose messenger is used to haul the probe to the receiving ship. This messenger can also be used to mate the probe and receiver.

MISCELLANEOUS TERMINALS.—Ships that have an open trunk fueling system need a semiridged, 4-inch hose pigtail that can be lashed in the trunk. For ships equipped with 4-inch risers, a 4-inch quick-release coupling is provided. For those ships fitted with 2 1/2-inch risers, a 2 1/2-inch quick-release coupling is furnished.

Riding Lines

Nine feet inboard of the hose's terminal coupling is a flow-through riding line hook, and 4 feet farther back is another hook of the same type. These hooks are for the two riding lines, which secure the hose on the receiving ship and take the strain of the hose from the terminal couplings (fig. 10-15). A riding line consists of a two-fold tackle, two 7-inch blocks reeved with 2 1/2-inch manila line (length to suit), and a 4-inch manila riding line 25 to 45 feet long. The riding line is spliced with a thimble and a 3 1/4-inch pear-shaped link in one end. When the hose comes aboard, the bight of the riding line is looped over the hook, the slack is

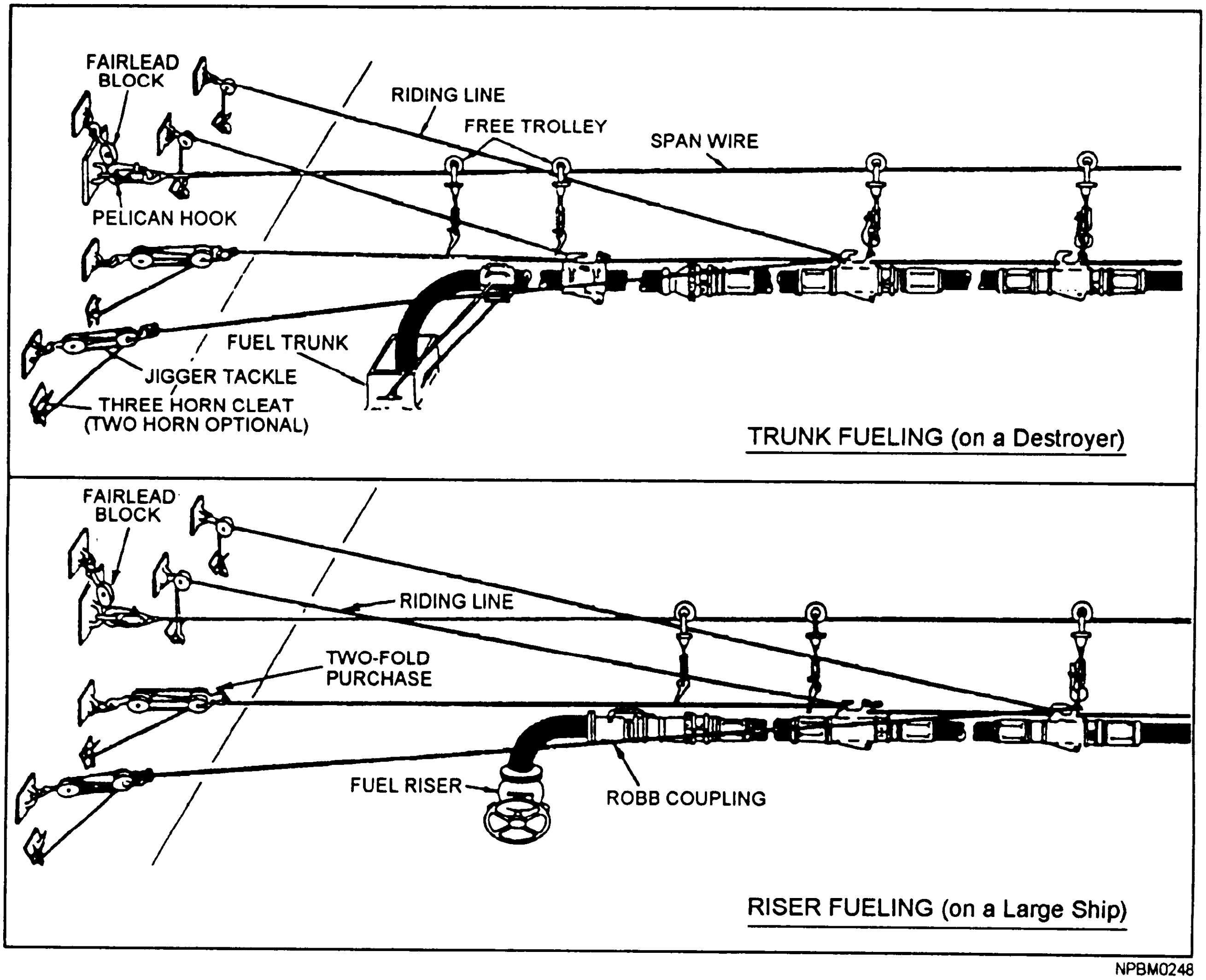


Figure 10-15.—Securing the hose.

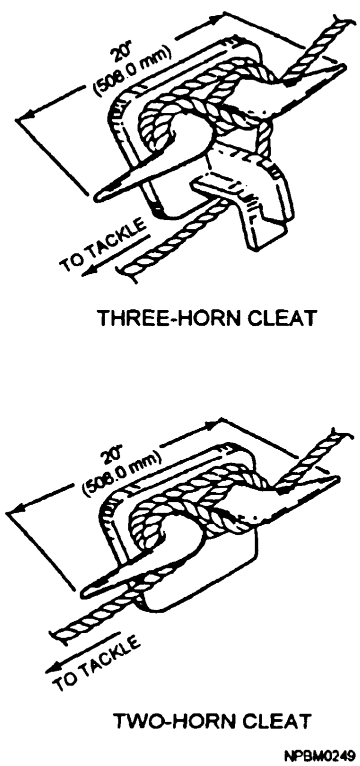


Figure 10-16.—Correct methods of securing a line to cleats.

hauled out, and the end is secured to a three-horn cleat. (A two-horn cleat is optional.) Then, a strain is taken on the tackle, and the tackle's hauling part is secured on another cleat. Figure 10-16 shows the proper way to secure a line on a three-horn cleat and a two-horn cleat.

WARNING

Nylon riding lines will not be substituted for manila lines. Failure to observe the prescribed riding line arrangement could result in overloading padeyes, cleats, or riding line fittings with resultant injury to personnel.

SPAN-WIRE METHOD

In the span-wire method of fueling at sea, the hose is carried between ships on a span wire, which may be tensioned or untensioned. Normally, the untensioned span wire is referred to as the conventional span-wire rig. See figure 10-17. The tensioned span-wire method is referred to as STREAM, an acronym for "standard

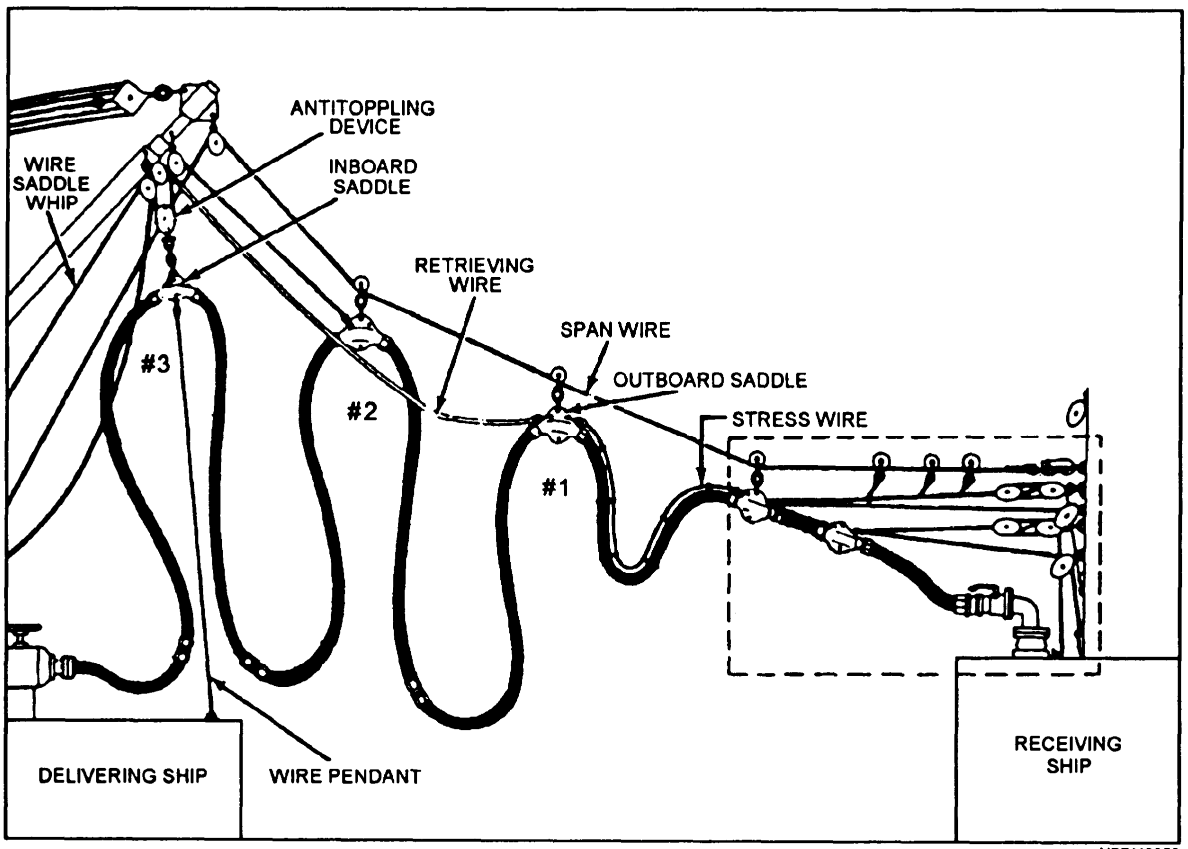


Figure 10-17.—Span-wire rig, single hose with Robb coupling.

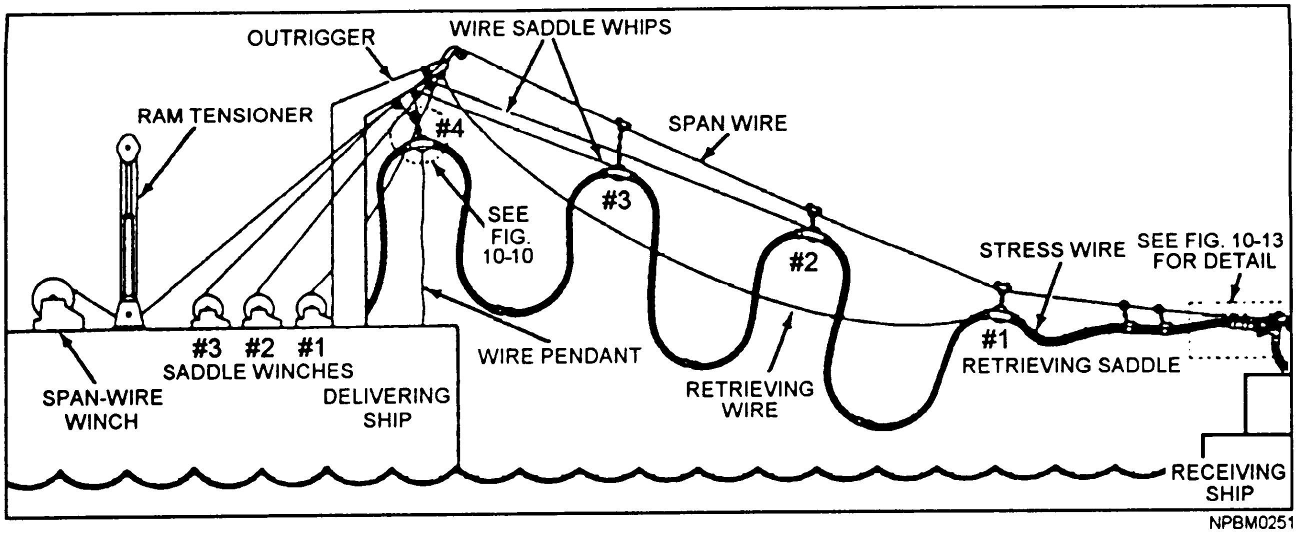


Figure 10-18.— Fuel STREAM, single hose with probe.

tensioned replenishment alongside method." STREAM rigs are rigged with four saddles and a hose approximately 300 feet long. See figure 10-18. The hose hangs from trolley blocks that ride along the span wire. Saddle whips position the hose while the ship is being fueled and serve to retrieve the hose after the fueling operation is completed.

The span-wire rig permits ships to open out from 140 to 180 feet. Such distance is reasonably safe and makes it fairly easy to maneuver and keep station. These factors not only allow commanders a wider latitude in choosing a fueling course but also facilitate the use of antiaircraft batteries, should the need for them arise. Additionally, the high suspension of the hose affords fair protection for it in rough weather.

Ordinarily, in the span-wire method, saddle whips and the retrieving line are of wire; but when the necessary winch drums are not available and winches with gypsy heads are available, 3 1/2-inch nylon line may be substituted for one or more of the whips. A wire rope retrieving whip is mandatory in double-probe rigs.

Rigging the Oiler

The following description can be used as a guide in rigging for the span-wire method of fueling (see fig. 10-17):

- Hose: The hose is suspended from the span wire by several trolley blocks. One trolley is shackled to each of the two outboard saddles, and one is shackled to each of the two riding line hooks. Two free trolleys are lashed with manila to the section of hose outboard of the outboard riding line hook. The hose line messenger is the main line used to assist in hauling the span wire and fuel rig across between the ships. When you are sending to a single-probe receiver, use the STAR messenger. The 60-foot releasing-line section of the STAR messenger will be used as the remating line at the receiving station.

When passing a single- or double-hose rig to double-probe receivers, use the star messenger without the 60-foot releasing line section and attach it to the special inhaul clamp using a 5/8-inch screw pin anchor shackle or the pip-pin (if provided) on the trolley carriage.

- Span wire: The span wire is secured in the manner shown in figure 10-19 to the hose line messenger, 350 feet from the inboard (shackled) end of the messenger. A span-wire weak-link end fitting is used with the probe rigs. A 3/4-inch fitting is used for a single-hose rig, and a 7/8-inch fitting is used for the double-hose rig. A 3/4-inch shackle and a l-inch pelican hook are used with span-wire rigs other than probe. The other end is passed through one of the outermost blocks at the head of the boom (or outrigger) and then fair-led to a winch or the ram tensioning device, as the case may be.

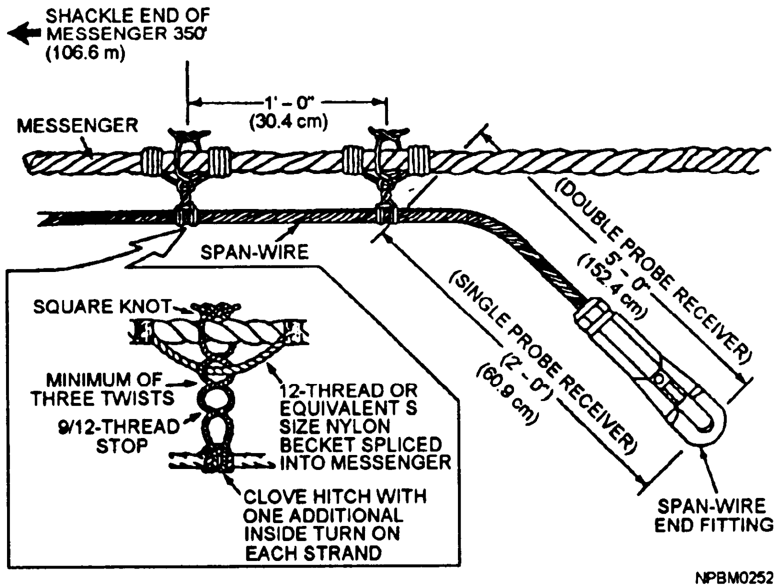


Figure 10-19.—Method of securing the span wire to the messenger.

- Saddle whips: Saddle whips are fair-led from their respective winch drums (wire whips) or gypsy heads (nylon whips) through blocks at the boom head (outrigger). The outboard whip (also known as the retrieving line or wire) is shackled directly to the outboard saddle. The inboard whip passes through a runner block (yo-yo block) secured to the inboard saddle and then is fair-led to the second saddle. The nonswiveling runner block (yo-yo block) is fitted with an antitoppling device. A 3/4-inch wire pendant secured on the main deck and to the bottom on the inboard saddle prevents the saddle from being two-blocked. If the saddle is two-blocked, it is apt to jam there. The saddle whip then can reeve freely through the blocks, and the next saddle will slide down the span wire. This situation may put a strain on the hose.

Rigging the Receiving Ship

Shackle a 12-inch snatch block to a padeye over the manifold and approximately 6 feet above the deck. To expedite hauling in the hose, lead a line with a steel snaphook on the end through the snatch block and such other blocks as are necessary to provide a fairlead.

Shackle the tackles of the two riding lines to the pad-eyes provided, but leave the hauling parts and pendants free.

On ships with fuel manifolds, the necessary lengths of hose with a hose terminal attached are secured to the manifold. If the Robb coupling is to be used, insert a breakable-spool coupling between the manifold and the Robb coupling. Chafing gear must be at hand wherever the hose or lines may chafe on the ship's structure.

Fake down the distance line at the proper station. Plug in and test the telephones. Have your station markers rigged, and break out the required signal paddles (wands), rags buckets of sand, and so on.

Passing the Lines

As the receiving ship completes its approach and steadies alongside, send over heaving lines, bolos, or line-throwing gun lines from each station on the oiler to corresponding stations on the receiving ship. By means of these lines, haul the messengers aboard. See figure 10-20. When a messenger reaches the receiving ship, secure it to the line rove through the messenger snatch blocks.

When the end of the span wire comes aboard, cut the first stop and secure the pelican hook to the long link of the padeye provided. Cut the remaining stops and have the oiler begin tending the span wire. Rig an easing-out line at this time.

Have the receiving ship continue heaving on the hose messenger. When the free trolleys come within reach, trip them, allowing the hose to be hauled farther

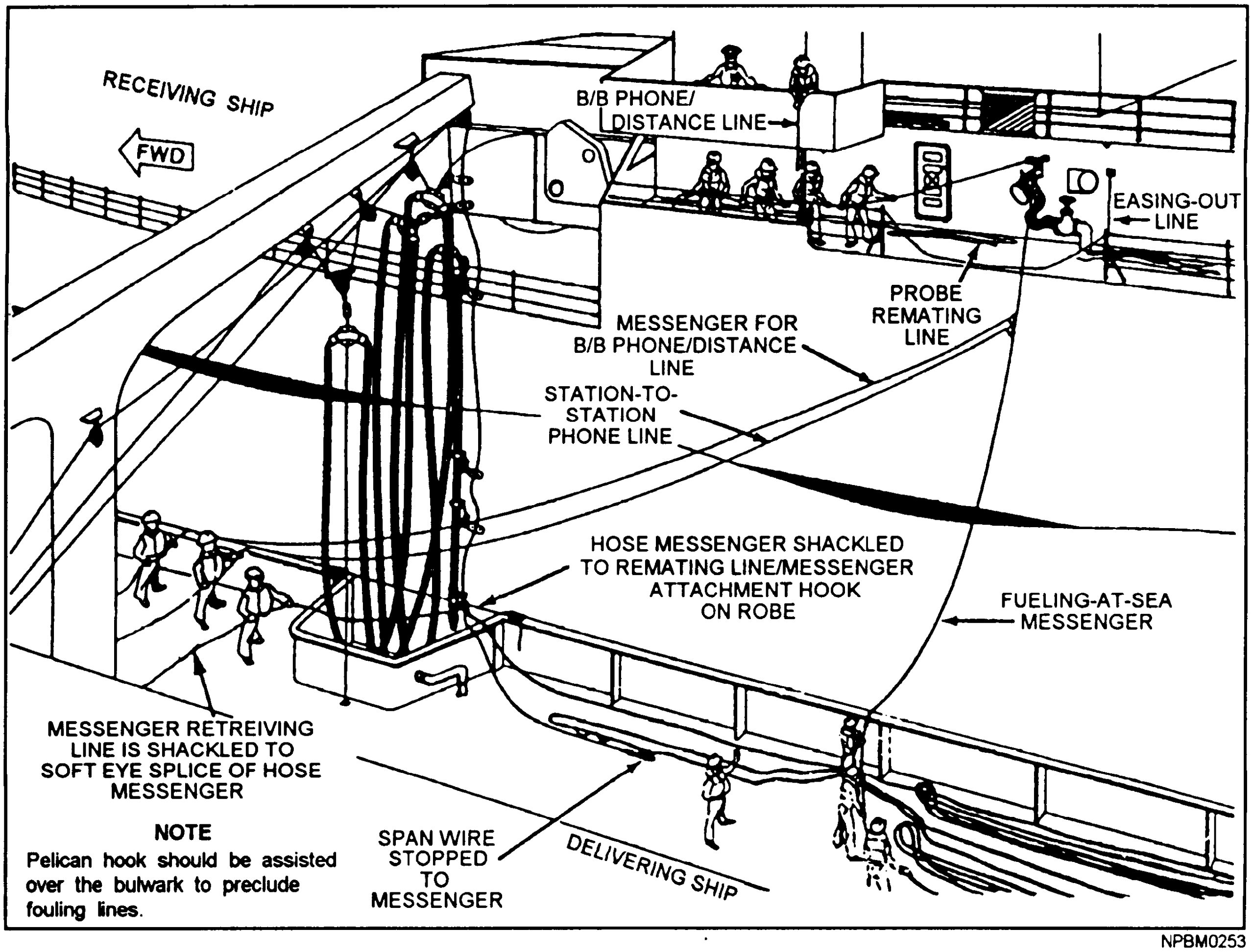


Figure 10-20.—Passing the lines.

inboard until bights of the riding lines can be looped over the riding line hooks. Have the riding lines taut and secure them. Take a strain on the tackles, and secure their hauling parts. Then couple the hose to the riser. You should have a lot of rags and a drip pan in case you have a spill or a leak in the line.

When refueling has commenced, return the messenger. When using the span-wire rigs, unshackle the messenger from the 9-foot riding line clamp on the probe trolley assembly and return it, shackle-end first, by the return messenger line. When refueling with the close-in rig, restop the messenger to the hose and attach the bitter-end (small end) to the return messenger line and then have it hauled in and tended by the delivering ship; the entire hose messenger may be returned. In this case, unshackle the messenger from the riding line fitting, and return it, large end first, to the delivering ship. The delivering ship indicates which method is required by labeling the return line identification tag with the additional words *small end* or *large end.*

Retrieving the Rig

When the blowdown of the hose is completed, have the receiving ship disconnect the hose coupling and secure the Robb operating lever in the closed position (or unlash the hose and replace the hose cap or end flange).

Unless otherwise requested by the delivering ship, have the receiving ship reconnect the free trolleys and ease the hose outboard by slacking the riding line while having the oiler heave in on the hose saddle whips.

When the hose has been retrieved, have the delivering ship slack the span wire and signal the other ship to trip the span-wire pelican hook. It is customary to ease the span wire clear of the side with an easing-out line. The easing-out line must be 12- to 21-thread manila and of an appropriate length to ease the wire clear of the ship's side. As the delivering ship hauls in the span wire, the receiving ship retrieves its distance line.

Tensioned Span Wire (Highline)

The untensioned span wire and highline have been a weakness in replenishment systems.

To keep the hose or load out of the water and to keep the span wire or highline from parting as the ship rolls, make sure the winch operator is well-trained and constantly alert. The tensioned wire, a device upon which several replenishment systems depend, is designed to automatically compensate for the slackening and tensioning of the span wire or highline, due to roll, and to accommodate heavier, palletized loads and missiles.

The hydraulic ram tensioner is the primary means of tensioning employed by the Navy. It consists of a ram cylinder, accumulator cylinder, air flasks, and an indicator assembly.

The span wire is fair-led from the boom or king post to blocks mounted on the ram and the ram cylinder and then to the winch. Air from the flasks maintains pressure on a piston in the accumulator cylinder, and this pressure is transmitted by means of oil to the ram. Thus, as the tension in the span wire is relaxed, the pressure in the system causes the ram to extend, taking up the slack in the span wire. Conversely, when tension increases, air is forced back into the flasks. A small wire cable transmits ram motion to the indicator dial. One pound of air pressure on the accumulator causes about 10 pounds of line pull on the span wire. Thus, 900 psi in the air flasks maintains a tension of about 9,000 pounds on the span wire.

All fueling-at-sea attachment points for span wire (tensioned and untensioned) are for 36,000 pounds, Other fittings and equipment are discussed in NWP 14 and will not be repeated here.

At this point, we will describe the probe method, one of the fueling systems that can make use of the tensioned span wire. See figure 10-18.

PROBE FUELING METHOD

The probe fueling system is a result of the Navy's efforts to reduce alongside time in replenishment operations. As stated before, the system comprises two parts—a male probe (fig. 10-13) attached to the end of the oiler's 7-inch hose and a receiver supported by a swivel arm mounted on the receiving ship. A pelican hook for securing the span wire is an integral part of the swivel fitting. Although the span wire may not be tensioned, this arrangement keeps the receiver aligned to take the probe.

Rigging the Oiler

The oiler is rigged just as in the span-wire method except for the following:

- A 7-inch hose is always used.
- A special weak link replaces the pelican hook on the outboard end of the span wire.

Rigging the Receiving Ship

Aboard the receiving ship, the same preparations for receiving the messenger are made as in the span-wire method. The 60-foot remating line is fair-led in similar fashion. Riding lines are unnecessary; therefore, they are not rigged. The probe receiver and swivel arm are mounted, and the wire-reinforced hose is connected to the manifold. At the appropriate station, the phone and distance line is faked down.

Passing the Lines

In the probe method of fueling, pass the first lines in the same manner as for the span-wire method. When the span wire comes aboard, have enough stops cut to permit the weak link to be secured to the pelican hook on the swivel arm. The easing-out line is rigged at this time. If the ship separation is less than 140 feet, the angle of the span wire is such that the delivering ship can ease the hose down to the other ship. Normally, however, have the receiving ship haul the hose aboard by means of the messenger. After the probe is engaged in the receiver, have the remating line attached to the probe by the receiving ship and disconnect and return the hose messenger to the delivering ship. A pull of approximately 300 pounds is required to engage the probe; therefore, several personnel must be available for the task. When the probe is seated, unshackle the messenger and return it. Fake down the remating line for running.

Retrieving the Rig

In the probe method of fueling, a blowdown is unnecessary before disconnecting the hose, but the hose should be cleared when the last ship has been refueled.

After fueling is completed, the remating line is unhooked, and the manual release lever on the probe receiver is used to free the probe. The oiler hauls in the hose, and after the hose is completely in, the delivery ship slacks the span wire. The easing-out line is 21-thread manila of the appropriate length with whippings on both ends. One end should be secured, and the other hand-tended. On signal from the oiler, the receiving ship trips the span wire and eases it over the side, then retrieves the distance line.

> **WARNING**
>
> **The span wire must NOT be tripped until the tension in it is relieved.**

DOUBLE-HOSE METHOD

A normal procedure for carriers was to receive the ship's fuel at stations forward and aft. Fuel for jet aircraft (JP-5) was received forward only. Late-model carriers, however, have JP-5 risers located within a few feet of every diesel fuel marine (DFM) riser. Looking for a way to increase the transfer rate of JP-5 without increasing the number of hose rigs, the Naval Sea Systems Command developed the double-hose method.

In the double-hose rig, two hoses are hung from the same span wire. This arrangement makes it possible to transfer two different types of fuel from the same station or to transfer twice as much of the same type of fuel by using both hoses.

DOUBLE-PROBE METHOD

The double probe is used as part of the double-hose rig. Currently, only carriers can be refueled with the double-probe, but it can be used by two oilers to consolidate their loads.

The double probe consists of two single probes suspended from a trolley block assembly (fig. 10-21). The messenger is shackled to an eye located between the hoses in the trolley block assembly with a pip-pin.

The two receivers hang from a baseplate assembly with a swivel device similar to the swivel arm/swivel joint arrangement of the single receiver. Instead of coming out of the bottom, the wire-reinforced hoses come out from one side or the other. The fueling station arrangement on the ship determines which combination of the two types of receivers is used.

Power is required to mate the two probes; therefore, the messenger is fair-led to a winch with a gypsy head. After mating, remove the messenger and secure the remating line to the pip-pin.

The stress wires, shown in figure 10-18, are added to the rig to prevent the hoses from taking any strain in case the oiler has to disengage the probe by heaving around on the inhaul.

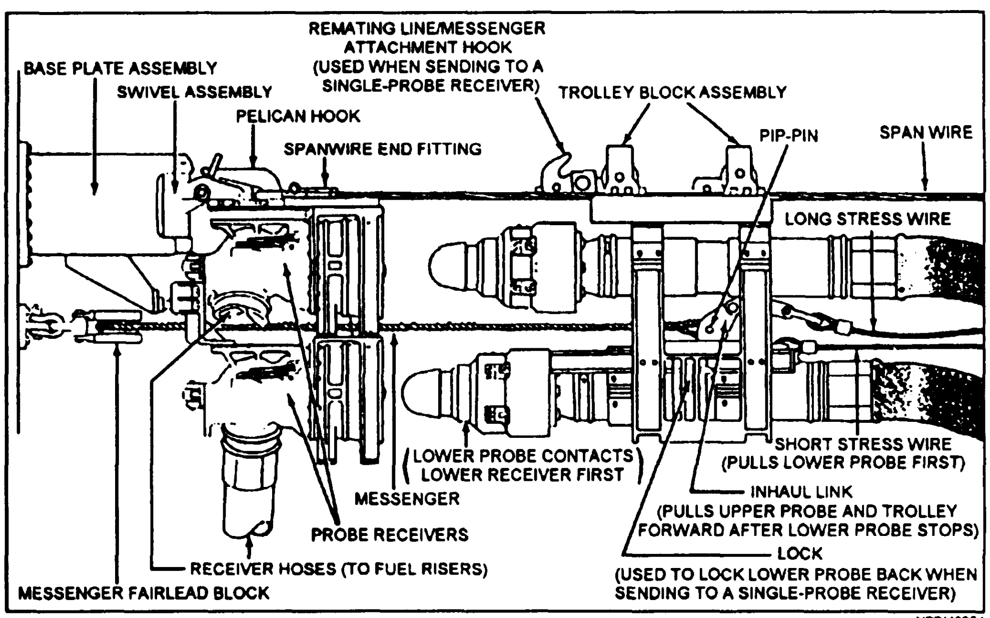


Figure 10-21.—Double probe and receiver.

CLOSE-IN METHOD

As stated before, the close-in method of fueling is used when the delivering ship is not equipped with the span-wire rig or the receiving ship does not have a padeye strong enough to hold a span wire.

In the close-in rig, the hose is supported by whips leading from the hose saddles to booms, king posts, or other high projections on the delivering ship. When the rig is used to fuel ships larger than destroyers, the outboard bight of hose also may be supported by an outer bight line (fig. 10-22) leading from the outboard saddle to a high point on the receiving ship. The outer bight line is passed to the receiving ship by means of the hose line messenger.

On the receiving ship, the same preparations are made as for receiving the span-wire rig except that an additional 12- or 14-inch snatch block must be shackled to a high, convenient, and adequately tested point above the point where the hose will come aboard. Such other blocks as are necessary to fairlead the bight line to a winch must also be rigged. A small pendant should be reeved through this set of blocks to quickly haul the outer bight line through the blocks and to the winch. The outer bight line is used to help haul the hose to the receiving ship and, once the hose is secured, is tended in the same manner as are the saddle whips.

FUELING EMERGENCY PROCEDURES

LEARNING OBJECTIVES: Identify the actions that should be taken during the following fueling emergencies: saddle whip casualty, span-wire casualty, and emergency breakaway.

Fueling emergencies are rare, considering the number of personnel involved, the vast amount of gear rigged, the hours ships spend alongside each other, and the action of the sea; but they do happen. As a BM, you must be on guard at all times to prevent emergencies, and you must know what to do when they do occur. The following is a discussion of a few emergencies and how to cope with them.

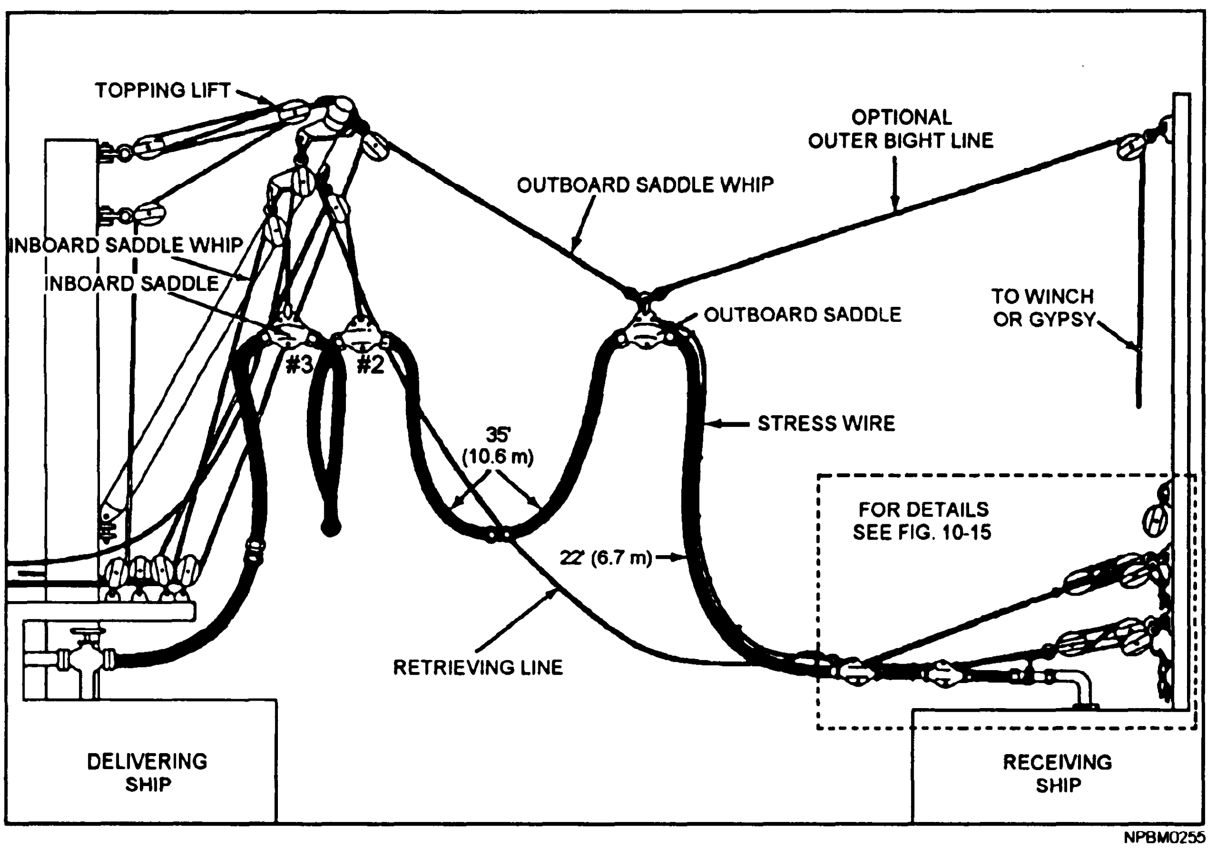


Figure 10-22.—Close-in rig.

SADDLE WHIP CASUALTY

A saddle whip should be secured to the winch with only a single clamp, and in an emergency, the whip should be allowed to pay out and pull loose from the clamp. The idea is that it is better to part the hose than a saddle whip. For this reason saddle whips seldom part, but when one does, the rig may become uncontrollable. For example, if the inboard saddle whip parts, the inboard saddle drops into the water, and the center saddle slides down the span wire. There is nothing to control these saddles. See figure 10-17. In such cases, recover the rigs as follows:

1. Lead the wire pendant to a winch and hoist the inboard saddle from the water.

2. Request that the receiving ship cast off the hose.

3. Keep the span wire as taut as possible.

4. Haul in on the outboard saddle whip until the hose bights are alongside. Tightly lash to the ship's structure any bights within reach. Do not attempt to two-block saddles to the boom or outrigger head.

5. Ask the receiving ship to cast off the span wire. Recover the remainder of the hose by heaving around on the span wire.

If the outboard saddle whip parts, the results are not as serious as when the inboard whip parts. The outboard saddle merely slides down the span wire, and the hose may not even reach the water if the inboard whip is hauled in promptly. After such a casualty, the inboard section of hose is recovered in the usual way, and the rest of the hose is recovered by hauling in on the retrieving wire.

SPAN-WIRE CASUALTY

Should the span wire become fouled on the winch or in the rigging, or otherwise cannot be used, take the following steps:

1. Take a strain on both saddle whips and the retrieving line.

2. Request the receiving ship to close to the appropriate distance for fueling by the close-in method.

3. Signal the receiving ship to cast off the span wire.

4. If possible, proceed with the refueling, tending the rig as for the close-in method.

NOTE

Do NOT use this procedure with large ships in heavy weather.

EMERGENCY BREAKAWAY

Because an emergency may occur at any time during replenishment at sea, preparation for an emergency breakaway must begin with the first line coming aboard. As the lines are received, fake them down and keep them clear for running. Do not stack the stores coming aboard where they block access to cleats on which replenishment lines are secured. As soon as you have secured a pelican hook, pass an easing-out line through the shackle holding the pelican hook to the line. Secure one end of the easing-out line, and leave the other free for running. Keep loose gear from underfoot. Wipe up decks made slippery by spilled oil and sand them immediately.

Basically, an emergency breakaway is an accelerated standard breakaway precipitated by one of the following conditions:

- An engineering casualty affecting the ability of one of the ships to maintain the replenishment course and speed.
- Discovery of an enemy presenting an immediate danger to the force.
- A refueling carrier must break off for emergency launching or recovery of aircraft.
- Ships separate by more than 240 feet when a single rig is used (200 feet for a double rig) and continue to open.
- A rig parts and the possibility exists that the screw might become fouled.
- A crew member is lost overboard and a lifeguard ship or helicopter is not on station.

Upon recognizing a condition warranting emergency breakaway, the officer in charge, senior petty officer, or rig captain at a replenishment station notifies command control, the bridge, and fuel (cargo) control of the situation. The commanding officer of either ship can order an emergency breakaway. Upon receiving the word for breakaway, take the following actions:

1. Have talkers notify the other ship and all stations on own ship.

2. Have the oiler stop pumping.

3. Have both ships retrieve their hand-tended lines.

4. Have the receiving ship secure its fuel riser valves.

5. Have the receiving ship disengage or break (breakable-spool) terminal couplings, slack or cut riding lines, and ease the hoses over the side.

6. Have the oiler retrieve the hose and slack the span wire; the receiving ship trips the span wire.

7. When all lines and hoses are free of the receiving ship, both ships maneuver to get clear.

> **NOTE**
>
> **Pass the signal for emergency breakaway between ships by telephone and hand signals to keep unnecessary noise to a minimum. When needed, however, use voice radio and bullhorns. Have the danger signal (five short blasts) sounded on the ship's whistle to warn other ship's of the emergency action.**

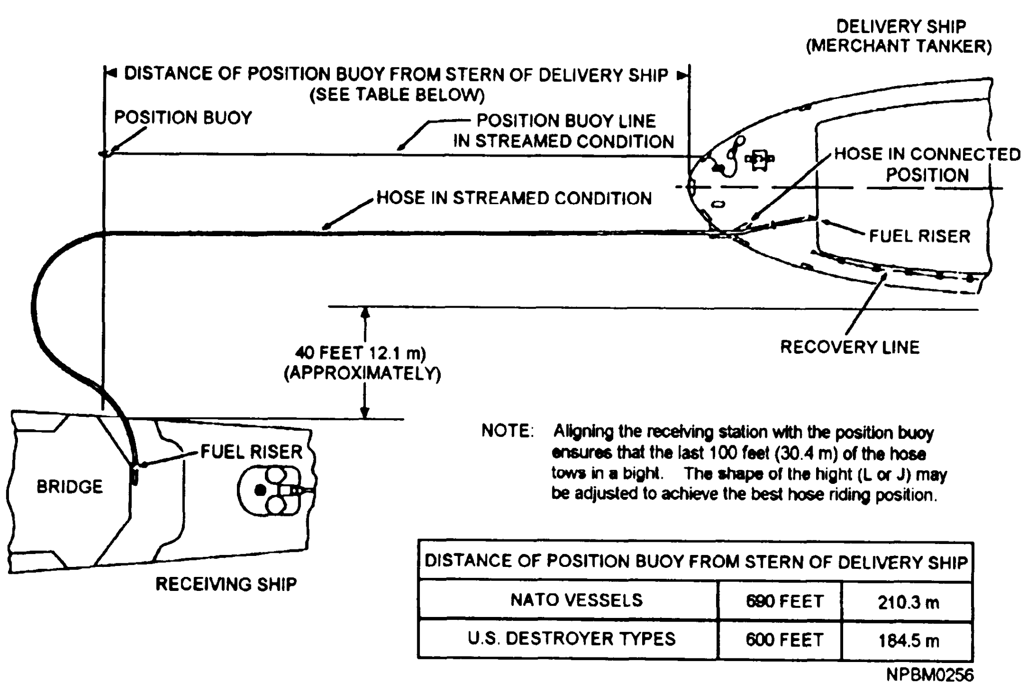
When the probe is being used and the receiving ship cannot quickly disconnect the probe, have the delivering ship do so by taking a strain (2,500 pounds) on the retrieving line saddle whip, provided you have a stress wire connecting the outboard saddle with the probe trolley.

ASTERN FUELING

> *LEARNING OBJECTIVES:* Describe procedures for astern refueling and include the safety precautions that should be followed.

Astern fueling is not normally conducted by oilers. However, selected fleet oilers and selected merchant tankers may have this capability. When you are astern fueling with a merchant tanker, the hose terminal fitting will be the NATO breakable-spool coupling, so you should be ready to receive it. The astern fueling rig may be either a lay-on-deck rig or a reelable rig if the tanker is so equipped. Following is some basic information on astern fueling. For more detailed information, consult NWP 14.

In the float method of astern fueling of escort ships, the merchant tanker streams a single 6-inch hose rig through a stern roller assembly and into the water. The escort ship maintains station astern and outboard to starboard of the delivery ship while receiving fuel. The astern fueling rig's characteristics dictate fueling at a forward receiving station, and you should make no attempt to receive the rig at an after station. Figure 10-23 is a drawing of a typical astern fueling operation and



DISTANCE OF POSITION BUOY FROM STERN OF DELIVERY SHIP		
NATO VESSELS	690 FEET	210.3 m
U.S. DESTROYER TYPES	600 FEET	184.5 m

Figure 10-23.—Correct positioning of delivery and receiving ships in a typical astern fueling operation,

SIGNAL		MEANING	
DAY	NIGHT	RECEIVING SHIP	DELIVERING SHIP
Green Flag	Green Light	Hose connected. Start pumping.	Pumping started.
Red Flag	Red Light	Stop pumping or blowing down hose.	Pumping or blowing down has stopped.
White Flag	Amber Light	Blow down the hose.	Blowing down started.

Figure 10-24.—Control signals for astern fueling.

shows the most desirable location of the receiving station relative to the marker buoy.

COMMUNICATIONS

In addition to the control signals indicated in figure 10-24, the hoist signals used during astern fueling operations are the same as those used with other fueling rigs. The control signals will be displayed at the appropriate fueling station on both ships. Your station flags will consist of 3-foot squares of bunting of the designated color. You must use wands or colored-lens flashlights in the appropriate colors for night operations. During astern fueling, sound-powered telephones will not be passed between ships.

MANEUVERING

The fueling course and speed will be determined by the officer-in-tactical command (OTC). Variations in speed are more important than steering a steady course when the escort is fueling astern of the tanker. Because the receiving ship's judgment of relative speed and distance is more difficult in the astern method than in the alongside method, great care must be taken in giving speed adjustments. Astern fueling can be carried out between 8 and 15 knots, but your best speed is 12 knots.

In all cases, it is the responsibility of the tanker to maintain a steady course and speed as prescribed by the OTC. The escort being refueled is responsible for adjusting her course and speed to maintain correct station on the tanker.

During the fuel transfer phase of astern fueling, the receiving ship maintains a safe distance astern of the tanker by station keeping on a position buoy that is towed about 600 feet astern and to port of the tanker. At that time, the receiving ship's horizontal position in relation to the tanker is ideally about 40 feet outboard of a line extended aft from the tanker's starboard beam. That condition should prevail in a relatively calm sea with no adverse effect from sea or wind. Actually, station keeping in a horizontal plane is a function of maintaining station on the hose, because at times wind and sea action prevents the hose from streaming directly astern of the tanker's stern roller.

RIGGING THE RECEIVING SHIP

Rig the receiving ship in the following manner:

- If the probe receiver assembly is installed on the station to be used for astern fueling, remove it and stow it out of the way.
- Install an adapter ell on the fuel riser with the A-end of a breakable-spool coupling on it.
- Shackle a 12-inch wooden block to the fairlead padeye, using an upset safety shackle. This will be used as your messenger fairlead block (fig. 10-25). Fairlead the messenger to power if available.
- Shackle another 12-inch wooden block to the padeye located below the probe receiver's swivel joint. This is your inhaul/retaining line fairlead block.
- The inhaul/retaining line is a 4-inch manila 50 feet long. One end of the line has a thimble eye spliced to the eye of a standard No. 27 safety hook, with a bight of the line at the hook end inserted in the inhaul block.
- Using a regular safety anchor shackle, shackle a 3-inch manila line to the probe receiver's swivel joint. Use this as the easing-out line. Your easing-out line should be twice as long as the distance from the messenger fairlead block to the waterline plus an additional 50 feet if the line is

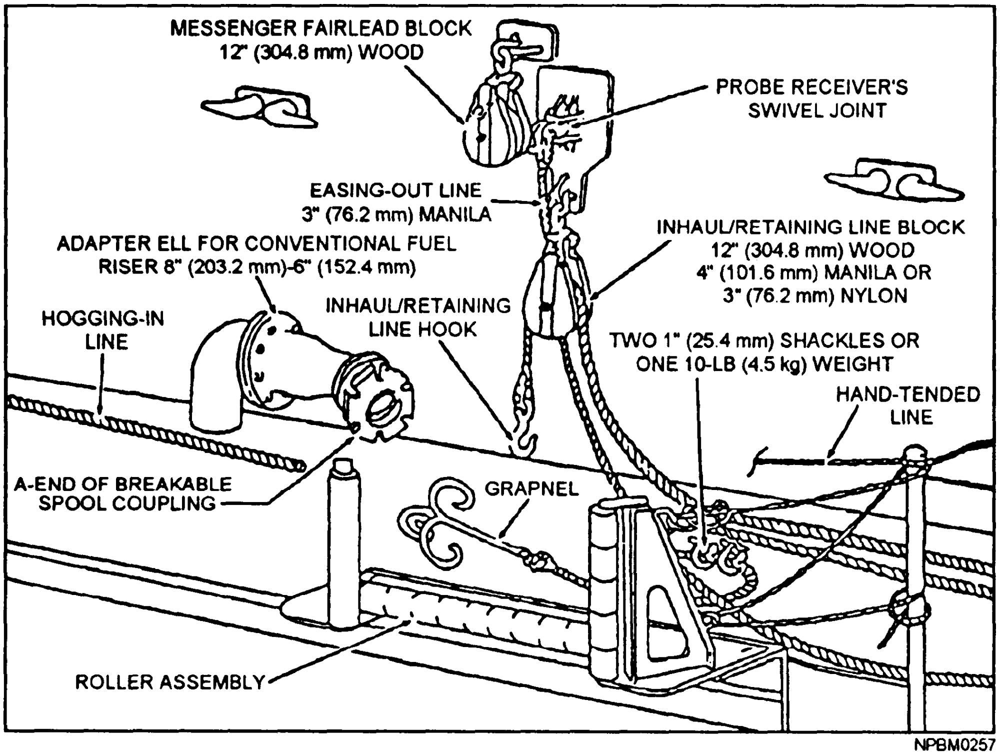


Figure 10-25.—Receiving station ready to receive astern fueling rig.

required for deck handling to a cleat and for easing-out operations.

- Then prepare a 3-inch manila grapnel line 50 feet long. Shackle a grapnel hook to a thimble eye in the end of the line. Place two l-inch shackles or 10 pounds of free running weight around the line. Secure the bitter end of the line to a bit or cleat.
- Coil down a 50-foot length of 2-inch manila line for use as a hose hogging-in line.
- Remove lifelines in the way of the rig, and install temporary ones. You will need antichafing gear for all sharp edges that the hose may ride on during replenishment.

GRAPPLING AND SECURING THE RIG

The receiving ship will approach the messenger buoy from astern and maneuver to bring the buoy close-aboard on the port side. When the messenger buoy is alongside, the grapnel line is heaved across the messenger before the float enters the bow wash, as shown in figure 10-26. Heave the messenger and float assembly up to the deck until both can be taken in hand safely.

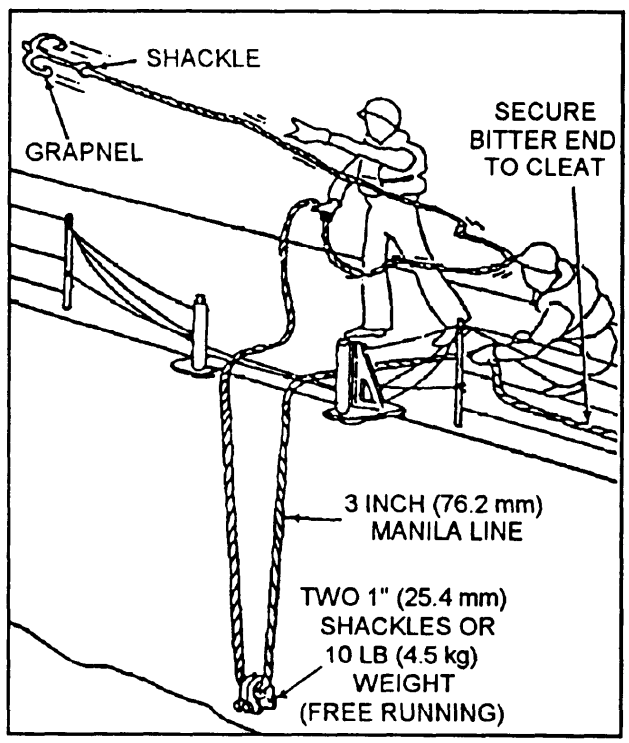


Figure 10-26.—Heaving the grapnel line.

CAUTION

Do not bring the float assembly inboard of the rail.

With the messenger and float assembly firmly in hand, disconnect the messenger from the float and connect it to the reeving line with three turns of 21 thread. The ship then increases speed about five turns and slowly moves up on station. As it moves up, slack is heaved in on the reeving line at the receiving station to bring the messenger aboard.

Haul in on the messenger until a safe working bight of the manila can be reeved in the messenger fairlead block. Disconnect the messenger from the reeving line. Haul the messenger through the fairlead block while your ship continues to approach the streamed hose end fitting. Belay the messenger to a cleat when it is close-up in the fairlead block.

Pass the bitter end of the easing-out line through the pear-shaped link that connects the messenger to the conical cap. Remove any slack from the easing-out line and belay it to a cleat (fig. 10-27). Secure the hogging-in line around the hose, and use it to haul the hose in as it is brought aboard by the inhaul line. Engage the hook on the inhaul line with the most outboard hose bridle link that can be safely reached. Haul the bridle in until the inhaul line is close-up in its fairlead block. Belay the free end of the inhaul line to a cleat.

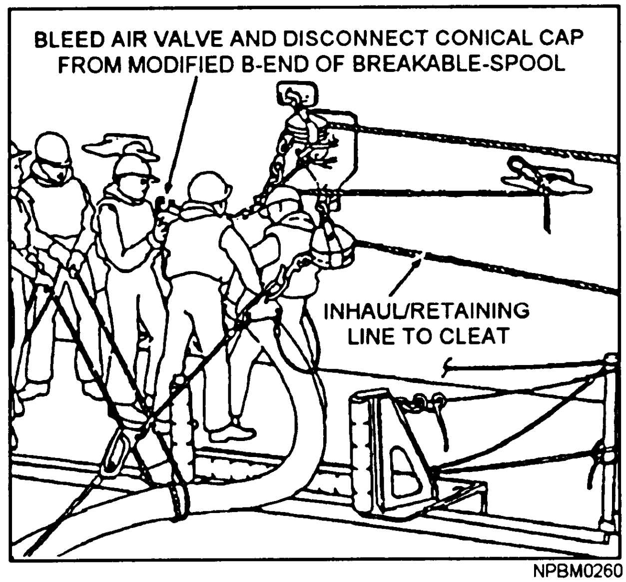


Figure 10-28.—Disconnecting the conical cap.

Use a socket wrench with a 1 1/2-inch socket to open the air valve in the conical cap and bleed off the air from the hose, then close the valve (fig. 10-28). Make sure the inhaul line is securely engaged to the flounder plate and that the hogging-in-line handlers have the hose tending toward the riser. You disconnect the conical cap from the B-end of the breakable-spool coupling by unscrewing the three drop-bolt nuts located on the modified breakable-spool coupling.

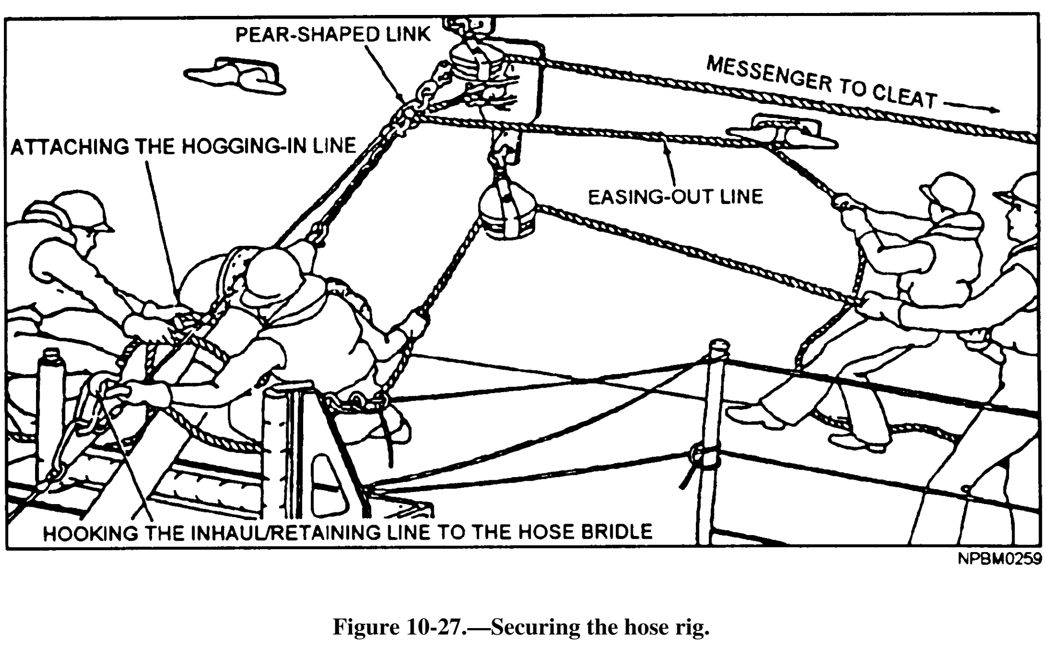


Figure 10-27.—Securing the hose rig.

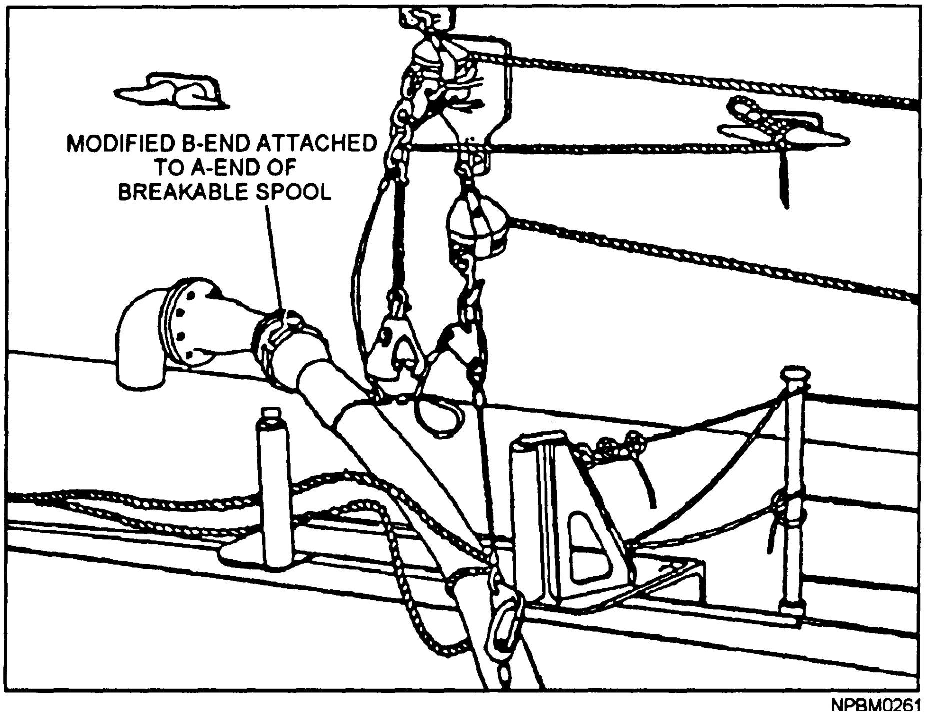


Figure 10-29.—Receiving station rigged for fuel transfer.

Manually position the hose so that the drop-bolts on the modified B-end of the coupling will line up with the corresponding lugs in the A-end of the coupling, fixed to the fuel riser, and join the two ends together as in figure 10-29.

> **CAUTION**
>
> **Because of the inherent danger of fuel loss caused by damage to the hose or fitting, it is essential to detect losses as soon as possible. A visual observation of the hose rig during daylight should reveal any leakage; however, during night fueling, the delivery ship should report immediately if a sudden pressure drop indicates a faulty hose rig.**

Make sure all valves in the fuel receiving system are correctly positioned. Signal the delivery ship to commence pumping by displaying a green flag during daylight or a green wand at night. The delivery ship will signal you with a green signal when pumping has started.

With the end of the messenger (with the conical cap) secured in the fairlead block, rig the remaining line in preparation for breakaway operations. Pass the line outboard, and stop it off with small stuff in long bights with the link for the float connection leading aft. Walk the hose float assembly aft to a location suitable for breakaway operations. Reconnect the messenger link with the float assembly swivel hook. Rig the messenger float over the side, below deck level, ready for immediate water entry as part of the breakaway operations, as shown in figure 10-30. On the receiving station, remove the bight of the messenger from the fairlead block, and position the conical cap to permit rapid connection before breakaway.

DISENGAGING THE RIG

When you are within about 500 gallons of the fuel required to complete transfer, signal the delivery ship to cease pumping. The delivery ship will signal when pumping has stopped. Upon receipt of stopped pumping from the delivery ship, signal them to start a blowdown. The blowdown is normally completed in 5 to 10 minutes, but should last until you signal the delivery ship to stop blowdown. When the delivery ship signals that blowdown has stopped, close the fuel riser valve and disconnect the A-end and the B-end of the breakable-spool coupling.

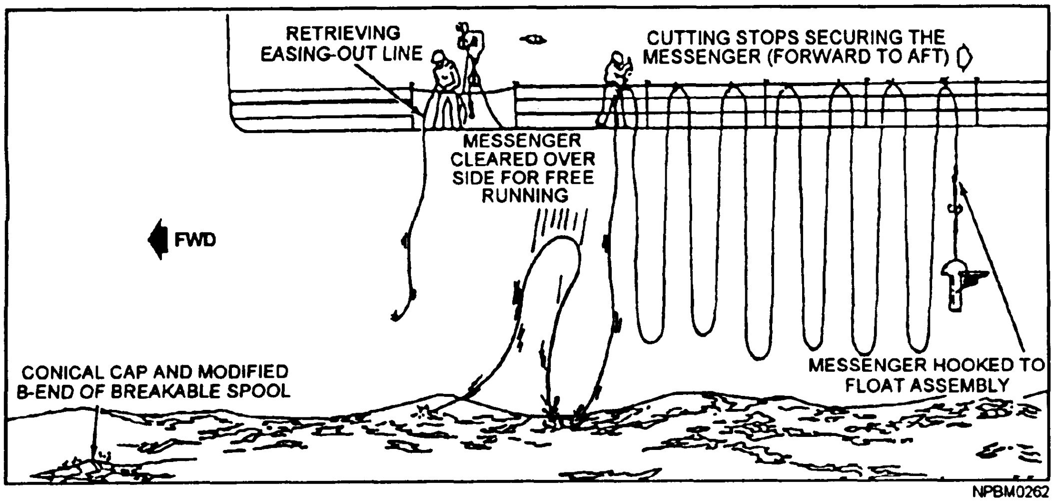


Figure 10-30.—Hose messenger rigged for disengaging.

Position the hose and reconnect the conical cap to the B-end of the breakable-spool coupling, disconnect the hogging-in line from the hose, and ease the hose slack over the side. Gradually slack off on the inhaul line; while your easing-out line accepts the load, remove the hook from the bridle (flounder plate) link. The easing-out line is now holding the hose rig load. Make sure the messenger line is slack enough to permit the conical cap and hose to ride free of the ship's side when the easing-out line is released. Surge the easing-out line until the hose and breakable-spool are clear of the ship's side.

The receiving ship gradually reduces speed to reduce the bight of hose in the towed rig. When you have the hose tending forward, ease the hose over the side; when the coupling enters the water, allow the bitter end of the easing-out line to run free. To prevent the easing-out line from fouling the rig, haul it back aboard. Cut the small-stuff stops you have securing the bights of the messenger, and allow the messenger and hose to be pulled away from the ship's side. To reduce the chance of fouling the messenger in the ship's screws or rudder, cut the stops from the hose end to the float assembly. The hose and messenger are veered as the receiving ship drops astern and clear of the rig.

See figure 10-31 for details of the float assembly, hose rig messenger, and hose bridle assembly.

ASTERN FUELING HOSE CLEANOUT

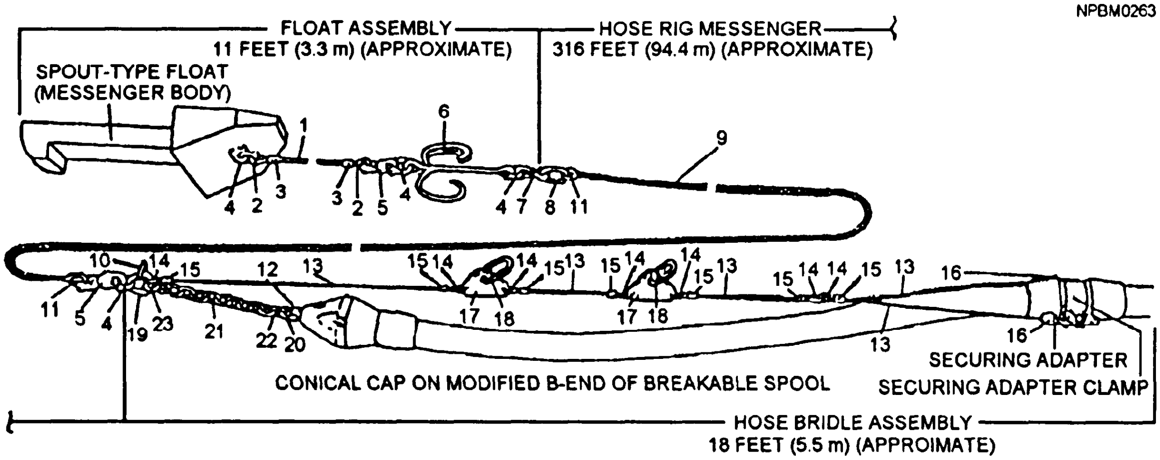
A pigging system developed for cleanout of the astern fueling hose can be used in place of the blowdown. The system consists of a polyethylene pig, launching and receiving stations, associated hardware, and air supplied from the delivery ship's service air system.

Pigging of the astern fueling hose commences after fueling has been completed and the receiving ship has signaled to commence blowdown. The pig is manually inserted into the hose on the delivery ship, and a controlled quantity of air is admitted into the hose to force the pig through the hose. This forces the fuel ahead of it from the hose and into the fuel tanks of the receiving ship. The pig is prevented from entering the fuel tanks by a strainer-like pig receiver mounted in the breakable-spool coupling at the end of the hose.

REPLENISHMENT AT SEA

LEARNING OBJECTIVES: Discuss five general principles for loading ships for delivering supplies to the fleet at sea. Identify the different types of replenishment at sea rigs. State five general guidelines to follow when transferring personnel at sea. Identify the safeguards to be followed when transferring classified material, controlled substances, and mail.

Replenishing ships may be loaded with cargo intended for delivery to a base or a replenishment group, in which case they are said to be base loaded; or they may carry cargo intended for delivery to the fleet at sea, in which case they are fleet-issue loaded. The one we are concerned with is the fleet-issue-loaded vessel, which carries a varied cargo stowed for quick and easy handling at sea.



1. **9/16" (14.2 mm) Dia Wire Rope 6 × 37**
2. **Thimble - for 9/16" (14.2 mm) Wire Rope**
3. **Wire Rope Clamp for 9/16" (14.2 mm) Dia Wire Rope**
4. **Shackle - 5/8" (15.8 mm) Anchor Safety**
5. **Jaw End Swivel 3/4" (19.0 mm) Size**
6. **Grapnel**
7. **Swivel Hook - 3 Ton (2,721 kg)**
8. **Link**
9. **310´ (94.4 m) Messenger - 1" (25.4 mm) Double Braided Nylon Rope**
10. **Link - 1" (25.4 mm) Dia Rod**
11. **Thimble for 3/4" (19.0 mm) Dia Wire Rope**
12. **Swivel**
13. **1/2" (12.7 mm) Dia Wire Rope 6 × 37**
14. **Thimble - for 1/2" (12.7 mm) Wire Rope**
15. **Wire Rope Clamp for 1/2" (12.7 mm) Dia Wire Rope**
16. **Wire Rope Socket - for 1/2" (12.7 mm) Dia Wire Rope**
17. **Flounder Plate - 1/2" (12.7 mm) thick**
18. **Securing Link - 5/8" (15.8 mm) Dia Rod**
19. **Pear-shaped Link - 1" (25.4 mm) Dia Rod**
20. **Shackle - 1/2" (12.7 mm) Anchor Safety**
21. **1/2" (12.7mm) Chain - Type 1**
22. **1/2" (12.7 mm) Rivet Link**
23. **5/8 (15.8 mm) Pear-shaped Rivet Link**

Figure 10-31.—Float assembly, hose messenger, and hose bridle assembly details.

What a delivering ship will carry is determined in one of several ways: for example, by requisitions on hand prior to loading, or by anticipated fleet requirements.

Fleet-issue-loaded ships are not loaded to capacity, but are loaded for mobility. Much cargo space has to be sacrificed to provide passageways throughout the stacks of cargo because each item must be constantly accessible.

Five general principles guide the loading of ships delivering supplies to the fleet at sea. They are as follows:

- Accomplish the overall objective in fleet-issue loading, which is to ensure efficiency in unloading.
- Regardless of the number of transfer stations to be used during unloading, stow portions of the same kind of cargo (where practical) in various holds so that they can be broken out simultaneously near as many stations as possible.
- Provide adequate passageways and working areas in and among the cargo to permit quick segregation, checking, and independent handling of different types of goods. Load so that provisions can be readily reshored to reduce the hazard to personnel from shifting cargo.
- Place bulky and heavy items near loading areas and in the holds that can accommodate their disposal most easily. Consider the hatch opening, the height of the hold, and the fact that certain types of receiving ships can take on bulky items only at certain stations.
- Replenish at the highest practicable tonnage rate per hour and in the shortest practicable time consistent with safety.

You can use various methods to transfer provisions and stores between delivering and receiving ships. Each has its advantages and disadvantages in relation to the size, structure, and rigging potential of the ships involved. Select the method to be used for a particular replenishment operation on the basis of the following:

- Type and quantity of cargo to be transferred
- Capacity of the rig and associated fitting
- Weight and size of the heaviest or largest load
- Type and location of the receiving station

Conventional nontensioned methods of cargo transfer and their load capacities are found in NWP 14 (Series).

Note that the capacities in tables and illustrations as shown in this book and NWP 14 are for the best of conditions. Therefore, you should not operate any rig at full capacity when the weather is bad or your gear is not in perfect condition.

SYNTHETIC HIGHLINES

Synthetic highlines are used to exchange personnel, light fleet freight, and mail during scheduled replenishments or as an independent operation.

WARNING

The maximum safe load for transfer by synthetic highline is 600 pounds.

A synthetic highline rigged for personnel transfer is shown in figure 10-32.

HIGHLINE

For personnel transfer, use double-braided, polyester line, 4 inches in circumference and at least 350 feet long. A synthetic (newco type) thimble of appropriate size is spliced in the delivery end of the highline with a 1-inch, grade-A, safety anchor shackle. Use this shackle to secure the highline to the receiving ship's attachment point.

NOTE

Use only this double-braided polyester line (MIL-R-24536) to transfer personnel by highline.

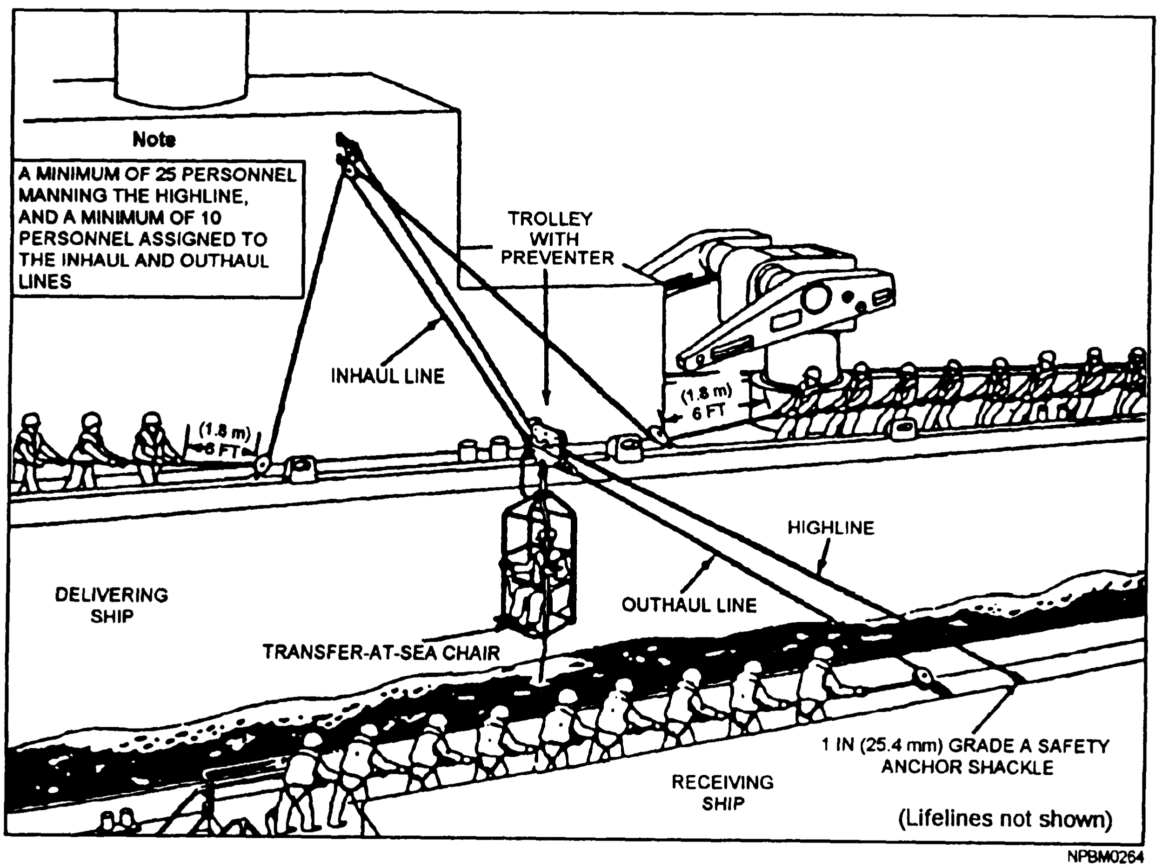


Figure 10-32.—Personnel transfer by synthetic highline.

INHAUL

The inhaul is 3-inch, plaited, polyester line (MIL-R-24537), at least 350 feet long. A 7/8-inch or 3/4-inch safety anchor shackle is dipped through the eye splice on the end for connecting to the trolley block.

OUTHAUL/MESSENGER

The outhaul is the star messenger that is used for refueling inhaul/outhaul line.

TRANSFER CHAIR AND LITTER FRAME

Information in NWP 14 shows how to set up and prepare the transfer at sea chair. A 1/2-inch wire preventer, 2 feet in length, is used for safety. Connect one end of the preventer to the inhaul shackle and the other end to the transfer chair or litter protective frame. Secure both ends with 5/8-inch safety anchor shackles. The wire preventer will make sure that the transfer chair or litter protective frame is not lost if the primary attachment fails.

WARNING

The litter protective frame with flotation gear attached must be connected to the trolley block; the preventer must be rigged, and the trolley flotation bag attached. Once these steps have been completed, bring the stretcher under the trolley block and attach it to the litter protective frame, using four flat iron shackles.

PREPARING FOR TRANSFER

The ship that provides the highline is responsible for the condition of the equipment and fittings. The highline must be thoroughly inspected before each transfer.

The receiving ship must notify the delivery ship when it is ready to receive personnel.

PERSONNEL REQUIREMENTS

The ship that provides the highline must assign a **minimum** of 25 personnel to the highline and a **minimum** of 10 personnel to the inhaul; the receiving ship must assign a **minimum** of 10 personnel to the outhaul. Additional personnel **must** be standing by and ready to assist under adverse conditions or an emergency.

Assign escorts to greet arrivals and brief personnel who are being transferred. This small service will speed movements to and from your landing area.

TRANSFER PROCEDURES

The common procedures and equipment described previously in this chapter apply to transfers by synthetic highline.

Rigging the delivery ship. Rig the transfer station on the delivery ship according to the ship's plan. The delivery station does the following:

- Reeves the highline through the trolley. (This is accomplished by removing one hinge bolt.)
- Attaches the inhaul and outhaul/messenger to the trolley block. Use 7/8-inch or 3/4-inch safety anchor shackles.
- Reeves the highline and inhaul through fairlead blocks.
- Stops off the highline to the outhaul/messenger.
- Attaches the station phone line and the lead line messenger for the phone/distance line to the outhaul/messenger.
- Fakes down all lines, free for running, and forward of the rig, if possible.
- Ensures that at **minimum** 25 personnel are assigned to the highline and at **minimum** 10 personnel to the inhaul.

Rigging the receiving ship. Rig the transfer station on the receiving ship according to the ship's plan. A padeye for the highline and a fairlead block for the overhaul are required. Once the highline is shackled to the attachment point and the stops are removed, the messenger becomes the outhaul.

A ship with a pendant receiving station must remove the pelican hook at the deck padeye and substitute a sufficient number of l-inch or larger shackles.

The receiving ship must assign at **minimum** 10 personnel for tending the outhaul.

When the highline comes aboard, the receiving station shackles the l-inch safety anchor shackle on the end of the highline to the attachment point, removes the stops, reeves the outhaul through the fairlead block, and tends the outhaul. The delivery station tends the highline and inhaul. Before attachment of the highline to the padeye, remove all twists of the messenger/outhaul from around the highline.

NOTE

Hand-tend all lines; power must NOT be used for transfer of personnel. Position line tenders inboard of the line and have them stay 6 feet or more away from fairlead blocks.

UNRIGGING PROCEDURES

When the transfer operation is completed, the rig is returned in the following manner:

1. Return the trolley to the delivery station.
2. Have the delivery station slack the highline.
3. Have the receiving station slack the outhaul and restop it to the highline.
4. Have the receiving station disconnect the highline and stop it off to the outhaul/messenger.
5. Have the delivery station retrieve the outhaul/messenger, highline, and station phone line.
6. Have the receiving station retrieve the phone/distance line.

SAFETY PROCEDURES

The primary consideration during transfer of personnel is the safety of personnel. The following is a general safety guideline to follow in personnel transfers at sea:

- Have anyone who is being transferred wear an orange-colored, inherently buoyant, life jacket; have in possession a one-cell, white, watertight flashlight, or a chemical light; a whistle; and wear a safety helmet with a chin strap.
- When the temperature of the water is 45°F (7°C) or below, have personnel who are being transferred wear immersion suits.
- Instruct personnel on how to unhook the quick-release belt and get out of the chair, in case the rig fails and the chair falls into the water.
- When possible, a lifeguard ship should be stationed astern of ships making personnel transfers. When no lifeguard ship or helicopter is available, each ship must have a lifeboat and crew ready in all respects for rescue operations.
- Before personnel are transferred, any other rig at the transfer station must be disconnected.

WARNING

Only in an emergency should personnel transfers be conducted at night or during heavy weather.

TRANSFER OF LIGHT FLEET FREIGHT AND MAIL

You can transfer light fleet freight, mail, medical supplies, movies, and similar materials by synthetic highline, light line, helicopter, a STREAM, or a nontensioned rig. VERTREP is an ideal means for underway transfer of light fleet freight, nonregistered mail, and movies. Use the procedures covered in this chapter.

Transfer light fleet freight and mail by synthetic highline taken to power, after the receiving station's highline padeye is static tested for a minimum load of 30,000 pounds (13,608 kg). When the highline padeye's test load is below the minimum, have the highline hand-tended.

NOTE

During transfer of mail at night, attach a cluster of at least three chemical lights or a cluster of at least three one-cell, white, watertight flashlights to the bag.

CLASSIFIED MATERIAL AND CONTROLLED SUBSTANCES

Classified material, registered United States mail, narcotics, alcohol, and drugs must be properly safeguarded when being transferred.

- Obtain a weighted bag from the CMS custodian. The weighted bag will sink if it is lost from the rig.
- Attach the weighted bag to a self-mousing cargo hook.
- Attach a wire preventer to the bag's straps, to preclude loss of the bag.

- Secure a seizing line to the opening of the bag to prevent inadvertent loss of the contents during transfer.

REGULAR UNITED STATES MAIL AND MOVIES

Transfer these items in a flotation bag to prevent them from sinking. Attach a wire preventer and seizing line to them as described above.

BURTON METHOD

Essential elements of the burton rig are two winches and two whips, one each in each ship. The outer ends of the whips are shackled to a triple-swivel cargo hook, and the load is transferred by one ship paying out on its whip while the other ship heaves in on its whip. A single burton can transfer loads up to 6,000 pounds. The burton method will not be covered in this book, but it is covered in NWP 14 (Series) in detail.

HOUSEFALL METHODS

Housefall methods of transferring differ from burton methods in that all sources of power are located on the delivering ship. Like burton methods, however, rigging can be done in several ways. This area will not be covered in this book but also can be found in NWP 14 (Series) in full detail.

MODIFIED HOUSEFALL METHOD

When it is necessary to keep the loads higher above the water than is possible with the ordinary housefall rig. The rigging is the same as for the ordinary housefall except that a trolley block is added and the suspension points for the transfer whips must be kept close together. As you can see, the trolley block rides on the outboard transfer whip. For further information see NWP 14 (Series).

STREAM RIGS

As you continue your study of STREAM, you will find that there are several STREAM rigs that can be used, depending on the product being transferred. Attachment points and STREAM equipment are available in both the delivering ship and the receiving ship.

The primary STREAM rigs in order of preference are as follows:

1. STREAM with all-tensioned lines
   a. STAR (preferred for nonsliding-padeye stations)
   b. Traveling SURF
2. STREAM with burton-whip outhaul
3. STREAM with hand-tended outhaul

RIG CAPACITIES

Load capacities for transfer rigs are given in NWP 14 (Series). These load limitations must be observed rigidly. However, in adverse weather conditions, these limitations should be decreased. Care must be taken to make sure that transfer loads and static test loads at hookup points are compatible.

DELIVERING SHIP STREAM EQUIPMENT

Most of the STREAM equipment is installed aboard the delivering ship. Figure 10-33 shows a typical missile/cargo STREAM delivering rig. The winch and ram tensioner apply pressure to the highline, which supports the trolley block. The trolley block is moved between ships by varying the tension on the inhaul and outhaul lines, which are on a separate winch.

A diagram showing the highline rigging from the highline winch to the ram tensioner to the transfer head is shown in figure 10-34.

The STREAM transfer station is made up of the following major components:

- King post (called M-frame in some ships), which has a track for the sliding block.
- Sliding block, which is driven up and down on the track inside the king post and carries the transfer head.
- STREAM transfer head, which carries the load up and down on the king post.

The transfer head carries the sheaves system for the highline and the inhaul wire. The outhaul block is usually mounted on the king post (or M-frame).

WINCHES

The STREAM system requires at each station three winches of two different types. Highline winches operate in a single control mode called speed control. When the control handle is moved to the payout

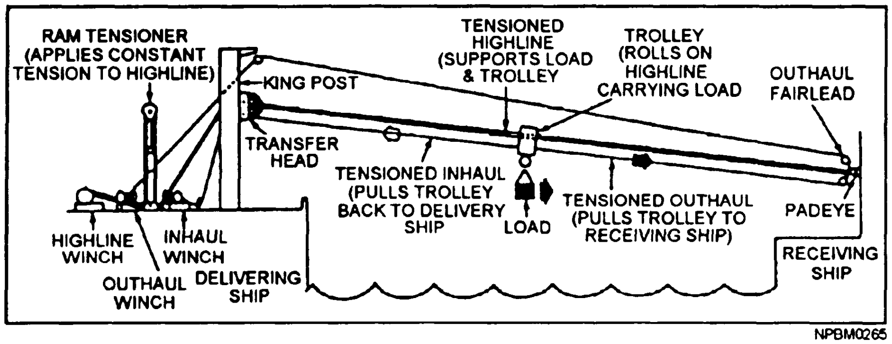


Figure 10-33.—Missile/cargo STREAM rig (all tensioned wires).

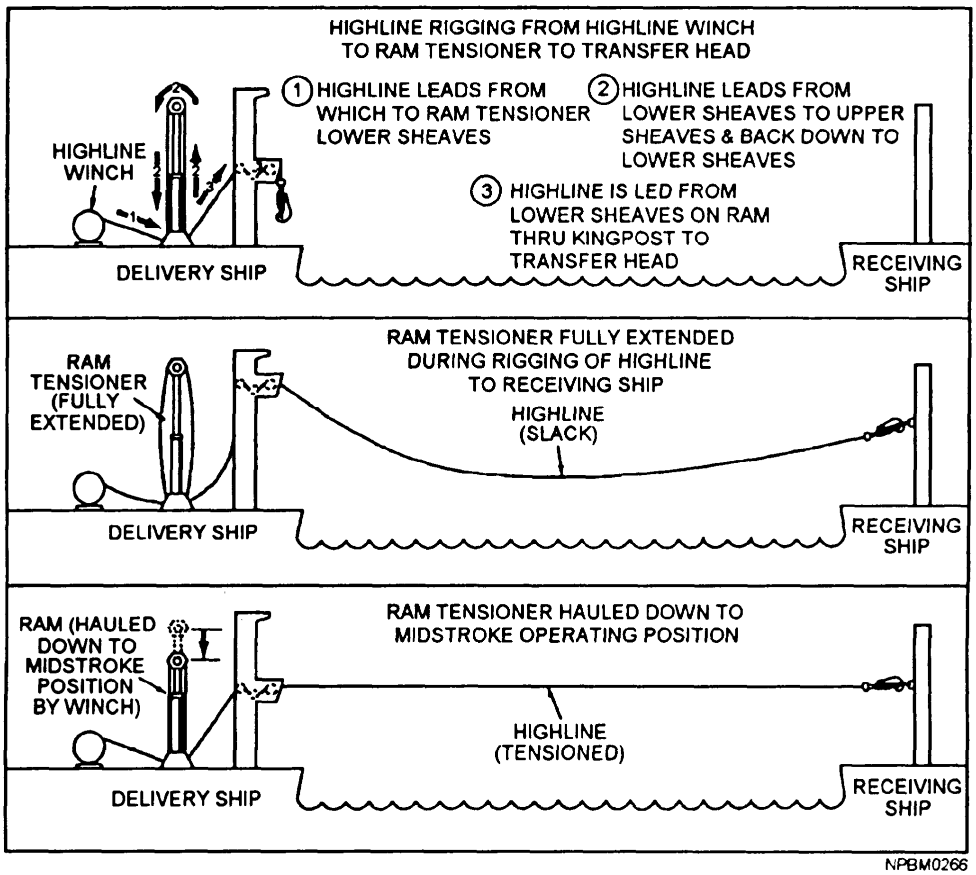


Figure 10-34.—Ram tensioner operation.

position, the winch pays out the highline. When it is moved to the haul-in position, the winch hauls in the highline. When the handle is centered, the winch brake sets, and all movement of the highline stops, regardless of how much pull may be on the wire. The highline winch, in conjunction with the ram tensioner, maintains a tension on the highline.

Each STREAM station is equipped with two electrohydraulic hauling winches—the inhaul winch and the outhaul winch. These winches can be operated in two control modes—speed control and tension control. In the speed control mode, the winch holds, pays out, or hauls in, in direct response to the position of the winch control handle. Speed control is used during rigging of STREAM rigs or during rigging and operation of untensioned rigs. Switching the winch to the tension control mode activates a tension-sensing mechanism in the winch, which causes the winch to heave in until the proper tension is reached on the whip, about 1,000 pounds; switching the other winch to the tension control mode does the same thing. So each winch is pulling the trolley in an opposite direction with about 1,000 pounds of pull. As long as the pull is equal, the trolley will remain stationary. When one of the winch control handles is moved toward the maximum tension position, it causes the winch to increase tension, and the winch hauls in. At the same time the other winch senses the increased tension so, to return the whip to its proper tension, it starts paying out. This moves the trolley in the direction of the winch applying the most tension. See figure 10-35. STREAM with all tensioned whips provides positive control of the trolley, and, at the same time, compensates for the ship's rolling motion to prevent tight lining or overstressing the whips. Since the inhaul and outhaul winches will immediately haul in to put 1,000 pounds (453.5 kg) of tension on wire ropes when the winches are put in tension control, the inhaul and outhaul bitter ends must always be properly secured, and personnel must be clear of lines before switching winches to tension control.

No attempt will be made here to explain the below-deck handling components on the delivering or receiving ship. This equipment is usually operated by personnel other than BMs.

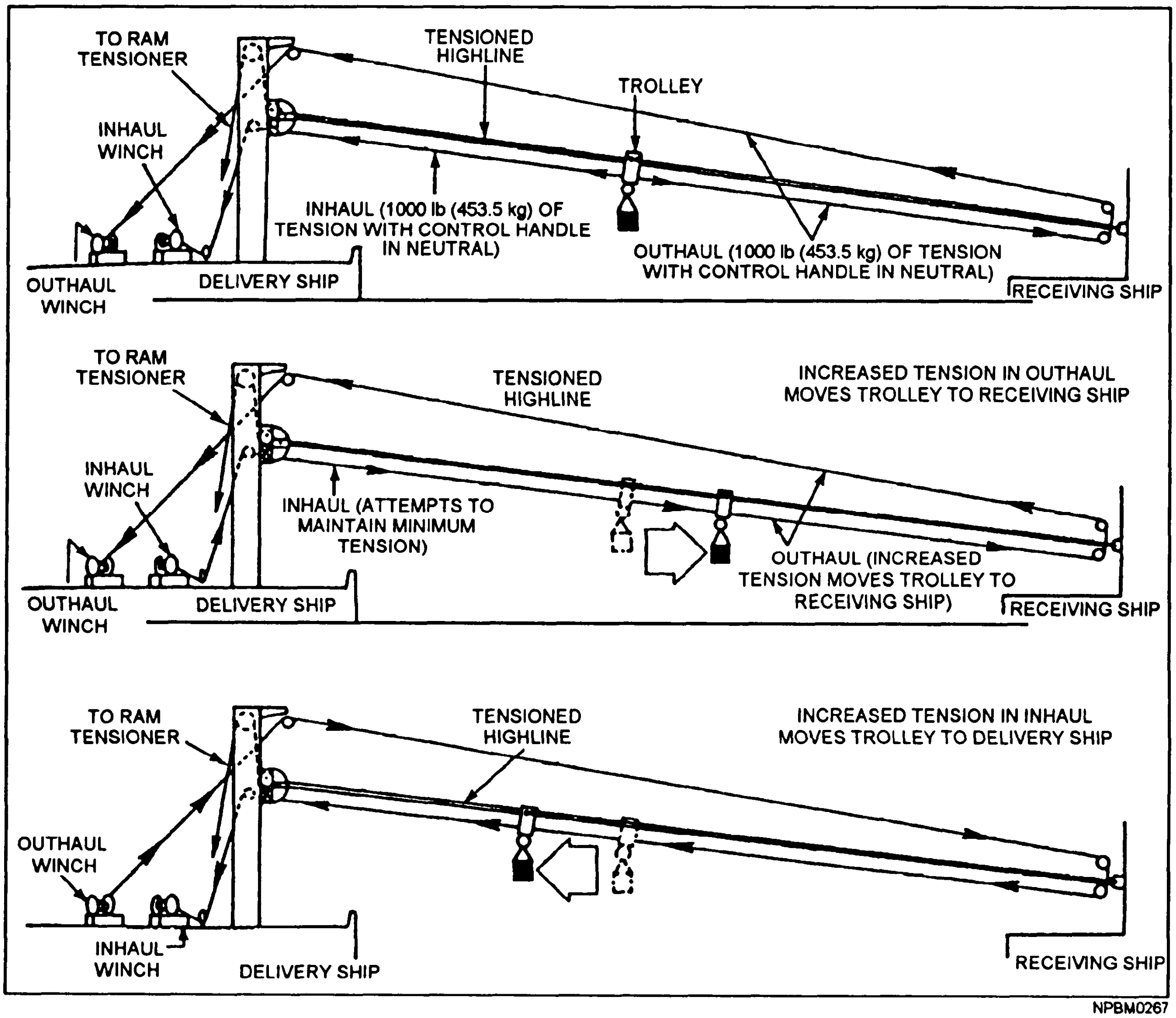


Figure 10-35.—Inhaul and outhaul rigged with winches in tension control.

RECEIVING SHIP STREAM EQUIPMENT

Receiving ships are equipped with one or more of four basic receiving stations.

- sliding-padeye
- fixed-padeye
- Pendant
- STREAM support leg (CV only)

Hardware for rigging the receiving ship's stations is listed in NWP 14 (Series).

Sliding-Padeye Receiving Station

The sliding-padeye is powered to move up and down in a guide track, which is mounted on the king post or a bulkhead. Portable types are stowed in trunks or in the overhead and moved, raised, or lowered to the operating position when needed.

The padeye is lowered to a point near the deck for rigging. When operating the rig, raise the padeye to the top of the trackway when receiving loads, and then move it down to lower the load to the deck. This feature provides good load control. When the sliding-padeye is used, the cargo drop reel is not needed. Loads up to the full capacity of the rig can be sent to or returned from the sliding-padeye station. A receiving station sliding-padeye rigged with a traveling SURF is shown in figure 10-36.

Fixed-Padeye Receiving Station

Although the fixed-padeye arrangement varies from ship to ship, STREAM rigs require one padeye with a long link for connecting the 1 3/8-inch pelican hook on the highline. A second padeye is required for a fairlead block for the rigging messenger or outhaul (depending on the STREAM rig used). fixed-padeyes are permanently mounted on the bulkhead, king post, or outrigger above the load landing area. Figure 10-37 shows a typical fixed-padeye arrangement.

When using a receiving ship outhaul (hand-tended or winch-tended), have the fairlead padeye 6 to 18 inches below the highline padeye to give direct pull on the trolley.

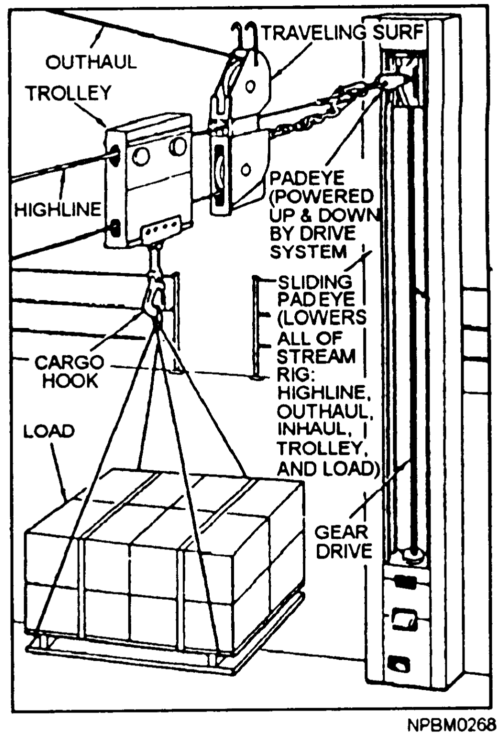


Figure 10-36.—sliding-padeye.

Use of a fixed-padeye keeps the highline at a single point above the load landing area. To lower the load, use a cargo drop reel. Although less desirable, tension/detension may be used to lower the load; that is, to slack the highline for lowering the load.

Pendant Receiving Station

STREAM rigs can also be sent to pendant receiving stations. See figure 10-38 for details. When rigging to a pendant receiving station, attach the 1 3/8-inch STREAM pelican hook on the highline to the outboard end of the pendant at deck level. After connecting the highline, raise the pendant to operating height and connect the pendant pelican hook to the deck padeye.

For lowering loads at a pendant receiving station, use a cargo drop reel, which is the preferred method. Tension/detension can also be used.

STREAM Support Leg

When a rig is received by a carrier, it may be rigged to a STREAM support leg. This rig may be rigged the same as a pendant station, or it may be rigged with a

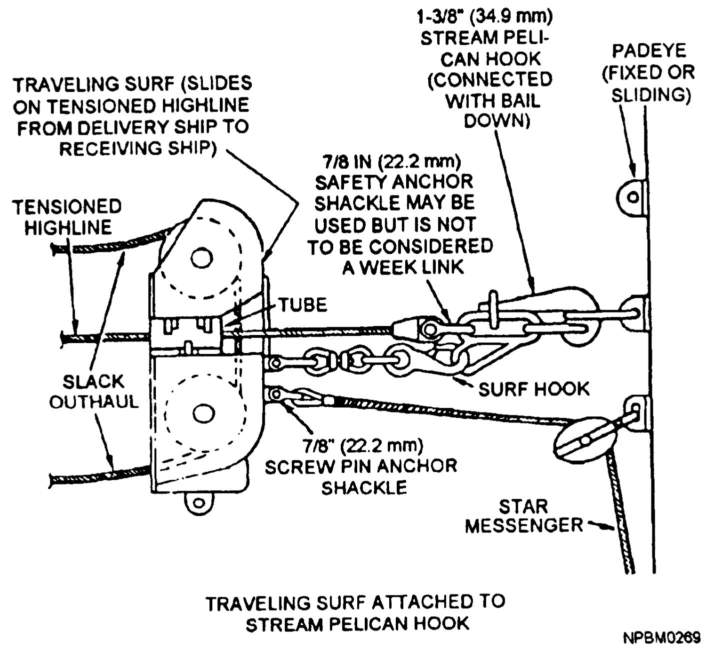


Figure 10-37.—Traveling surf hooked up to a fixed-padeye.

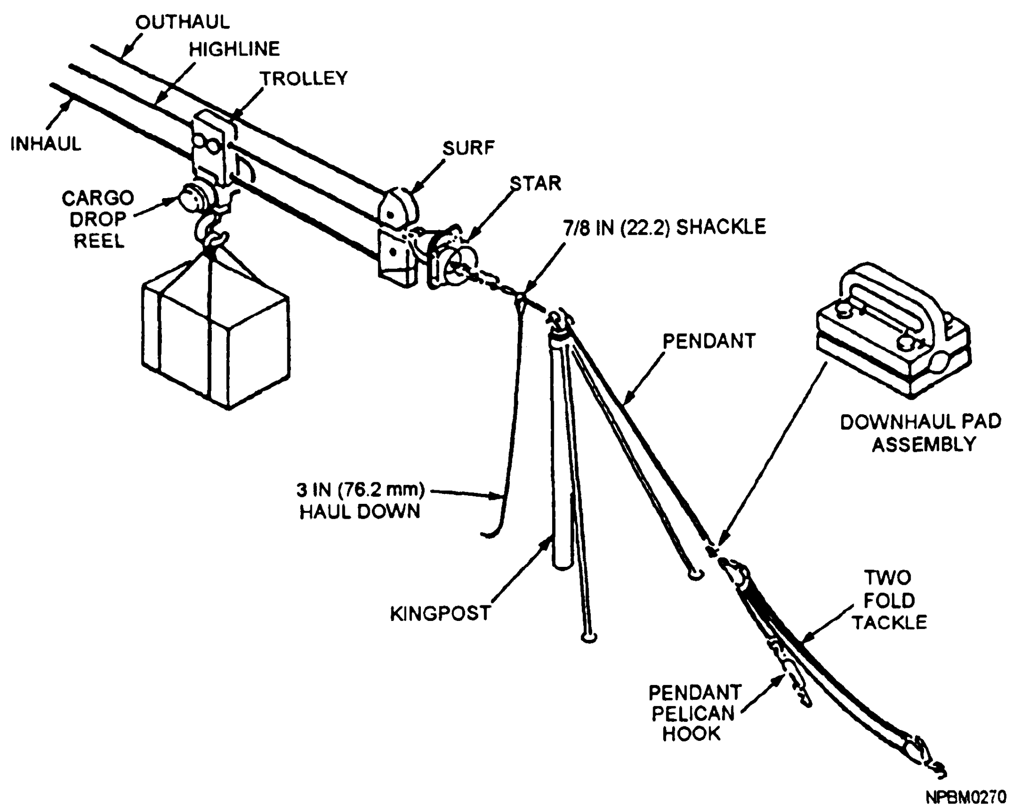


Figure 10-38.—Pendant-receiving station (typical)—shown with STREAM with STAR.

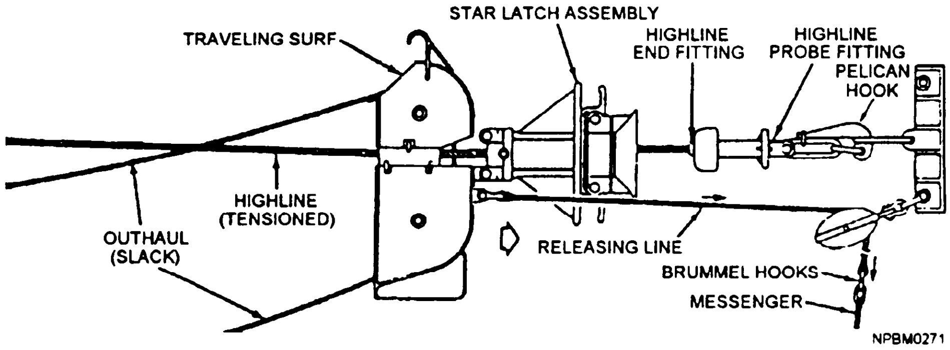


Figure 10-39.—STREAM with messenger-rigged STAR hauled into receiving station.

STREAM with messenger-rigged STAR, as shown in figure 10-39. STAR will be explained later in this chapter.

THE CARGO DROP REEL

The cargo drop reel (CDR), shown in figure 10-40, is a device that lowers the load from the tensioned highline, allowing the STREAM rigs to be used by ships having only fixed-padeyes, a pendant station, or support legs. Although the CDR does not provide the same degree of load control as the sliding-padeye, it does allow the load to be lowered under the control of the receiving ship.

The CDR is provided by the delivering ship and is attached to the STREAM trolley.

HANDLING EQUIPMENT AND PROCEDURES

Cargoes of different types have different procedures for safe and expeditious handling. We will not attempt to explain the many different types here, but will mention a few pertaining to ammunition and missile transfer. The use and limitations of such equipment are detailed in NAVORD OP 2173, *Approved Handling Equipment for Weapons and Explosives.* All personnel involved in working with the equipment should be familiar with the contents of this publication.

Conventional ammunition and missile components are normally transferred on pallets. Palletized munitions require special slings. NAVORD OD 44617, *Underway Replenishment Ordnance Handling Equipment and Transfer Units,* provides configuration data regarding palletized ordnance units authorized for transfer at sea.

Because of the heavy weight of ammunition and missiles, use the following equipment when you are transferring these items:

- Positive lock. This piece of equipment is used in conjunction with the CDR and is used to prevent accidental lowering of the load.
- Load stabilizer. This device is used in conjunction with the CDR. It prevents a long load, such as a missile in a Mk 6 dolly, from rotating on a hook and allows the load to be lowered to the receiving ship's deck safely. Steadying lifts are not required when a CDR is used.
- STREAM strongback. This equipment is used when missiles and components are delivered to a sliding-padeye, regardless of the type of containers used.

Missiles and missile components should be transferred simultaneously so that if the replenishment is interrupted, missiles already on board the combatant ship will be complete for operational purposes.

Personnel engaged in handling munitions must understand and comply with all safety precautions regarding the methods and equipment used for ammunition handling according to OPNAVINST 5100.19 (Series).

STREAM SYSTEM DESCRIPTION

LEARNING OBJECTIVES: Describe procedures for rigging a STREAM system using sliding-padeyes, fixed-padeyes, pendant receiving stations, and other STREAM delivery stations.

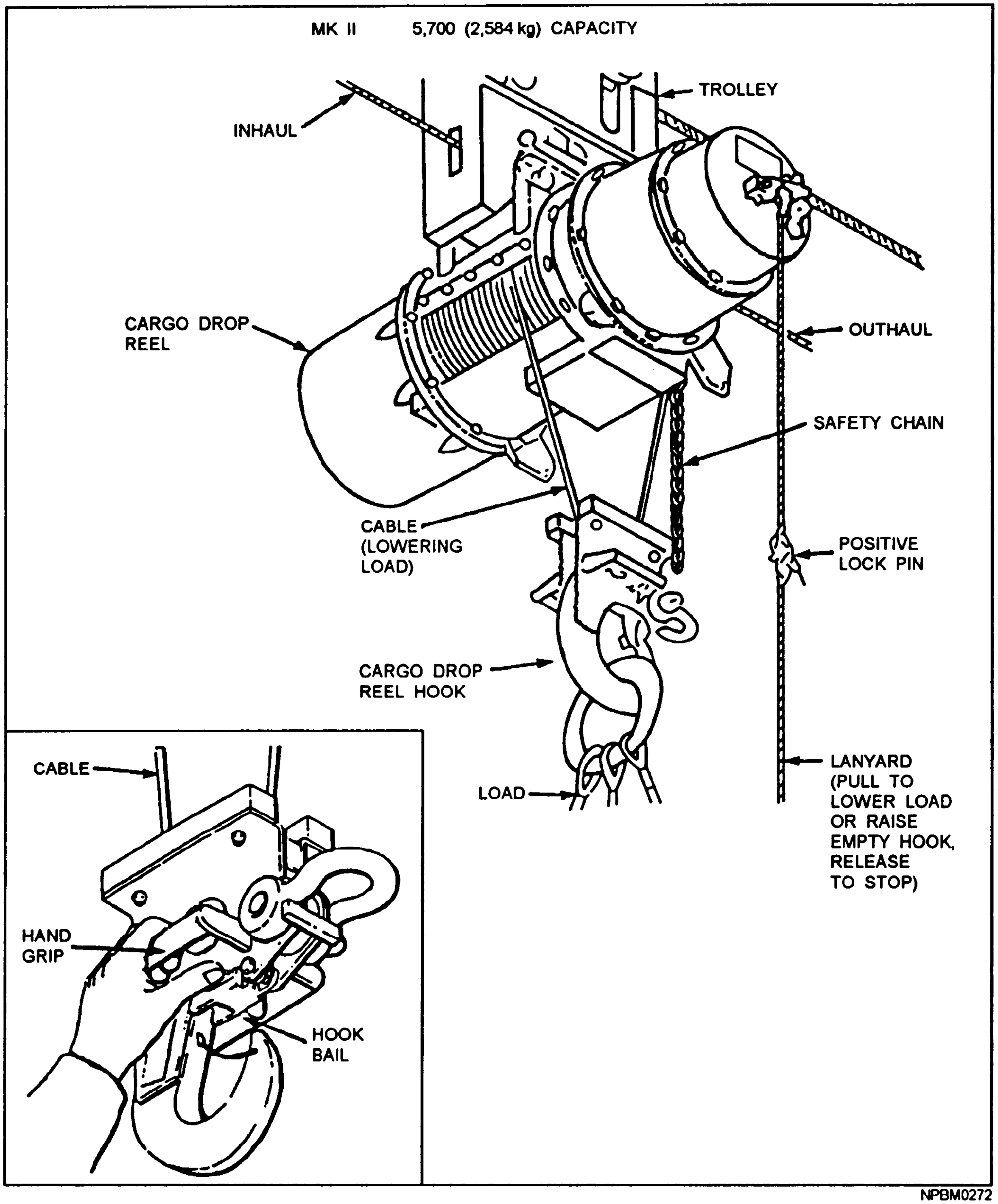


Figure 10-40.—Cargo drop reel.

All STREAM rigs use a tensioned highline to support the trolley and load. There are different rigging arrangements used for the inhaul and outhaul, and different methods used for lowering the load to the receiving ship deck. A general description of the different STREAM rigs, with rigging and steps of operation, follows.

The STREAM rigs described in this section can be rigged to a sliding-padeye, a fixed-padeye, pendant receiving stations, or to another STREAM delivery station. When delivering to a sliding-padeye or to another STREAM delivery station, attach a cargo hook to the trolley. When rigging to a fixed-padeye or pendant, attach a CDR to the trolley to lower the load to the receiving ship's deck. An alternate method that can be used for lowering or raising loads at the receiving station is tension/detension.

STREAM rigs in order of preference for various receiving stations are as follows:

1. STREAM with messenger-rigged STAR
2. STREAM with traveling SURF
3. STREAM with hand-tended outhaul

The STREAM with a burton-whip outhaul is a secondary rig that requires the receiving ship to have a burton whip available on station to receive the rig.

STREAM WITH MESSENGER-RIGGED STAR

STREAM with messenger-rigged STAR is an all-tensioned wire rig with the highline and the inhaul and outhaul lines being tended by winches in the delivering ship.

The highline with the STAR highline probe fitting and pelican hook attached is passed to the receiving ship by the STAR messenger. The pelican hook is secured to the receiving station, padeye, or pendant link. The STREAM pelican hook is replaced in this rig by a standard 1 3/8-inch pelican hook. The highline is tensioned by hauling in slack wire and compressing the ram tensioner. The traveling SURF, with the outhaul reeved through and the STAR latch assembly bolted on, is hauled along the tensioned highline to the receiving station. The STAR latch assembly slides over the highline probe fitting and the latches (inside the STAR latch assembly) engage the probe. The receiving ship slacks the messenger; the delivering ship tensions the outhaul; and the rig is ready for transfer. Details of the messenger are shown in figure 10-6. The highline is fitted with a poured, left-hand-threaded socket that screws into the highline end fitting. The highline end fitting is equipped with two set screws, which keep the end fitting from unscrewing. The rigging arrangement is shown in figure 10-41. Figure 10-42 illustrates STAR in the cocked and the uncocked positions. All of the

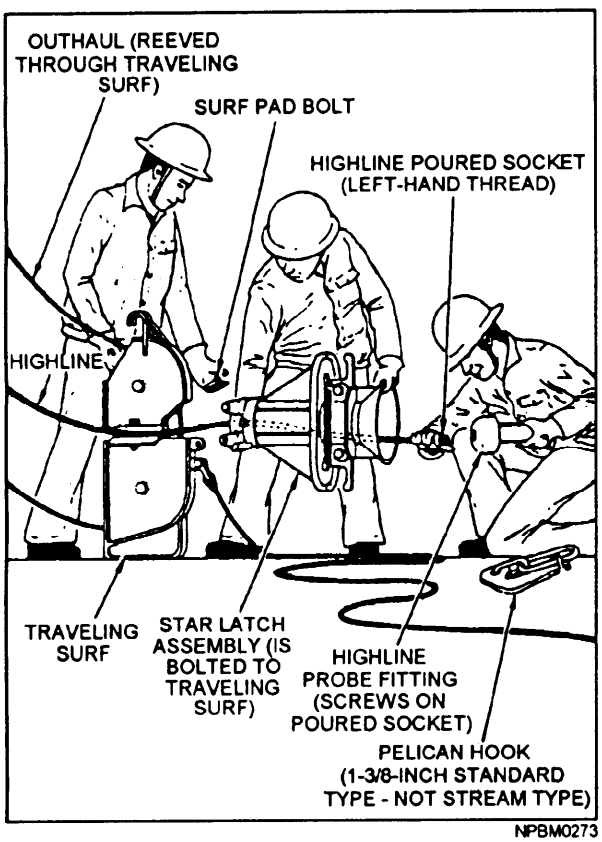


Figure **10-41.—Preparing messenger-rigged STAR on delivering ship.**

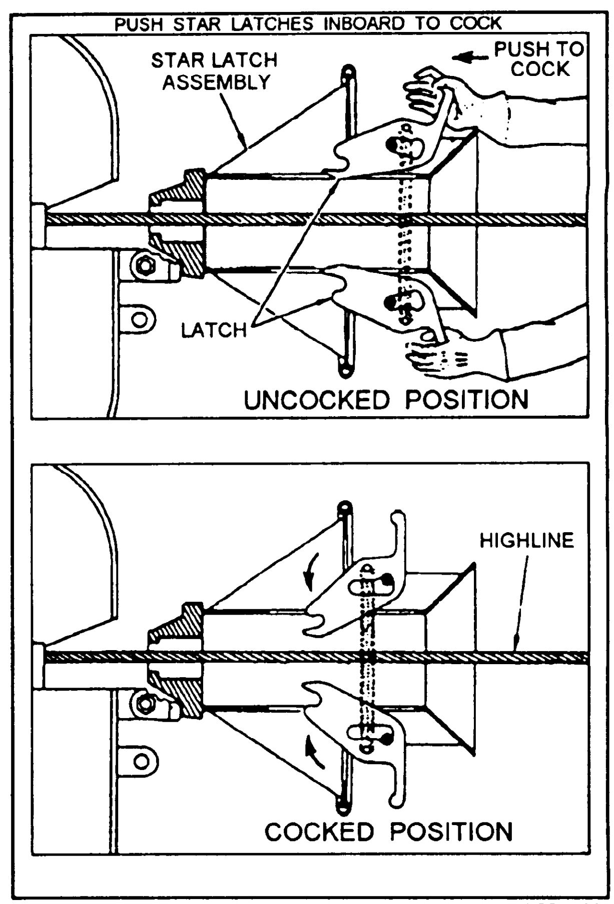


Figure 10-42.—How to cock STAR latches.

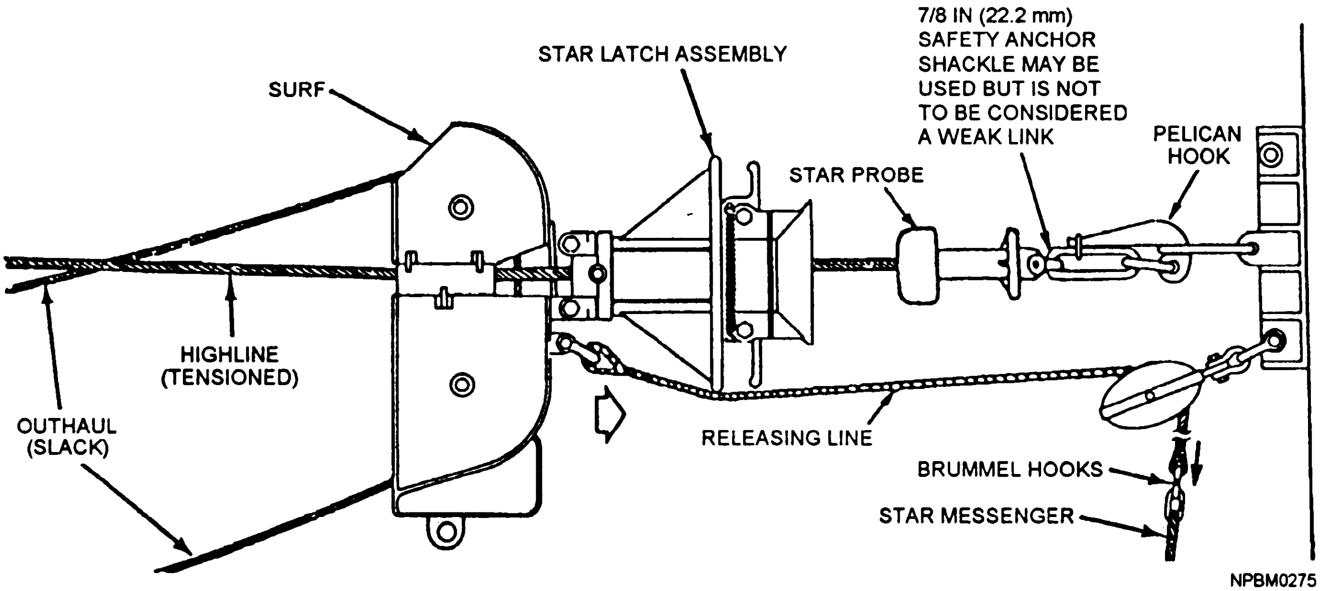


Figure 10-43.—STREAM with STAR—major assemblies.

major assemblies of the STREAM with messenger rigged STAR can be seen in figure 10-43.

PASSING THE RIG

The STAR rig is passed almost the same way as other connected rigs. When the highline has been connected and tensioned, the messenger is heaved in. The SURF is hauled in as the delivering ship slacks the outhaul wire. When the STAR latching assembly comes in contact with the probe head, the latches momentarily tilt open and then snap closed after they have passed the head of the probe. This indicates that the STAR rig is latched onto the probe. To unlatch the STAR latching assembly, a strain is taken on the messenger releasing line until the latches tilt open, indicating they are unlatched.

NOTE

Use STREAM with traveling SURF, vice the STAR latch assembly, when you are conducting transfers to and from aircraft carriers equipped with sliding-padeyes.

STREAM WITH TRAVELING SURF

STREAM with traveling SURF is an all-tensioned wire rig with highline, inhaul, and outhaul lines being tended by winches in the delivering ship. See figure 10-44.

The highline is passed by messenger to the receiving ship and is connected by a STREAM pelican hook to the receiving padeye link. The highline is tensioned by hauling in slack wire and compressing the ram tensioner. Traveling SURF, which provides a return fairlead for the outhaul, rides on the highline. After the highline is tensioned, the outhaul is payed out in speed control, and traveling SURF is hauled by messenger to the receiving ship and secured to the STREAM highline pelican hook. The outhaul is tensioned, and the rig is ready to operate. Figure 10-44 shows the hookup assembly of the STREAM with traveling SURF.

STREAM WITH HAND-TENDED OUTHAUL

The trolley and load are hauled to the receiving ship by using the messenger outhaul, with the receiving ship providing line handlers. The delivering ship pays out the inhaul winch in speed control while the load is being hauled across. The delivering ship raises the STREAM transfer head to the full-up position on the king post during transfer to reduce the force needed to haul the load.

STREAM with hand-tended outhaul can be rigged to a sliding-padeye, fixed-padeye, or pendant receiving station. For delivery to a sliding-padeye, a cargo hook is used. For delivery to a fixed-padeye or pendant receiving station, the CDR is used. The messenger used

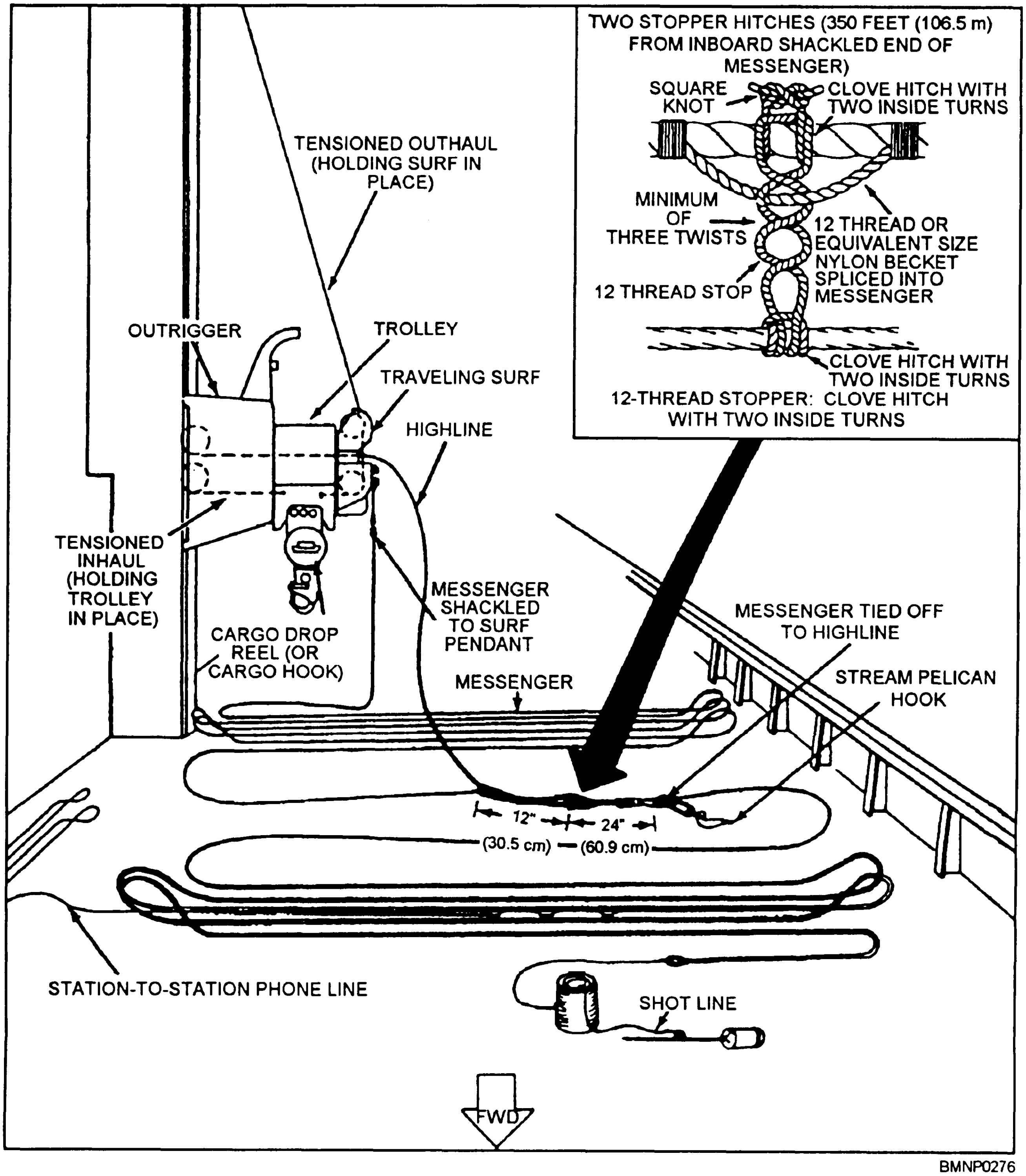


Figure 10-44.—Typical STREAM delivery station prepared for STREAM rig with traveling SURF.

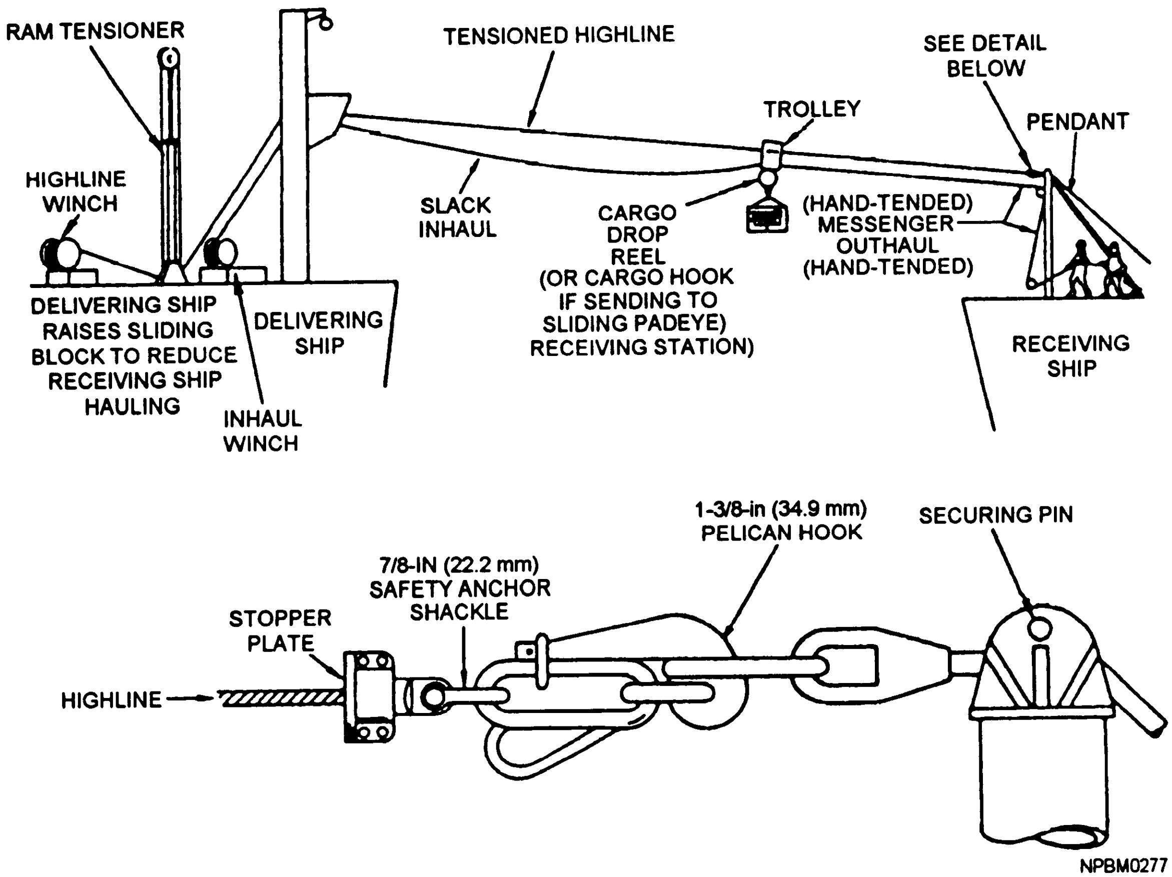


Figure 10-45.—STREAM with band-tended outhaul.

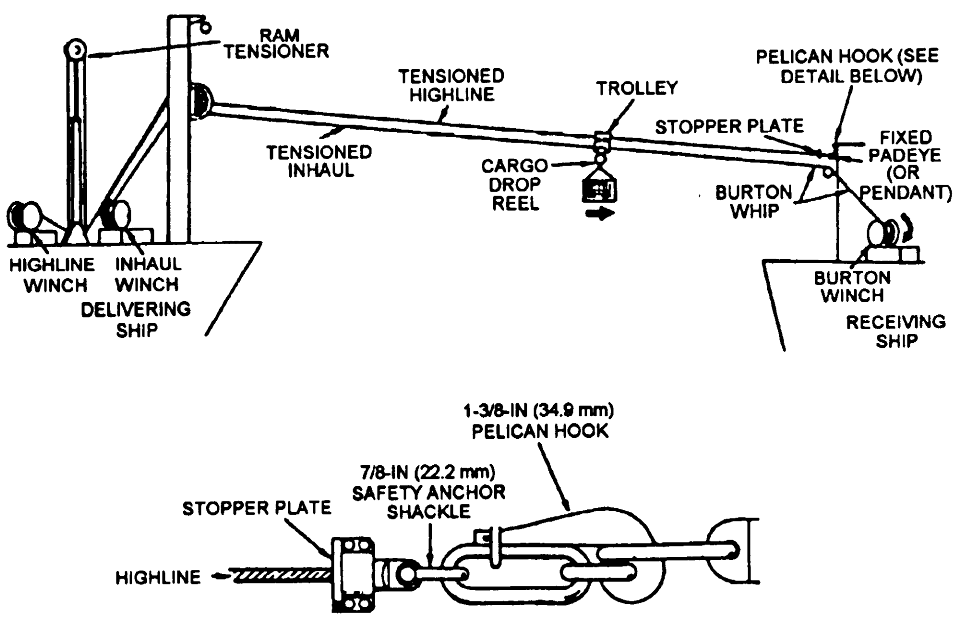


Figure 10-46.—STREAM with burton whip outhaul.

to haul the rig over is also used as the outhaul. For a description of the rig, see figure 10-45.

STREAM WITH BURTON WHIP OUTHAUL

The burton whip outhaul can be used when the delivering ship cannot provide an all-tensioned rig, because of equipment failure, and the receiving ship has a burton winch. The receiving ship provides the burton whip as the outhaul. The delivering ship keeps the inhaul winch in tension control. During transfer, the burton whip outhaul pulls against the tension in the inhaul and controls movement of the trolley and load. See figure 10-46.

STREAM with burton whip outhaul can be rigged to a fixed-padeye, a pendant receiving station, or another STREAM delivery station where a fairlead for the button whip is available near, and preferably below, the highline attachment padeye. The rig is not recommended for a sliding-padeye receiving station.

Use of STREAM with burton whip outhaul instead of the burton rig reduces the workload on burton winches, since the highline supports the load, and the button winch is only required to move the load.

For details on rigging hardware and emergency breakaway procedures for the STREAM rigs, refer to NWP 14(E).

STREAM TRANSFER OF PERSONNEL

Personnel STREAM is the preferred rig for transferring personnel while ships are alongside. Since this rig uses the highline winch and ram tensioner to furnish the load-carrying line, one ship must have a STREAM delivery station. The receiving ship must have STREAM capabilities or a sliding- or fixed-padeye receiving station.

For transfers to a STREAM delivery station or a sliding-padeye receiving station, you can use a one-person or two-person transfer chair or a stokes litter and cargo hook or gull wing strongback at the delivery station.

For delivery to a fixed-padeye receiving station, use a one-person transfer chair or stokes litter and a CDR with a safety cable extender.

Figure 10-47 shows a personnel STREAM rig with a hand-tended outhaul.

For a complete list of equipment and details in setting up of personnel STREAM, refer to NWP 14(E), chapter 7.

VERTICAL REPLENISHMENT

LEARNING OBJECTIVES: Describe helicopter replenishment operations and handling. Identify handling signals and describe safety requirements for VERTREP.

Vertical replenishment (VERTREP) employs a helicopter to transport cargo from the deck of an UNREP ship to the deck of the receiving ship. VERTREP augments or, in some cases, replaces

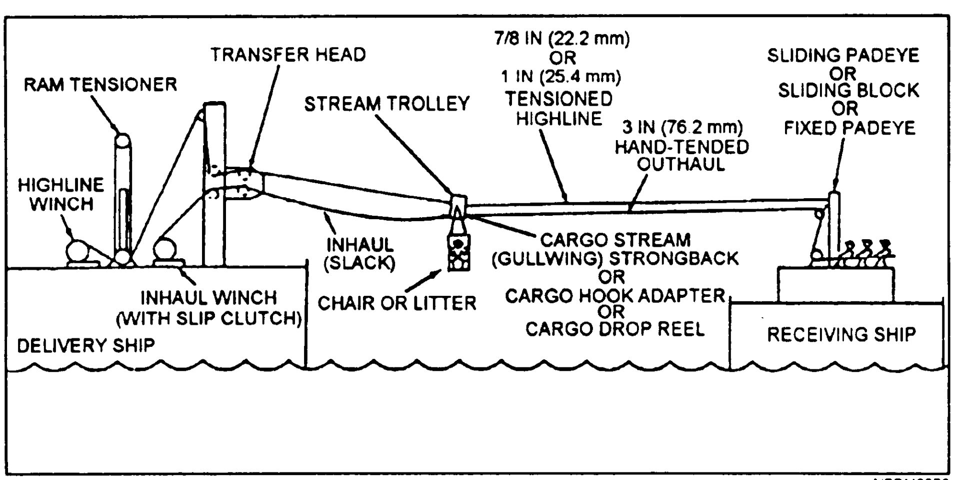


Figure 10-47.—Personnel STREAM with hand-tended outhaul.

connected replenishment. It can be conducted with the receiving ship alongside during connected replenishment; over the horizon in an ASW screen, firing gunfire support; or at anchor anywhere within range. Range depends upon the helicopter, flying conditions, and the load.

Cargo can be carried internally, but the preferred method is to sling it externally since this method is faster and provides more flexibility. Internal cargo is restricted to that which can be handled by a winch inside the helicopter with a capacity of 600 pounds. Depending on the helicopter and flying conditions, up to 6,000 pounds can be carried externally.

SHIP FACILITIES

As a part of the Navywide certification program, all ships with VERTREP capabilities must be inspected by a group of specialists who are knowledgeable in the requirements of both the ship's safety and the helicopter's safety of flight. These experts determine the ship's deck strength, obstruction-free landing hover area, fire-fighting capability, ability to communicate with helicopters on various radio circuits, adequacy of the helicopter control station, accuracy of deck markings, ability to provide aircraft fuel, and other items related to support and safety. On the basis of their inspection, the ship is certified to VERTREP, land, or fuel helicopters, as appropriate. Sometimes, a ship that nearly meets the inspection requirements for certification receives a waiver, which enables it to VERTREP until the next regular overhaul.

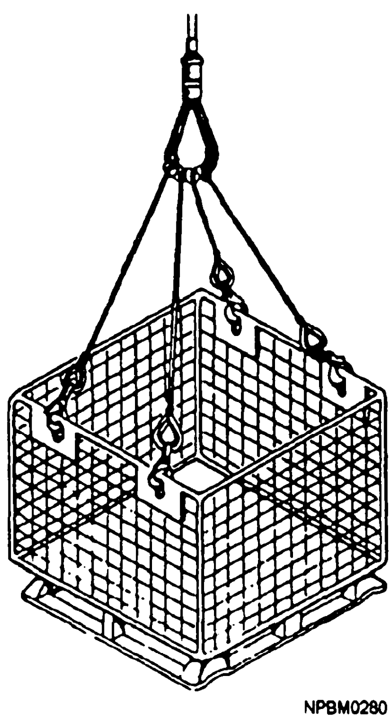


Figure 10-48.—Hoisting sling hooked to cargotainer (four attachment points).

VERTICAL REPLENISHMENT EQUIPMENT

The majority of VERTREP cargo-handling items are identical to or are adaptations of ordinary cargo-handling equipment. For example, the forklift and pallet trucks, wooden and metal pallets, and nylon cargo nets used for VERTREP are the same as those used in ordinary cargo-handling operations. Other items that may not be so familiar are cargotainers, cargo wraparounds, special hoisting slings, and various missile containers and dollies. Some of these articles are briefly discussed here. For more information, you should consult NWP 14(E) and NWP 42.

Cargotainers

Cargotainers are steel pallets with wire mesh sides that fold down for compact storage. See figure 10-48. They are ideal for transferring loose and odd-shaped items. The sides of the cargotainer may be raised and locked before or after all of the cargo is placed on the pallet. Light items near the top of the load must be strapped down or covered to prevent their being blown out during transfer.

Cargo Wraparound

The cargo wraparound (fig. 10-49) is a laminated, vinyl-nylon cloth load retainer used to strap loads on the

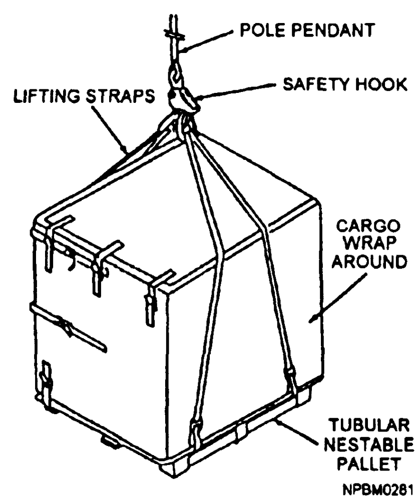


Figure 10-49.—Cargo wraparound.

nestable, tubular-steel pallet. Completely enclosing the load, it offers good protection from the elements. Its most frequent use is for transferring general cargo.

The cargo is stacked on the pallet as tightly as possible, preferably to a height of 50 inches. The side panels are drawn around the load and secured with the straps and buckles provided. Then, the top panel is strapped tightly over the top of the load. The lifting straps may be secured to the load with masking tape or a couple of turns of sail twine to prevent their becoming entangled under the forklift truck while being transported to the staging area.

Adjustable Pallet Slings

The adjustable pallet sling, also known as the Peck and Hale sling, is a two-loop, wire rope sling used for transferring pallets (fig. 10-50). To adjust the sling, press the loops under the pallet and pull the bitter ends of the wires through the stirrups, removing all slack from the loops and tightening the spreader wire across the top of the load. The sling is adjusted so that the hoisting eyes are centered at equal heights above the pallet; then the stirrups are latched over the nearest swage fittings, and the lock is engaged.

The four available sizes of adjustable slings are color-coded as follows:

Red (Mk 85)	For loads 13 to 31 inches high
Black (Mk 86)	For loads 20 to 40 inches high
Green (Mk 87)	For loads 36 to 50 inches high
Yellow (Mk 100)	For loads 48 to 70 inches high

Hoisting Slings

Several types of hoisting slings are available in the fleet today. One type is the Mk 105, sometimes called the multileg pole pendant. It is approved for all types of

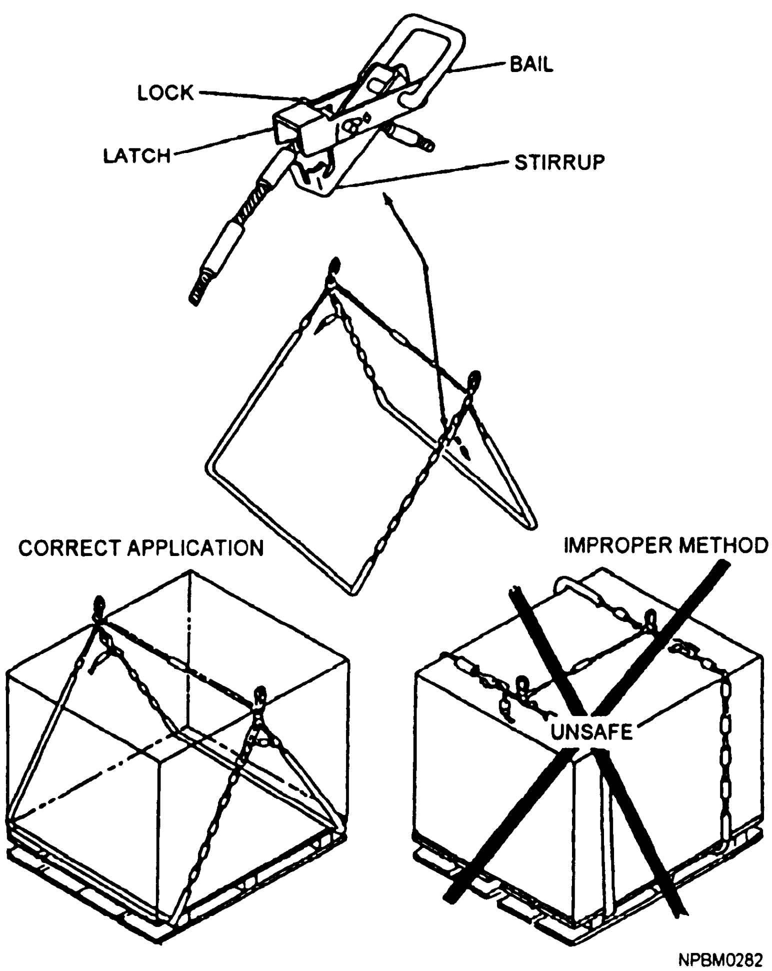


Figure 10-50.—Adjustable pallet sling.

VERTREP loads up to 6,000 pounds. The Mk 105 consists of two parts: the pendant and the legs. See figure 10-51. The pendant, made of 1 1/8-inch-diameter double-braided nylon rope, is approximately 12 feet long, with a silicone-impregnated eye at one end. The silicone impregnation allows the eye to slip off the helicopter hook when released and aids in removing the legs from the pendant. A 6-foot plastic reach tube encases the upper portion of the pendant and provides the rigidity needed to place the upper eye over the helicopter cargo hook. The legs, made of 15/16-inch double-braided nylon, are 6 and 10 feet long, with an open eye splice at one end and a positive-closing, self-locking cargo hook at the other. As many as six legs may be attached to the lower pendant eye by means of choker hitches. The number of legs used is determined by the number of attachment points on the load. Four legs are furnished with each pendant at the time of issue. The SWL for a single leg is 3,000 pounds. The double-braided nylon rope, being nonconductive, prevents the discharge of static electricity from the helicopter to the ship, through the hookup person. Another benefit derived from nylon rope is its ability to act as a shock absorber between the helicopter and the load. The pendant's stretch allows the pilot to slowly take up on the load, thereby reducing the g-force applied to the load as the slack goes out of the pendant.

PREPARATIONS AND PROCEDURES ON THE DELIVERING SHIP

VERTREP can commence within an hour after the order is given. Usually, 1 to 3 days before the scheduled day, the delivering ship begins to break out, strike up, sort, and palletize cargo to be transferred. With the exception of chilled and frozen items, as much material as possible is assembled into loads and staged near the VERTREP area. Cargo is staged by destination and type within the specified area so as to be accessible to the

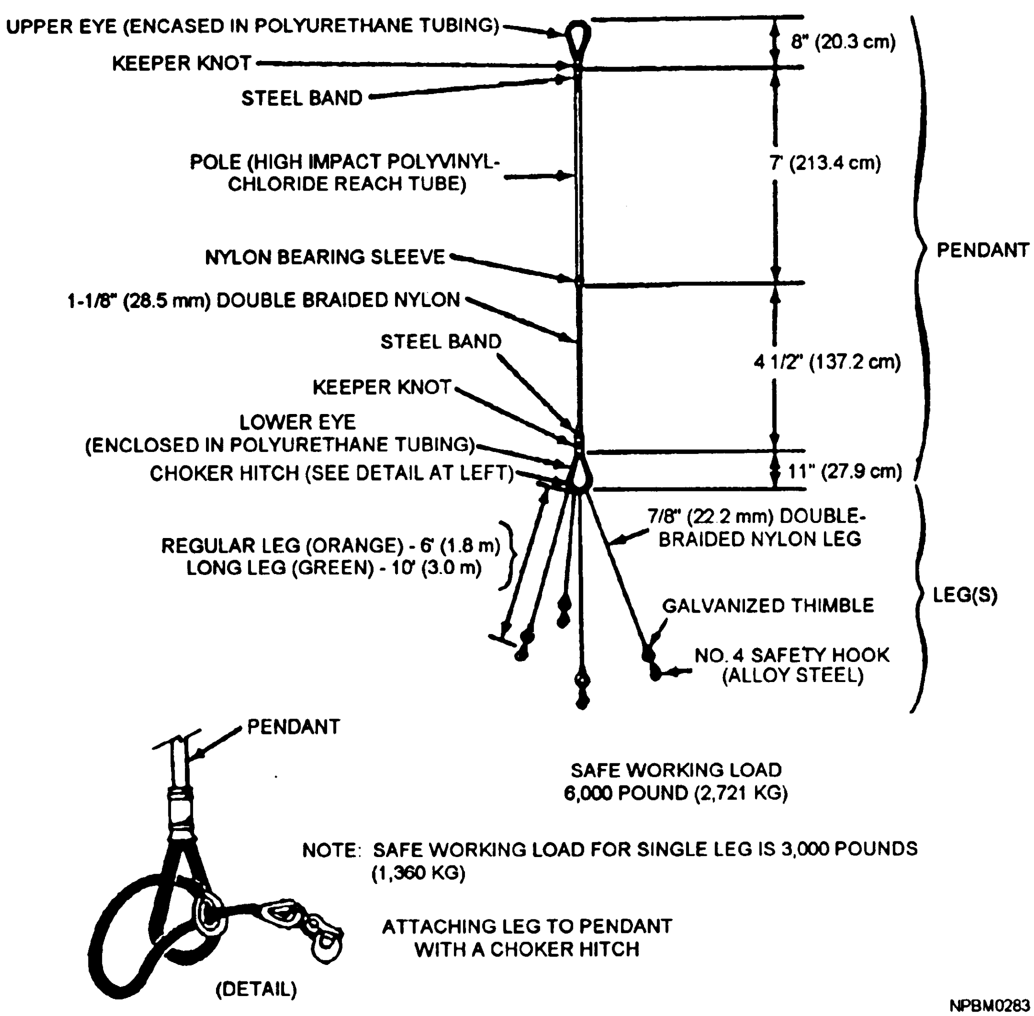


Figure 10-51.—Mk 105 hoisting sling (multileg pole pendant).

hovering helicopter. It is important that like cargo be transferred load after load, so that strikedown crews on the receiving ships need not be shifted back and forth. Usually, chilled and frozen cargo is broken out last and transferred first.

The bulk of VERTREP cargo is transported in nylon cargo nets (fig. 10-52) by placing a loaded pallet on the center of the net and drawing the net up around the pallet. The cargo should be banded to the pallet. Nets used for VERTREP are made of 1 1/2-inch nylon webbing with an overall size of 12 by 12 feet or 14 by 14 feet. Oblong metal rings on each of the four corners are used to lift the net with the aid of a becket. Rough treatment, such as dragging the nets across the flight deck, causes extensive damage to the nylon webbing, and should be avoided.

Pallets and nets should be loaded as heavily as safety permits. Small and lightweight articles should be placed on top of heavier items and covered with tarps or otherwise secured to keep them from blowing away. Complete loads should never be made up of items such as light bulbs, because the wind or rotor wash may blow light loads against the fuselage of the helicopter, damaging either the load or the aircraft, or both. When possible, all packages should be interlaced on a pallet. All palletized loads should be strapped or banded as tightly as possible. Previously banded loads should be checked, and bands or straps added if needed.

Primary considerations in staging cargo are as follows:

- Leave space in the center of the deck to roll out the helicopter and permit it to take off and land.
- Stage cargo within the periphery lines so that it is accessible to the hovering helicopter.
- Group loads for each customer ship so that they are accessible for pickup in the event of a change in schedule, and so that simultaneous multiship VERTREP is possible.
- Stage cargo for each ship in a manner that will permit an orderly delivery sequence of like commodities (for example, all chilled and frozen loads first, then all dry stores, then all ammunition, and so on).
- Leave room for the hookup person to move about; leave an escape route for the hookup person.
- Locate loads over 3,000 pounds where they can be picked up later in the delivery schedule when the helicopter has used some of its fuel and, thus, has a wider margin of power available when it is lifting the heavy loads.

Each load must be marked with its weight and destination. Because the most efficient load for helicopters presently being used for VERTREP is around 3,000 pounds, light loads should be stacked together and paired for delivery. See figure 10-53 for an

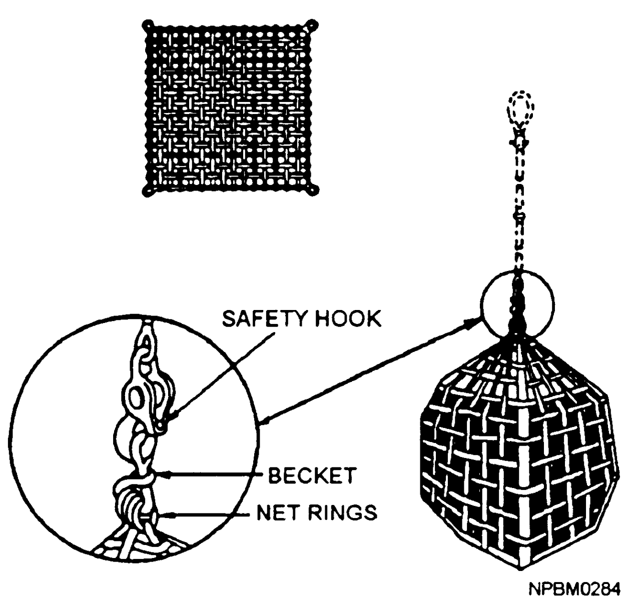


Figure 10-52.—Nylon cargo net.

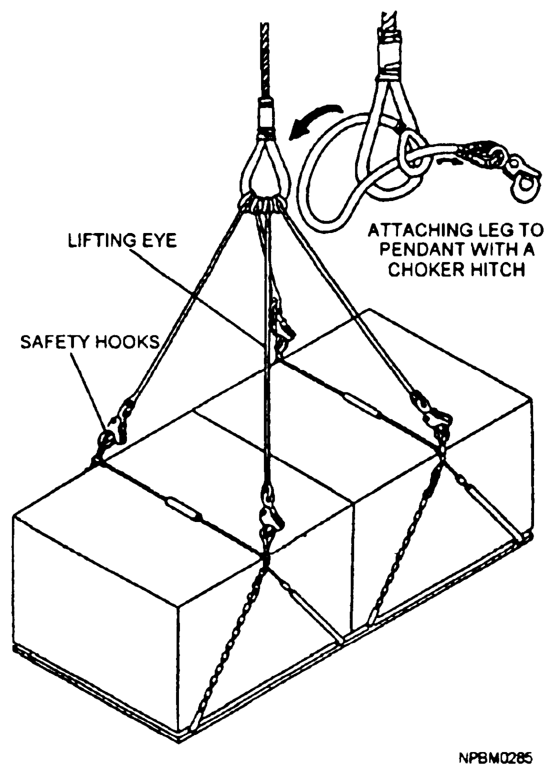


Figure 10-53.—Multileg hoisting sling lifting a paired load.

example of a paired load. Paired loads should be approximately the same size and shape to reduce the possibility of their tipping when being picked up or set down. Depending on the space available on the receiving ship, up to four pallets may be transported at the same time.

As each load is picked up, its destination and weight are displayed on a hand-held blackboard from a position clearly visible to the pilot. If registered mail or classified material is included in the load, that fact is made known to the pilot. Voice radio may be used as an alternate method of communicating such information, but during daylight hours, radio transmissions should be kept to a minimum.

When the helicopter approaches the delivering ship, its approach is announced over the 1MC. All hands clear the landing and pickup zone, except the hookup person, who takes position alongside the load and holds up the pole pendant to show the location of the load to the pilot. Guided by hand signals, or wands if at night time from the landing signalman (fig. 10-54) and by instructions from a helicopter crewman, the pilot maneuvers the helicopter over the load. As the helicopter hovers there, the hookup person slips the loop of the pendant over the cargo hook, then clears the area directly under the helicopter.

> **WARNING**
>
> **The hookup person must NEVER stand on the load being picked up or between the load being picked up and another load.**

PREPARATIONS AND PROCEDURES ON THE RECEIVING SHIP

Preparations on the receiving ship include the following actions:

- Clear cargo-handling area of obstructions; cover and pad any fixed fittings; train mounts on the beam and depress the guns; unstep flagstaffs.
- When the tactical situation permits, lower the variable-depth sonar to the trial position.
- Batten down all hatches in the area to keep burning fuel from pouring below should the helicopter crash
- Notify the helicopter coordinator of the location of the receiving area (unless it is obvious).
- Man and equip the lifeboat for aircrew rescue.
- Make sure that the crash and rescue detail with all required gear is on station.
- Make sure that all hands required to work in or near the VERTREP area are wearing goggles, life jackets, and ear protectors.
- Clear the VERTREP area of all loose gear, such as trash cans, hats, loose clothing, empty boxes, sheet metal, plywood, and trash. Sweep down to ensure that all small objects are removed.

> **WARNING**
>
> **The powerful rotor wash of the helicopter can pick up a loose object and hurl it with sufficient force to injure an individual or the aircraft.**

- Station a signalman to direct the helicopter. Signal flags are optional.

> **WARNING**
>
> **Personnel on deck must not attempt to steady loads swinging under a helicopter.**

As soon as the helicopter departs, cargo-handlers rush out to clear the area. If pallet trucks have been furnished, most of the loads will be delivered on pallets with adjustable pallet slings, and it is a simple matter to jack up the pallets and haul them clear. Netted pallets can be moved with two-pallet trucks, but cargo-handlers should be prepared to break down loads by hand if a net interferes with the operation of the truck.

When no pallet trucks are furnished or they cannot be used, assigned personnel release the pendant hooks, open the net or cargo wraparound, and cut bands or unbuckle straps. The other crew members then move in and carry boxes from the zone. The last crew member removes the pendant, empty pallet, and loose debris from the drop zone and places them in a staging area.

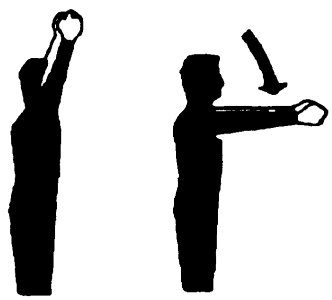
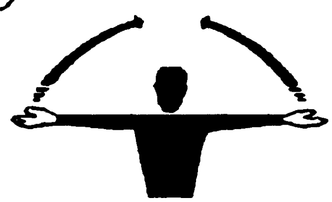
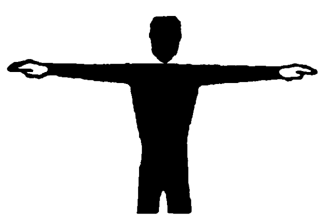
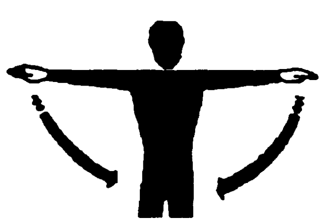
SIGNAL	DAY	NIGHT
(1)  LANDING DIRECTION	STAND WITH ARMS RAISED VERTICALLY ABOVE HEAD AND FACE TOWARD THE POINT WHERE THE AIRCRAFT IS TO LAND. THE ARMS ARE LOWERED REPEATEDLY FROM A VERTICAL TO A HORIZONTAL POSITION.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(2)  MOVE UPWARD	ARMS EXTENDED HORIZONTALLY SIDEWAYS BECKONING UPWARDS, WITH PALMS TURNED UP. SPEED OF MOVEMENT INDICATES RATE OF ASCENT. CONFORMS TO ICAO SIGNAL. (INTERNATIONAL CIVIL AVIATION ORGANIZATION)	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(3)  HOVER	ARMS EXTENDED HORIZONTALLY SIDEWAYS, PALMS DOWNWARD. CONFORMS TO ICAO SIGNAL.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(4)  MOVE DOWNWARD	ARMS EXTENDED HORIZONTAL SIDEWAYS BECKONING DOWNWARDS, WITH PALMS TURNED DOWN. SPEED OF MOVEMENT INDICATES RATE OF DESCENT. CONFORMS TO ICAO SIGNAL.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.

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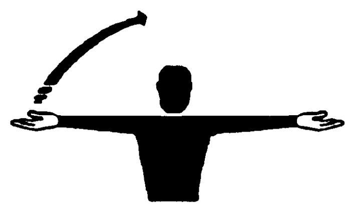
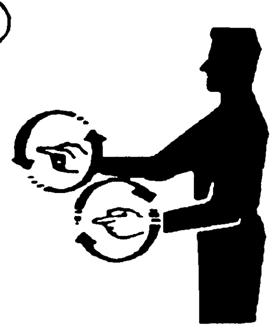
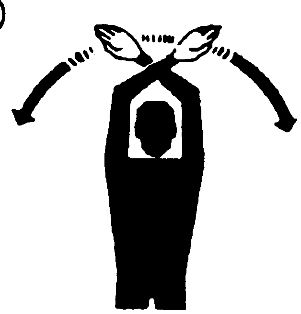
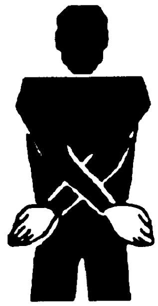
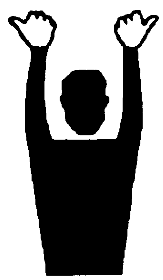
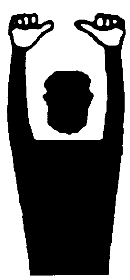
Figure 10-54.—Helicopter-handling signals.

SIGNAL	DAY	NIGHT
(5)  MOVE TO LEFT	RIGHT ARM EXTENDED HORIZONTALLY SIDEWAYS IN DIRECTION OF MOVEMENT AND OTHER ARM SWUNG OVER THE HEAD IN SAME DIRECTION, IN A REPEATING MOVEMENT.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(6)  MOVE TO RIGHT	LEFT ARM EXTENDED HORIZONTALLY SIDEWAYS IN DIRECTION OF MOVEMENT AND OTHER ARM SWUNG OVER THE HEAD IN SAME DIRECTION, IN A REPEATING MOVEMENT.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(7)  LOWER WHEELS	WHEN AIRCRAFT APPROACHES DIRECTOR WITH LANDING GEAR RETRACTED, MARSHALER GIVES SIGNAL BY SIDE VIEW OF A CRANKING CIRCULAR MOTION OF THE HANDS.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(8)  WAVE OFF	WAVING OF ARMS OVER THE HEAD.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.

NPBM0287

Figure 10-54.—Helicopter-handling signals—Continued.

SIGNAL	DAY	NIGHT
(9)  LAND	ARMS CROSSED AND EXTENDED DOWNWARDS IN FRONT OF THE BODY. CONFORMS TO ICAO SIGNAL.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(10)  DROOP STOPS OUT	WHEN ROTOR STARTS TO "RUN DOWN" MARSHALER STANDS WITH BOTH HANDS RIASED ABOVE HEAD, FISTS CLOSED, THUMBS POINTING OUT.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(11)  DROOP STOPS IN	WHEN DROOP STOPS GO IN, MARSHALER TURNS THUMBS INWARDS.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(12)  REMOVE BLADE TIEDOWNS	LEFT HAND ABOVE HEAD, RIGHT HAND POINTING TO INDIVIDUAL BOOTS FOR REMOVAL.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.

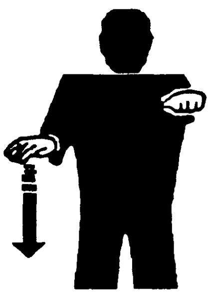
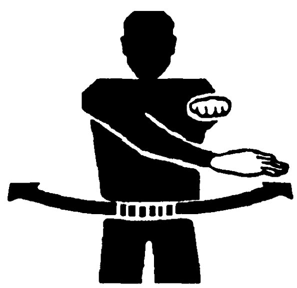
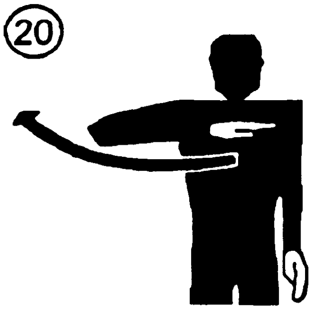
NPBM0288

Figure 10-54.—Helicopter-handling signals—Continued,

SIGNAL	DAY	NIGHT
13  ENGAGE ROTOR(S)	CIRCULAR MOTION IN HORIZONTAL PLANE WITH RIGHT HAND ABOVE HEAD.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
14  HOOK UP LOAD	ROPE CLIMBING MOTION WITH HANDS.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
15  RELEASE LOAD	LEFT ARM EXTENDED FORWARD HORIZONTALLY, FIST CLNCHED, RIGHT HAND MAKING HORIZONTAL SLICING MOVEMENT BELOW THE LEFT FIST, PALM DOWNWARD.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
16  LOAD HAS NOT BEEN RELEASED	BEND LEFT ARM HORIZONTALLY ACROSS CHEST WITH FIST CLENCHED, PALM DOWNWARD; OPEN RIGHT HAND POINTED UP VERTICALLY TO CENTER OF LEFT FIST.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.

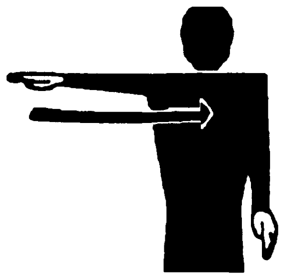
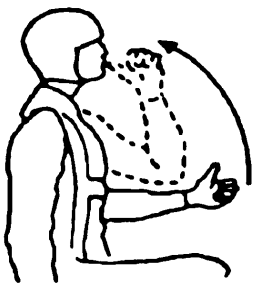
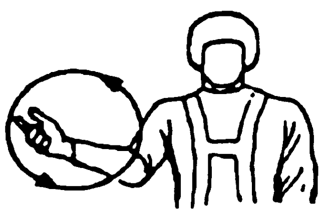
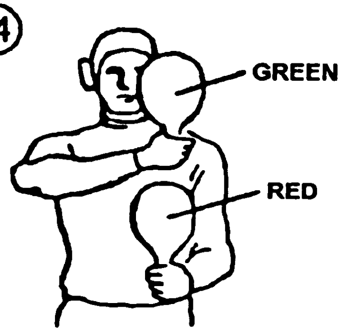
NPBM0289

Figure 10-54.—Helicopter-handling signals—Continued.

SIGNAL	DAY	NIGHT
(17)  WINCH UP	LEFT ARM HORIZONTAL IN FRONT OF BODY, FIST CLENCHED, RIGHT HAND WITH PALM TURNED UPWARDS MAKING UPWARD MOTION.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(18)  WINCH DOWN	LEFT ARM HORIZONTAL IN FRONT OF BODY, FIST CLENCHED, RIGHT HAND WITH PALM TURNED DOWNWARDS MAKING DOWNWARD MOTION.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(19)  CUT CABLE	A SIGNAL SIMILIAR TO "RELEASE LOAD" EXCEPT THAT THE RIGHT HAND HAS THE PALM DOWNWARD AND NOT CLENCHED. RAPID REPETITION OF RIGHT HAND MOVEMENT INDICATES URGENCY.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
(20)  SPREAD PYLON	BEND ELBOW ACROSS CHEST, PALM DOWNWARD. EXTEND ARM OUTWARD TO HORIZONTAL POSITION, KEEPING PALM OPEN AND FACING DOWN.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.

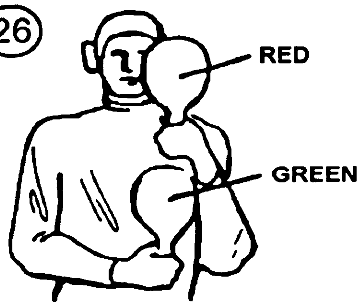
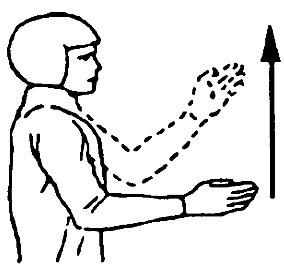
NPBM0290

Figure 10-54.—Helicopter-handling signals—Continued.

SIGNAL	DAY	NIGHT
21  FOLD PYLON	EXTEND RIGHT ARM HORIZONTALLY, PALM DOWNWARD. BEND ARM KEEPING PALM DOWN.	SAME AS DAY SIGNAL WITH ADDITION OF WANDS.
22  I DESIRE HIFR/FUEL	HELICOPTER CREW-MEMBER BRINGS THUMB TO MOUTH AS IF DRINKING FROM A GLASS.	SAME EXCEPT USE **RED** LENS FLASHLIGHT.
23  COMMENCE FUELING	HELICOPTER CREW-MEMBER MAKES CIRCULAR MOTION WITH RIGHT HAND.	HELICOPTER CREW-MEMBER MAKES CIRCULAR MOTION WITH **RED** LENS FLASHLIGHT.
24  AM PUMPING FUEL	SHIP'S FUEL CREW-MEMBER HOLDS **GREEN** DEVICE VERTICALLY OVER **RED** DEVICE.	SHIP'S FUEL CREW-MEMBER HOLDS **GREEN** WAND VERTICALLY OVER **RED** WAND.

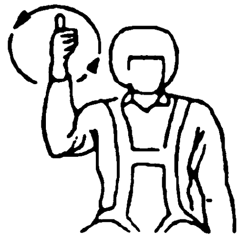
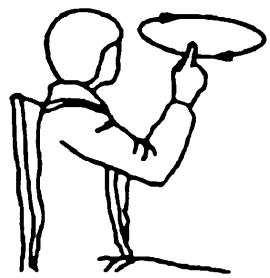
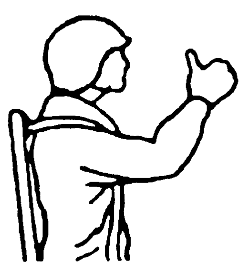
NPBM0291

Figure 10-54.—Helicopter-handling signals—Continued.

SIGNAL	DAY	NIGHT
25  CEASE FUELING	HELICOPTER CREW-MEMBER MAKES HORIZONTAL CUTTING MOTION OF RIGHT HAND ACROSS THROAT.	HELICOPTER CREW-MEMBER MAKES HORIZONTAL MOTION WITH RED LENS FLASHLIGHT.
26  HAVE CEASED PUMPING FUEL	SHIP'S FUEL CREW-MEMBER HOLDS **RED** DEVICE OVER **GREEN** DEVICE.	SHIP'S FUEL CREW-MEMBER HOLDS **RED** WAND VERTICALLY OVER **GREEN** WAND.
27  DESIRE TO MOVE OVER DECK AND RETURN HOSE	HELICOPTER CREW-MEMBER MAKES VERTICAL MOTION OF HAND.	HELICOPTER CREW-MEMBER MAKES VERTICAL MOTION WITH **RED** LENS FLASHLIGHT.
28  EXECUTE EMERGENCY BREAKAWAY	LSE/DIRECTOR MAKES "WAVE-OFF" SIGNAL. SIGNAL IS MANDATORY.	LSE/DIRECTOR MAKES "WAVE-OFF" SIGNAL WITH WANDS.

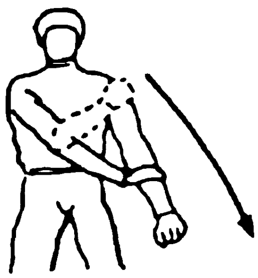
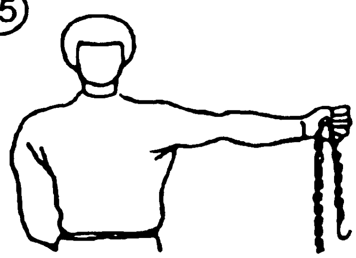
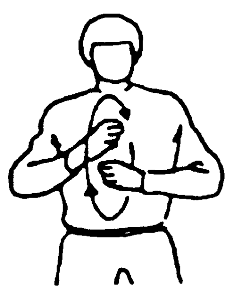
NPBM0292

Figure 10-54.—Helicopter-handling signals—Continued.

SIGNAL	DAY	NIGHT
(29)  READY TO START ENGINE (PILOT)	MOVES HAND IN A CIRCLE PERPENDICULAR TO THE DECK; FOLLOWS WITH A "THUMBS UP" SIGNAL. SIGNIFY BY NUMBER OF FINGERS ENGINE TO BE STARTED.	TURNS ON FLASHLIGHT OR MOVABLE LIGHT AND MOVES IN A CIRCLE PERPENDICULAR TO THE DECK.
	THE AIR OFFICER SHALL SIGNAL AUTHORITY TO START ENGINES BY ILLUMINATING A **RED** ROTATING BEACON.	
(30)  READY TO ENGAGE ROTORS (PILOT)	MOVES HAND IN HORIZONTAL CIRCLE BY EYE LEVEL, INDEX FINGER EXTENDED. AIRCRAFT LIGHTS "FLASHING BRIGHT."	SAME AS DAY EXCEPT HOLDS **RED** LIGHT IN HAND. AIRCRAFT LIGHTS "FLASHING DIM."
	AT NIGHT, AIRCRAFT LIGHTS SHOULD BE ON "FLASHING DIM" UNTIL AIRCRAFT IS DECLARED UP AND READY FOR TAKEOFF BY THE PILOT.	
(31)  READY TO ENGAGE ROTORS (LSE)	FACES PRI-FLY: HOLDS LEFT FIST ABOVE HEAD; GIVES CIRCULAR MOTION OF RIGHT HAND ABOVE HEAD, INDEX FINGER EXTENDED.	ROTATES ONE WAND AT CHEST LEVEL; HOLDS OTHER WAND ABOVE HEAD.
	THE AIR OFFICER SHALL SIGNAL AUTHORITY TO ENGAGE ROTORS BY ILLUMINATING A **YELLOW** ROTATING BEACON.	
(32)  READY FOR TAKEOFF (PILOT)	GIVES "THUMBS UP" SIGNAL AT EYE LEVEL. AIRCRAFT LIGHTS "STEADY BRIGHT."	PLACES RUNNING AND FORMATION LIGHTS ON "STEADY DIM." MAY GIVE "THUMBS UP" SIGNAL BY TURNING ON FLASHLIGHT OR OTHER MOVEABLE LIGHTS AND MOVING IT UP AND DOWN.

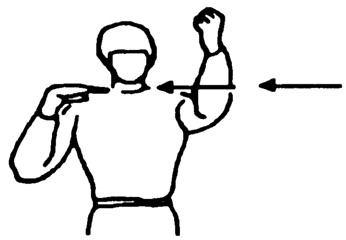
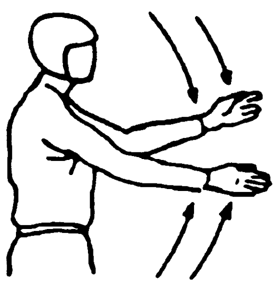
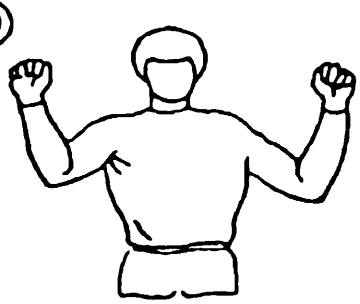
NPBM0293

Figure 10-54.—Helicopter-handling signals—Continued.

SIGNAL	DAY	NIGHT
(33)  READY FOR TAKEOFF (LSE)	FACES PRI-FLY: HOLDS RIGHT THUMB UP AT EYE LEVEL; HOLDS LEFT FIST AT EYE LEVEL. THE AIR OFFICER SHALL SIGNAL AUTHORITY FOR LAUNCH OF HELICOPTERS BY ILLUMINATING A **GREEN** ROTATING BEACON.	SIGNAL NOT REQUIRED. PILOT'S "STEADY DIM" INDICATES READINESS TO PRI-FLY.
(34)  REMOVE TIEDOWNS (LSE)	TO TIEDOWN CREW: MAKES WIPING MOTION DOWN LEFT ARM WITH RIGHT HAND.	SAME AS DAY EXCEPT HOLDS **AMBER** WANDS.
(35)  TIEDOWNS REMOVED (DECK CREW)	STANDS IN FULL VIEW OF PILOT AND LSE AND HOLDS TIEDOWN AND CHOCKS EXTENDED TO SIDE.	SAME AS DAY EXCEPT ILLUMINATES TIEDOWN WITH **AMBER** FLASH-LIGHT.
(36)  INSTALL TIEDOWNS (LSE)	TO TIEDOWN CREW: ROTATES HANDS IN A CIRCLE PERPENDICULAR TO AND IN FRONT OF HIS BODY. GIVE "HOLD" SIGNAL AS SOON AS FIRST TIEDOWN IS ATTACHED.	SAME AS DAY EXCEPT WITH **AMBER** WANDS.

NPBM0294

Figure 10-54.—Helicopter-handling signals—Continued.

SIGNAL	DAY	NIGHT
(37)  DISENGAGE ROTORS (LSE)	HOLDS LEFT FIST ABOVE HEAD; MAKES THROAT CUTTING ACTION WITH RIGHT HAND. GIVE "HOLD" SIGNAL AS SOON AS FIRST TIEDOWN IS ATTACHED. THE AIR OFFICER SHALL SIGNAL AUTHORITY TO DISENGAGE ROTORS BY ILLUMINATING A **YELLOW** ROTATING BEACON.	SAME AS DAY EXCEPT WITH **AMBER** WANDS.
(38)  HOOK NOT DOWN/UP	ARMS EXTENDED, MAKE SHORT UP AND DOWN CHOPPING ACTION, ALTERNATING HANDS.	SAME AS DAY EXCEPT HOLDS **AMBER** WANDS.
(39) SAME AS GENERAL AIRCRAFT HANDLING SIGNAL FOR TURN LEFT/RIGHT (SEE FIGURE 10-54, SIGNALS 5 AND 6). SWING TAIL RIGHT OR LEFT	USE STANDARD FIXED-WING AIRCRAFT TURN SIGNAL, POINTING WITH HAND TO WHEEL TO BE PIVOTED AND GIVING "COME-ON" WITH OTHER HAND.	SAME AS DAY EXCEPT WITH **AMBER** WANDS.
(40)  HOLD POSITION	MAKES CLENCHED FISTS AT EYE LEVEL. SIGNAL IS MANDATORY.	HOLD CROSSED WANDS (ANY COLOR) OVERHEAD.

NPBM0295

Figure 10-54.—Helicopter-handling signals—Continued.

Pallets are stacked and nets are folded to be returned later.

> **NOTE**
>
> **A loaded helicopter should not be waved off just because the drop zone has not been cleared of the previous load. If space is adequate for additional drops, the load being worked should be secured temporarily by pulling the net over the load and threading a pendant leg through the beckets. All personnel then must clear the area while the next load is deposited.**

During the approach to the customer ship, the pilot lines up on the VERTREP approach lines and flies high enough to keep the load from dragging on the deck. Guided by the landing signalman, who the pilots keeps in sight while avoiding any obstruction, the pilot maneuvers the helicopter over the ship. Once over the drop zone, the pilot follows the crew member's directions to position the load over the landing spot. As soon as the load is on deck, the crew member informs the pilot of that fact and releases the cargo hook on signal or when the pendant is slackened.

Empty pallets, nets, cargotainers, and pendants accumulating on the receiving ship take up space needed for cargo; besides, they are needed back on the delivering ship. Therefore, they must be assembled into loads and periodically returned to the UNREP ship. See figure 10-55.

Stack metal pallets, leaving the wraparounds connected. Secure pendants inside the load, saving one to hook up the load. Tighten the bottom wraparound over the group, and connect the pendant to the wraparound straps. If a net is used, stack the pallets on the center of the net and place the folded nets on top of the pallets. Draw the bottom net up around the pallets and other nets, and hook a pendant to the beckets. Four wooden or six metal pallets plus twelve cargo nets make a good stable load.

Cargotainers may be returned in nets or folded and placed in another cargotainer.

Pole pendants may be returned by securing them inside a load or by threading one of them through 10 or 15 others and hooking it back on itself.

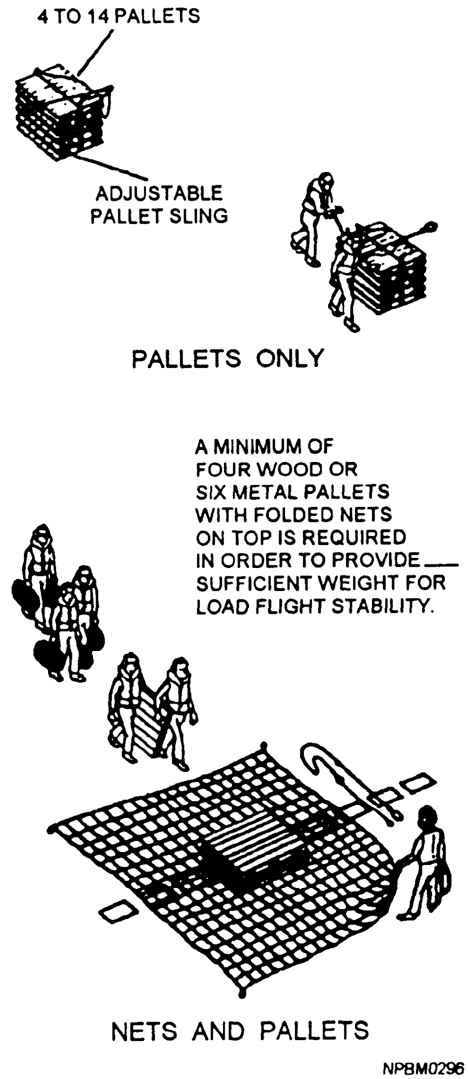


Figure 10-55.—Preparation of nets and pallets for return to UNREP ship.

Any cargo to be returned must be prepared in the fashion described under instructions for the delivering ship.

NIGHT REPLENISHMENT

LEARNING OBJECTIVES: Identify all night replenishment lighting requirements. Compare night VERTREP operations with daytime operations.

Lighting for night replenishment must be sufficient to permit operations to proceed, but white lights, which might interfere with the night vision of bridge personnel and pilots, are not permitted. For this reason, only red, green, and amber lights are used. Most area, obstruction, and identifying lights are red; green and amber lights are used by signalmen. Because of the dim lights, replenishment must proceed slowly and cautiously.

CONTOUR LIGHTS

To facilitate the approach, the control ship (usually the delivering ship) shows on the approach side two blue contour lights placed to indicate the portion of the side that is parallel to the keel. Ships over 600 feet long show a third blue light in line with the other two (fig. 10-56). If the control ship is a carrier or an LPH, it shows two blue lights forward along the starboard edge of the flight deck. One-cell red flashlights or green chemical lights also are placed on any obstruction (booms, sponsons, aircraft elevators, and so on) outboard of the line indicated by the contour lights. During the approach, the control ship also shows its truck light and wake light.

AREA LIGHTS

Working areas are lighted by low-intensity yellow floodlights. Figure 10-57 is a good example of night lighting. In addition to the floodlights, six red lights are displayed in a horizontal line along the deck edge or on a level with the highest obstruction outboard of the receiving station landing or work area. The lights are

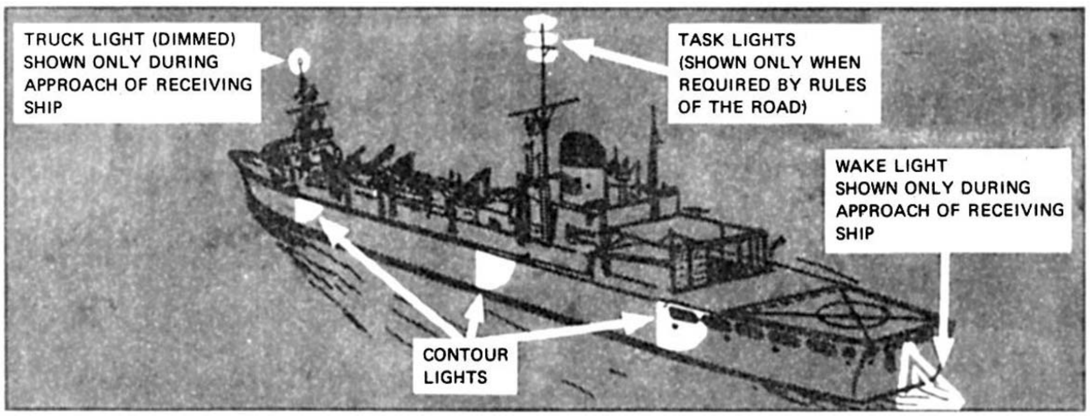


Figure 10-56.—Approach and station-keeping lights.

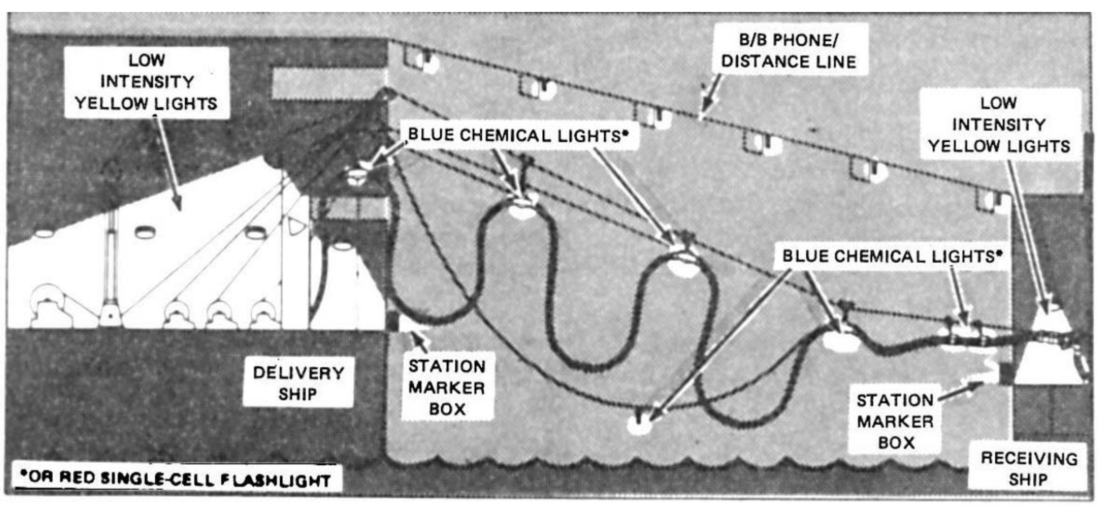


Figure 10-57.—Lighting for night replenishment.

one-cell flashlights or chemical lights with lenses up and are pinned at 2-foot intervals on a 6-inch canvas strip. Similar lights are secured to the comers and edges of gun and torpedo mounts and like structures. Booms, guys, preventers, stanchions, and so on, are marked by rows of three red lights placed 6 inches apart.

RIG MARKINGS

To reduce the chances of mixups, identify the ends of messengers and other lines by stencils on 5-inch by 6-inch pieces of canvas, handsewn to the lines in such a way that they will pass through fairlead blocks. Identifying stencils are as follows:

- Messenger
- Attach zero end B/B phone/distance line
- Sta/sta phone
- Messenger return
- Highline messenger
- Burton messenger

Each square of canvas also should have a red flashlight or a chemical light attached.

The B/B telphone/distance line is marked as shown in figure 10-3. Other parts of the replenishment rigs are marked by red lights as follows:

1. Hose saddles: three—in line, on side, or end to delivering ship
2. Free trolleys (span-wire rig): two—one on each side
3. Riding line fittings: two—one on each side, behind the hook
4. Robb coupling: three—around the hose, just behind the hose adapter
5. Messengers: one—where the shot line or bolo is attached
6. Transfer chair: one at each comer, top and bottom
7. Trolleys, highline, and modified housefall: eight—four on each side, in a horizontal line with lenses alternately up and down
8. Inhaul: three—on a shackle or ring around the line
9. Highline end: two—one on each side of the end fitting
10. Housefall block: three on each side
11. Burton whip: one—attached to messenger near end of wire
12. Cargo hook steadying lines: one—at the lower end
13. Missile transfer dollies: four—one at each lower corner
14. Special weapons transfer dollies and con-tamers: four—one at each lower comer
15. Special weapons transfer slings: three—at the sling attachment point

Attachment fittings (pelican hooks, shackles) and attachment points should be painted white. The receiving ship, in addition to painting the attachment points, marks each of them with six red lights, placed three on either side in line with the point. The lenses should face the point.

The replenishment stations themselves are identified according to the commodities they deliver or receive, as shown in figure 10-7.

NIGHT VERTREP

Essentially, the same procedures used during the day are used during night VERTREP, but increased care and precision are required. The primary difference in night VERTREP is a reduction in speed of operations, because of decreased visibility. Delivery rates, therefore, are lower than during daylight hours. When there is no visible horizon, VERTREP operations must proceed even more slowly.

Ships must be authorized before taking part in night VERTREP, and only those with adequate lighting will be certified. Night operations with uncertified ships will be conducted only on an emergency basis. As a minimum, a ship must display the following lights:

- Enough red lights to clearly define for the pilot the perimeter of the drop area. (Dim white light or red dustpan-type lights also may be used to aid the pilot in seeing the deck, but they should be shielded to keep the direct light from the pilot’s eyes.)
- Red lights must mark obstructions and boundaries of areas over which the helicopter cannot fly.

- On the delivering ship, at least three red lights must be arranged horizontally athwartships, forward of the flight deck. These lights must be focused on the flight deck at a point forward of the landing area.

When a transfer must be made to a noncertified landing or hover area, the pilot may use red or white landing lights to make a safe approach.

The landing signalman uses amber wands for directing the helicopter. The hookup person uses a green wand to show the point of pickup, or a one-cell flashlight taped to the top of his or her helmet. This procedure leaves both hands free to hook up the loads and makes it less likely that the light will drop and be lost among the loads.

Information on weight and destination of loads is transmitted to the pilot by radio, but no transmissions should be made to the pilot by outside sources while the aircraft is hovering over the ship. Such transmissions will interfere with directions from aircrew personnel at the cargo hatch.

During night VERTREP, only the shortest pole pendants should be used to hook loads to the helicopter's cargo hook. Using only pendants of one length makes it easier for the pilot to use the same reference points for hovering while picking up or dropping successive loads. The shortest pendants are preferable because it is difficult to hover at the higher altitudes required with the longer pendants.

CHECKOFF LISTS

You should study the replenishment-at-sea safety precautions and checkoff lists appearing in NWP 14(E) and learn them thoroughly.

SUMMARY

In this chapter we have briefly described areas of replenishment-at-sea and VERTREP operations. These areas are so indepth that there is no way we could possible cover this in this book. During operations on a ship all boatswain's mates will have to refuel and take on stores at one time or another and remember that safety is the No. 1 priority. Be safe and good luck.

CHAPTER 11

PAINTING

LEARNING OBJECTIVE: Identify the ingredients that make up all paints and understand how each ingredient is used to make paint.

After reading this chapter, you should be able to explain the composition of paint, the various paint systems, and the procedures for preparing a surface and applying the paint correctly. In addition, you should acquire the ability to run a paint locker and be able to choose the proper tools for a job from start to finish.

Some of your time as a Boatswain's Mate will be the upkeep and preservation of your spaces. While the principles of this operation are simple, they are often overlooked. Proper instruction and supervision must be given a painting crew. You must never assume that a group of Seamen will do all that is required of them. They must be trained to do a job properly, and this requires constant effort and attention to detail by you, the petty officer.

The object of painting is well known, but many sailors have the wrong idea and think that paint can be used to tidy up spaces that, in fact, just need a good cleaning.

When a space needs painting, the first rule to remember is that no surface should be painted unless it has been thoroughly cleaned and properly prepared, Violation of this rule results in the following:

- The surface will not look its best and will soon need chipping down and repainting.
- The Navy's paint and your valuable time are wasted.
- The most important point of all, a surface painted wrong is not protected against the elements and will deteriorate fast.

You must plant it firmly in your head that the first step to good paintwork is proper preparation of the surface. The most expensive and best paint in the world will be of little value as a protective or decorative coating when it is applied on a surface that has not been properly prepared.

The Navy has spent many years experimenting with different paints in all types of climate and environment. As a result of these tests, the paints that you use are the best and most efficient for general use aboard ships.

You must use the proper pretreatment, and then primers and paints, in sequence, with the prescribed number of coats to make the surfaces painted hold up to the ocean environment and retard deterioration of the ship.

COMPOSITION OF PAINT

Paint consists of four ingredients—pigment, vehicle, drier, and thinner. In the making of any paint, the pigment is ground into the vehicle and the drier is added. Next, the thinner is added to make the paint the proper consistency for applying by brush, roller, or spray gun.

PIGMENT

Opaque white pigment is zinc oxide. It has a very fine texture, but is usually mixed with titanium dioxide and other pigments for exterior work. 'This action is taken because zinc oxide alone makes a film that is too hard and brittle to withstand the extreme changes of outdoor temperature, which causes the paint to crack and scale off.

Titanium dioxide and zinc oxide are the principal white pigments in Navy paints. Titanium dioxide is a white pigment with the highest hiding power of any known pigment. Both titanium dioxide and zinc oxide are also considered "strengthening pigments" because they help increase the lasting quality of the paint.

Paint extenders, or inert pigments, are those that are chemically stable and do not affect color or destroy the life of the vehicle. They are used for various purposes, such as the following:

- To provide a less expensive base for certain kinds of colors
- To decrease the amount of chemically active pigments in the paint

- To reinforce the paint film
- To limit spreading power and increase the thickness of the paint film
- To make a good primer coat (base) for the finish coat
- To help prevent settling or caking in the container

Some of the more important extenders in common use are barium sulfate, calcium carbonate (or whiting), magnesium silicate (or talc), and silica.

VEHICLE

The vehicle, usually referred to as the base, is the liquid portion in a paint that acts as a binder and brushing medium for the pigment particles. It wets the surface to be painted, penetrating into the pores, and causes adhesion of the film formed by the drying vehicle.

Until recently the base of most paints was an oil, such as linseed oil. Today, very few of the Navy paints contain raw oil of any kind. Some have bases of processed oils in combination with synthetic resins; others have vinyl bases. Some fire-retardant paints have chlorinated alkyd bases; some high-performance paints have two-component epoxy or urethane bases. There are some that have water bases. Most oil-base vehicles dry partly by evaporation, partly by oxidation, and partly by polymerization—a process whereby two or more similar molecules combine chemically to form a larger molecule of a new substance. Older paints containing raw oils had poorer physical properties when dry, and dried much slower than modern paints. For these reasons raw oils never should be added to a Navy paint. If the paint is thick and needs to be thinned, add some of the recommended thinner. Never add diesel oil, varnish, or similar materials.

DRIERS

Certain metallic compounds, when mixed with oil, add to the drying properties of paint. These are driers and, as used in the Navy, consist chiefly of compounds of manganese and cobalt naphthenates.

A paint drier acts as a conveyor of oxygen, taking it from the air and adding it to the oil. This speeds the oxidation of the paint. Without the drier, absorption of oxygen would be too slow a process, and you would have to wait too long for the paint to dry.

THINNERS

Thinners reduce the consistency of the paint to the proper degree for application by spraying or brushing. They also increase the penetration of the paint into the surface and cut down the gloss. Too much thinner, However, will reduce the proportion of the vehicle. As you will remember, the vehicle is the binder, so if it is diluted too much, the durability of the paint will be affected. In flat paints, the proportion of the oil is deliberately reduced by thinners to such an extent that the paint dries without gloss.

The most common type of thinner is made of mineral spirits, but the proper type to use depends on the base of the paint. The correct thinner for each type of paint is listed in chapter 631 of *Naval Ships' Technical Manual (NSTM).*

MIXING PRECAUTIONS

Practically all of the paints you will be using will be ready-mixed; that is, when you draw them from the paint locker, they are ready for use. These paints have been carefully prepared to produce coatings that will be most satisfactory under the conditions in which the paints will be used.

Certain paints require mixing immediately before use. These are zinc-dust water-tank paint, aluminum paint, and high-performance epoxy or urethane hull, tank, or nonskid deck paints (which contain more than one component). If the zinc-dust or aluminum paints were mixed and then stored, the heavier particles would settle to the bottom. The zinc-dust or aluminum paste must be added in exactly the quantity needed, and the paints should be stirred frequently while you are using them. Multicomponent epoxy or urethane paints have a limited "pot life" after mixing and will thicken or harden if not used within that time.

Aluminum paint and zinc-dust paint should always be freshly mixed just before use. When they are left standing any length of time after mixing, they lose the property of leafing. (Leafing is the ability of the pigment to rise to the surface of the vehicle.) In all cases, they should be used the same day they are prepared. When kept in a sealed container, they have a tendency to become gaseous. The gases will rupture the container or blow the top off the can, presenting a danger to personnel and a fire hazard, leaving the paint exposed to the air, and ruining any paint left in the can. So mix aluminum paint and zinc-dust paint only as needed, and use them right away.

TYPES OF PAINT

LEARNING OBJECTIVES: Identify the different types of paints. Explain their uses and list their applications.

As you know, there are many different kinds of paint. For example, you cannot use the same type of paint on the deck topside and on the bulkheads in the captain's cabin. There is a different paint made for almost every purpose. In this section, you will find described under various headings some of the most important paints. Detailed instructions concerning the proper paints to use for each job will be found in chapter 631 of NSTM or in NAVSEA publication S0600-AB-MMO-010, *Preservation of Ships by Ship's Force.*

VARNISHES

Varnish is used as a vehicle and also as a separate coating. As a vehicle, it is found chiefly in primers, deck paints, and boot topping, where hardness, gloss, water resistance, and similar properties are desired.

The varnishes used by the Navy may be classified under two types—oil varnishes (such as spar varnish and interior varnish) and spirit varnishes (such as shellac and dammar varnish).

Oil varnishes are solutions of synthetic or natural resins, drying oils, volatile solvents, and metallic driers. Oil varnishes dry or harden partly through evaporation and partly through oxidation. Oil varnishes should be allowed plenty of time to dry before another coat is applied. Twenty-four hours is a safe period.

Spirit varnishes are made from gums or resins that are soluble in solvents such as alcohol, turpentine, acetone, or similar volatile solvents. They contain no drying oils and dry by evaporation, usually quite rapidly. Spirit varnishes often contain very flammable solvents and have few shipboard uses.

PRIMERS

Primers are prepared especially to adhere to the surfaces for which they are mixed. They provide the base needed for the finish coats of paint, and some include chemicals that inhibit (hold in check) rust and other corrosion.

Some of the common primers you will use are zinc molybdate formula 84 and formula 150; they are used as epoxy primers.

You should always apply at least one primer coat to interior surfaces. On topside metal that has been taken down bare, after pretreatment, you should apply no less than two primer coats. Make sure your crew applies an additional coat of primer to all edges, welds, rivet heads, and any other protruding objects in the work area.

Your epoxy primers are used on ships where a high state of performance is required, such as the weather decks and hull, and under some interior coverings. The epoxy primers are supplied in two parts, component A and component B, and mixed by volume. If the balance ratio is not correct, the surface will not cure properly, and failure of your paint or nonskid job will result. Make sure you consult *NSTM,* chapter 631, for further guidance on epoxy primers.

When your paint crew is applying a vinyl system of paint, they need to use formula 120, which is a vinyl primer.

PRETREATMENT

Before you prime a topside bare-metal surface, a coat of formula 84 pretreatment must be applied. You must also pretreat plastic surfaces that are to be painted with a coat of formula 150.

EXTERIOR TOPSIDE PAINTS

Properly primed vertical surfaces above the upper limit of the boot topping area are painted with two coats of haze gray, TT-E-490. In general, horizontal steel surfaces are painted with two coats of deck gray, formula 20. Refer to applicable type regulations for the exact color for each surface.

SHIP'S BOTTOM PAINTS

Protecting a ship's bottom presented special problems, which have been solved by the development of special paints for the purpose. Because this part of the ship is continuously under water, it is exposed to two dangers, either of which could shorten the life of the ship if left unchecked. These two dangers are corrosion and fouling. The part of the steel hull below the waterline would rust quickly if left unprotected from the salt water, and it would also become fouled with various types of marine growth. Two paint coverings help overcome these problems—anticorrosive bottom paint and antifouling bottom paint.

Anticorrosive

For both the underwater hull and boot topping of surface ships, apply pretreatment formula 150, followed by anticorrosive formula 14N or, in the vinyl system, vinyl primer formula 120. Epoxy hull primers are also approved; see *NSTM,* chapter 631, for details. For submarines, only the vinyl or epoxy systems should be used.

Anticorrosive paint does not protect against fouling. Anticorrosive and antifouling paints are always used together on active ship underwater hulls, and the anticorrosive always goes on first.

> **NOTE**
>
> **Vinyl and formula 14N anticorrosive dry very quickly because the vehicles used evaporate rapidly. Because of this, you must apply anticorrosive with short, quick strokes and progress steadily over the area you are painting. Anticorrosive also contains heavy pigments, which settle quickly. Because the beneficial effect of the paint depends largely on these pigments, you must stir the paint frequently.**

Antifouling

Antifouling paint prevents the fouling of the ship's bottom that results in loss of speed and increased fuel consumption. It contains copper oxide—the chemical most effective in preventing the attachment and development of marine growth. Remember, antifouling goes OVER an anticorrosive. It should not come in contact with the steel plating of the ship, because it can pit the surface. Be sure that total thickness and required coats of anticorrosive paint have been applied before you apply antifouling paint.

There are several kinds of antifouling paints used for steel-hulled surface ships. Cold plastic antifouling formula 105 is used for both steel and wooden hulls. Vinyl antifouling formula 121 is required for submarines and is normally used, rather than the hot or cold plastic paints, for surface ships. Formula 121 should not be used over formula 14N primer, since they are not compatible.

BOOT TOPPING PAINTS

The boot topping area is that portion of the ship just below the waterline (betwixt wind and water). It undergoes buffeting from both the sea and the air.

Vinyl alkyd formula 122 and vinyl formula 129 are used for boot topping on surface ships. Submarines require vinyl (black) antifouling formula 129.

On most warships, the boot topping area extends from the designer's waterline, at the lower edge, to 6 inches above the full-load waterline. On cargo vessels, oilers, and other ships that have a wide variation in service drafts, the boot topping area extends from the light-load waterline to 6 inches above the full-load waterline. On submarines, the area that requires boot topping extends from the waterline at maximum beam to the waterline at maximum condition diving trim.

DECK PAINTS

Deck paints are a standard stock item. For example, deck gray is used topside and in some working spaces; red deck paint is used in machinery spaces and workshops; and black is used in light-trap areas.

Exterior steel decks may be covered in more than one way. One system is to clean the deck down, removing all paints and applying formula 150 or another equally good epoxy primer (as found in *NSTM,* chapter 634), and finishing with two coats of formula 20 deck gray.

When a deck is to have a nonskid surface, make sure that you consult *NSTM,* chapter 634, for information on nonskid decking materials. Nonskid material should be applied within 24 hours after the primer has cured, for it to have maximum adhesion. Make sure that the primer is cured and presents a clean, dirt- and grease-free surface before you apply nonskid material. Do not apply nonskid over painted surfaces, because it will not adhere for any length of time.

For flight deck areas, a special nonskid coating is available. This system is critical in its need for proper application because of its special purpose in handling naval aircraft. There are contractors and shipyards certified by the Navy to lay out the flight deck system. Touch-ups and repairs can be done by the ship's force under strict guidelines found in *NSTM,* chapter 634.

The Navy has experimented with many different types of nonskid materials. The coatings used today provide a superior slip-resistant surface and if applied correctly should last over 6 months in aircraft areas and from 12 to 18 months on other decks. Application is accomplished either with a napless roller or by a new application technique that employs a troweling applicator that has a long handle and a serrated edge on the blade.

MACHINERY PAINTS

The paint used for the external parts of machinery except shafts and identification plates and any rotating parts or armatures is formula 111, machinery gray enamel. Use one coat of formula 84 primer, and two coats of formula 111, machinery gray.

There are special paints available for application to machinery parts such as boiler drums and superheater steam lines, which are subjected to high temperatures.

CAUTION

Machinery paints are very flammable. Make sure you check the flash points on the container label. Apply machinery-type paints only when the surfaces to be painted are in a cold-iron condition and when the equipment in the same or adjacent compartments is de-energized.

STAINS AND VARNISHES

When you have wooden items that are to be stained and varnished, take care of any defects in the wood first. This procedure is accomplished by filling bad areas with wood filler (Fed Spec TT-F-336) and dry sanding them to a uniform finish. Next, stain the wood to the desired finish, and after a few minutes, wipe the piece down with a lint-free rag to remove any excess stain. The wood must then be coated with at least three coats of varnish to bring out its luster and preserve it.

TANK PAINTS

The Navy stocks several paints made expressly for coating the inside of tanks. Most tank-painting jobs are done in a shipyard. If for some reason you must paint a tank, follow the manufacturer's instructions for mixing and applying paints or coatings to tanks or to potable water tanks. Detailed information on tank coatings can be found in *NSTM,* chapter 631, and in the NAVSEASYSCOM publication *Preservation of Ships by Ship's Force,* S0600-AB-MMO-010.

VERTICAL SIDES AND OVERHEAD PAINTS

Formula 124 is a white semigloss, chlorinated alkyd, fire-retardant paint that provides a decorative, yet corrosion-resistant coating. Although this paint will not prevent wood or other combustibles from burning and heat may cause it to break down, it will not burst into flame when exposed to fire.

It is important that you be careful when storing and handling fire-retardant paint. In the liquid state it is highly flammable because of the solvent it contains. The designation fire retardant applies to the paint only in its dried form. When more than three coats of this paint are applied to a surface, it is no longer fire retardant, and it will cause fire to spread.

In addition to formula 124, various shades of chlorinated alkyd-base paints are used. Formula 125 (pastel green) is used in such places as radio rooms, medical spaces, pilothouses, and offices. Formula 126 (equipment gray) is used in electronic spaces, certain flag spaces, and so forth.

ALUMINUM PAINTS

Aluminum paint is made of aluminum paste and varnish. For mixing purposes, the standard mix is 2 pounds of aluminum paste (Fed Spec TT-P-320, type II, class 2) with 1 gallon of varnish (Fed Spec TT-V-199). In general, bare wood that is to be painted is primed with 1 coat of aluminum paint. Then, your finish paint is applied (two coats). Do not use aluminum paint on underwater surfaces or under vinyl paints. For underwater wood surfaces, treat the wood with wood preservative, and then prime with formula 150.

CANVAS PRESERVATIVE

Just as metals must be protected by paint to prevent their disintegration from rust, fabrics must be protected by a preservative to stop decay, rot, and mildew. A piece of deck canvas used for hatch, gun, or boat covers will completely rot out unless preserved properly. Canvas preservative compound TT-P-595, designed for this purpose, contains ingredients that prevent mildew attack, retard fire, resist the deteriorating effects of sunlight, and prevent water leakage. Awnings, canvas covers, curtains, and any fabrics exposed to the weather should be thoroughly impregnated with this compound.

The best method of application is by brushing it on, because spraying will not give enough penetration into the fabric to furnish fireproofing, waterproofing, and weatherproofing. The fabric must be kept dry; otherwise, the protective materials will not penetrate. Both sides should be coated. The first side should be allowed to dry for an hour before you apply the compound to the second side.

Regular ship-type paints must never be used on any type of fabric. Paints will make the item too stiff to handle, will cause the item to crack and break, and will not protect the article from fire or rot.

The canvas preservative compound is supplied in four colors: haze gray, deck gray, olive drab, and white. There is, in addition to these colors, a plastic coating (sea rescue orange, color 12197), which can be used on ring buoys for preserving them until an orange-colored ring buoy can be obtained from stock.

ANTISWEAT COATING SYSTEM

LEARNING OBJECTIVES: Recognize how to prepare different types of surfaces for painting. Explain the drying time for different paints.

The antisweat coating system is used to prevent rust and corrosion on interior spaces that are subjected to continuous moisture.

For maximum corrosion resistance, at least two coats of primer—one of formula 150 and one of formula 151—must be used under the antisweat coating. The application of the antisweat coating system is a two-step process. First, you must apply one heavy coat of binder formula 34 to the surface. Do not thin formula 34. This coating must have a thickness of 5 mils. The Second, vermiculite (ASTM C 516, type I, grade 4) to the binder coating with compressed air. Complete details on mixing and applying antisweat coating are found in *NSTM,* chapter 631, and in the publication *Preservation of Ships by Ship's Force,* S0600-AB-MMO-010.

THERMAL SPRAY

You will find improved corrosion control and reduced shipboard maintenance achieved when metal-type coatings (zinc and aluminum) are applied by the thermal-spray process. These thermal-spray coatings provide electrochemical protection to surfaces exposed to the elements or close to dissimilar metals. Thermal spraying is a shipyard job, but it is important for you to know about it. When a surface is maintained properly, the thermal-spray coating will save you valuable time. In the thermal-spray process, aluminum or zinc in wire or powder form is fed into a spray nozzle where it is melted by a torch or electric arc. Compressed air breaks down the molten metal into droplets and sprays them on the surface to be coated. This coating provides an excellent base for painting, and you can consider this coating the initial permanent primer coat. The application of a sealer or topcoat provides the thermal-sprayed surface with long-term protection.

Based on long-term-exposure tests conducted by the Navy, aluminum is preferred for thermal-spray applications.

The use of wire-sprayed aluminum (WSA) applications on surface ships must be accomplished using the procedures described in NAVSEA 6435-AE-MMA-010, *Wire-sprayed Aluminum Coating.*

Wire-sprayed aluminum is approved for the following topside areas and fixtures:

- Aircraft and cargo tie-downs
- Stanchions
- Scupper brackets
- Deck machinery casings and foundations
- Chocks, bitts, and cleats
- Pipe hangers, light fixtures, and brackets
- Capstans and gypsy heads (except wear areas)
- Rigging fittings (blocks and hooks)
- Fire station hardware
- Steel catwalks, brackets, supports, ladders, steel attached to aluminum bulkheads, refueling stations, intake plenums, roller chocks, flagstaffs, hatches and scuttles, safety net components, watertight doors, weather deck storage boxes, and boat davit components

As you can see by the list of equipment that can be coated with WSA, your maintenance requirements topside, and in the spaces that deck maintains, can be greatly reduced through the superior corrosion resistance of thermal spray.

Your job, as a PO supervisor, is to make sure that your crew does not destroy this protection by chipping it off. Tell your crew what items are to be worked and what equipment is to be left as it is. For more information on thermal-sprayed items, refer to *NSTM,* chapter 631, section 6.78.

DRYING TIME

Paint drying times vary widely, from 4 hours for zinc-dust tank paint to several days for some paints at cold temperatures or with poor ventilation. When you are going to add a second coat, it is especially important to know when the first coat will be dry. Actual drying times may vary a few hours because of atmospheric conditions, the condition of the surface, the paint film thickness, and other factors. The normal drying time for most Navy topcoat paints is 8 hours under normal conditions. For example, if you are doing interior painting on a damp day, you must remember that it may take longer than average for the paint to dry.

SURFACE PREPARATION

The most important single factor in securing good paint performance is proper surface preparation. Dirt, oil, grease, and rust or mild scale must be removed completely; and the surface must be thoroughly dry.

Equipment used to prepare surfaces includes hand tools, power tools, sandblasters, soap (or detergents) and water, and various paint and varnish removers.

CAUTION

Some paint removers or strippers are extremely hazardous and are not suitable for ordinary shipboard use. If in doubt, consult NSTM, chapter 631.

HAND TOOLS

The hand tools or materials most commonly used in surface preparation are sandpaper, a steel-wire brush, and a hand scraper.

There are several kinds of sandpaper. In general, they can be divided into two types—those that are natural abrasives and those that are artificial abrasives. The flint and garnet grits of ordinary sandpaper are natural abrasives. Emery and corundum, which are used in the production of some of the cheaper grades of abrasive sheets are natural abrasives also. Artificial abrasives have largely replaced the natural abrasives used on metal. The two principal artificial abrasives are silicon carbide and aluminum oxide.

The size of abrasive is indicated by code number, ranging from 4 to 5/0 (or 00000). In garnet and artificial abrasives, 4 or 3 is a very coarse abrasive (16-24 mesh); 2 1/2 to 1 1/2 is coarse (30-40 mesh); 1 to 0 is medium (50-80 mesh); and 2/0 to 5/0 is fine (100-180 mesh). In flint paper or emery cloth, 3 to 2 is coarse; 1 1/2 to 1/2 is medium; and 0 to 3/0 is fine. You will find sandpaper indispensable in cleaning comers. The usual procedure is to go over the surface first with a coarse sandpaper and polish it with one of the fine grades. Do not polish any more than what the final finish requirements dictate: paints bond best to clean surfaces that are rough enough to provide "mechanical teeth."

There is a waterproof type of sandpaper. This sandpaper usually consists of a better grade of garnet grit, bonded (made to stick on the paper) with a special resin. These sheets may then be used with water or oil for wet sanding. Ordinary sandpaper will disintegrate when used with liquids.

A hard wire brush is a handy tool for light work on rust or on light coats of paint. It is also used for brushing around weld spots. When the surface is pitted, use a steel wire brush to clean out the pits.

Scrapers are most useful for removing rust and paint from small areas and from plating less than one-fourth of an inch thick, where it is impractical or impossible to use power tools.

Occasionally, it is necessary to use a chipping or scaling hammer: but before you put personnel to work with such a hammer, make sure they have been instructed to use only enough force to remove the paint. When a great deal of force is required to remove the paint, the paint is still good and should not be chipped off. Feather the edges with a wire brush (hand or power). Prime and paint the area in such a way as to give it a natural appearance.

Sharpening Scrapers

The first step in sharpening a scraper is to square the end. Adjust the tool rest of the grinder so that it just clears the face of the wheel (views A and B of fig. 11-1). Lay the scraper flat on the rest. Then, keeping the end of the scraper parallel with the shaft of the grinder, move the scraper back and forth across the face of the wheel. Grind across the entire width of the scraper. Use enough pressure to keep the wheel cutting but not enough to appreciably decrease its speed or overheat the metal. Keep a can of water handy while you are grinding, and frequently dip the scraper into the water. This helps prevent the scraper from overheating and drawing the temper from the metal.

When your scraper has been chipped, grind away the edge until the chips disappear.

With the end squared, begin to sharpen the scraper. Hold it in such a way that the original bevel lies flat against the face of the wheel (view C, fig. 11-1). If the construction of the tool rest is such as to facilitate it, hold your forefinger against the tool rest to serve as a guide as you pass the scraper back and forth across the wheel (view D, fig 11-1).

Sharpening any tool in this manner causes the sharp edge to curl back or feather. The last step in sharpening is to remove the feathered edge. This may be done by lightly touching the flat side of the scraper to the side of the wheel, but a better method is to remove the feather with a fine file.

Sharpening Chipping Hammers

A chipping hammer is not sharpened like a cutting tool, but like the blade of an ice skate. First, square the edge as described for scrapers. Then, grind away alternately on both bevels until the squared face is from one sixteenth to one-eighth of an inch wide, as shown in figure 11-2.

POWER TOOLS

The most useful power tool for surface preparations is the portable grinder, shown in figure 11-3. This usually comes equipped with a grinding wheel which, for wire brushing purposes, is replaced by either the rotary wheel wire brush or the rotary cup wire brush. The light-duty brushes are made of crimped wire, and the heavy-duty brushes are made of tufts of wire formed by twisting together several strands of wire.

Scaling may be done by either of the tools shown in figure 11-4. A chisel about 8 inches long and 1 1/4 inches wide is used with the pneumatic hammer. The hammer

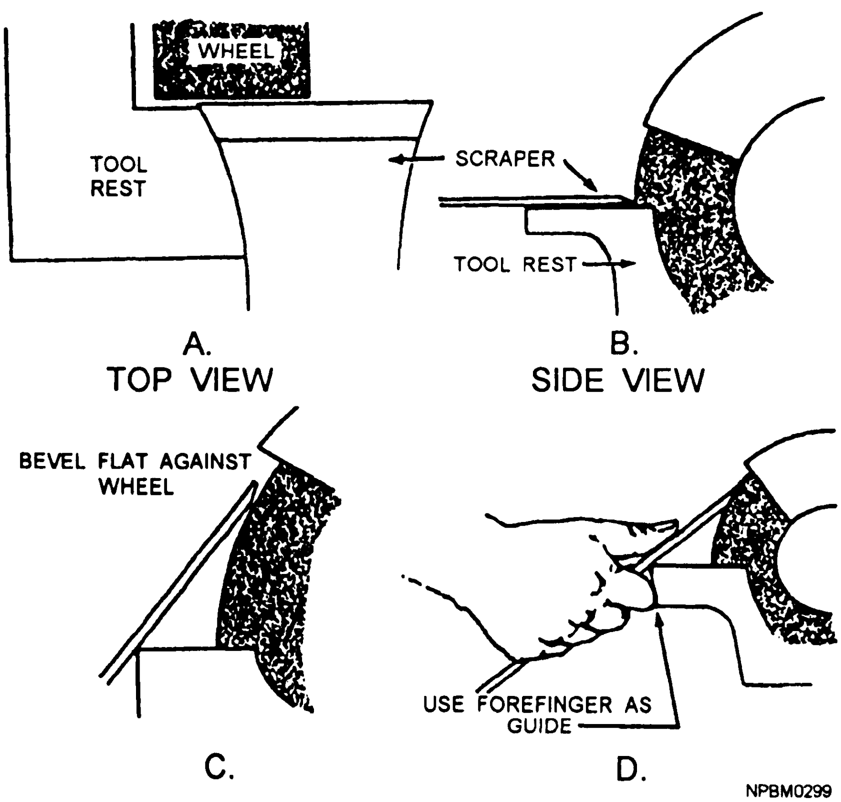


Figure 11-1.—Sharpening a scraper.

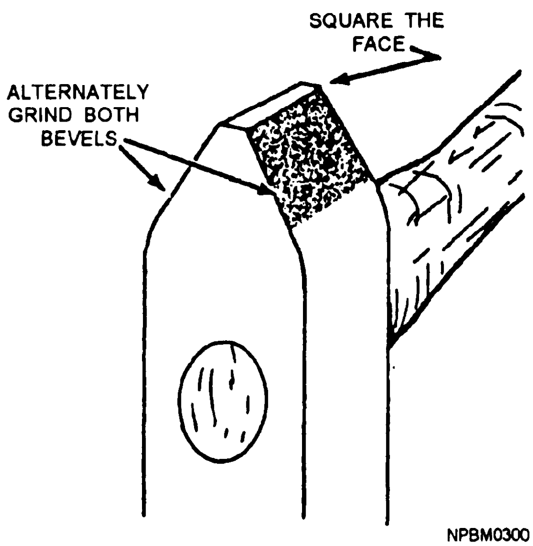


Figure 11-2.—Sharpening a chipping hammer.

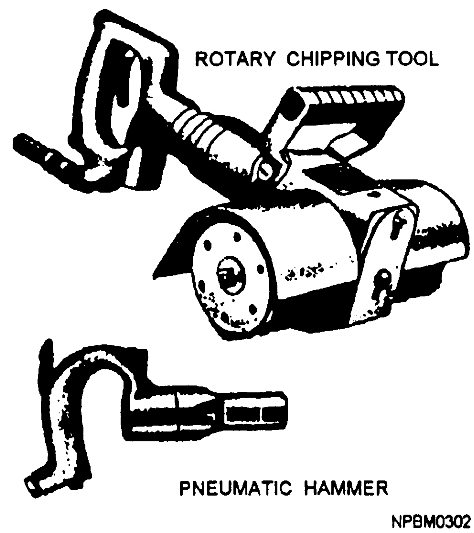


Figure 11-4.—Power scaling tools.

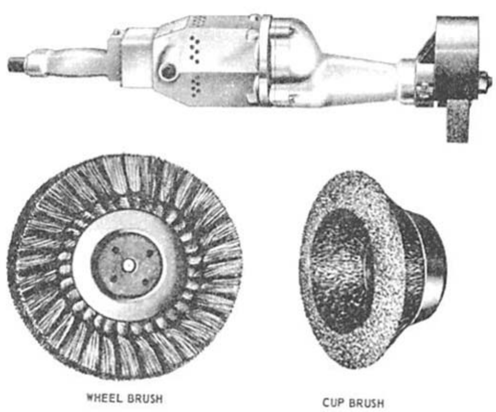


Figure 11-3.—Electric portable grinder and wire brushes.

is held so that the chisel strikes the surface at an 45 degree angle. Great care must be taken not to dent the surface, thereby forming low and high areas, which might lead to early failure of the thin paint film deposited on the high points.

The rotary scaling and chipping tool, sometimes called a "deck crawler," is electric-powered and has a bundle of cutters (or chippers) mounted on either side. In use it is pushed along the surface to be scaled, and the rotating cutters do the work. Replacement bundles of cutters are available.

Also available is a larger, heavier model of this tool, designed especially for scaling decks, but only carriers and tenders have them on their allowance lists.

The electric disk sander is also a handy tool for surface preparation, but great care must be taken when you are using this machine. The disk should be moved smoothly and lightly over the surface. It should never be allowed to stay in one place too long, because it will cut into the metal or wood.

Sanders

Portable sanders are designed to hold and operate abrasives for sanding wood, plastics, and metals. The two types of sanders you will find useful on deck are the disk sander and the orbital sander.

- **DISK SANDER.**—Electric disk sanders (fig. 11-5) are especially useful on work where a large amount of material is to be removed quickly, such as scaling surfaces in preparation for painting. This machine, however, must not be used where a mirror-smooth finish is required.

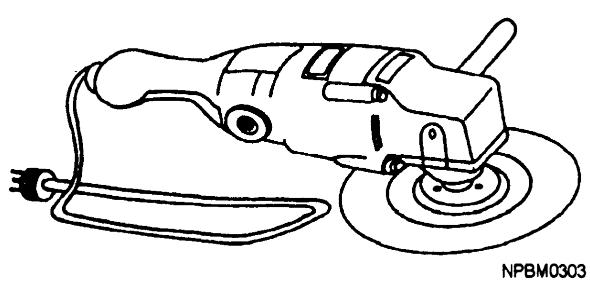


Figure 11-5.—Portable electric disk sander.

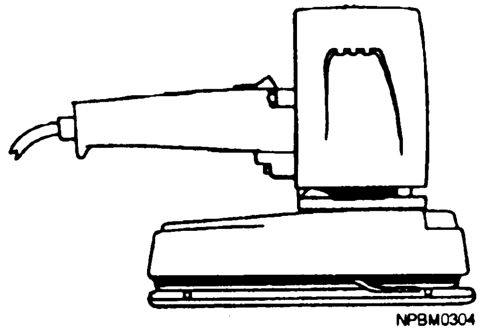


Figure 11-6.—Orbital sander.

The disk should be moved smoothly and lightly over the surface. Never allow the disk to stay in one place too long, because it will cut into the metal and leave a large depression.

- ORBITAL SANDER.—The orbital sander (fig. 11-6) is so named because of the action of the sanding pad. The pad moves in a tiny orbit, with a motion that is hardly discernible, so that it actually sands in all directions. This motion is so small and fast that when fine paper is mounted on the pad, it is nearly impossible to see any scratches on the finished surface.

The pad around which the abrasive sheet is wrapped extends beyond the frame of the machine, so it is possible to work in tight comers and against vertical surfaces.

Needle Gun Scaler

The needle gun scaler (fig. 11-7) is used to remove rust, scale, and old paint from steel surfaces aboard ship. You must be careful when using the needle gun, because it will "chew up" anything in its path. The needle gun scaler does the job with an assembly of needles impacting on the surface hundreds of times a minute. The main advantage of this scaler is that it can clean out irregular surfaces. Figure 11-8 shows how the needles self-adjust to the contour of various surfaces. Do not use the needle gun scaler on light-metal surfaces, as it will pit the surface with its impacting needles.

Safety Precautions for Electric and Pneumatic Tools

Most electric tools are powered by 115-volt motors. Many people tend to consider 115 volts not worthy of even moderate precautions. But, make no mistake about it, 115 VOLTS CAN AND DOES KILL!

All electric power tools in the Navy are of the three-wire, grounded type. Even so, the operator can receive a shock if

- the insulation on the wires becomes defective (because of age, abrasion, or defective repairs),
- the ground circuit is not complete, or
- the operator becomes grounded

All electric power tools must be inspected by an electrician before they are used. If there is any doubt about the condition of a tool while you are operating it, take it to the electric shop immediately. Never allow anyone to operate any power tool that is functioning improperly.

Always make sure your personnel wear goggles when they are using power tools. This is particularly important with wire brushes, because strands of wire frequently break off and shoot through the air like tiny arrows. They will penetrate a person's skin with ease, so imagine what one of them can do to an eye.

Insist that your personnel give their full attention to the job and keep all parts of their bodies away from the business end of the tools. Many people have been rudely jolted out of a daydream by a power brush crawling up a pants leg.

Keep nonessential personnel out of the area where power tools are in use, and do your supervising behind the operators.

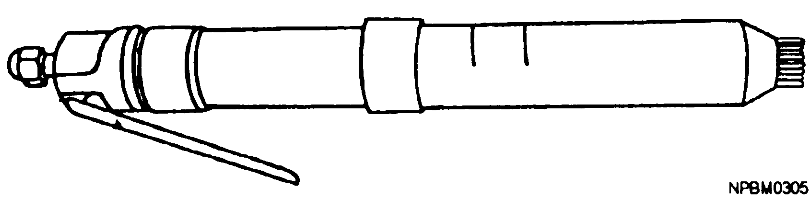


Figure 11-7.—Needle gun scraper.

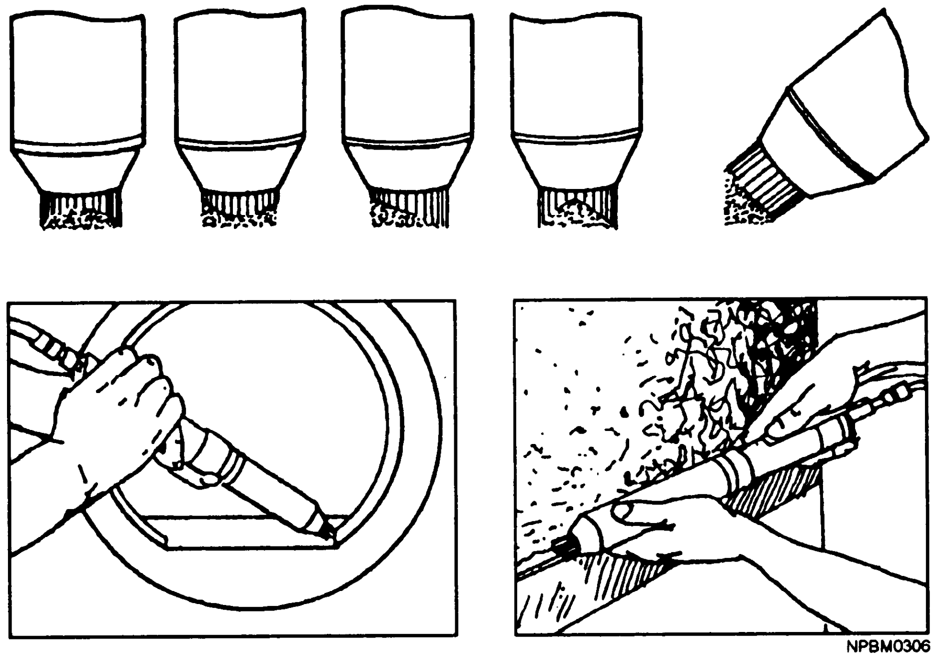


Figure 11-8.—Needle gun scaler operations.

In operating or maintaining air-driven tools, take the following precautionary measures to protect yourself and others from the damaging effects of compressed air:

- Inspect the air hose for cracks or other defects; replace the hose if it is defective.

CAUTION

Before you open the control valve, see that nearby personnel are not in the path of the airflow. Never point the hose at another person.

- Before you connect an air hose to the compressed air outlet, open the control valve momentarily. Then, make sure the hose is clear of water and other foreign material by connecting it to the outlet and again opening the valve momentarily.
- Before you connect, disconnect, adjust, or repair a pneumatic tool, stop the flow of air to the pneumatic tool by closing the control valve at the compressed air outlet.

PAINT AND VARNISH REMOVERS

There are three types of paint and varnish removers in general use: the flammable solvent type containing benzol, acetone, and amyl acetate; the nonflammable type containing chlorinated hydrocarbons; and the water-base alkali type containing caustic materials. Although all three are effective, their use aboard ship is limited because they are definitely hazardous. These removers must not be used except in well-ventilated spaces; and all safety precautions for the type of remover in use must be observed. Removers made to strip epoxy paints are extremely hazardous, from the standpoints of both toxicity and skin burns.

CAUTION

Before using epoxy paint removers, personnel must be familiar with *NSTM,* chapter 631.

Alkali paint removers must not be used on aluminum or galvanized surfaces.

Use the same procedure, regardless of the type of paint remover. Wet the surface with a smooth coat of the remover and let it soak in thoroughly until all paint or varnish is loosened. Then, lift the paint off with a hand scraper.

Soon after the remover is spread on the object, a film forms on the surface of the remover. Do not disturb or break this film until you are ready to lift off the paint. If you break the film, the remover will lose some of its effectiveness. After the surface is cleaned, wet it again with the remover and wipe it off with a rag. Next, wash the surface thoroughly with paint thinner or soap and water. This will get rid of any wax left by the remover and any acids that have worked into the grain of the wood.

Safety Precautions for Paint and Varnishes

NEVER use paint and varnish removers around an open flame, because some of the removers contain flammable ingredients. Do not use them in confined spaces, since some of them have dangerous anesthetic properties. Do not use paint and varnish removers if you have open cuts or sores on your hands, unless rubber gloves can be used. Avoid letting the remover touch your skin; watch out particularly for your face, eyes, and mouth. If paint or varnish remover touches the skin and begins to burn, wash it off with cold water immediately and consult the medical officer.

NEVER use turpentine, spirits, or other thinners for cleaning your hands; they can be absorbed through the skin's pores. Gasoline also is dangerous because it may contain lead. Use hand soap and water or a commercial hand cleaner. Stubborn paint spots usually can be removed by rubbing with petrolatum. A lubricating oil or diesel oil can be used if, immediately after its use, you wash your hands thoroughly with soap and water.

SMALL BOAT BOTTOMS

LEARNING OBJECTIVE: Identify what type of paint you will use for what type of surface on small boat bottoms.

In preparing small boats for painting, you must remove any foreign matter on the boat by scraping and surface cleaning. Surface cleaning provides a rough surface, which is free from contamination, gouges, and sharp projections. Surface cleaning varies with the type of surface, the preparation needed, and the size of the area being cleaned. The different cleaning methods are as follows:

- Hand cleaning by the use of hand tools and solvent cleaning of the surface
- Power-tool cleaning by scaling and sanding the surface
- Abrasive blasting on metal surfaces

WOOD SURFACES

Usually, the first step in preparing a wood surface for repainting—particularly if no paint is to be removed—is to wash it. The next step would be to lightly sand the surface to smooth it out and give the new coat of paint something to adhere to.

NOTE

As you remember, we stated that aluminum paint is the primer for wood that is to be painted. Also, aluminum paint is not to be used on underwater surfaces or under vinyl paints.

For your wood planking in the chain locker, USC a heavy coat of wood preservative MIL-W-18142.

STEEL SURFACES

Bare steel surfaces must not be left exposed to the elements. After surface preparation and pretreatment (in paint systems calling for it), apply one primer coat to interior surfaces and two primer coats to exterior surfaces. Give all edges, comers, welds, rivet heads, and protruding objects an additional coat of primer. You will find these are the areas that break out and rust first, so they need special attention in your surface preparation.

GALVANIZED SURFACES

The process of galvanizing includes dipping sheet metal in a molten zinc bath, which gives the base metal a long-wearing, protective coating. You will find many galvanized fittings on ships. All galvanized steel should be painted unless specifically excluded.

Before you paint galvanized surfaces, rough up and clean the surface with a solvent. Apply epoxy paints where specified; otherwise, use one coat of formula 150 and one coat of formula 84.

NOTE

Use formula 150 instead of formula 84 when a vinyl paint system is to be applied.

Where painting is not required, apply one of the following coatings to welds and damaged areas:

- Two coats of galvanizing repair paint MIL-P-20135
- Two coats of zinc-dust paint MIL-E-15145, formula 102

ALUMINUM SURFACES

The Naval Sea Systems Command is greatly concerned with the amount of corrosion of aluminum aboard ship. This section, some of which bears little relation to painting, was prepared especially to acquaint BMs with the problem, for it is felt by personnel of NAVSEA that properly informed BMs will be able to halt or prevent much of the deterioration of shipboard aluminum.

In all cases the corrosion is greater where moisture is present and metal of another type (or wood) comes in direct contact with aluminum. When dissimilar metals, such as aluminum and steel in contact, are exposed to an electrolyte (seawater, for example), an electrical current flows from one to the other, resulting in galvanic corrosion of the aluminum. The principle is the same as that used in batteries and in electroplating. The character of aluminum alloy is such that its contact with any other metal (or even a different aluminum alloy) under the conditions just described will produce corrosion of the aluminum.

The condition is first indicated by a white powdery residue deposited in the area of contact; later, by pitting and scarring of the aluminum surface; and finally, by complete deterioration of the aluminum in the area. Holes in aluminum plate enlarge, and the screws, bolts, or rivets pull out. Screws, bolts, or rivets made of aluminum alloy disintegrate.

Obviously, the way to prevent this corrosion is to insulate completely the aluminum from the other metals. This is especially important when the joint is exposed to moisture.

Briefly, the method of insulating the aluminum from other surfaces is by installing tape between the joined surfaces where one or both sides of a joint are exposed to the elements. The insulating tape must be at least 17 mils thick. This can be accomplished by applying two layers of MIL-E-24391 tape. The tape must be wide enough to extend beyond the joint edge. The joints must be sealed with caulking compound (MIL-C-18255). Figure 11-9 shows how to caulk the joints. When butyl or neoprene rubber tape is used, caulking is not required.

When you are preparing to paint these joints, never remove the caulking. If you find an area of caulking that has deteriorated or if moisture appears to be underneath the caulking, remove the damaged section. The surface of the joint must be completely dried and the caulking renewed before you start priming. Never cut away the insulating tape.

Wood that comes in contact with aluminum must be covered with a coat of spar varnish (Fed Spec TT-V-119). Insulation tape must be placed between the two surfaces. This applies to all cases, even minor items such as aluminum label plates attached to wood or steel and to plates of any kind of metal attached to aluminum.

Power tools, such as sanders (using aluminum oxide grit), stainless steel wire brushes, and needle guns, or a combination of these tools, may be used to prepare aluminum surfaces for painting. Hand sanding with aluminum oxide paper is used to feather the edges of intact paint.

Paint systems for exterior aluminum surfaces are as follows:

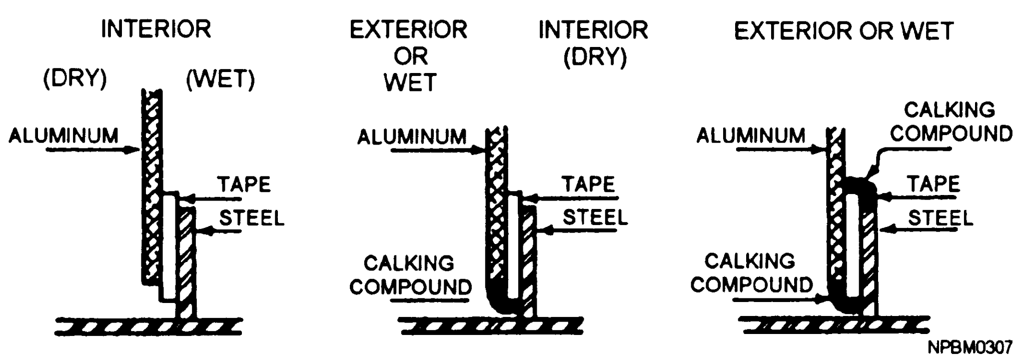


Figure 11-9.—Aluminum-steel joints.

- The best system—one coat of epoxy primer MIL-P-24441, one coat of epoxy paint formula 151, and two coats of silicone alkyd haze gray TT-E-490
- Alternative system—one coat of epoxy primer formula 150, one coat of epoxy paint formula 151, and two coats of silicone alkyd haze gray TT-E-490
- Conventional system—one coat of pretreatment formula 150, two coats of zinc chromate formula 84, and two coats of silicone alkyd haze gray TT-E-490

Interior surfaces are prepared with one coat of formula 84 or 84D.

If a vinyl system of paint is to be used, formula 120 vinyl primer is used.

On some ships, fasteners (screws, bolts, rivets, toggle pins, and so on.) of steel, brass, and bronze have been substituted for the original in aluminum ladders, lifeline stanchions, lockers, and so on. This practice must be discouraged; the substitutes must be replaced by fasteners of the original type. If information concerning the original item is not available, replacements of stainless or galvanized steel generally may be considered safe.

SHIPS' BOTTOMS

The condition of the ship's bottom has considerable effect on steaming performance. So, before applying paint to the bottom, you must be certain that it has been cleaned carefully. A special problem is involved because oil and grease often accumulate near the waterline. Paint applied over grease may not adhere or dry, so you must remove all traces of grease with a solvent.

One other point about preparing ships' bottoms for painting: DO NOT REMOVE PAINT THAT STICKS AND IS FREE FROM FOULING. Remove blistered, flaked, or loose paint by sandblasting, hydroblasting, or hand cleaning; but do not touch paint that adheres firmly and gives protection to the bottom. Clean antifouling paint that is over 2 years old to its original color and apply two additional coats. Where paint is completely removed and the metal or wood is bare, replace all the coats of the bottom system.

PIPING SYSTEMS

In cleaning piping systems, you must not mar the surface. The ordinary procedure is to remove loose paint from the pipe with a scaling tool, and then go over the pipe with a wire brush to remove all loose particles.

At some naval shipyards, when a big overhauling job is under way, the pipes may be taken out and sandblasted while other machinery is being moved.

If you have ever wondered how the inside of a pipe is cleaned, you will find one answer in an ingenious tool called a vibrator. It has a long shank with a malletlike head. This shank is inserted in the pipe, and the vibration of the head removes scale and rust. Then, an air hose is used to blow out all the loose flakes.

ELECTRICAL EQUIPMENT

No attempt should be made to remove paint from electrical cables, fixtures, control enclosures, or switchboards. If you take the paint off a cable, you may injure the protective armor and watertight sheath directly beneath it. Damage to the sheath will allow moisture to enter and will result in grounding. If you twist or bend a cable to remove paint from it, you might destroy the watertightness of the packing in the bulkhead stuffing tubes.

The impervious-sheath flexible cable furnished to naval vessels requires no paint to protect its synthetic resin surface.

When you are scraping paint, sandblasting, or painting near electrical equipment, be sure that the equipment is covered to protect it from paint, dust, or sand particles. After your work is finished, clean the electrical equipment thoroughly, using a vacuum cleaner if you have one. Remember: Paint dust is full of abrasive and semiconducting particles, which can seriously damage electrical equipment.

GENERAL PAINTING GUIDELINES

LEARNING OBJECTIVES: Recognize what type of surfaces you should paint and how to prepare the surfaces to start your painting.

Painting of interior and exterior areas should be done only when it is necessary to prevent corrosion or deterioration or when the existing paint has failed. When you are painting out spaces, touch-up painting is the preferred method, rather than a complete paint job. This action, of course, is up to the discretion of the commanding officer.

When you are repainting interior surfaces, to retain fire retardance, apply only the minimum number of coats of paint. One coat of paint is usually enough in interior spaces.

On topside areas, you should try to catch potential problems before they start. Here again, touch-up painting is the preferred method. There is no sense in scaling down a whole bulkhead when all that is wrong is a small patch of deterioration.

The small areas that are bad should be cleaned down to the metal. The adjoining paintwork must then be feathered down to a tapering edge around the spot to be painted. The new primers and paint are then applied in such a way as to give a natural appearance to the finished job.

You will find some areas and articles on a ship that are not painted. These parts may be part of a mechanical mechanism of a door or hatch. The area must still be cleaned and protected. In some areas this is accomplished by applying a rust-preventive compound; other items must be cleaned frequently with emery cloth.

WHAT NOT TO PAINT

The following items must NOT be painted:

- Start-stop mechanisms of electrical safety devices and deterioration control switchboards on machinery elevators
- Bell pulls, sheaves, annunciator chains, and other mechanical communication devices
- Composition metal on the water end of pumps
- Condenser heads and outside surfaces of a condenser made of composition metal
- Dry sprinkling piping within magazines
- Exposed composition metal parts of any machinery
- Glands, stems, yokes, toggle gear, and all external parts of the valves on machinery
- Heat-exchange surfaces of heating or cooling equipment
- Identification plates and warning plates
- Joint faces of gaskets and packing surfaces
- Lubricating gear, such as oil holes, oil or grease cups, zerk fittings, lubricators, and surfaces in contact with lubricating oil
- Lubricating oil reservoirs
- Machined metal surfaces of reciprocating engines or pumps
- Metal lagging
- Rods, gears, universal joints, and couplings of valve-operating gear
- Rubber elements of isolation mounts
- Ground plates
- Springs
- Strainers
- Threaded parts
- Zinc
- Working surfaces
- Hose and applicator nozzles
- Knife edges, rubber gaskets, dogs, drop bolts, wedges, and operating gear of watertight doors, hatches, and scuttles
- Electrical contact points and insulators
- The original enamel, lacquer, or crackle finish on all radio, electrical, and sound equipment, unless damage makes refinishing essential
- Decorative plastic, such as tabletops
- Porcelainized bulkheads
- Corrosion-resistant stainless steel (CRES) decks, cres galley equipment, and CRES bulkheads
- The following interior surfaces are constructed of aluminum (these surfaces may be waxed where desired for appearance):

  a. Bins, shelves, dressers, drawers, cabinets, battens, and fittings

  b. Interior gratings, handrails, and floor plates

  c. Internal surfaces of ventilation ducts

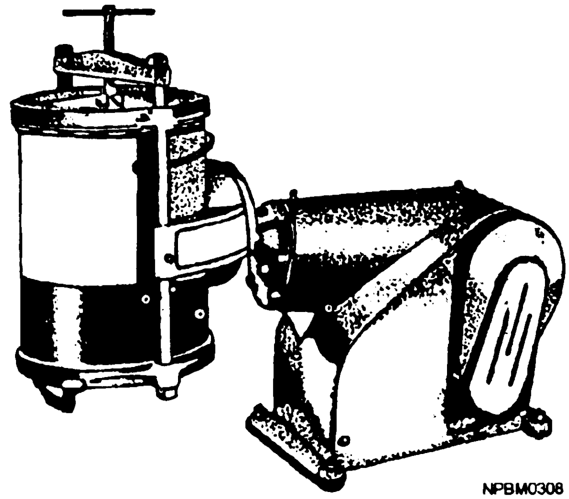


Figure 11-10.—Paint-mixer vibrating shaker.

PAINTING SAFELY

Painting operations can put you and your paint crew in situations that are dangerous. Sure, you have painted things before and nothing has ever happened. Stop and think for a minute about the gear you are using. You have toxic and flammable materials, pressurized spray equipment, stages, bos'ns chairs, and rigging involved in the job. There may also be walking, talking hazards caused by the inexperience, the lack of training, or the carelessness of the paint crew.

You, as the supervisor, must be aware of all potential hazards in and around the area of operations. You are the one that must train your crew, and it is you that must take the proper measures to minimize the dangers to your paint crew.

It is your responsibility to make sure your crew has proper ventilation in painting operations. You must also see that they are properly dressed and wearing hearing and eye protection. Personnel working with and around paints must wear respirators if toxic vapors exist or if there is a difference between the air in the work space and the outside air.

PAINT PREPARATION

No matter how high the quality of a paint, it will give you poor service if not thoroughly mixed before applied. When paint stands for long periods of time, the pigment settles to the bottom of the container and the vehicle rises to the top. Naturally, you must remix the paint before it is used.

The best system for mixing paint is the paint-mixer vibrating shaker (fig. 11-10), and it should be used whenever possible. If a shaker is not available, the paint must be stirred until all lumps, cakes, and sediment are mixed. The best method of stirring paint is as follows:

- Open the paint can, and if a skin has formed on the top of the surface, carefully remove it and throw it away.
- Pour the top two-thirds of the paint into another can, as shown in view A of figure 11-11.
- Stir the pigment and liquid in the first can until the paint is mixed smoothly. You may use a

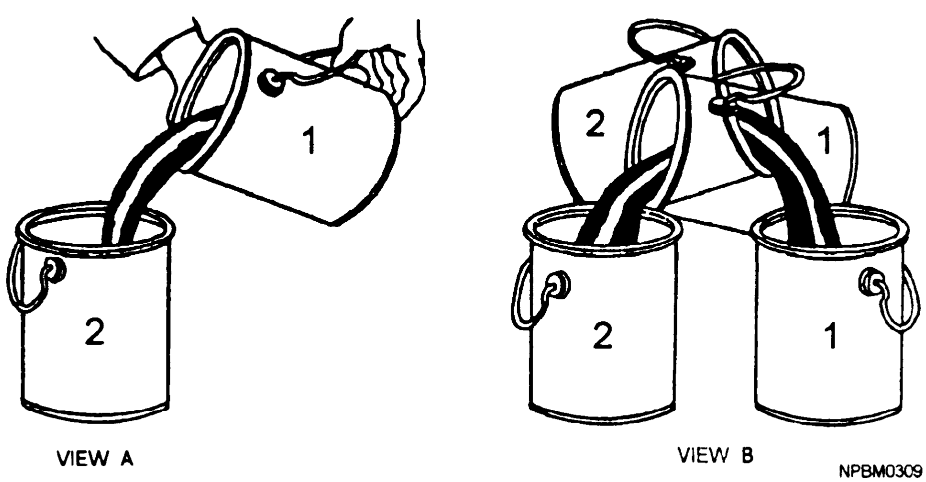


Figure 11-11.—Paint mixing (boxing).

mixture attachment on an electric or pneumatic drill.

- Slowly add the contents of the second can back into the first can. Continue to stir the paint.
- Now, start to mix your paint by pouring it back and forth from one can to the other (this is called boxing) until the paint is completely smooth, as shown in view B of figure 11-11.

Once the paint is completely mixed, strain it through cheesecloth or a fine-mesh wire screen to catch any particles or bits of skin that did not get dissolved in mixing.

Some of the newer paints require special mixing procedures and waiting periods before they are used. When preparing your epoxy and polyurethane paints, make sure you carefully follow the manufacturer's instructions on mixing, waiting periods, and application.

PAINT MIXING AND ISSUE ROOM

LEARNING OBJECTIVES: Distinguish a paint mixing and issue room. Interpret the methods of preparing and applying paint to the different types of surfaces.

The paint mixing and issue room (paint locker) is a readily accessible space aboard ship, designed for the mixing and issuing of paint and materials used in daily work. The paint locker is also used to store brushes, rollers, spray equipment, and mixing attachments. The paint locker must be kept clean, cool, and dry. Inside the paint locker, you should have a worktable, shelves, racks for storing the paint, and a wash-tank system. The wash tank is place to clean used brushes and a space to dry them. The tank must be cleaned at regular intervals and the surrounding area kept clean.

The paint locker must have a CO_2 or Halon flooding system installed. All applicable safety signs, warnings, and operating procedures must be posted. Vents, vent closures, and controllers must be clearly marked and operable. In addition, an eye/face bath station must be installed either in or just outside the paint locker.

Remember that only the paints, thinners, and so on, that are needed for the day's painting should be kept in the paint locker.

Keep your paint cans tightly sealed and make sure they are marked with the name, formula number, and date of manufacture.

The remainder of your ship's allowance of paint is stored in the flammable-liquid storerooms. They are located below the full-load waterline. When new stocks of paint are obtained, they must be stored below in this storeroom and stored behind the old paint, so that the old paint is used first.

At least once every 3 months, the cans in the paint stowage spaces should be turned "bottom up" to keep the pigment from hardening into a solid mass at the bottom of the container.

NOTE

Do NOT use the bottom-up procedure on cans of paint that may have been opened or that are not sealed properly, or you will have a real mess on your hands.

Good housekeeping conditions must be maintained at all times. Passages and aisles must be kept open, and free access to all exits must be maintained. All fire alarms and extinguishing equipment, as well as ventilation and drainage, must be kept clear of stored materials.

PAINT INSPECTIONS

Containers of paint more than 2 years old must be inspected. When the paint is found to be not suitable for use, it must be surveyed. When you are uncertain as to whether the inspected paint is suitable for use, especially when large quantities are involved, send samples of the paint to the laboratory division at the nearest naval shipyard.

PAINTING BY BRUSH

LEARNING OBJECTIVE: Explain the proper procedures for painting with a brush and a paint roller.

Smooth and even painting depends as much on good brushwork as it does on good paint. There is a brush for almost every purpose, so be sure you use the right brush and keep it in the best condition.

The following listing contains the name and general use of the most frequently used brushes in the Navy:

TYPE OF BRUSH	FOR USE ON
Flat paintbrush	Large surfaces
Oval sash and trim brush	Small surfaces
Fitch brush	Small surfaces
Oval varnish brush	Rough work
Flat varnish brush	Medium work
French bristle varnish brush	High-grade work
Lettering brush	Small surfaces
Lettering brush	Large work
Painter's dusters	Cleaning work

The most useful paintbrushes are the flat brush, the oval sash, and the trim brush. A skillful painter using a flat brush can paint almost anything aboard ship. Flat brushes are wide and thick, carry a large quantity of paint, and provide a maximum of brushing action. Sash brushes are handy for painting small items and those hard-to-get places and for cutting in at comers. These brushes and some others commonly used aboard ship are shown in figure 11-12.

CARE OF BRUSHES

Brushes are only as good as the care given them. The best brush can be ruined very quickly if not properly treated. If you follow the suggestions given in the next few pages, the brushes will last longer and give better service.

When bristles of paintbrushes were set in wood, painter dampened the wood to cause it to swell and hold the bristles more tightly. Today, however, nearly all paintbrushes have bristles set in rubber or in some composition material. This means, of course, that wetting the end of the handle holding the bristle is useless. In fact, this practice will probably cause harm, because it will tend to make the metal band (ferrule) rust faster.

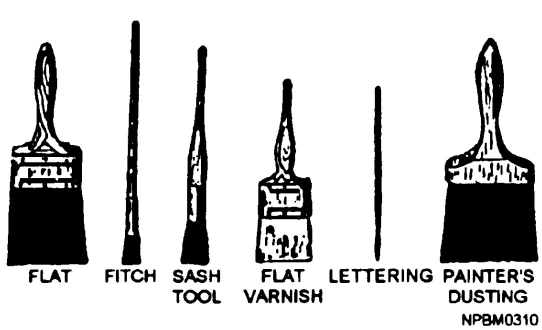


Figure 11-12.—Types of brushes.

To make a new natural-bristle brush more flexible and easier to clean, rinse it in paint thinner and soak it in boiled linseed oil for about 48 hours. Before using the brush, drain the oil from it. Wipe the bristles clean and wash them in a solvent or other oil remover. (Synthetic-bristle brushes do not require special treatment before use.)

CARE AFTER USE

Every paint locker should have a container with divided compartments for stowing different types of brushes (for example, paint, varnish, and shellac) for short periods of time. The container should have a tight cover and a means of hanging brushes so that the entire length of the bristles and the lower part of the ferrule are covered by the thinner or linseed oil kept in the container. The bristles must not touch the bottom, because they eventually will become distorted, making it impossible to turn out an acceptable job with them.

Brushes that are to be used the following day should be cleaned in the proper thinner and placed in the proper compartment of the container. Brushes you do not expect to use soon should be cleaned in thinner, washed in soap (or detergent) and water, rinsed thoroughly in fresh water, and hung to dry. After drying, they should be wrapped in waxed paper and stowed flat. Brushes should not be left soaking in water; the water causes the bristles to separate into bunches, flare, and become bushy.

The proper cleaners for brushes used with different finishes are as follows:

FINISH	CLEANER
Natural and synthetic oil-base paints and varnishes; chlorinated alkyd resin paint	Paint thinner or mineral spirits
Latex emulsion paints	Water
Chlorinated rubber paints	Synthetic enamel thinner or xylene
Shellac	Alcohol
Lacquer	Lacquer thinner

Remember: After brushes have been used, they should never be left in an open can of paint or exposed to the air. Good brushes are hard to get, take care of them. Clean them immediately after they are used, and then store them properly.

HOW TO USE A BRUSH

There is an art to using a paintbrush properly. It is an art you will have to master if you are going to become a good painter. The following general hints will help you. Read them once to see how many mistakes you have been making. Then, concentrate on each point separately until you are sure you have mastered it.

First, hold the brush firmly but lightly in the position shown in figure 11-13. Do not put your fingers on the bristles below the ferrule. Hold the brush in a way that will permit easy wrist and arm motion.

When you are using a flat brush, do not try to paint with the narrow edge. That will wear the corners down and spoil the shape and efficiency of the brush. When you are using an oval brush, do not let it turn in your hand. An oval brush that has been revolved too much will wear to a pointed shape and become useless. Do not poke oversized brushes into corners and around moldings. Such use will ruin a good brush by bending the bristles. Use a smaller brush that will fit into such odd spots.

Before you start to apply paint to the surface, work the paint well into the brush. This is done by holding the mixing paddle tightly over the rim of the bucket, dipping the brush into the paint, and then wiping the brush clean across the edge of the paddle. Do this several times so you will be sure the brush is filled with paint.

When applying paint, dip slightly less than half of the bristles into the can. Draw the brush lightly against the inside of the can, and then apply it to the surface to be painted. Be careful not to overfill your brush; if it is too full, paint will drop all around the work.

Hold the brush at right angles to the surface being painted, with the ends of the brush just touching the surface. Lift the brush clear of the surface when you are starting the return stroke. If the brush is held obliquely and is not lifted, the painted surface will be uneven, showing laps and spots and a "daubed" appearance. Also, a brush that is held at too great an angle will soon wear away at the ends.

Paint Application

Here is how to apply paint by brush. For complete coverage, follow the Navy style and first lay on, and then lay off. Laying on means applying the paint first in long, horizontal strokes. Laying off means crossing your first strokes by working up and down. (See fig. 11-14).

By using the laying on and laying off methods, you distribute the paint evenly over the surface, the surface is completely covered, and a minimum amount of paint is used. A good rule is to lay on the paint the shortest distance across the area and lay off the longest distance. When you paint bulkheads or any vertical surface, lay on in horizontal strokes and lay off in vertical strokes.

Always paint overhead first and work from the far comer. By working overhead first, you can keep the bulkhead free of drippings by wiping up as you go along.

When you paint overhead surfaces, lay off the ceiling panels fore-and-aft, and those on the beams, athwartships. But where panels contain pipes running parallel with the beams, it is often difficult to lay off the ceiling panels fore-and-aft. In such cases, you will get better results in laying off the panels parallel with the beams.

To avoid brush marks when you finish a square, use strokes directed toward the last square finished, gradually lifting the brush near the end of the stroke while the brush is still in motion. Every time the brush

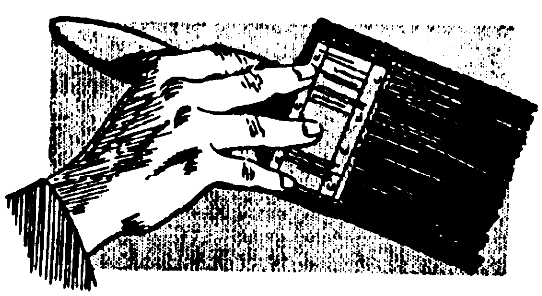


Figure 11-13.—Correct way to hold a brush.

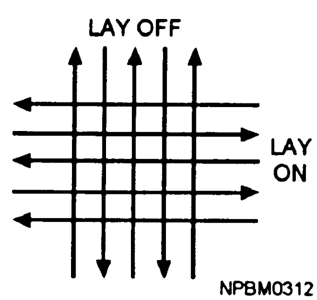


Figure 11-14.—Laying on and laying off.

touches the painted surface at the start of a stroke, it leaves a mark. For this reason, never finish a square by brushing toward the unpainted area, but always end up by brushing back toward the area already painted.

When painting pipes, stanchions, narrow straps, beams, and angles, lay the paint on diagonally, as shown in figure 11-15. Lay off along the long dimension.

Always carry a rag for wiping dripped or smeared paint.

Cutting In

A painter who has learned to cut in properly can do a job in less time than it takes another person to apply masking tape.

Cutting in is not hard, and anyone with a fairly steady hand can learn it in a short time. Suppose you have to cut in the angle between an overhead and a bulkhead, as shown in figure 11-16. Start at one comer. Hold your brush at an angle of about 75° to 80° from the bulkhead and about 10° from the overhead. Draw your brush along in fairly swift, long, smooth strokes. This is one job where working slowly will not produce better results. The slower your stroke, the wavier your line.

If there is no definite break such as the angle between bulkheads and overheads or bulkheads and decks, you should draw a line to follow. You can do this either with a straightedge or by snapping a chalk line. To snap a chalk line, mark a couple of reference points first, one at each end where the line will be. Then, chalk the line and stretch it taut between the reference points. Have somebody pull the center of the line about 6 inches out from the surface and let it snap back against the

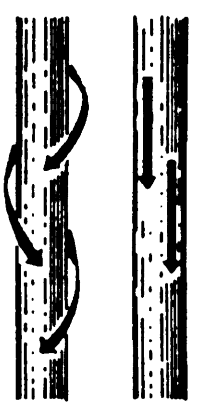


Figure 11-15.—Painting pipes and stanchions.

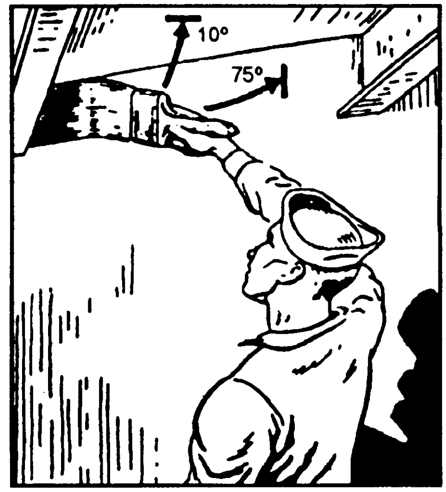


Figure 11-16.—Cutting in.

surface. This leaves a neat, straight line. Cut in as already described. You may want to paint up close to the line, and then cut in; but usually it is best to cut in first and paint out from that line.

Film Thickness

For interior painting, apply paint in the lightest possible coat that will cover the surface. Several reasons are explained here.

- Heavy layers of paint constitute a fire hazard—the thicker the paint film, the more readily it will burn. Also, if paint is applied heavily, it is likely to entrap solvents and thinners, which burn rapidly.
- Heavy layers of paint may add noticeably to the weight of the ship, with a consequent reduction in speed. For example, a single extra coat of paint on a destroyer will add from 1 to 1 1/2 tons to its weight.
- Thick coats of paint tend to crack and peel. They are likely to be uneven and may show marks and scratches more readily than thin coats. Thick coats of paint do not penetrate as well as thin ones and do not dry to as hard a surface.

When an interior surface has already had a total of four coats of paint (including primer) or if the total thickness of the existing paint amounts to 0.005 inch, the old paint should be removed before a new coat is applied.

WORKING CONDITIONS

LEARNING OBJECTIVE: Describe the best working conditions when you are getting ready to start painting and as you finish painting.

Painting should not be attempted when the temperature is below 32°F. In cold weather, moisture condenses on surfaces and the paint will not stick. Also, the thinner evaporates too slowly, increasing the drying time.

For best results, painting should be accomplished in warm weather—between 60°F and 80°F. In hot weather, however, paint dries too rapidly and makes brushing and rolling difficult.

Humidity and ventilation are also important conditions. If there is too much humidity, it may condense on the bulkheads and make painting difficult. To reduce humidity, you can increase the temperature or improve the ventilation. Proper ventilation is also necessary to carry off solvent fumes and to furnish oxygen so the paint will dry properly.

STRIPING

Striping can be a relatively easy job if you use masking tape. You can use either a brush or a spray gun with masking tape. There are two basic methods to follow, depending on whether the surface to be striped has been finished.

Striping Method No. 1

If the surface is already painted and you do not want to do a complete repainting job, you can still add stripes without injuring the finish. First, decide on the position and width of the stripe; then apply masking tape to both sides of the stripe. Figure 11-17 shows how to apply the tape. It is a good idea to add a further protective covering on both sides, wide enough to prevent daubs or overspray from striking the rest of the surface. This protection may be provided by placing newspapers or wrapping paper in the proper position before painting. Then, spray or brush on the striping color. When the paint has set, remove the masking tape.

Striping Method No. 2

When the surface is unfinished, the process of striping is a little different. First, decide on the position and width of the stripe; then spray or brush the color on, allowing it to overlap the edge of the stripe a little on both sides. Allow the striping color to dry thoroughly, and then cover the exact area of the stripe with masking tape. Attach the tape firmly, but do not stretch the masking tape out much. Rub or roll it down to smooth out the wrinkles and make it a tight protective covering. Some painters recommend, as your next step, a light "fog" covering of the finishing material right over the tape. This will help to prevent the final coat of paint from sticking to the edges of the tape, cementing the tape to the surface. Now, you are ready to spray or brush on the finishing coat. Do this right over the masking tape. When the surface coat has set, remove the tape to reveal a clean-cut stripe.

There may be a slight ridge along the edges of the stripe after you pull off the masking tape. If this is too noticeable, you can scrape it off after it has dried thoroughly, and then rub it smooth with a rubbing compound.

REMOVING MASKING TAPE

There is a trick to removing masking tape so it will not mar the surface. The right way is to pull the tape off somewhat diagonally and back upon itself. The wrong way is to pull the tape directly away from the surface at a right angle. Figure 11-18 shows the proper angle. Work

Figure 11-17.—Applying masking tape.

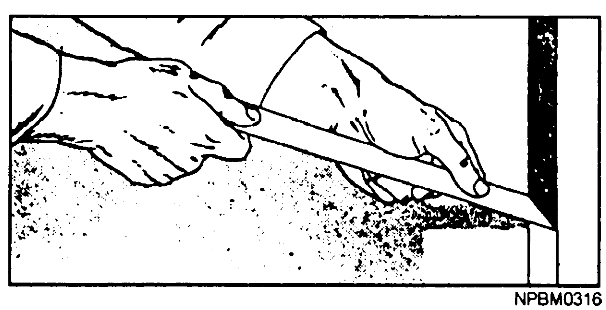


Figure 11-18.—Removing masking tape.

slowly, with your hands moving close to and parallel to the surface.

STENCILING

One of the standards for BMs is to prepare and use stencils for painting letters and numerals.

All ships should have adjustable stencil sets with locking edges. These sets are made of brass and include punctuation marks, as well as the 26 letters of the alphabet and the numerals 0 through 9. The sets come in three sizes: 1/2 inch, 1 inch, and 2 inches. The edges of each piece are crimped, and combinations of letters, figures, and punctuation marks may be made by slipping the edge of one piece into the edge of the adjoining piece.

In addition to the adjustable locking-edge type of stencil sets, most larger ships have a stencil-cutting machine. These machines cut the usual punctuation marks and all the letters of the alphabet, but only the numerals 2 through 9. The letters I and O, respectively, are used for numerals 1 and 0. These machines are stocked in four sizes, ranging from 1/2 inch to 1 3/4 inches.

Only the proper stencil boards should be used in this machine, since ordinary cardboard will jam it. Occasionally, small bits of stencil board will become lodged in the cutting dies. These can be removed with the small wire hook provided for this purpose. The stencil board is issued in sheets 20 inches wide by 24 inches long, but stencils are more conveniently handled if you cut them in strips about 4 inches wide.

To cut a stencil, place a strip of stencil board in the machine and lock it in place by pushing down the small lever at the front. Turn the handwheel until the arrow at the top points to the letter desired. Then, push down on the operating handle, and move the next letter into place. Each time the operating handle is pushed down, the stencil board moves the proper distance for the next letter to be cut. When you wish to space, as between words, hold in the button on the operating handle while pushing the handle down.

Flat-ended brushes designed for stenciling are available, but an old toothbrush makes an acceptable substitute. Use the stencil paints available in general stores. After stenciling one surface, wipe off the back of the stencil before laying it on the next surface to be stenciled. Make sure the stencil does not slip while you are applying the paint. Stencils should be cleaned immediately after use—the brass ones with the proper thinner, and the other type with only a clean soft rag.

PAINT ROLLERS

LEARNING OBJECTIVE: Explain the proper procedure on how to use and clean a paint roller properly.

The dip type of paint roller used in the Navy consists of a replaceable, knotted Dyne1 plush fabric roller with a solvent-resistant paper core, which rotates on the shaft of a corrosion-resistant steel frame.

Large areas, such as decks and ships' sides, free of rivets, bolts, cable, pipes, and so on, can be quickly covered with paint by using rollers. To get uniform coverage, always try to pick up the same amount of paint with your roller and paint the same size area. (A 7-inch roller filled with paint will cover about a square yard; a 9-inch roller, of course, will cover slightly more.)

There are two types of trays used with a paint roller: a conventional type, found in a hardware store, and a specially designed grid that fits inside 5-gallon pails. To use either type, dip your roller in the paint at the lower end of the tray and roll it lightly toward the raised end. Repeat this process as necessary to fill the roller evenly. Then, quickly apply it to the surface to be painted, using the same laying on, laying off technique used when painting with a brush. A moderate amount of pressure must be applied to the roller to ensure that the paint is worked into the surface. If pressure is not applied, the paint will not adhere and soon will peel off.

After use, the fabric cylinder should be stripped from the core, cleaned in the solvent recommended for the paint used, washed in soap and water, rinsed thoroughly, and replaced on the core to dry. Combing the pile of the fabric while damp will prevent matting.

SPRAY GUN PAINTING

LEARNING OBJECTIVES: Identify all paints and uses for a spray gun.

A spray gun is a precision tool in which air and paint are separately directed into the same area, where the paint is atomized, and sprayed out ahead of the gun. This mixing area may be outside or inside the gun's spray cap. Spray guns are classed according to where the air and paint are mixed (external-mix, internal-mix), how the air is controlled (bleeder, nonbleeder), and how the gun is supplied fluid (suction-feed, pressure-feed).

In an external-mix gun, the air and paint are mixed outside and in front of the air cap (fig. 11-19). 'This type of gun requires high air pressure and, thus, uses more cubic feet of air per minute than does an internal-mix gun. Atomization of the paint is extremely fine, however, and the size of the spray pattern can be controlled. There is no wear on the air nozzle. With different nozzles, an external-mix gun works with both suction and pressure feeds.

In an internal-mix gun, air and paint are mixed within the gun (fig. 11-20). In this type of gun, atomization of the paint is coarse, and the spray pattern is fixed. This gun works only with a pressure-feed, but the pressure is lower and the amount of air used is less than for the external-mix gun. Because atomization of the paint is coarse, more paint is applied on each pass.

The bleeder type of gun is one in which air is allowed to leak, or bleed, from some part of the gun to prevent air pressure from building up in the air hose. In this type of gun the trigger controls the fluid only. It is generally used with small air-compressing outfits that have no pressure control on the air line.

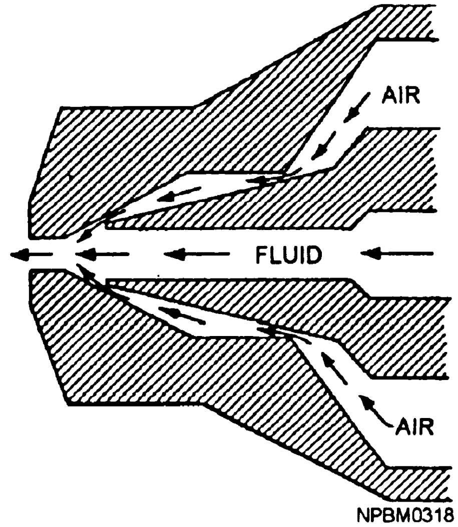


Figure 11-20.—An internal-mix air cap.

The nonbleeder gun is equipped with an air valve that shuts off the air when the trigger is released. It is used with compressing outfits having a pressure-controlling device.

In a suction-feed spray gun, the air cap, as shown in figure 11-21, is designed to draw the fluid from the container by suction, in somewhat the same way that an insect spray gun operates. The suction-feed spray gun is usually used with l-quart (or smaller) containers.

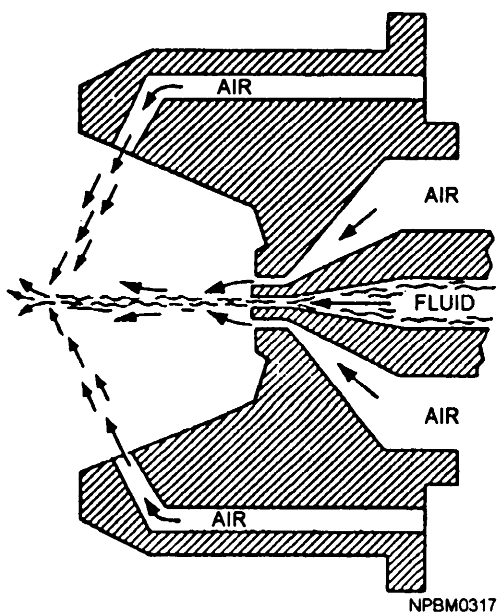


Figure 11-19.—An external-mix air cap.

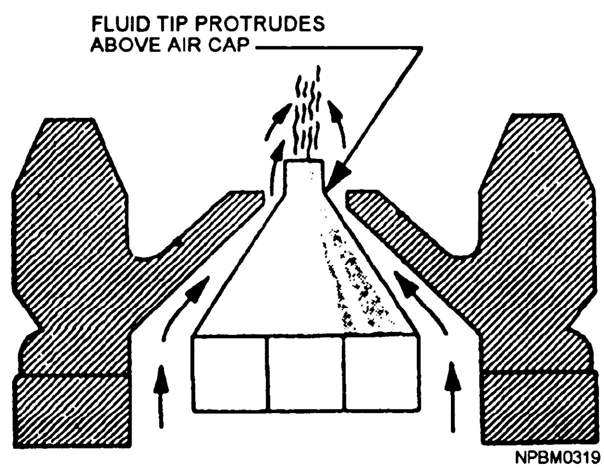


Figure 11-21.—A suction-feed air cap.

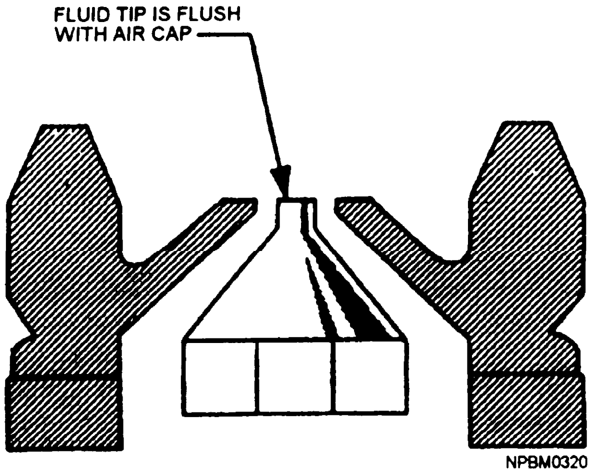


Figure 11-22.—A pressure-feed air cap.

A pressure-feed gun operates by air pressure that forces the fluid from the container into the gun (fig. 11-22). This is the type used for large-scale painting.

PARTS OF THE SPRAY GUN

The two main assemblies of the spray gun are the gun body assembly and the spray head assembly. Each of these assemblies is a collection of small parts, all of which are designed to do specific jobs.

The principal parts of the gun body assembly are shown in figure 11-23. The air valve controls the supply of air and is operated by the trigger. The spreader adjustment valve regulates the amount of air that is supplied to the spreader horn holes of the air cap, thus varying the paint pattern. It is fitted with a dial that can be set to give the pattern desired. The fluid needle adjustment controls the amount of spray material that passes through the gun. The spray head locking bolt locks the gun body and the removable spray head together.

Most guns are now fitted with a removable spray head assembly. This type has many advantages. It can be cleaned more easily; it permits quick changing of the head when you want to use a new color or material; and, if the head is damaged, a new head can be put on the old gun body.

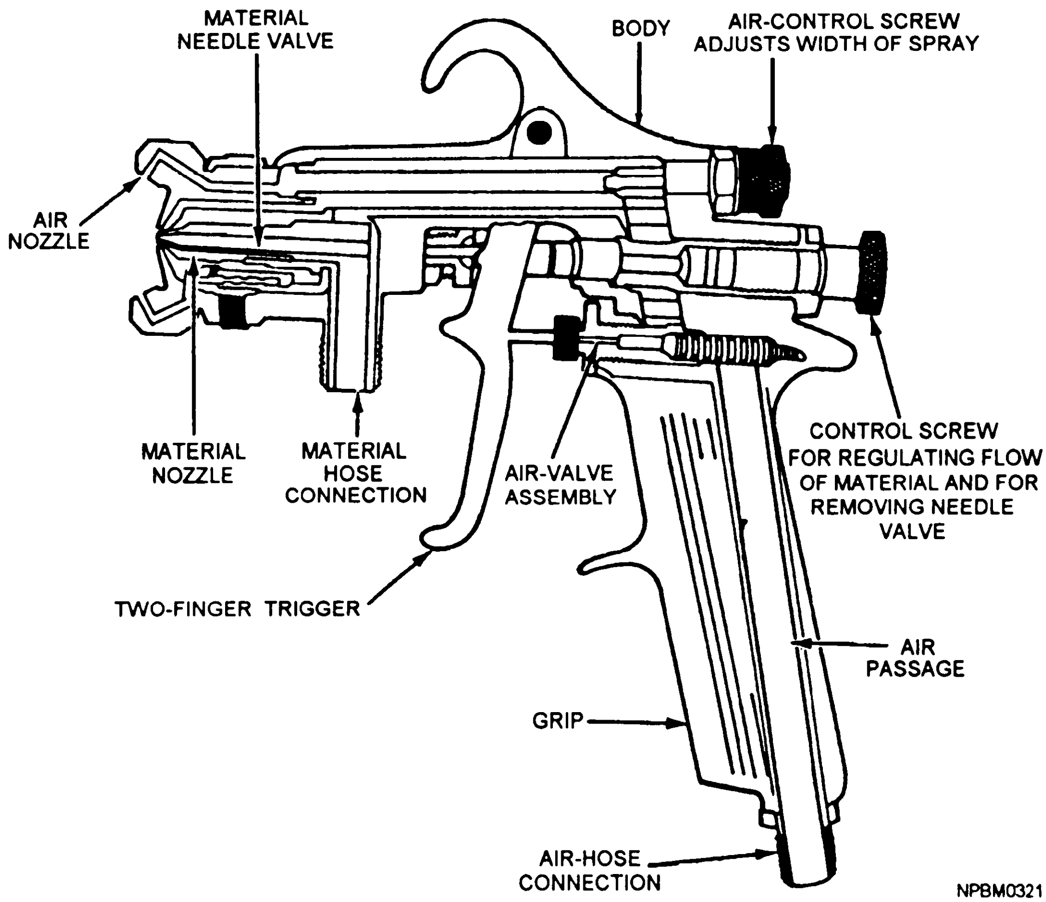


Figure 11-23.—Cross section of a spray gun.

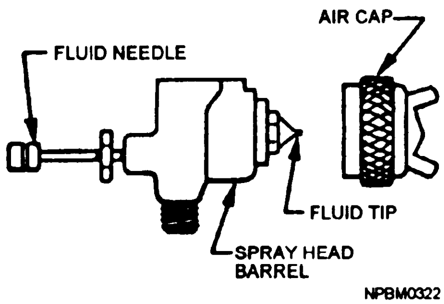


Figure 11-24.—Principal parts of the spray head.

The principal parts of the spray head assembly are the air cap, the fluid tip, the fluid needle, and the spray head barrel (fig. 11-24).

The fluid tip regulates the flow of the spray material into the airstream. The tip encloses the end of the fluid needle. The spray head barrel is the housing for the head mechanism.

Containers

The cups or tanks that hold the spray material before delivery to the gun are called containers. The job you are going to do determines which one of the several kinds of containers to use.

Suction-feed cups are used for small quantities of lightweight and mediumweight spray materials, such as lacquers.

Gravity-feed cups are small and are attached directly to the top or side of the gun. They normally are used only on artist's and decorator's guns, or on small touch-up guns.

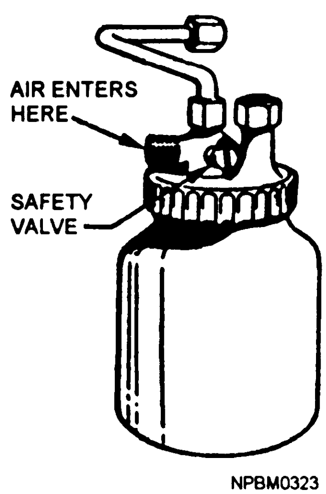


Figure 11-25.—Pressure-feed cup.

Pressure-feed cups (fig. 11-25) are considered best for handling small quantities of enamels, plastics, or other heavy materials on jobs where fine adjustments and speed of application are needed.

Pressure tanks vary in size, from 2-gallon to 60-gallon containers. Figure 11-26 shows a common type of pressure tank. As you can see, it is a complicated mechanism. There are two general types: the regulator type and the type that uses the equalized pressure tank.

The regulator type is equipped with one or two regulators, a safety valve, a release valve, and a pressure gauge. The equalized pressure tank is equipped only with a safety valve and a release valve. The regulator type may also have one or two hand-operated or motor-operated agitators. If there is only one regulator, it regulates the fluid pressure in the tank only. If there are two regulators, one regulates the fluid pressure in the tank while the other regulates the air pressure to the gun. Each regulator operates independently of the other.

The pressure tank shown in figure 11-26 is equipped with air and fluid outlets and fittings, pressure regulators, and gauges to permit more than one spray gun to be used at the same time.

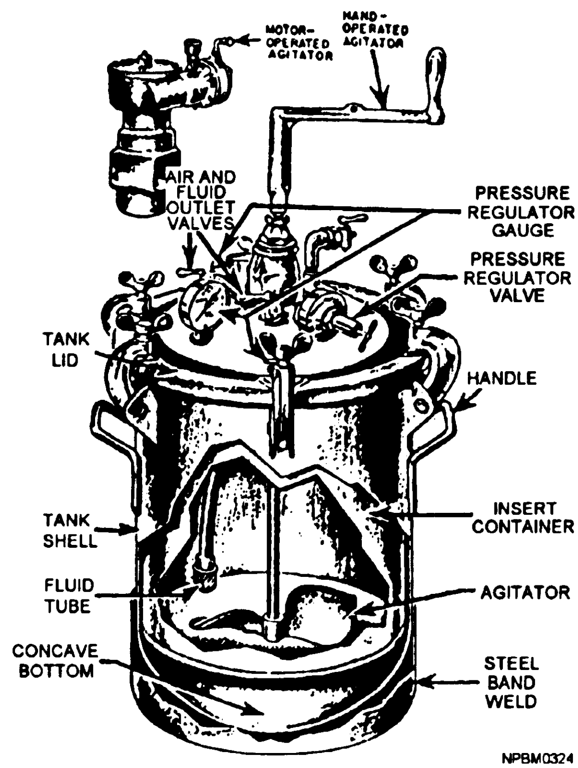


Figure 11-26.—A pressure tank.

Sometimes, instead of pouring the material directly into the tank, you put a separate container, called an insert container, into the tank. With this type of container, you can make quick changes of color or material without having to clean the tank. Moreover, you can mix your materials ahead of time and have them on hand.

Hose Lines

Spray gun hose is of two varieties—one kind to handle air, and another kind to handle liquids. Air hose is usually made of braid-covered tubing, with either one-braid or two-braid construction. Fluid hose is made of a special solvent-resistant material, which can withstand the attacks of paint, lacquer, and similar liquids.

AIR SUPPLY

Spray guns are operated by compressed air, which may be supplied by either portable or installed compressors. However, aboard ship, guns using pressure tanks are usually connected to the low-pressure ship's service air line. Pressure on this line is usually from 100 to 125 psi, but this is cut down to spraying pressure at the tank by a pressure regulator valve such as shown on the tank in figure 11-26.

When you use air compressors, follow exactly the manufacturer's instructions for operation. If you intend to use air from the low-pressure line for long periods, it is a good idea to inform the engineering officer of the watch.

The air should be dry and free from dust to spray paint properly. Because all air contains moisture and dust in varying amounts, some means must be provided to remove them. This is commonly done by an air transformer, frequently called an air separator or air regulator. (See fig. 11-27.)

Air enters the transformer through an air inlet, passes through a series of baffles and a filter chamber, and then through a regulator diaphragm, which adjusts the pressure. Normally, the transformer should be drained daily. If the weather is damp, it should be drained several times daily. You do this by turning a drain cock at the bottom. The packing and filtering material should also be changed at regular intervals.

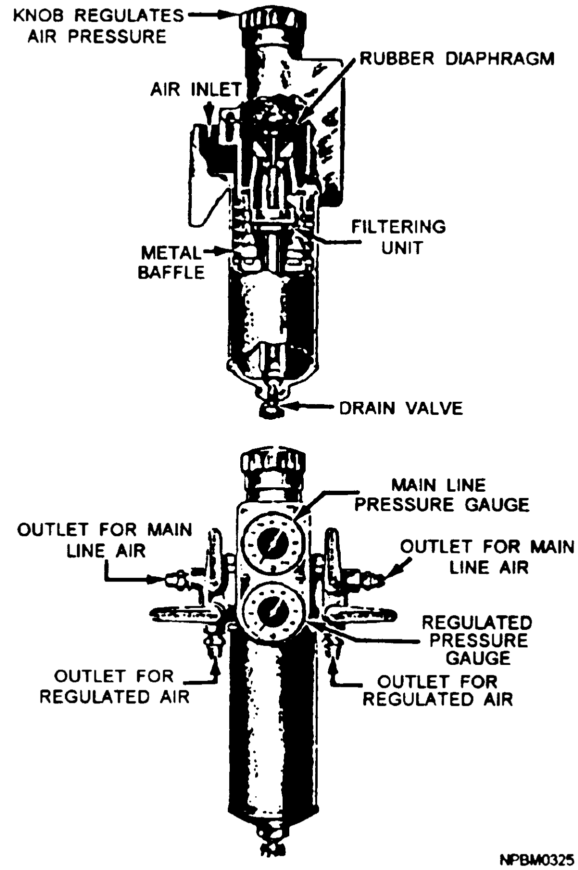


Figure 11-27.—Air transformer.

OPERATION OF THE SPRAY GUN

When you squeeze the trigger of your spray gun, the air valve opens, admitting compressed air through the air inlet. The air passes through the gun body to the spray head. In the most common type of spray head (external-mix), the air does not come in contact with the paint inside the gun, but is blown out through small holes drilled in the air cap. Paint is shot out of the nozzle in a thin jet, and the force of the air striking it breaks the jet into a fine spray. You can control this spray, making it into various patterns, by setting the air control screw, which regulates the spreader adjustment valve. For a round spray, turn the screw clockwise. For a fan spray, turn it counterclockwise. Turn the fluid control screw clockwise to increase the flow. To obtain the same coverage over a wider area, increase the flow of paint as the width of the spray is increased.

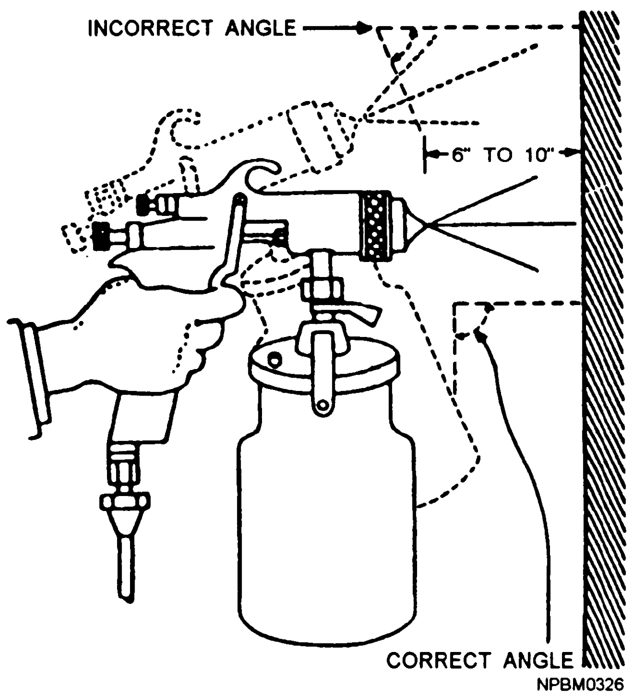
Using a Spray Gun

The handling of a spray gun is best learned by practice, but this section will give you some tips.

Before starting to spray, check adjustments and operation of the gun by testing the spray on a surface similar to that which you intend to coat.

There are no set rules for spray gun pressure or for the distance to hold the gun from the surface, because pressure and distance vary considerably with the nozzle, the paint used, and the surface to be coated. The minimum pressure necessary to do the work is the most desirable, and the distance normally is from 6 to 10 inches.

Always keep the gun perpendicular to and at the same distance from the surface being painted. (See figs. 11-28 and 11-29.) Start the stroke before squeezing the trigger, and release the trigger before completing the stroke. If the gun is not held perpendicular or is held too far away, part of the paint spray will evaporate and strike the surface in a nearly dry state. This is called dusting. Failing to start the stroke before you start the spray or spraying to the end of the stroke will cause the paint to build up at the end of the stroke, and the paint will run or sag. Arcing the stroke makes it impossible to deposit the paint in a uniform coat.



Fire 11-28.—Hold spray gun perpendicular to the surface.

When you spray corners (both inside and outside comers), stop 1 or 2 inches short of the comer. Do this on both sides, and then turn your gun on its side and, starting at the top, spray downward, coating both sides at once. (See fig. 11-30.)

When you are spraying a large area into which small parts and pieces protrude, first lightly coat those items. Then, go over the whole surface. For example, if you are painting a compartment, first spray the hatch coamings, doorframes, rivets, exposed bolt heads, and all small items secured to the bulkheads. Then, do the entire compartment. This eliminates a lot of touching up later.

Common Spraying Defects

The most common defects in spraying paint coats are "orange peel," runs and sags, pinholes, blushing, peeling, and bleeding.

- ORANGE PEEL is a general term used to describe a painted surface that has dried with a pebbled texture resembling an orange peel. This may be caused by the use of improper thinners, a spray that is not fine enough, holding the gun too far from (or too close to) the surface, improper mixing of the material, drafts, or low humidity.

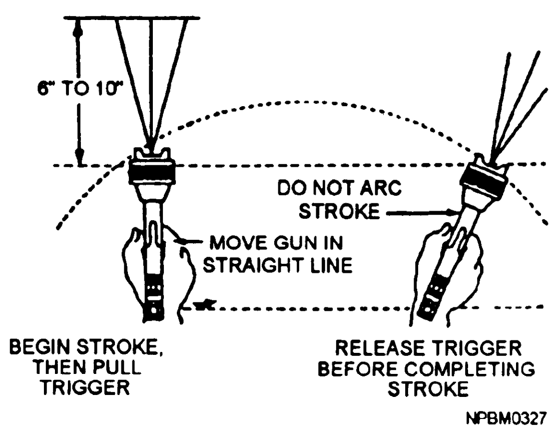


Figure 11-29.—Proper spray gun stroke.

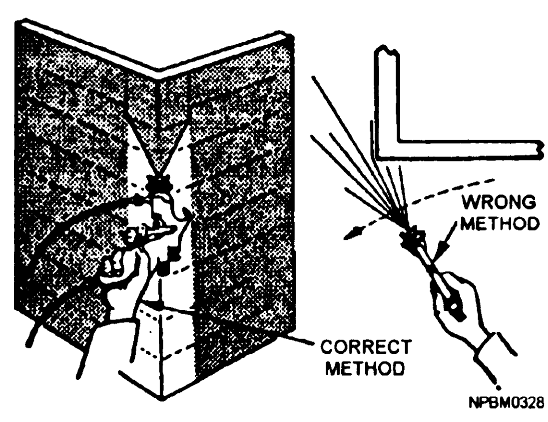


Figure 11-30.—Right way and wrong way to spray corners.

- RUNS usually are the result of using material that is too thin.

- SAGS result from too much material. Runs and sags can also be caused by too big a lap being allowed in spraying strokes and by poor adjustment of the spray gun or pressure tank. Dirty or partially clogged passages for air or fluid will also cause uneven distribution.

- PINHOLES may be caused by the presence of water or excessive thinner in the paint or by too heavy an application of quick-drying paint. In either case, small bubbles form and break in drying, leaving small holes.

- BLUSHING resembles a powdering of the paint. What happens is that the cellulose material in the paint separates from its solvent and returns to its original powder form. Water is usually the cause of this—either moisture on the sprayed surface or excessive moisture in the air. When blushing occurs, you will have to remove the defective coating, because the moisture is trapped within the material and will remain there unless the coating is removed.

- PEELING is almost invariably caused by carelessness in cleaning the surface. Before any spraying is attempted, clean the surface. Cheap spray materials sometimes will give poor adhesion, but you will not have this trouble if you always use standard Navy paints.

- BLEEDING occurs when the color of a previous coat discolors the finish coat. A paint containing a strong aniline dye (synthetic organic dye) will do this when another color is sprayed over it.

CARE OF THE SPRAY GUN

Spray guns (as well as paint containers and hoses) must be cleaned thoroughly after they are used.

The steps in cleaning a pressure-feed gun are shown in figure 11-31. First, back up the fluid needle adjusting screw and release the pressure from the pressure tank by means of the release valve. Hold a cloth over the air cap and pull the trigger—this forces the spray material back into the tank. Now, remove the fluid hose from the gun and run a solvent through it. There is a special hose cleaner made for this purpose. Dry out the tip and clean the tank. Soak the air cap in solvent. When the holes are clogged, use a toothpick to clean them. Put all clean parts back in place, and the gun is ready for use again.

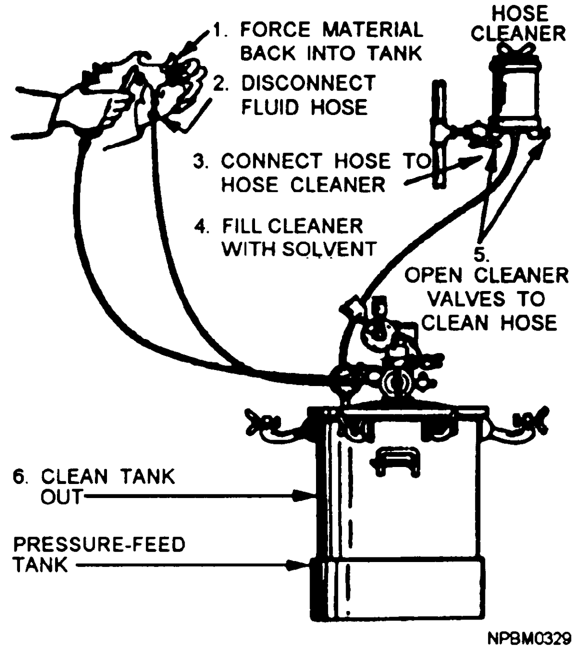


Figure 11-31.—Steps in cleaning a pressure-feed gun.

To clean a container type of gun (fig. 11-32), remove the container first. Then, hold a cloth over the air cap and pull the trigger. Empty the container and pour in a small quantity of solvent. Attach the container to the gun and spray in the usual way. This process cleans out all passageways. Clean the air cap by soaking it in a solvent; then replace it. Some spray gun troubles, their possible causes, and their remedies are listed in table 11-1.

Lubrication of the Spray Gun

Your spray gun also needs a lubrication. The fluid needle packing should be removed occasionally and

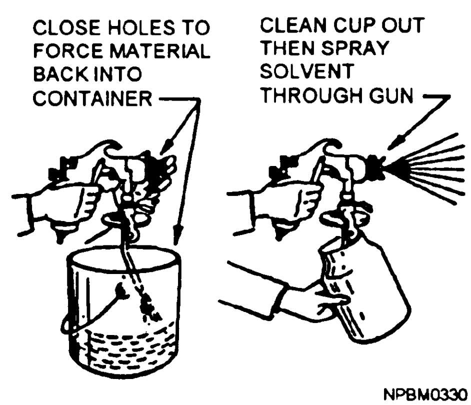


Figure 11-32.—Steps in cleaning a container type of gun.

Table 11-1.—Spray Gun Troubles, Possible Causes, and Remedies

TROUBLES	POSSIBLE CAUSES	REMEDIES
Air leaks from front of gun	Foreign matter on valve seat Worn or damaged valve seat Sticking valve steam Bent valve stem Packing nut lose	Clean Replace Lubricate Replace Adjust
Fluid leaks from front of gun	Worn or damaged fluid tip or needle Foreign matter in fluid tip Packing nut too tight Wrong size needle	Replace Clean Adjust Replace
Jerky or fluttering spray (both suction and pressure feed)	Insufficient material in container Tipping container to excessive angle Obstructed fluid passageway Loose or cracked fluid tube Loose fluid tip or damaged tip seat	Refill Take greater care Clean Tighten or replace Tighten or replace
Jerky or fluttering (suction feed only) spray	Too heavy a material Clogged air vent in container lid Loose or damaged coupling nut or cup lid Fluid tube resting on bottom	Change to pressure feed Clean Tighten or replace Use proper fluid tube
Defective spray pattern	Air cap horn holes partially plugged Dirt on air cap or fluid nozzle	Rotate air cap 1/2 turn and spray another pattern If defect is inverted, fault is on/in air cap. If pattern is same, fault is on/in fluid nozzle. Clean proper part.

softened with oil. The fluid needle spring should be coated with grease or petrolatum. Figure 11-33 shows where these parts are and also the oil holes in which you occasionally should put a few drops of light oil.

How to Remove the Spray Head

To clean or repair the spray gun or to change to a different color of paint, you may have to change the spray head. In modern spray guns, this is a fairly simple operation. First, remove the gun from the air and fluid hose lines. Holding the gun in the left hand, pull the trigger all the way back and loosen the locking bolt with the wrench provided for the purpose. Push the trigger forward as far as possible, and pull the spray head

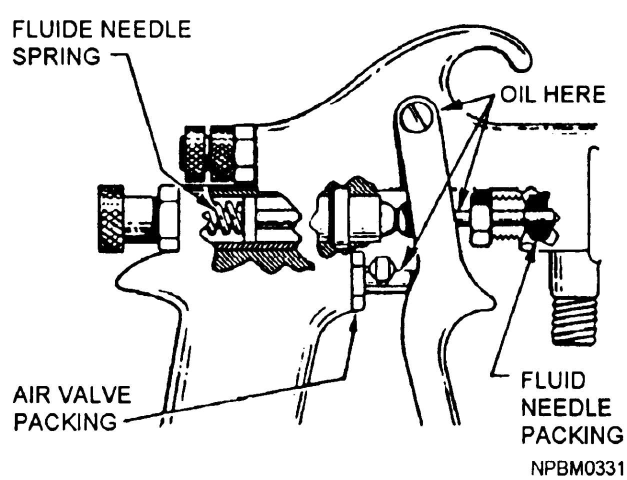


Figure 11-33.—Lubrication points of a spray gun.

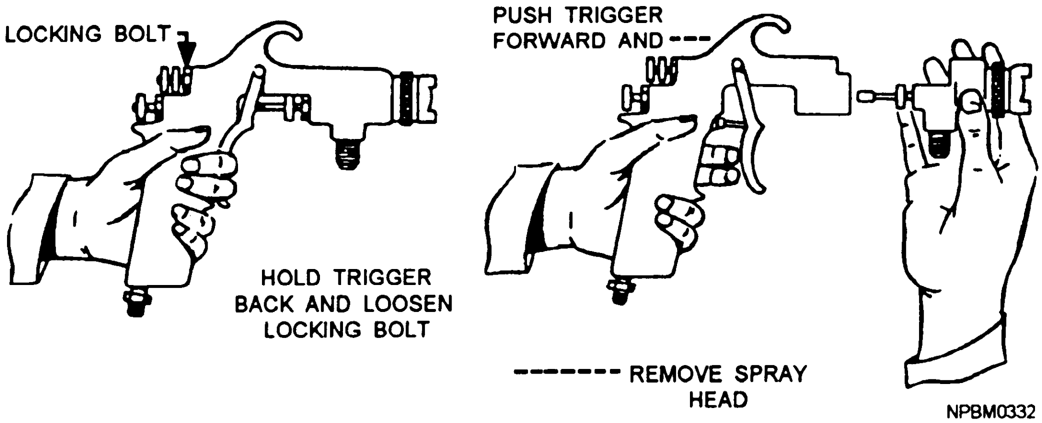


Figure 11-34.—Removing the spray head.

forward. (See fig. 11-34.) To replace the head, push the trigger forward and insert the spray head. Then, hold the trigger back and tighten the locking bolt.

What Not to Use in Your Spray Gun

As a general rule, Navy paints, enamels, lacquers, synthetics, varnishes, and shellacs are suitable for spray work with ordinary equipment. Material containing small gritty particles, such as alkaline coverings, rubber hose paints, plastics, and mastic paints, should NEVER be used in standard equipment. They will damage the ordinary machines; therefore, you should use only the special outfits designated for use with those paints.

RESPIRATORS

Spray painting breaks up the paint into a fine spray in which fumes, pigment, and vehicle are released in the air. If you breathe these fumes and particles or otherwise absorb them into your body, they can permanently damage your health. Be careful. Always wear a respirator when you spray or when you are in the vicinity of spray work. (See OPNAVINST 5100.19 for detailed protective requirements.) A respirator is a necessary piece of personal protective equipment to protect you from the toxic chemicals in painting operations. To get full protection, you must use the proper type of respirator for the job you are doing and the chemicals you handle. The general types of respiratory protective devices used in spray painting operations are the air-line respirator and the chemical cartridge respirator.

Air-line respirators (fig. 11-35) are needed when you are working in confined spaces or when adequate ventilation is not available. Air supplied must be approved for use in breathing air systems. The chemical cartridge respirators (fig. 11-36) are used only for exposure to specific chemicals, which are indicated on the cartridge, and for limited time periods in atmospheres that contain sufficient oxygen. Cartridges must be replaced when you can smell vapors in the mask, when breathing becomes difficult, or when the respirator has been used for the specified lifetime of the cartridge.

SAFETY PRECAUTIONS

The application of paints, varnishes, lacquers, enamels, wood-bleaching liquids, and other flammable liquids by the spray process is more hazardous than brush or roller applications. The effect chemicals used in paint formulations may have on your body depends on the type of chemical, how it is used, and the amount of time you are exposed. Skin contact with these chemicals must be minimized, rigorous personal cleanliness encouraged, and protective equipment used by the operator, because the chemicals can also produce skin irritation, rashes, and allergic reactions. In addition to the health hazards presented, most solvents such as alcohols, acetone, methyl ethyl ketone, and thinners are fire and explosion hazards.

Adequate ventilation controls health, fire, and explosion hazards when you are spray painting. A system that supplies fresh air and exhausts vapors is necessary.

While spray painting, personnel should wear a respirator, chemical safety goggles, coveralls, a drawstring hood, and gloves. In addition to protective clothing, barrier creams can be helpful in protecting areas not covered by protective clothing.

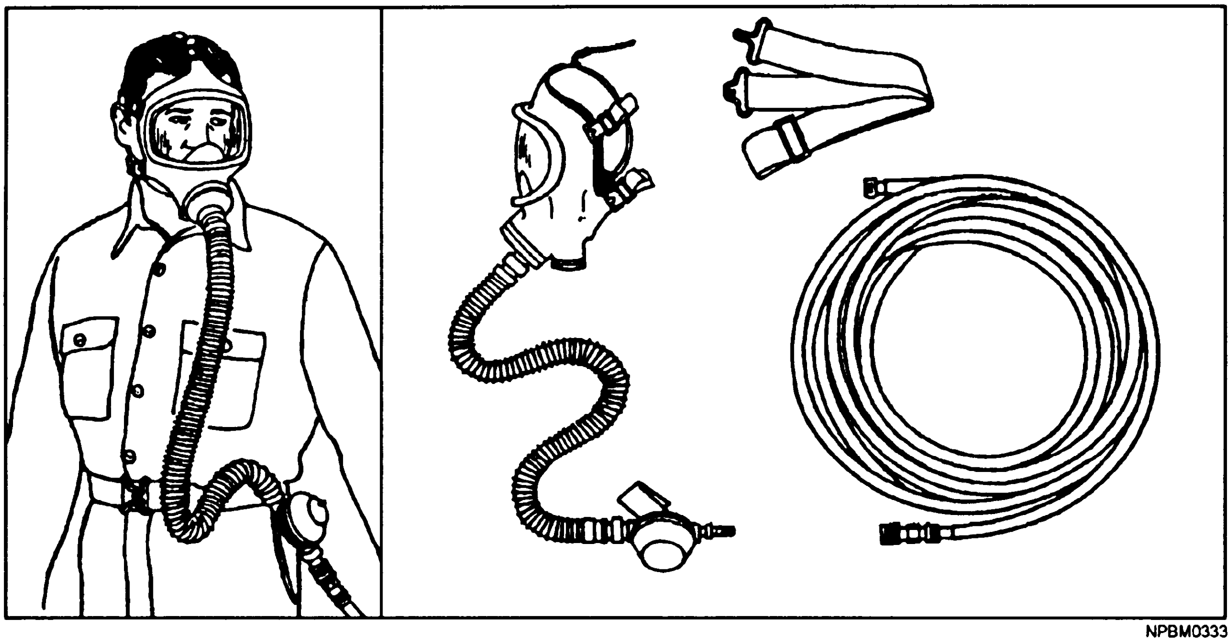


Figure 11-35.—Pressure demand air-line respirator with ultravue facepiece and required hose and belt.

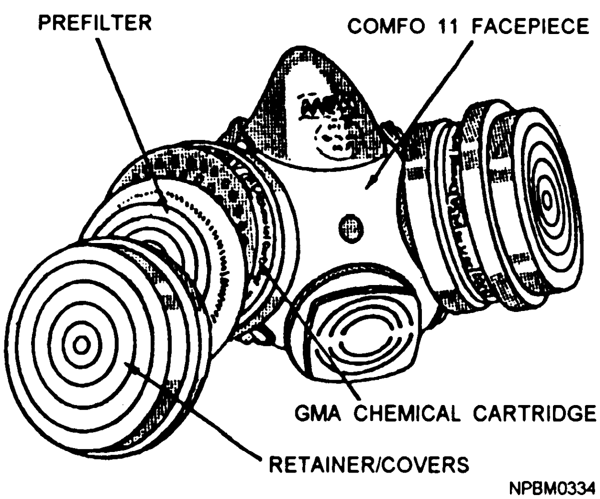


Figure 11-36.—Chemical cartridge respirator.

Smoking, open flames, welding, grounding of spray equipment, chipping, and other spark-producing operations are prohibited in compartments where spraying is in progress. Explosion-proof portable lights should be used. Care should be taken to make sure that wires do not become exposed from dragging and pulling. Bulbs must not be replaced in a compartment or tank being painted until flammable or explosive vapors have been removed.

SUMMARY

Each year the Navy spends thousands of dollars developing and testing finishes for specific surfaces. Consequently, you have access to the best materials available. Prepare the surface properly, use the recommended finish, and apply the finish correctly, and you will have a first-rate job that will last a long time. Do not use materials not provided by or methods not recommended by the Navy.

CHAPTER 12

HAZARDOUS MATERIAL

In this chapter you will learn some of the most important areas of shipboard life. While you may not work with hazardous material (HM) every day, you will need to know about this subject for the one day that you may need it. You will also need to know all the safety precautions dealing with HM. Of course we will not be able to cover all areas of HM, but if you have a general knowledge, you will learn more each and every day.

If you are going to work in a paint locker or any other hazardous area, you should be familiar with all the areas of HM in the area that you are assigned. Always remember, it is everyone's responsibility to have a working knowledge of HM and the safety involved in all areas concerned.

RESPONSIBILITY FOR HAZARDOUS MATERIAL

LEARNING OBJECTIVE: Identify the personnel responsible for hazardous material.

The HM on board a ship is everyone's responsibility. You must know what to do if you have a spill or a fire that has HM involved in it. You should know who is in charge of HM, who is the HM/HW coordinator and what are their responsibilities. This part of the chapter will discuss who does what job in dealing with HM.

COMMANDING OFFICER

The commanding officer is responsible for the overall areas that have to deal with HM on board his/her ship or shore facility. The commanding officer shall do the following:

- Appoint, in writing, a commissioned officer as HM coordinator. Small ships and afloat activities, specifically designed by type commander in which the number of officers is limited and appointment would pose an excessive burden to the ship, may assign a chief petty officer as HM coordinator.
- Ensure that all instructions and written directives are up to date at all times.
- Report all HM mishaps as required.
- Report to proper authorities when a piece of equipment/system malfunctions that has resulted in discharge of HM within restricted waters.
- Ensure that all spills of HM are handled properly.
- Ensure HM coordinator has attended the formal school for HM coordinator.
- Sign all open purchase request dealing with HM material not listed in the Ships Hazardous Materials List (SHML).

HAZARDOUS MATERIAL COORDINATOR

The job of HM coordinator is one of the most important jobs in the Navy. This is one of the hardest jobs on any ship or shore facility. The HM coordinator shall do the following:

- Ensure that all shipboard management procedures are followed at all times.
- Ensure that all supervisors are trained annually in all procedures dealing with HM handling, stowage, usage, spill response, and proper disposal procedures relative to HM and in the use of Material Safety Data Sheets (MSDS).
- Ensure that all HM are in their proper locations and that the types and quantities kept on board ship are identified and listed. The list will be reviewed annually by the executive officer, safety officer, and the department heads to determine ways to minimize the number of HM stowage places on board. The safety officer, gas free engineer, damage control assistant, and medical department representative (MDR) shall be provided a list of locations.
- Ensure that all HM is inventoried annually and that the inventory is updated monthly for new procured items.

- Retain all Hazardous Material Information System (HMIS) data, which contains MSDS information. Make sure that all MSDSs are available to all hands.

DIVISION OFFICER

The responsibilities of the division officer are just as important as the HM coordinator, because they are more familiar with their spaces. The division officer shall do the following:

- Ensure that when new HM is transferred into other containers, they are properly labeled.
- Ensure that approved personal protective clothing and equipment are available for training and normal handling of HM.
- Prior to personnel handling any HM, ensure that they be trained to understand all procedures for each piece of HM they are handling.
- Make sure that all MSDSs are available for personnel at all times.
- Ensure all personnel are trained upon reporting aboard and also, trained annually thereafter.
- Maintain records of all stock levels, locations, and usage of HM.
- Ensure that the commanding officer approves all open purchase items.

WORKCENTER SUPERVISOR

The workcenter supervisor shall do the following:

- Train workcenter personnel in the use of MSDSs.
- Ensure that all personnel are trained properly in the handling and care of all HM stock.
- Ensure that DCPO has conducted PMS on all flammable liquid stowage lockers
- Ensure there are copies of the Hazardous Material Users Guide for all personnel.
- Ensure there is a valid maintenance requirement for any open purchased HM item not listed in the SHML.

ALL hands shall do the following:

- Ensure that all HM removed from stowage for use is returned to appropriate stowage upon completion of use, or at the end of the work day.
- Follow the instructions provided for the proper use of HM.
- Collect and segregate all residue resulting from the use of HM for proper disposal.
- Report all spills of HM to the officer of the deck, division officer, and damage control central.
- Return HM improperly stowed in work or berthing spaces for proper stowage.
- Report any violation of HM use, stowage, and handling precautions to the supervisor for resolution/correction.

As you can see, HM is the responsibility of all hands to ensure that everything you do concerning HM handling is in the proper manner, and if you do not know what to do, ask someone who does.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

LEARNING OBJECTIVE: Explain the difference in the HM labels, placards, and warning label plates.

LABELS

Department of Transportation (DOT) hazardous labels must appear on shipping containers of HM. You must be able to identify the symbol. The DOT's version is shown in figure 12-1.

A number at the bottom of the label without any name identifies the material in the container. Table 12-1 lists the numbers and corresponding materials.

PLACARDS

Placards are almost the same thing as labels; they are just larger in size and some of them have the name of the material and the flash points on them for quick reference.

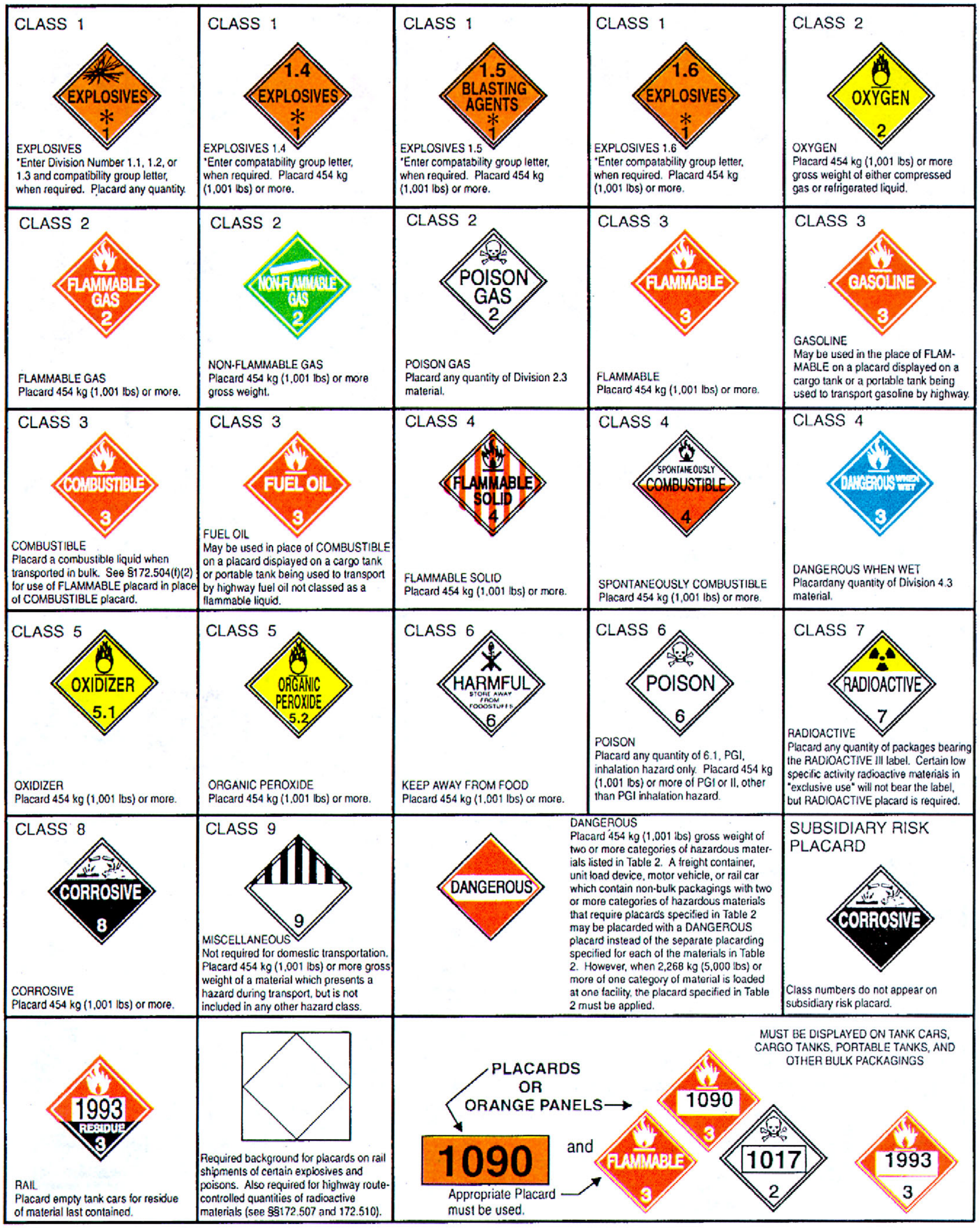


Figure 12-1.—Department of Transportation hazardous placards (page 1 of 2).

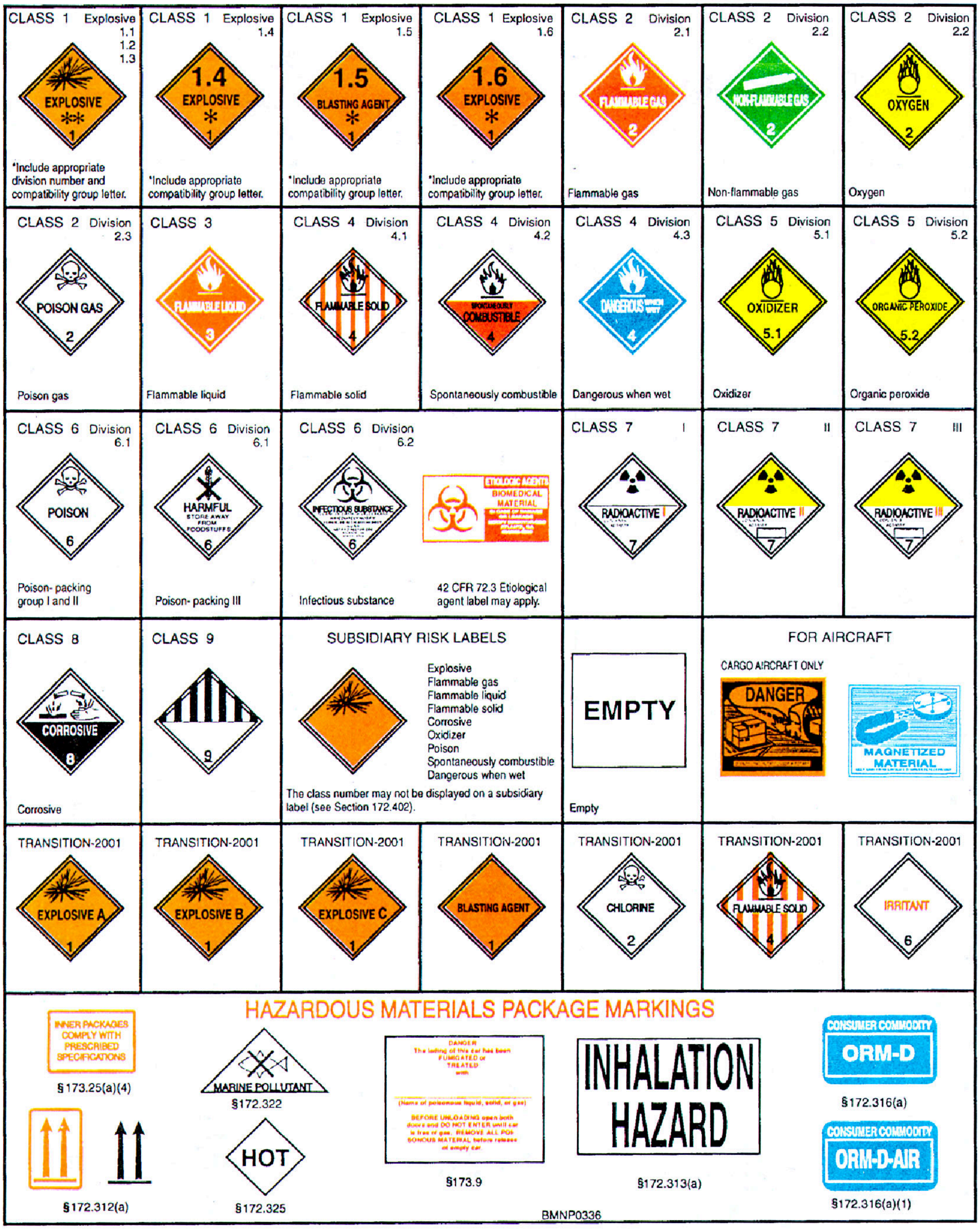


Figure 12-1.—Department of Transportation hazardous placards (page 2 of 2).

Table 12-1.—Department of Transportation Numbers and Corresponding Hazardous Materials

DOT NO.	HAZARDOUS MATERIAL	DOT NO.	HAZARDOUS MATERIAL
1	Explosives	5	Oxidizers and organic peroxides
2	Gases	6	Poisons
3	Flammable and combustible liquids	7	Radioactive materials
4	Flammable solids	8	Corrosives

WARNING LABEL PLATES

Warning label plates have various types of information on them dealing with a particular type of HM you may encounter in your everyday life on board ship or on shore duty.

HAZARDOUS MATERIAL/HAZARDOUS WASTE PROGRAM

LEARNING OBJECTIVES: Explain the definition of HM and HW. Explain what MSDSs are and how to read and understand everything on them.

HM is used daily, afloat and ashore, in maintenance, repair, and cleaning. You could not maintain operational effectiveness without using HM. In using HM, however, you may also produce hazardous waste (HW).

You can use HM effectively and safely if you take care during handling, storage, and disposal. To help ensure that, OSHA passed a regulation called the *Hazardous Communication Standard,* 29 CFR 1910.1200. Since DOD and SECNAV have adopted that regulation, all civilian and military employees of the federal government must comply with it.

The HM you must use to do your job can be hazardous to your heath and the environment if handled improperly. Therefore, you have the right to be trained in the use of HM and to have all the information about those materials that could threaten your safety or health.

To protect your rights and to ensure personnel comply with OSHA and Environmental Protection Agency (EPA) regulations, the Navy has developed an HM control and management program. *Hazardous Material Control and Management (HMC&M),* OPNAVINST 4110.2, provides the details of this program. OPNAVINST 5100.23 and OPNAVINST 5100.19 also discuss HM control and management.

The Naval Supply Systems Command manages the overall program for HM control and management for the Navy. The program objectives are as follows:

- Minimize the amount of HM in use.
- Use HM safely.
- Decrease the amount of HW produced.

DEFINITION OF HAZARDOUS MATERIAL

What is hazardous material? HM is any material that, because of its quantity, concentration, physical and chemical characteristics, may pose a real hazard to human health or the environment. Hazardous materials include the following categories:

- Aerosols
- Compressed gases
- Oxidizing material
- Toxic or poisonous materials
- Flammable and combustible materials
- Corrosive materials, such as strong acids and alkalies

Separate directives cover some materials considered hazardous. These materials include mercury; asbestos; propellants; bulk fuels; ammunition; medical waste; and chemical, biological, and radiological materials.

DEFINITION OF HAZARDOUS WASTE

Hazardous waste is any discarded material (liquid, solid, or gas) that meets the definition of hazardous material. Only the EPA or a state authority may designate material as HW.

CATEGORIES OF USED AND EXCESS HAZARDOUS MATERIAL

Afloat units turn in used or excess HM to public works centers or other shore collection sites. The shore site then restores, recycles, or disposes of the used or excess HM.

Material Safety Data Sheets

Material Safety Data Sheets (MSDSs) are technical bulletins containing information about HM (fig. 12-2). Manufacturers produce MSDSs based on their testing and research of the products. By law, they must provide the data to HM users. They tell you how to use, store, and dispose of HM. OPNAVINST 5100.19 series requires all hands to follow these guidelines. MSDSs must be in English and contain the following information about the material:

- Identify
- Hazardous ingredients
- Physical and chemical characteristics
- Physical hazards
- Reactivity
- Heath hazards
- Precautions for safe handling and use
- Control measures
- Routes of entry into the body
- Emergency and first-aid procedures for exposure
- Date of preparation of the MSDS or last change
- Name, address, and phone number of a responsible party who can provide additional information on the hazardous material and give the appropriate emergency procedures

Manufacturers may use any format or arrangement of this information, but every MSDS must include all the items. Some MSDSs contain ingredient information that the manufacturer considers proprietary (a trade secret). Proprietary information is provided on the compact disk-read only memory (CD-ROM) labeled "LR" version. The "L" version does not contain proprietary information. Only safety and health professionals should have access to the "LR" version of the CD-ROM.

Every HM user must be trained on the precautions associated with that material. MSDSs must be available upon request to any user. If you have a question, check with your command's HM/HW coordinator.

Hazardous Materials Information System

The Hazardous Materials Information System (HMIS) is a computerized data base of MSDSs. It provides information for people working in HM management. The system provides basic technical information required at all levels to aid in the proper handling, storage, transportation, and disposal of HM. In addition, it provides information about safety, health, and environmental functions.

The HMIS data base provides useful information on more than 70,000 hazardous materials used by DOD. The Naval Supply Systems Command distributes the data base quarterly on CD-ROM as part of the Hazardous Material Control and Management (HMC&M) CD-ROM, which contains the following materials:

- HMIS data base with MSDSs and labels
- Hazardous Material Afloat Program (HMAP) Management Guide
- Hazardous Material User's Guide (HMUG)
- Ships Hazardous Material List (SHML)
- Safety Equipment Shopping Guide
- Naval Safety Center roster
- Various hazardous material and environmental compliance instructions
- Tutorial for hardware and software

Each ship and most shore stations have been issued computer compact disk (CD) players, which are on

DOD Hazardous Materials Information System
DOD 6050.5 5-LR
AS OF MAY 1992
For U.S. Government Use Only

FSC 6505
NIIN 001538480
Manufacturer's CAGE: 1BF21
Part No. Indicator: A
Part Number/Trade Name: HYDROGEN PEROXIDE SOLUTION 3%

General Information

Item Name: HYDROGEN PEROXIDE TOPICAL SOLUTION, USP
Manufacturer's Name: MALLINCRODT INC
Manufacturer's Street:
Manufacturer's P.O. Box: M
Manufacturer's City: PARIS
Manufacturer's State: KY
Manufacturer's Country: US
Manufacturer's Zip Code: 40361-0315
Manufacturer's Emerg Ph #: 314-982-5000
Manufacturer's Info Ph #: 314-982-5000
Distributor/Vender # 1: RUGER CHEMICAL CO. INC.
Distributor/Vender # 1: Cage: 64220
Distributor/Vender # 2:
Distributor/Vender # 2 Cage:
Distributor/Vender # 3:
Distributor/Vender # 3 Cage:
Distributor/Vender # 4:
Distributor/Vender # 4 Cage:
Safety Data Action Code:
Safety Focal Point: D
Record No. For Safety Entry: 001
Tot Safety Enties This Stk#: 006
Status: SE
Date MSDS Prepared: 21JAN86
Safety Data Review Date: 05DEC90
Supply Item Manager: KX
MSDS Preparer's Name:
Preparer's Company:
Preparer's St or P.O. Box:
Preparer's City:
Preparer's State:
Preparer's Zip Code:
Other MSDS Number:
MSDS Serial Number: BJFCN
Specification Number:
Spec Type, Grade, Class:
Hazard Characteristic Code: P2
Unit of Issue: BT
Unit of Issue Container Qty: 1 PT
Type of Container: BOTTLE
Net Unit Weight: 1.16 LBS
NRC/State License Number:
Net Explosive Weight:
Net Propellant Weight-Ammo:
Coast Guard Ammunition Code:

Ingredients/Identity Information

Proprietary: NO
Ingredient: HYDROGEN PEROXIDE, SOLUTION 3%
Indredient: Sequence Number: 01
Percent: UNKNOWN
Ingredient Action Code:
Ingredient Focal Point: D
NIOSH (RTECS) Number: 1005359HP
CAS Number: UNKNOWN
OSHA PEL: UNKNOWN
ACGIH TLV: UNKNOWN
Other Recommended Limit: NONE SPECIFIED

Physical/Chemical Characteristics

Appearance and Odor: CLEAR, COLORLESS SOLUTION, ODORLESS.
Boiling Point: 212F, 100C
Melting Point: 32.0F, 0.0C
Vapor Pressure (MM Hg/70 F): N/K
Vapor Density (Air=1): N/K
Specific Gravity: N/K
Decomposition Temperature: UNKNOWN
Evaporation Rate and Ref: N/K
Solubility In Water: INFINITELY
Percent Volatiles By Volume: N/R
Viscosity:
pH: N/R
Radioactivity:
Form (Radioactive Matl):
Magnetism (Milligauss):
Corrosion Rate (IPY): UNKNOWN
Autoignition Temperature:

Fire and Explosion Hazard Date

Flash Point: N/K
Flash Point Method: N/K
Lower Explosive Limit: N/K
Upper Explosive Limit: N/K
Extinguishing Media: MAY USE WATER SPRAY TO PUT OUT SURROUNDING FIRE & COOL EXPLOSED CONTAINERS. WATER SPRAY WILL REDUCE FUME & IRRITANT GAS.
Special Fire Fighting Proc: USE NIOSH APPROVED SCBA WITH FULL POSITIVE PRESSURE FACE PIECE & CLOTHING. NOT COMBUSTIBLE, BUT LIQUID IS OXIDIZER & MAY IGNITE/W REDUCING AGENTS/COMBUSTIBLES.
Unusual Fire and Expl Hazards: EXTREMELY VIOLENT COMBUSTION IF CONTACT WITH OXIDIZING SUBSTANCES. DRIED CONCENTRATED HYDROGEN PEROXIDE/COMBUST. MATERIAL ON CLOTHES MAY CAUSE FIRE OR EXPLOSION.

Reactivity Data

Statility: NO
Cond To Avoid (Stability): HEAT. SPONTANEOUS COMBUSTION MAY OCCUR ON STANDING IN CONTACT WITH READILY FLAMMABLE MATERIALS.
Materials to Avoid: REDUCING AGENTS, ORGANIC MATERIALS, DIRT, ALKALIES, RUST & MAY METALS.

Figure 12-2.—Material Safety Data Sheet (front).

Hazardous Decomp Products: DECOMPOSES TO WATER & OXYGEN WITH RAPID HEAT RELEASE. USE VENTED CONTAINERS. SOLUTION CAN DECOMPOSE RAPIDLY UPON HEATING
Hazardous Poly Occur: NO
Conditions to Avoid (Poly): NOT APPLICABLE

Health Hazard Data

LD50-LC50 Mixture: LD50 UNKNOWNLD
Route of Entry–Inhalation: YES
Route of Entry–Skin: YES
Route of Entry–Ingestion: YES
Health Haz Acute and Chronic: ACUTE-EYES: IRRITATION. SKIN: INTACT SKIN, NONE. CONTACT ON BURN/OPEN SKIN MAY CAUSE IRRITATION. INHALE: UPON HEATING, MAY CAUSE IRRITATION TO MUCOUS MEMBRANES OF NOSE & THROAT. INGEST: IRRITATION TO MOUTH, THROAT & ABDOMEN. CHRONIC-NONE.
Carcinogenicity–NTP: NO
Carcinogenicity–IARC: NO
Carcinogenicity–OSHA: NO
Explanation Carcinogenicity: THIS PRODUCT IS NOT LISTED BY IARC, NTP, OR OSHA AS A CARCINOGEN.
Signs/Symptims Of Overexp: EYE: REDNESS & PAIN. SKIN: STINGING PAIN. INHALE: IRRITATION TO MUCOUS MEMBRANES OF NOSE & THROAT. INGEST: BLISTERING TO MOUTH, THROAT & ABDOMEN. ABDOMINAL PAIN, VOMITING & DIARRHEA.
Med Cond Aggravated By Exp: NONE
Emergency/First Aid Proc: FIRST AID-INHALATION: REMOVE TO FRESH AIR. SEE DOCTOR IF NEEDED. EYES: WASH WITH PLENTY OF WATER FOR 15 MINUTES. SEE DOCTOR. SKIN: WASH WITH SOAP & WATER. IF IRRITATION PERSISTS, GET MEDICAL ADVICE. INGEST: GIVE SEVERAL GLASSES OF WATER TO DRINK TO DILUTE. GET MEDICAL ADVICE.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: VENT SPILL AREA. MAY REQUIRE PROTECTIVE CLOTHING. ABSORB SPILL WITH DRY ABSORBENT OR DILUTE WITH LARGE AMOUNTS OF WATER AND HANDLE AS NONHAZARDOUS WASTE. CONTAINERIZE UNSTABLE MATERIAL FOR DISPOSAL IN AN APPROVED WASTE FACILITY.
Neutralizing Agent: NOT APPLICABLE.
Waste Disposal Method: DISPOSE OF IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL LAWS.
Precautions-Handling/Storing: STORAGE-STORE IN A COOL, WELL-VENTILATED DARK AREA. ISOLATE FROM INCOMPATIBLE SUBSTANCES. PROTECT FROM PHYSICAL
Other Precautions: NONE

Control Measures

Respiratory Protection: NONE.
Ventilation: DILUTION VENTILATION IS SATISFACORY. HOWEVER IF WORKER FEELS DISCOMFORT, LOCAL EXHAUST SYSTEM SHOULD BE USED.
Protective Gloves: RUBBER
Eye Protection: CHEMICAL SAFETY GOGGLES/FULL FACE SHIELD
Other Protective Equipment: EYEWASH STATION & QUICK-DRENCH FACILITY.
Work Hygenic Practices: OBSERVE GOOD PERSONAL HYGIENE PRACTICES AND RECOMMENDED PROCEDURES.
Suppl. Safety & Health Data: NONE

Transportation Data

Transportation Action Code:
Transportation Focal Point: D
Trans Data Review Date: 90339
DOT PSN Code: ZZZ
DOT Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
DOT Class: N/R
DOT Label: N/R
Limited Quantity: NO
DOT Mode Indicator:
Identification Number: N/R
Reportable Qty.–Trans File: NO
DOT/DoD Exemption Number:
IMO PSN Code: ZZZ
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
IMO Regulations Page Number: N/R
IMO UN Number: N/R
IMO UN Class: N/R
IMO Subsidiary Risk Label: N/R
IATA PSN Code: ZZZ
IATA UN ID Number: N/R
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
IATA UN Class: N/R
IATA Subsidiary Risk Class: N/R
IATA Label: N/R
AFR 71-4 PSN Code: ZZZ
AFR 71-4 Prop. Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
AFR 71-4 Class: N/R
AFR 71-4 Label: N/R
AFR 71-4 ID Number: N/R
AF MMAC Code:
Tech Entry NOS Shipping Name:
Additional Trans Data:

Disposal Data

Disposal Data Action Code:
Disposal Data Focal Point:
Disposal Data Review Date:
Rec # For This Disp Entry:
Tot Disp Entries This Stock#:
Landfill Ban Item:
Disposal Supplemental Data:
1st EPA Haz Wst Code UnUsed:
1st EPA Haz Wst Name UnUsed:
1st EPA Haz Wst Char UnUsed:
1st EPA Acute Hazard UnUsed:
2nd EPA Haz Wst Code UnUsed:
2nd EPA Haz Wst Name UnUsed:
2nd EPA Haz Wst Char UnUsed:
2nd EPA Acute Hazard UnUsed:
3rd EPA Haz Wst Code UnUsed:
3rd EPA Haz Wst Name UnUsed:
3rd EPA Haz Wst Char UnUsed:

Figure 12-2.—Material Safety Data Sheet (back).

distribution for HMC&M updates. Navy Environmental and Preventive Medicine Units (NEPMUs) also offer a 1-day course that covers the retrieval of data, including the type of data available, from the HMIS system.

PERSONNEL PROTECTIVE EQUIPMENT

LEARNING OBJECTIVE: Explain the different types of personnel protective equipment (PPE), such as gloves, goggles, and respiratory.

The purpose of PPE is to minimize the hazard of handling HM. All PPE shall be readily available near the working area. Ensure that you use the proper PPE for the job you are doing. Additional information about PPE is located in OPNAVINST 5100.19, NSTM chapters 074, volume 3,079, volume 2,631, and 635.

HEAD AND FACE PROTECTION

When you are using a head and face protective device it is to protect you from flying objects or chemical splashes. Head and face protection devices are as follows:

- Helmets or hardhats to protect against blows to the head.
- Face shields, to be attached to a helmet, to provide full-face splash and splatter protection.
- Hoods to protect the head, face, and neck from HM.
- Face mask, such as respirator components, to provide face protection against chemical splashes and mists. The degree of protection varies with the type of mask.

EYE PROTECTION

Eye protection equipment is to protect against chemical vapors, mists, gases, dusts, and splinters. The following devices provide eye protection:

- Safety glasses with sideshields to protect against direct splashes and flying objects, but which are not gas tight.
- Splash goggles, which protect against liquid HM and are resistant to gases.
- Gas goggles, which are gas tight.
- Face shields, which when used with safety glasses, protect the eyes from HM splashes and mists.

FOOT PROTECTION

To protect your feet from falling objects and spills the following items are used:

- Safety shoes or boots, made from leather or rubber and reinforced with steel toe, instep, or sole inserts. Nonskid soles might be necessary to prevent sparks when you handle volatile chemicals.
- Splash boots to protect shoes and feet from HM spills. These are frequently worn over safety shoes.

HAND PROTECTION

Hand protection prevents injury from HM or falling objects. This equipment includes the following:

- Work gloves of leather or heavy cloth to provide impact protection and insulation. These offer little or no protection from HM, but can be worn over chemical-resistant gloves.
- Impervious and chemical-resistant gloves, made of rubber or synthetic materials. Different glove materials provide varying protection against different chemicals.
- Barrier creams, used alone or under gloves, to protect against skin sensitizers or irritants such as epoxy resins.

FULL BODY PROTECTION

Full body protective clothing provides protection against HM spills, splashes, and mists. This clothing includes the following:

- Aprons, covering the front of the body from ankles or knees to the chest

- Chemical-resistant coveralls, which may be disposable
- Chemical-resistant splash suits, which are typically reusable
- Fully-encapsulating suits that completely isolate the wearer from atmospheres and contact with HM

SUMMARY

In this chapter you have learned about HM and HW. By no means is this all you need to know about this area, but it is a start. If you ever have a problem, make sure you speak to the most qualified person about it. Please remember, it is better to be safe than sorry.

CHAPTER 13

AMPHIBIOUS DUTIES

A special amphibious signal system for ship-to-shore movements is used when amphibious landings are conducted. Panels, shapes, flags, and lights are used for this system. Do not confuse these signals with any of those in ATP 1, volume II, or the International Code of Signals. Review the amphibious signal system instructions in NWP 22-3, Ship-to-Shore Movement, for complete details on all amphibious signals and instructions. This chapter covers just the basics that you, as a Boatswain's Mate, need to know for an amphibious landing.

AMPHIBIOUS OPERATIONS

LEARNING OBJECTIVES: Explain the general concept of an amphibious operation ship-to-shore movement.

The ship-to-shore movement is the portion of the assault phase of an amphibious operation that includes the deployment of the landing forces from assault shipping to designated areas. Its object is to ensure the landing of troops, equipment, and supplies at prescribed times and places and in the formation required by the landing force scheme of maneuver for operation ashore. Ship-to-shore movement may be executed by water, air, or a combination of both. It commences at the order of the Commander, Amphibious Task Force (CATF), and concludes when the unloading of all assault shipping is completed.

AMPHIBIOUS SHIPS AND CRAFTS

LEARNING OBJECTIVES: Identify and explain the duties of ships and landing crafts involved in an amphibious operation.

The following ships and landing craft are vital to carrying out the operation of an amphibious assault.

COMMAND SHIP (LCC)

The amphibious command ship serves as a command ship for the amphibious task force (ATF), landing force, and tactical air commanders during an amphibious assault. It also provides facilities for a joint communications center, supporting arms coordinating center, and central control of both the waterborne and helicopterborne ship-to-shore movement. The LCC may also provide facilities for the task force medical regulating center, but has limited medical facilities and is unsuitable as a major casualty receiving and treatment station.

GENERAL-PURPOSE ASSAULT SHIP (LHA)

The LHA combines many of the operational capabilities of other amphibious ships. It has helicopter operating facilities greater than those of an assault ship (LPH), and has well deck capacity twice the size of a transport dock (LPD). The LHA is also capable of carrying the landing craft, air cushion (LCAC) in the well deck. The LHA also provides facilities for Navy and Marine command and control, including a helicopter direction center and a medical regulating control officer. When augmented with appropriate personnel, LHAs serve as primary casualty receiving and treatment ships and provide triage functions and early definitive medical and surgical care for combat casual ties.

MULTIPURPOSE ASSAULT SHIP (LHD)

The LHD is the largest class amphibious ship in service. It has improved capabilities over the LHA, in particular; the LHD is able to operate conventional landing craft, LCAC, fixed-wing tilt-rotor aircraft, and helicopters.

TRANSPORT DOCK (LPD)

The LPD transports and lands troops and their essential equipment and supplies by means of landing craft, amphibious vehicles, and helicopter. An LPD can function as a primary control ship (PCS) for waterborne crafts, but it has limited boat haven, helicopter storage, and control facilities. Some ships of this type are configured with Navy and Marine command and control facilities. The LPD has less extensive medical facilities than the LPH/LHA, but would be suitable for use as a secondary casualty receiving and treatment ship.

ASSAULT SHIP (LPH)

The LPH is the principal ship employed to support vertical assault (helicopterborne) ship-to-shore movement. It embarks, transports, and lands troops and their essential equipment and supplies. It may land the personnel and equipment by embarked transport helicopters or, under unusual circumstances, by landing craft provided by other ships. The LPH also provides facilities for Navy and Marine command and control, including a helicopter direction center, and a medical regulating control officer. When appropriate personnel are on board, the LPH serves as a primary casualty receiving and treatment ship and provides triage functions and early definitive medical and surgical care.

LANDING SHIP (LSD)

The LSD transports and lands amphibious vehicles or landing crafts and their accompanying troops and equipment. It is capable of repairing landing craft and may also be used as a helicopter landing platform, a PCS for waterborne craft, and a boat haven. The LSD has limited medical facilities, and is not suitable for service as a casualty receiving and treatment ship.

LANDING CRAFT

The types of landing craft used to land assault troops, their equipment, and supplies are as follows:

- LANDING CRAFT PERSONNEL LARGE (LCPL)—The LCPL is used to support UDT operations, as a gig/officer boat, and as a general utility boat. Although not normally used for troops/cargo, it is capable of transporting 17 troops or 3,000 pounds of cargo. In amphibious operations, it is used for control/safety purposes within the boat group or as the LVT safety boat.
- LANDING VEHICLE TRACKED (LVT)—The LVT operates on both land and water and can negotiate obstacles that prevent other landing craft from beaching. Primarily used as a personnel carrier, it may also be used later in offshore personnel transfer. In addition, the LVT is an important vehicle for logistic support, since cargo may be carried directly from the ship to an inland beach dump.
- LANDING CRAFT UTILITY (LCU)—The LCU is made of steel with cargo space measuring 100 feet long by 18 feet wide and 4.5 feet deep, for a carrying capacity of 400 tons. See figure 13-1.
- LANDING CRAFT MECHANIZED (LCM 8, LCM 6)—There are two types of LCMs: LCM 6 and LCM 8. The LCM 6 can carry 34 tons of cargo, 80 combat-equipped troops, or a 36-ton tank. The LCM 8 steel hull can carry up to 65 tons, 200 combat-equipped troops, or a 60-ton tank. The LCM is shown here in figure 13-2.
- LANDING CRAFT, AIR CUSHION (LCAC)—The LCAC is a fully amphibious, air-cushion vehicle capable of operating from an exiting well deck ship. Its mission is to transport weapons systems, equipment, cargo, and personnel of the assault elements of the Marine Air/Ground Task Force both from ship-to-shore and across the beach. Figure 13-3 is a picture of an LCAC.

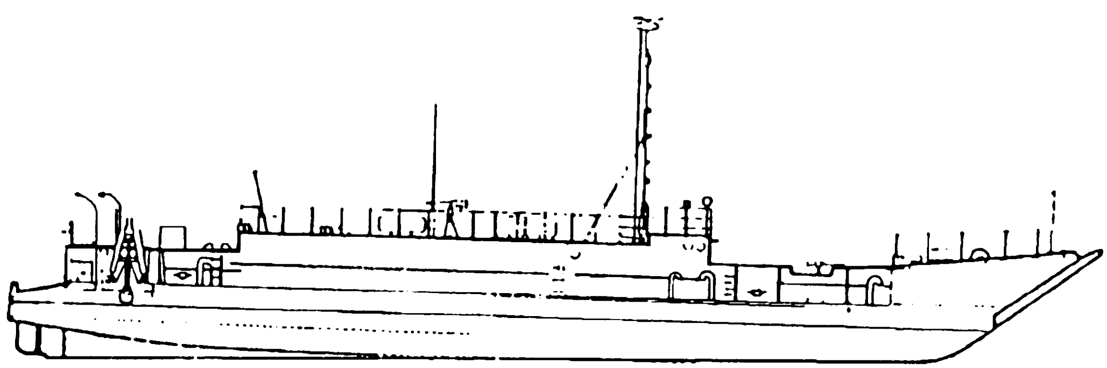


Figure 13-1.—Landing craft utility (LCU).

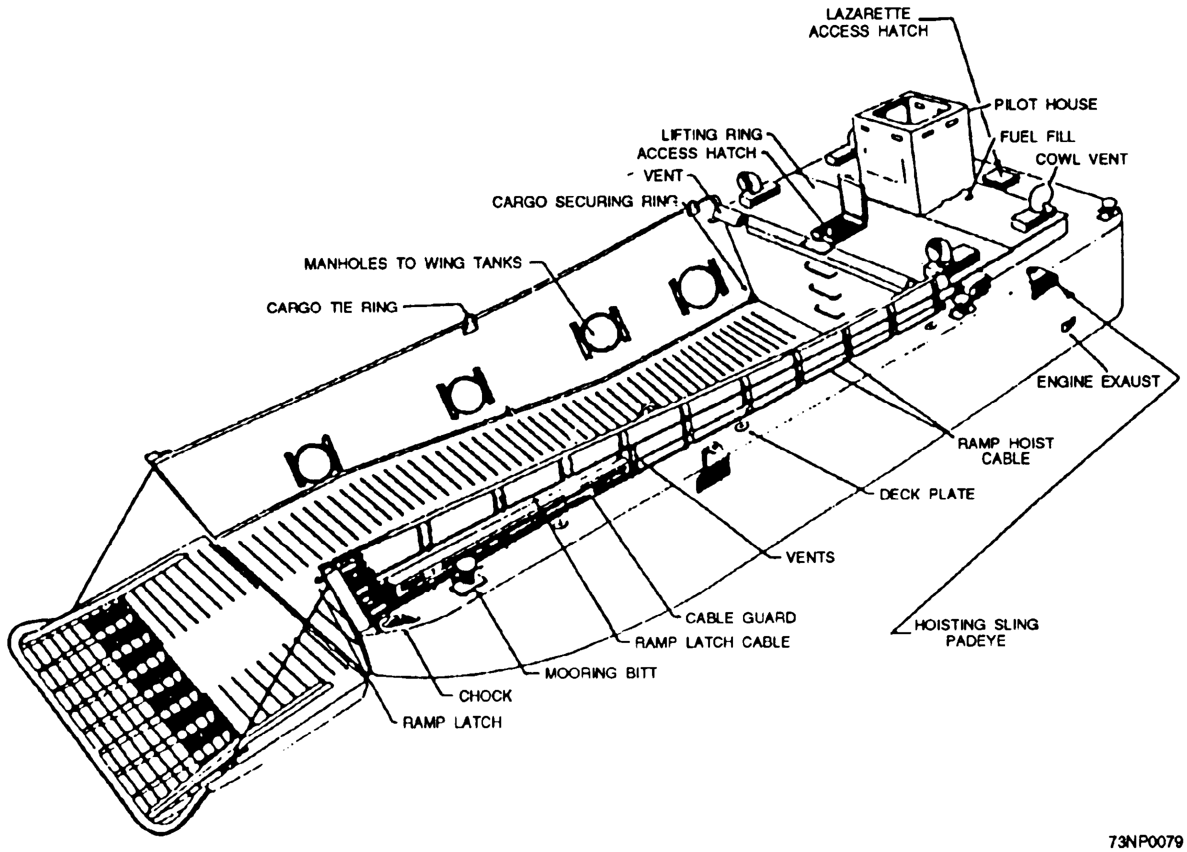


Figure 13-2.—Landing craft mechanized (LCM).

These craft are capable of beaching where conditions permit and, with the exception of the LCPL, are provided with bow ramps for discharging personnel and equipment directly on the beach. Landing craft are usually preloaded and lifted to the objective area in the well of LHAs, LHDs, LSDs, and LPDs.

WATERBORNE SHIP-TO-SHORE MOVEMENT

LEARNING OBJECTIVES: Explain the procedures for conducting a ship-to-shore waterborne movement, including the sequence of operation, preparation, and execution.

Waterborne ship-to-shore movements are conducted in the following sequence:

1. Assembly and formation of landing ships, amphibious vehicles, and landing craft in the transport area.

2. Debarkation of troops and equipment from assault shipping into the landing craft and amphibious vehicles.

3. Transfer line operations, when required.

4. Landing of assault, combat support, combat service support, and reserve troops and their supplies.

When underway launch of amphibious vehicles and/or preloading landing craft is used, the ship-to-shore movement is modified. The sequence begins with the underway launch of the troops and equipment from assault shipping by amphibious vehicles or landing craft, and then continues as just listed.

FINAL PREPARATION

As the ATF starts the final approach to assigned positions for the assault, ships prepare for the debarkation of embarked troops, equipment, and supplies according to previously prepared plans. The beginning of debarkation and the timing of the ship-to-shore movement depends on the designated H-hour. All elements must be prepared to modify timing on short notice to conform with changes to H-hour.

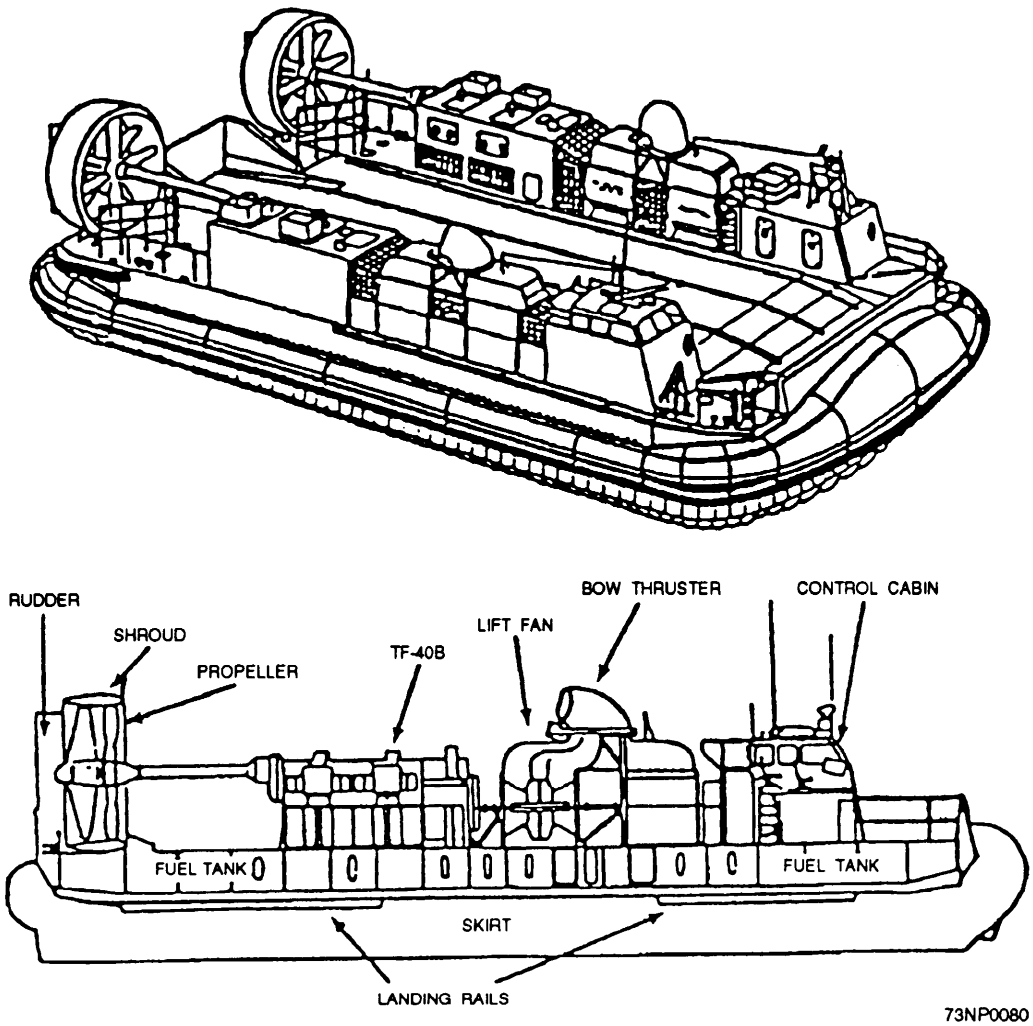


Figure 13-3.—Landing craft, air cushion (LCAC).

SHIPS AND ELEMENTS POSITIONING

To ensure that H-hour will be met, all elements of the ATF arrive on station sufficiently in advance of H-hour to permit preliminary operations between the time the signal "Land the landing force" is made and H-hour. The time required depends upon a number of things, such as the need for pre-H-hour transfers, the nature of loading, and the number of scheduled waves.

EXECUTION

Prior to the arrival of the assault elements in the transport area, the decision will have been made to execute either the primary assault plan or one of the alternate plans. The amphibious task force commander initiates the landing with the landing force signal. When the signal has been made, ships that are debarking troops or material in the scheduled waves will take the actions that are necessary to meet the prescribed H-hour, and boats and craft that are being discharged proceed to the assembly area. After being advised on the progress of debarkation and consulting with the landing force commander, the amphibious task force commander will either confirm or modify H-hour.

DEBARKATION

LEARNING OBJECTIVES: Explain debarkation, debarkation areas, and control areas. List the day and night procedures for calling boats alongside and into the well deck area.

Designated debarkation stations are used for off-loading troops into boats alongside. Debarkation nets for debarking over the side of the ship are used by all troops to be landed in boats except those accompanying equipment preloaded in craft. The following paragraphs pertain to the debarkation process.

DEBARKATION AREAS

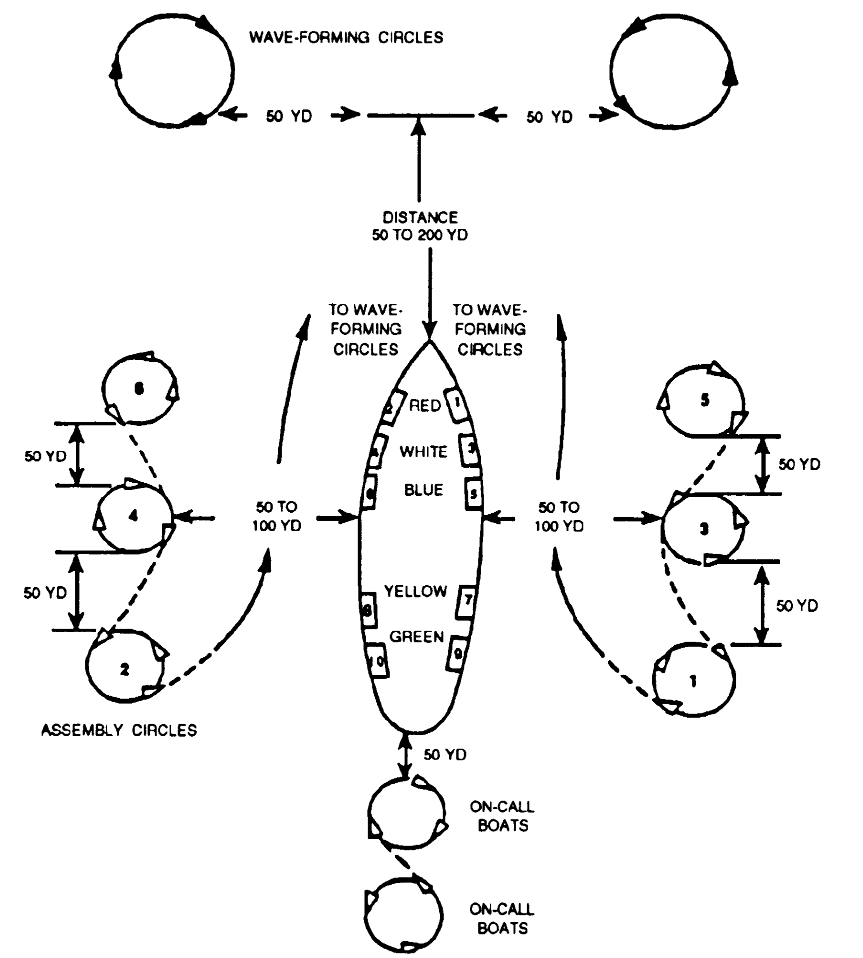
Landing craft or boats are placed in assembly circles, wave-forming circles, or rendezvous areas (fig. 13-4) prior to dispatching them for their duty.

Assembly Areas

Assembly circles are located on each bow, beam, and quarter of the transport, as appropriate. On-call circles are located astern of the transport. Boats will only approach when called from the aft circle. Boats in midships and boats in the forward circle cannot shift until all boats have cleared the aft circle.

Wave-Forming Circles

Wave-forming circles are located close to the bow of the parent vessel to facilitate the assembly of a wave



NOTES:

1. LANDING CRAFT APPROACH SHIP FROM ASSEMBLY CIRCLES 1 AND 2 ONLY.
2. LANDING CRAFT IN MIDSHIP ASSEMBLY CIRCLES (3 AND 4) AND FORWARD ASSEMBLY CIRCLES (5 AND 6) DO NOT EXECUTE AUTOMATIC CIRCLE SHIFT UNTIL ALL LANDING CRAFT HAVE CLEARED AFTER CIRCLES.
3. IN EXECUTING AUTOMATIC ASSEMBLY CIRCLE SHIFT, LANDING CRAFT FOLLOW A FIGURE-EIGHT PATTERN TO EFFECT REVERSAL IN DIRECTION OF MOVEMENT IN FOLLOWING CIRCLES.
4. UNDER CONDITIONS OF LOW VISIBILITY, ASSEMBLY CIRCLES ARE MOVED CLOSER TO THE SIDE (25 TO 50 YARDS).
5. LOADED LANDING CRAFT PROCEED FROM ALONGSIDE DEBARKATION STATIONS TO WAVE-FORMING CIRCLES.
6. WAVE-FORMING CIRCLES ADJUST DISTANCE FOR POSITIVE RADAR TRACKING.
7. THE BOAT WAVE COMMANDER (BWC) LEADS THE WAVE TO THE RENDEZVOUS AREA.

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Figure 13-4.—Landing craft assembly circles.

after loading. The wave-forming circles provide CIC with the opportunity to better identify and control the wave.

Landing Craft Rendezvous Area

The rendezvous area is designated for assembling loaded landing craft by waves prior to dispatching them along the designated approach lane to the line of departure (LOD).

CONTROL AREAS

The assault wave control areas (fig. 13-5) of an amphibious assault are discussed in the following paragraphs.

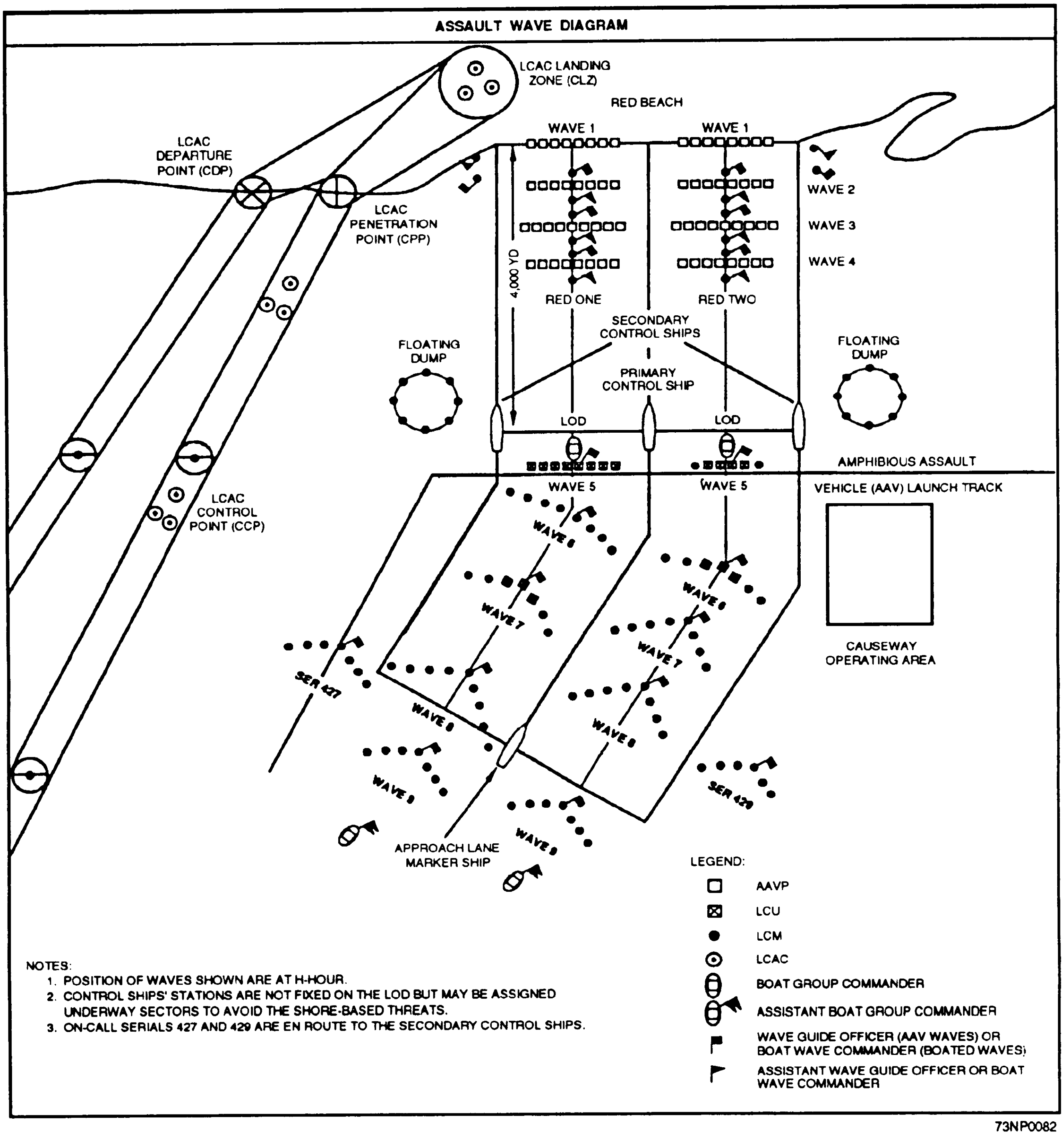

Figure 13-5.—Example of an assault wave diagram.

Line of Departure (LOD)

The LOD is a designated line offshore approximately parallel to the landing beach. From this line the successive assault waves are dispatched for their final movement to the beach. When landing beaches are separated, each beach has its own LOD, which may be marked by a ship or ships of the control organization or by boats or buoys. In some landings the LOD may not be marked.

Boat Lanes

Boat lanes extend seaward from the landing beach to the LOD. The length of the landing beach determines the width of the boat lane. The flanks of the boat lane may be marked at the LOD by a control ship, a marker boat, or a buoy.

Approach Lanes

Approach lanes are extensions of the boat lanes from the LOD towards the transport area. They may be terminated by marker ships, boats, or buoys. Adjacent approach lanes may be parallel or may diverge seaward to provide for early dispersion of the assault waves. Approach lanes indicate the exact routes for craft to use in approaching the LOD.

IDENTIFICATION OF DEBARKATION STATIONS

There is a maximum of 10 debarkation stations, 5 on the starboard side and 5 on the port side, each identified by color and number (odd-numbered, starboard; even-numbered, port). See figure 13-4.

PROCEDURES FOR CALLING BOATS ALONGSIDE

Signals are used to call boats and landing craft from the assembly areas to embark troops at the debarkation stations.

Day

The starboard and port yardarms are used to signal for the starboard and port debarkation stations, respectively. The type of boat or craft is called to the station by displaying the designated flag over the colored debarkation station flag (see fig. 13-6). For example, to call the LCM 8 required at (port)

Information to Signal				Day Signal Flags	Night Signal Lights
Sides	Starboard Port			Use starboard yardarm Use port yardarm	Top GREEN light Top RED light
Boats and Displacement Landing Craft	LCPL LCU AAV LCM 6 LCM 8			L FLAG U FLAG T FLAG 6 FLAG 8 FLAG	Middle AMBER light Middle WHITE light Middle AMBER light, flashing Middle BLUE light Middle GREEN light
Stations	Color	Starboard	Port		
	RED	1	2	RED FLAG	Bottom RED light
	WHITE	3	4	WHITE FLAG	Bottom WHITE light
	BLUE	5	6	BLUE FLAG	Bottom BLUE light
	YELLOW	7	8	YELLOW FLAG	Bottom AMBER light
	GREEN	9	10	GREEN FLAG	Bottom GREEN light
Well Deck/ Tank Deck	Note:	Paragraph A.1.4 contains special signals for LHA well deck. See NWP 22.		WHISKEY FLAG	Top WHITE light Middle (type landing craft indicated by middle light marry up and enter well deck) Bottom WHITE light Note: Turned off for calling single landing craft into well deck or to tank deck.

Figure 13-6.—Signals for calling boats and landing craft to debarkation stations.

debarkation station BLUE 6, the signal bridge hoists the 8 flag over the BLUE flag at the port yardarm. When boats are alongside the designated station, the flag signal is hauled down.

Night

A light box (fig. 13-7) is mounted on a swivel base at the signal station on each side of the ship for aiming at a particular assembly area. The box is fitted with three holes on a vertical line and is shielded at the front so the lights are visible in one assembly area only. The holes will be of such size to permit interchange of the standard colored light filters for a 12-inch searchlight.

The top color in the light box indicates starboard or port side; the middle color indicates type of boat or craft desired; and the bottom color designates the debarkation station (see fig. 13-6).

Each debarkation station suspends a small, single-cell flashlight colored the same color as the debarkation station marker. All lights are in the same location as the station marker painted on the hull. These small lights serve only to identify the stations as the boat or craft comes close alongside.

Day and Night

Landing craft are called alongside by signal on orders from the debarkation officer. Loudspeaker equipment may be used as a supplementary means of communication. Radio to the boat group commander (BGC) or his or her assistant may be used as a backup.

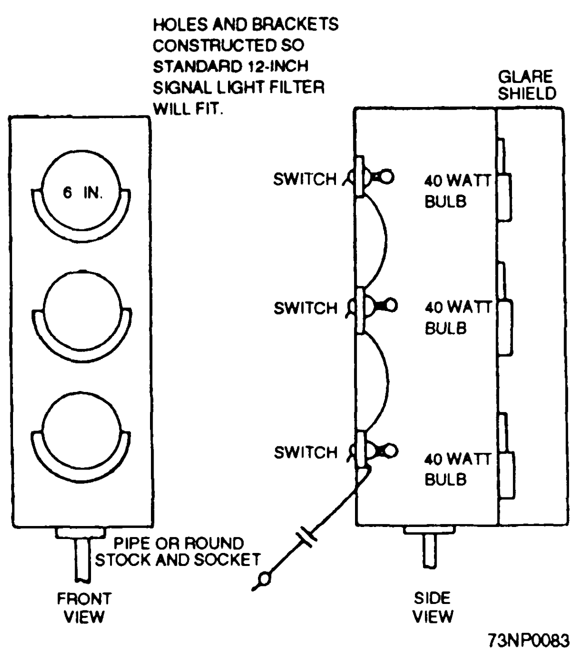

Figure 13-7.—Debarkation light box.

PROCEDURES FOR CALLING BOATS AND CRAFT INTO WELL DECKS/TANK DECKS

Signals are used to call boats and landing craft from on-call circles into the well decks, to the tank of an LST for stem gate marriages, or to embark troops or cargo.

Day

Signals are similar to those used in calling boats or craft to debarkation stations. To call boats or craft into well decks, the signal bridge hoists the signal for a type of boat or craft (see fig. 13-6). To call an LCM 8, for example, the signal bridge hoists (on either yardarm with the exception of LHAs) flag 8 over flag WHISKEY, which would tell the boats in the on-call circle that a single LCM 8 is to enter the well deck. To bring two LCM 8s married into the well, the signal is flag 8 over flag 8 over flag WHISKEY. This indicates that two LCM 8s are to marry up in the on-call circle and enter the well deck. Once the boats cross the sill, the well deck control officer positions them at any desired station. For calling boats or craft into the well deck of an LHA, the signal bridge hoists flag signals on the port or starboard yardarm to indicate which side of the split well deck the boat or craft is to make.

To call LCUs or LVTs to the tank deck, the signal bridge hoists the appropriate flag over the WHISKEY flag from either yardarm.

Night

At night, the light box and the same middle light color signals are used for calling individual boats and craft alongside. The top light for calling boats to the well deck is white instead of red or green. The bottom light is left blank when single boats are called. To have boats marry up, the bottom light is white. For LHAs, a steady top light indicates a boat or craft is to make the starboard side of the split well deck. A flashing top light indicates the port side of the split well.

CONTROL ORGANIZATION

LEARNING OBJECTIVES: Explain the duties of the control organization personnel, including the duties of the central control officer (CCO), a BGC, and the BWC.

This section discusses the duties and organization of control personnel and the procedures for coordinating the various ships for an amphibious operation.

CENTRAL CONTROL OFFICER (CCO)

The CCO is designated by the CATF for overall coordination of the waterborne assault. This officer is embarked on the control ship, and his/her responsibilities include the following:

- Planning and supervising the waterborne ship-to-ship movement
- Organizing the Navy control group to support the ATF landing plan
- Maintaining liaison with the tactical air officer (TAO)
- Maintaining liaison with the tactical logistics (TACLOG) group

ASSISTANT CENTRAL CONTROL OFFICER (ACCO)

An ACCO may be designated if the scope of the operation requires it. He/she embarks in an appropriate ship or craft and coordinates, as necessary, the movement of landing craft, amphibious vehicles, and landing ships in his/her designated area.

PRIMARY CONTROL OFFICER (PCO)

A PCO is designated for each colored beach and is responsible for the following:

- Providing detailed plans, called PCO instruc-tions, to conduct the ship-to-shore movement for amphibious assaults or withdrawals across a colored beach
- Maintaining current location and status of all ships, landing craft, and boats assigned to conduct the landing on the assigned beach
- Monitoring surf conditions and weather predictions and recommending the termination of boating when conditions warrant
- Maintaining the status of debarkation or embarkation
- Landing scheduled waves at the correct beach at the specified time
- Arranging for fueling boats and providing rest and food for boat crews
- Providing liaison to the surfaceborne RLT TACLOG detachment
- Conducting assault craft salvage operations
- Coordinating the employment of landing ships and craft within his or her area of responsibility following the initial assault

SECONDARY CONTROL OFFICER (SCO)

The SCO embarks in the secondary control ship (SCS) and is a principal assistant to the PCO. The SCS is assigned a fixed point station on the LOD or underway sector in the vicinity of the PCS; SCO\SCS duties include the following:

- Maintaining duplicate control records and plots required of the PCO and PCS
- Monitoring PCO radio circuits
- Controlling the waterborne ship-to-shore movement over a numbered colored beach when two or more numbered beaches are designated for colored beach
- Assuming PCO and PCS duties in an emergency

BOAT GROUP COMMANDER (BGC)

The BGC is embarked in an LCPL displaying the ZERO flag over the beach flag and is under the tactical control of the PCO. The BGC is thoroughly briefed on the approach schedule; assault wave, landing area, and transport area diagrams; and weather conditions; and is responsible for the following:

- Maintaining discipline within the boat group
- Maintaining proper wave positions in the rendezvous area
- Leading the first displacement landing craft wave from the rendezvous or underway launch area to the surf zone
- Controlling waterborne traffic off the beach

ASSISTANT BOAT GROUP COMMANDER (ABGC)

The ABGC embarks in an LCPL displaying the WHISKEY flag over the beach flag and reports to the BGC. The ABGC is responsible for the following:

- Assuming BGC duties in an emergency
- Assisting in organizing waves into proper position in the rendezvous area
- Assisting in dispatching waves from the rendezvous area to arrive at the LOD on time
- Checking for stragglers or malfunctioning/ damaged assault craft in later waves
- Following the last scheduled wave to the surf zone
- Conducting landing craft and amphibious vehicle salvage operations

BOAT WAVE COMMANDER (BWC)

The BWC embarks in the number one displacement landing craft and displays the beach flag over the wave number numerical flag. The BWC communicates with the BGC, ABGC, and PCS and is responsible for the following:

- Forming the wave into proper organization for landing
- Maintaining boat discipline in the wave
- Maintaining proper boat and wave intervals
- Arriving at the LOD and beach on time

WAVE GUIDE OFFICER/ASSISTANT WAVE GUIDE OFFICER

A wave guide officer and an assistant wave guide officer are assigned to each wave of amphibious vehicles. They are normally provided by the ship in which the wave is embarked. Each officer embarks in an LCPL that is equipped for communication the same as the BWC's craft. The wave guide officer's duties are as follows:

- Forming up the amphibious vehicles and guiding them to position seaward of the LOD line.
- Reporting to the PCS, giving details affecting the readiness of his or her wave.
- Taking station ahead of the wave, with his/her assistant astern of the wave, and leading the wave to the LOD and across on signal from the PCS.
- Ensuring that the wave is maintaining proper position in the boat lane and reaches the proper beach on time. (This officer is assisted by directions from the PCS.)
- Guiding the wave to the first line of breakers. Here the wave guide boats take station in the return lane if the amphibious assault vehicles are to return seaward after landing, and guide returning vehicles to the designated control ship or boat haven. If the vehicles do not return seaward, the guide boats normally report to the PCS.

STANDARD IDENTIFICATION FLAGS, LIGHTS, MARKERS, AND SIGNALS

LEARNING OBJECTIVES: Identify the standard identification flags, lights, markers, and signals used in ship-to-shore movement.

A variety of standard identification flags, lights, and markers are used in the ship-to-shore movement (refer to NWP 22-3, appendix C). In addition, a number of special markers and signals are used, as described in later paragraphs of this section.

BEACH MARKING FLAGS AND PANELS

During the planning stage of an amphibious assault, beach areas are divided into sections and assigned colors for identification purposes. Beach markers are approximately the size of a No. 4 flag, and are with the normal beach colors of red, yellow, green, or blue. Fluorescent cloth is used in beach flags and markers wherever possible for greater ease in identification under all weather conditions.

BEACH FLAGS

Beach flags (fig. 13-8) are flown from designated boats and ships; the color and design of the flag corresponds to the beach assignment. When not otherwise specified, the size of flags flown from boats will be a No. 8 signal flag or larger. Fluorescent cloth is

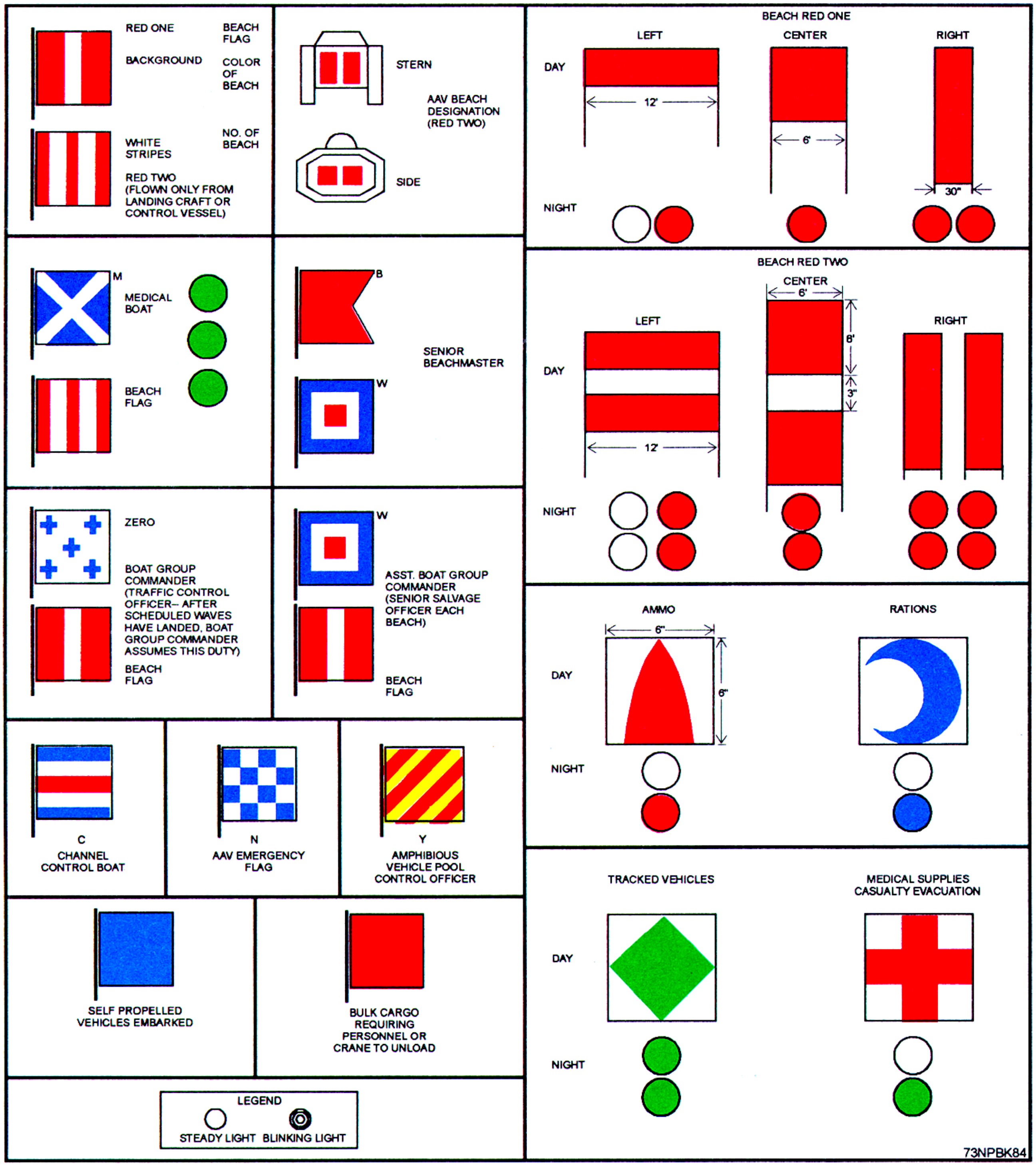

Figure 13-8.—Beach flags, markers, and signs.

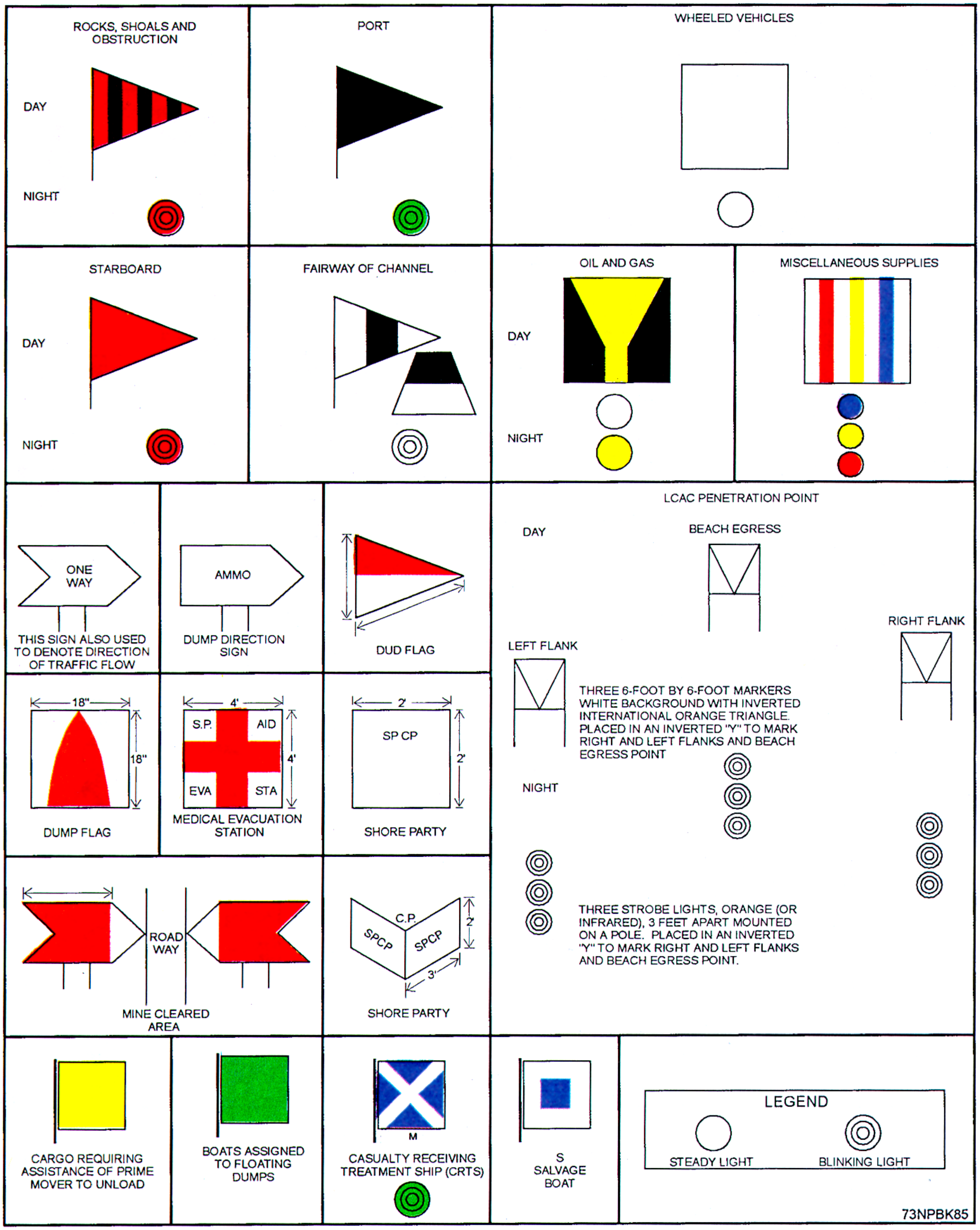

Figure 13-8.—Beach flags, markers, and signs—Continued.

used in beach flags and markers whenever possible for greater ease in identification.

SIGNAL OR MARKER LIGHTS

Signal or marker lights should be of sufficient intensity to be visible at a distance of at least 1,000 yards. Beach and unloading marker lights should be directional with not over lo-point visibility to seaward only. Should marker lights conflict, unloading-point marker lights may be one-half the intensity of beach center and flank markers.

DISPLAY OF STANDARD FLAGS AND MARKERS

Boats, craft, and amphibious vehicles in scheduled waves should remove from sight all special designators, such as flags and boat team paddles, at the time of crossing the LOD. Required designators should again be displayed following the landing of the last scheduled wave, or earlier if directed by the beachmaster, as shown in figure 13-9.

FLAG REQUIREMENTS

All wave guide officer, BWC, salvage, medical, safety, and ABGC boats should carry the ZERO, WHISKEY, and the numeral flags for all waves in order to facilitate substitution of one boat for another, if required.

NIGHT AND LOW-VISIBILITY SIGNALS

At night and during conditions of low visibility, colored lights should be used instead of flags and other daylight markers. All-around lights, except oceanographic markers, should be displayed only after H-hour. During darkness, screened wake lights should be used on the stems of all assault boats and vehicles. Lights should be displayed as indicated in figure 13-10.

BOAT TEAM PADDLES

Each boat team should be provided with a boat team paddle on which is prominently marked the boat team number that is shown in the landing craft and amphibious vehicle assignment table. A member of each boat team should be designated to display the paddle prominently at all times that the team is in the landing craft or amphibious vehicle, until the LOD has been crossed.

1. Paddle Number—The number on the paddle indicates both the scheduled wave number and the position of the boat or amphibious vehicle in that wave. The first digit(s) indicate(s) the wave; the last digit(s), the position within the wave. For example, boat team paddle 2-3 (fig. 13-11) indicates the third boat or amphibious vehicle in the second wave; boat team paddle 9-3 indicates the third boat or amphibious vehicle in the ninth wave. Each coxswain should be furnished with a copy of the landing diagram showing wave composition and timing.

2. Visibility—Boat team paddles are constructed for good visibility at a considerable distance, yet are easy to handle. They are three-sided, readable from any direction, with black numerals on a white background. Paddles are made to the following specifications:

- Three rectangularly shaped boards, 14 by 10 inches, nailed together to form a three-sided figure, attached to a wooden staff 6 feet by 2 inches by 2 inches
- Black numerals, 7 inches high, on a white background

3. Boats Carrying Serials and Free Boats—These boats should display paddles on which is clearly marked the serial number of the embarked serial. Each ship is responsible for ensuring that boats carrying serials unloaded from that ship clearly display the correct serial numbers. The numbers must be displayed constantly until the landing craft has beached.

Cargo Identification

Boats carrying various types of cargo display distinctive flags or lights so control and beach party personnel may readily identify the type of cargo embarked. The colored and numeral flags or colored lights used to identify various types of cargo are listed in figure 13-12. For example, a boat that is assigned to a floating dump and carries flame-thrower fuel flies a 3 flag under a GREEN flag or, at night, shows a fixed RED light under a fixed GREEN light.

Load Dispatching Signals

All signals normally are paralleled by voice radio from the central control ship. All lights used are shielded and aimed at the approaching wave only.

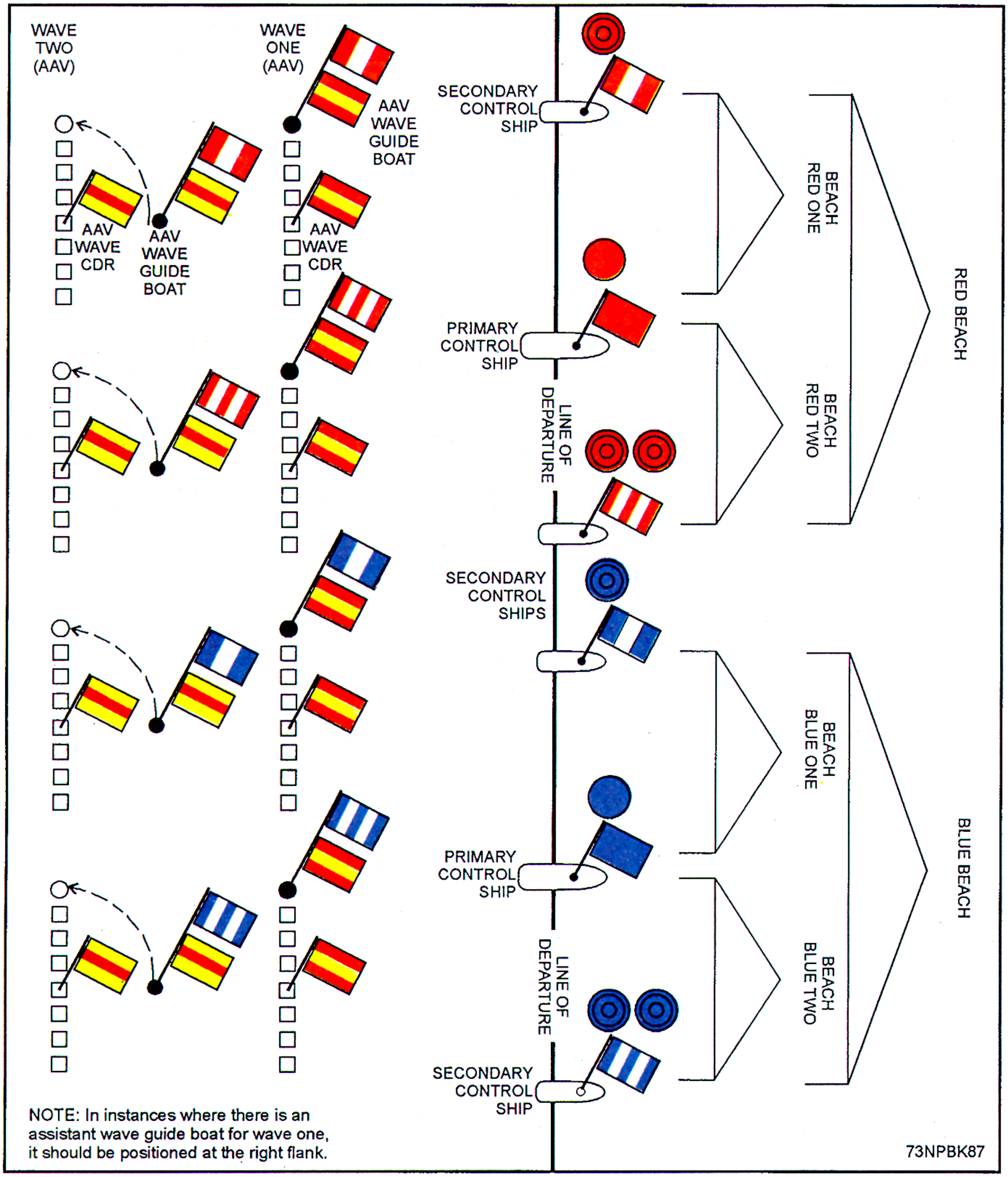

Figure 13-9.—Standard flags and identification insignia.

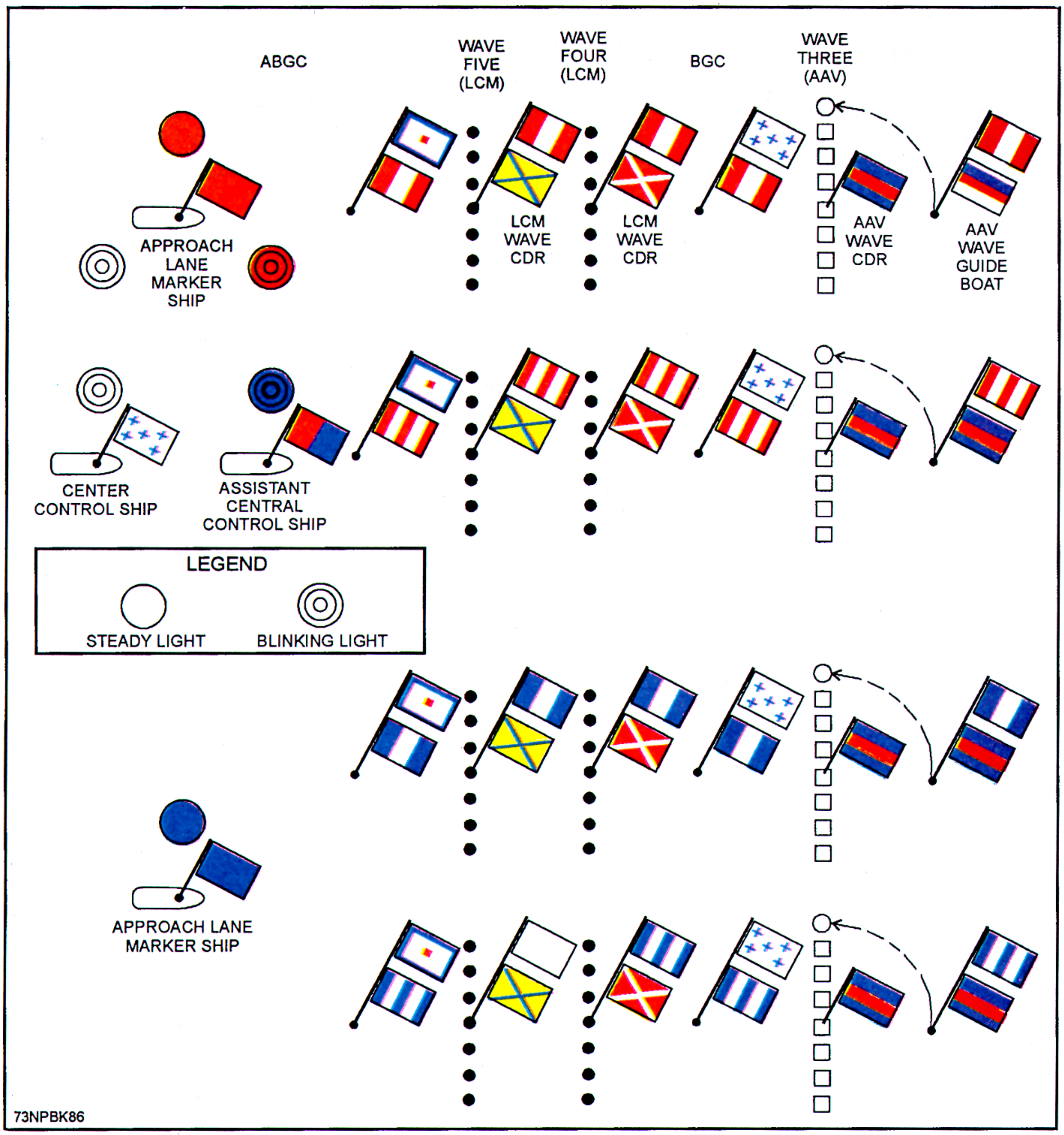

Figure 13-9.—Standard flags and identification insignia—Continued.

	Lights
a. Ships, Boats, and Landing Craft	
Central Control Ship	2, vertical, blinking White
Assistant Central Control Ship	2, vertical, blinking, color to be designated
Primary Control Ship	1, steady, directed seaward, same color as beach (all-around after 1st wave touches down)
Secondary Control Ship	1, blinking, same color as beach
Approach Lane Marker Ship	1, steady, same color as beach, directed seaward
Boat Group Commander (Traffic Control Officer)	3 wake lights, vertical, 1 foot apart, same color as beach (convertible to all-around)
Assistant Boat Group Commander (Senior Salvage Officer)	3 wake lights, horizontal, 2 feet apart, RED (convertible to all-around)
Boat Wave Commander	2 wake lights, vertical, 1 foot apart, same color as wave
Wave Displacement Landing Craft	1 or 2 wake lights, horizontal, colored (see c)
Salvage Boats	3 wake lights, horizontal, 2 feet apart, RED (convertible to all-around)
Medical Boats	3, vertical, steady, 1 foot apart, GREEN, all-around
Floating Dumps	2 or 3 vertical (1 steady GREEN over 1 to 2 cargo colors, 2 feet apart (see figure 12-12)
b. Ocean Markers and Navigation Aids	
Obstruction	Blinking WHITE over blinking RED
Channel, port side	Blinking GREEN
Channel, starboard side	Blinking RED
Fairway	Blinking WHITE
c. Screened Wake Lights	
1st Wave	1 RED
2nd Wave	1 BLUE
3rd Wave	1 AMBER
4th Wave	1 GREEN
5th Wave	2 RED (see note)
6th Wave	2 BLUE (see note)
7th Wave	2 AMBER (see note)
8th Wave	2 GREEN (see note)
Successive Waves	Repeat entire sequence
Note: Two lights, horizontal, 3 feet apart.	

Figure 13-10.—Wave lights requirements.

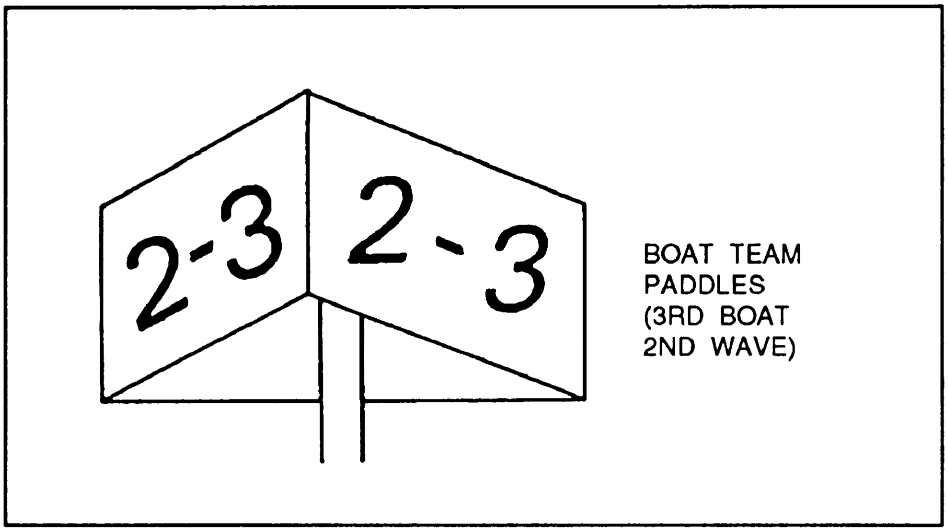

Figure 13-11.—Boat team paddle.

Floating Dump Supplies	**Day**	**Night**
	Green flag light over cargo flag	Steady GREEN light over cargo color light(s), 2 feet apart
Rations	ONE flag	1 steady WHITE light
Medical Supplies	TWO flag	1 steady GREEN light
Water	FOUR flag	1 steady BLUE light
81-mm Ammunition	FIVE flag	1 steadv AMBER light
Bulk Cargo	RED flag	2 steady RED lights
Self-Propelled Vehicles	BLUE flag	2 steady BLUE lights
Cargo Requiring Prime Mover	YELLOW flag	2 lights, steady BLUE over steady AMBER

Figure 13-12.—Floating dump cargo identification.

Departure

Departure time sequence is shown in figure 13-13. For a 5-minute standby for wave one, the ONE flag will be placed at the dip. The nighttime signal is a steady RED light for 30 seconds. For a 2-minute standby, the ONE flag is closed up, and the nighttime signal is a flashing RED light for 30 seconds. The nighttime signal for a l-minute standby is a flashing RED light for 50 seconds, then a 10-second steady RED light. There is no daytime signal for a l-minute standby. For dispatching during daytime, the ONE flag will be hauled down; and for nighttime, extinguishing of the 10-second steady RED light. The color lights for wave two will be blue; wave three, amber; wave four, green. After wave four the color of lights starts repeating: wave five would be red; wave six, blue; and so on. After the 5-minute standby for wave one, no other 5-minute standby will be used.

Wave	Departure Time	Day	Night
Wave One	5 minute standby	One flag at dip	Steady RED light for 30 seconds
	2 minute standby	One flag close-up	Flashing RED light for 30 seconds
	1 minute standby	— — —	Flashing RED light for 50 seconds then a lo-second steady RED light
	Departure time	One flag hauled down to dispatch wave	Extinguish lo-second steady RED light to dispatch wave
Wave Two	2 minute standby	Numeral flag of wave close-up	Flashing BLUE light for 30 seconds
	1 minute standby	— — —	Flashing BLUE light for 50 seconds, then a lo-second steady BLUE light.
	Departure time	Numeral flag hauled down to dispatch wave	Extinguish lo-second steady BLUE light to dispatch wave
Wave Three		Same as wave two	AMBER light is used
Wave Four		Same as wave two	GREEN light is used
Wave Five		Same as wave two	RED light is used
Wave Six		Same as wave two	BLUE light is used
Successive Waves		Continue using cycle outlined above for waves three through six	

Figure 13-13.—Departure time sequence.

Numeral flags are normally flown from both port and starboard yardarms. However, waves on both sides might not be scheduled to land at the same time. In that case, the PCS hoists the appropriate signal on the yardarm on the side of the ship the wave is scheduled to pass. Waves with two-digit numbers are dispatched by a hoist using the numeral flag corresponding to the last digit of the wave number.

In addition to megaphone, radio, and blinker messages, various visual signals are used in beach operations, as shown in NWP 22-3, appendix C.

Visual Emergency Signals for Boats

The following signals are visual emergencies:

OSCAR flag—Man overboard

Life jacket on perpendicular boat hook—Break-down

BRAVO flag—Fire/flooding

ZULU flag—Loss of receive/transmit corn-munications

GRID REFERENCE SYSTEM

LEARNING OBJECTIVES: Explain the purpose of the grid reference system. Identify procedures for using it.

The amphibious grid reference system is used primarily to control waves moving in the lanes from the rendezvous area to and across the LOD and until they land on the assigned beach. The grid is an overlay composed of a series of boat lanes (LOD to beach), one for each scheduled wave. Each boat lane is marked with the time and speeds applying to that specific wave. A standard voice procedure is used that reduces voice transmissions to a minimum while transmitting accurate positions to the waves. The procedure virtually

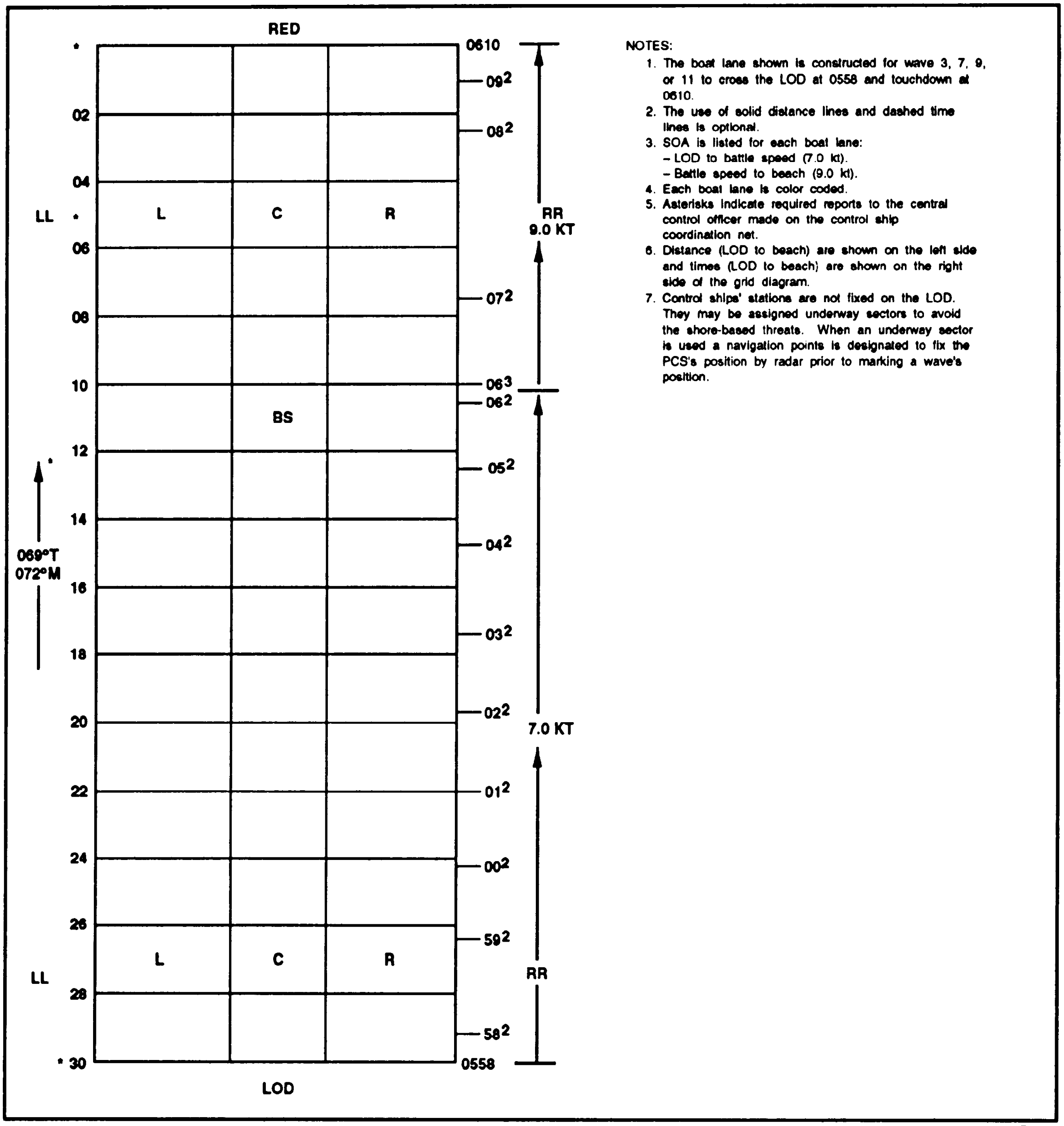

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Figure 13-14.—Amphibious grid reference system.

eliminates the probability of "pyramiding" vectors to the waves.

The system may also be used in the approach lanes and enroute from the parent ship or transport area to the rendezvous area or LOD provided that frequencies are assigned that prevent interference. Boat waves or nonscheduled units may be guided effectively by this system during periods of darkness or reduced visibility.

BEFORE DEBARKATION

Before debarkation of the boats and amphibious vehicles of an amphibious assault, the BGC, all BWCs, and all wave guide officers are issued a gridded diagram of the boat lane to be used (see fig. 13-14). The diagram is an approximate picture of the boat lane from the rendezvous area to the beach.

- Longitudinal lines in the diagram divide the lane into three sections: L (left), C (center), and R (right). Left and right sections are each 40 percent of the total width; the center section is 20 percent of the total width.
- Lateral lines are drawn at 200-yard intervals along the lane and are numbered to indicate distance to go in hundreds of yards.
- Lane positions are described by a letter (L, C, or R) followed by a number of one or two digits. Positions outside the lane are indicated by a double letter: RR or LL.

Time lines should be plotted on the grid overlay by the following method:

- Using the given wave speed of advance (SOA) and touchdown time, determine LOD crossing time for that wave.
- For the final 1,000-yard transit, waves will be making battle speed (BS); therefore, count backwards from touchdown time to the BS line, accounting for the complete time (whole minutes and fractions).
- Divide the time from LOD to BS, again accounting for every whole minute and fraction.
- Label all times on the boat lanes blank, as shown in figure 13-14.
- When more than one wave is being controlled, the time clock will be divided into four primes:

Prime	Time (Seconds)	Waves Marked
0	52 1/2 to 07 1/2	1, 5, 9
1	07 1/2 to 22 1/2	2, 6, 10
2	22 1/2 to 37 1/2	3, 7, 11
3	37 1/2 to 52 1/2	4, 8, 12

If the 15-second primes for grid construction (and grid position transmission) are used, the complete time for the transit can be accounted for.

The control party has the gridded boat lanes plotted to scale in CIC, one lane for each wave to be tracked and controlled, to minimize confusion and obtain a clear and concise picture of the movement of each wave.

RENDEZVOUS AREA

In the rendezvous area, boats should be provided navigational assistance to keep the waves in their rendezvous circles. In addition, CIC tracks the waves and fixes the position of each wave on the grid upon the departure of the waves from the rendezvous area. The control party then transmits the position to the BWC by flashing light or by voice radio. The BWC, on receipt of a grid position that indicates the wave is not in the center of the proper lane and/or not progressing along the lane according to schedule, corrects the position and movement of the wave. Control officers supplement grid positions with vectors and "early" or "late" information as necessary.

Grid positions normally are transmitted every minute from the rendezvous area to 200 yards from the beach unless corrective action is required, in which case they are transmitted more frequently. Grid positions will be provided once each minute in periods of low visibility, from the predesignated assembly circle to the beach. The last 1,000 yards to the beach is run at full (battle) speed. However, the control group commander should ensure that Wave One never arrives early, because of the hazards from pre-H-hour neutralization fires, the difficulty of terminating such fires early, and the necessity for beach preparation by such fires.

To obtain full benefit from the grid and to track the wave's progress, wave commanders will plot their position each time the controlling station transmits it. The effects of wind and sea and/or taking incorrect headings can thus be determined and corrected. Once firm radio communications are established, grid positions can be transmitted without requiring wave commanders to receipt. However, vectors should be receipted for. If the wave commander fails to receipt for orders by radio, the primary control ship will continue to transmit "blind" and request visual acknowledgment.

COMMUNICATION CIRCUITS

Two nets are designated for each colored beach: channels ALFA and BRAVO. Channel ALFA is a direct net, used by the PCS to pass grid positions and boat wave directions to the BWCs and wave guide officer from the LOD until touchdown. Channel BRAVO, the beach boat operations net, is used by the PCO/PCS and ships to control assigned boats before they are dispatched to the beach. Touchdown reports and operational/administrative traffic between control ships and boats is passed on this station. Good judgment should be used when using the net, to avoid cluttering.

Voice Calls

Voice calls on the control group net and beach boat operation net use daily-changing call signs. The beach boat control net uses JANAP 119 call signs. Additionally, the boat group commander uses the JANAP 199 call signs on all nets to avoid confusion with wave call signs.

Voice Transmissions

The following are examples of voice transmissions:

Turnover from parent ship to PCS (channel BRAVO)

"_____ ONE, THIS IS _______ SWITCH TO CHANNEL ALFA AND REPORT TO________ OR CONTROL AND VECTOR TO THE BEACH. OVER."

Reporting it to PCS (ALFA)

"_____ ,THIS IS TWO BLUE ONE. REPORTING FOR CONTROL AND VECTOR TO THE BEACH. OVER."

Positive control

"TWO BLUE ONE, THIS IS _______ HOLD YOU UNDER POSITIVE RADAR CONTROL. STEER COURSE _______ AND SPEED ______ FOR THE LOD. SET AND DRIFT AT THE LOD IS (DIRECTION) AND (SPEED, IN KNOTS). OVER."

"TWO BLUE ONE, THIS IS ________ DO NOT HOLD YOU UNDER POSITIVE' RADAR CONTROL. MAINTAIN PRESENT COURSE AND SPEED (POSITION), OVER."

"ONE BLUE ONE, THIS IS _______ HOLD YOU UNDER POSITIVE RADAR CONTROL. STEER COURSE _______ AND SPEED _______ FOR THE LOD. SET AND DRIFT AT THE LOD IS (DIRECTION) AND (SPEED, IN KNOTS). MY INTENTION IS TO EXECUTE A LEFT (RIGHT) FLANKING MOVEMENT SEAWARD OF THE LOD. OVER."

Dispatch from LOD

"TWO BLUE ONE, THIS IS_______. YOU ARE DISPATCHED FROM THE LOD TO THE BEACH, STEER COURSE _________, SPEED _______. OVER."

LOD crossing report (control group net)

"_______, THIS IS _______ TWO BLUE ONE CROSSED LOD LATE ONE HALF OVER."

Grid posits (ALFA)

'TWO BLUE ONE, THIS IS ______ . GRID POSIT ROMEO THREE EIGHT OUT." (Wave 2 Blue 1 is right side of boat lane, 3,800 yards from the beach and on time.)

"TWO BLUE ONE, THIS IS ______ . GRID POSIT ROMEO THREE TWO EARLY ONE. OUT." (Wave 2 Blue 1 is right side of boat lane, 3,200 yards from beach and is ahead of schedule 1 minute.)

Vectoring waves (ALFA)

"TWO BLUE ONE, THIS IS__________ GRID POSIT ROMEO THREE ZERO EARLY ONE. VECTOR LEFT TEN. OVER." "TWO BLUE ONE, THIS IS ________ GRID POSIT ROMEO, ROMEO TWO SEVEN EARLY ONE. VECTOR LEFT TWENTY. OVER."

Battle speed (ALFA)

"TWO BLUE ONE, THIS IS _________ GRID POSIT CHARLIE ONE ZERO. BATTLE SPEED. BATTLE SPEED. OVER."

Touchdown report (wave) (channel ALFA)

"_________, THIS IS TWO BLUE ONE. TOUCHDOWN, TOUCHDOWN, TOUCHDOWN. OVER."

Touchdown reports (control group net)

"_______, THIS IS _______. TWO BLUE ONE TOUCHDOWN. LATE ONE QUARTER. OVER."

Governing Notes

The following governing notes are to be used when communicating to waves:

- ___________ where appearing, indicates daily changing call signs.
- The shift to channel ALFA can be ordered by PCS when desired but no later than when boat waves cross the LOD. If no channel shift order is given, boat waves will automatically shift to channel ALFA upon crossing the LOD.
- Amphibious assault vehicle (AAV) waves require an intention statement from PCS when PCS takes positive control.

- A full call-up is required for all transmissions to ensure that the proper wave received the information. When ordering courses to boat waves, make sure they are given in magnetic degrees.

- All reports to the CCO should include a time status. Fractions of minutes are spoken one-quarter, one-half, three-quarters, and so forth.

- Because many boat compasses are unreliable, it is best to change the course of boats by vectors of 10 degrees to 30 degrees instead of course headings. To minimize the initial error and consequent loss of time, the BGC, ABGC, and all BWCs should check and compare their magnetic compass headings with the PCS while transmitting from the wave-forming circles to the landing craft rendezvous area. Vectors may be given at any time to maintain a wave's position in the boat lane center. However, vectors should be held to 10 degrees or less in the surf zone for boat safety.

- Waves outside the boat lanes must be vectored to regain boat lane positioning.

- Prior to the order for BS, speed changes may be given at any time to keep waves on time. Speed changes must be ordered when waves are early or late 2 minutes or more.

- BS must be ordered at the 1,000-yard mark. Even if a wave is doing maximum speed before the 1,000-yard mark, the order "BATTLE SPEED" is still mandatory at that time.

- Note that all information transmissions end in OUT and those directing waves to perform a duty end in OVER. If at any time you desire a wave to acknowledge receipt of information, end the transmission with OVER, thus requiring an answer.

- Dispatched orders are not required if waves have been shifted to channel ALFA or the shift to channel ALFA upon each wave's crossing LOD is provided for in the OPORDER or prebrief.

VISUAL PROCEDURES FOR TRANSMITTING GRID POSITIONS

LEARNING OBJECTIVES: Explain procedures for visually transmitting grid positions.

Grid positions by flashing light or Nancy will normally be preceded only by flashing the wave number. However, if confusion would result from transmitting into different numbered boat lanes or different colored beach lanes, it will be necessary to modify the call accordingly. For example, to call the wave commander of Wave Three, Blue Beach Two, the normal call-up is the numeral 3. If confusion would result, and it is therefore necessary to send the complete call, the call is transmitted as numeral 3, Blue, numeral 2. The control ship, after establishing communications with the wave commander, then transmits the grid position.

The wave commander receipts for each group by flashing a *T* with his or her signal equipment and receipts for the message with the usual *R*.

Visual grid positions and information are transmitted by control ships using the procedures in the following paragraphs.

After the wave call-up, insert the group GP. This acts as a proword and alerts the receiver that a grid position is to follow.

Transmit the grid position using letter *L* for left, *C* for center, *R* for right, and *LL* or *RR* for being outside of the boat lane to the left or right, respectively. The distance from the beach is transmitted in hundreds of yards as a single or double numeral. For instance, 1 equals 100 yards; 11 equals 1,100 yards.

Transmit the letter *T* followed by two digits to indicate the time, in minutes, of the grid position. Given the time of the position, the wave commander knows how early or late he or she is once the position is plotted. Knowledge of grid position time is important because, depending on the proficiency of the control team, receipt of the position can be up to 2 minutes after actual time.

If necessary to order a speedup or slowdown, the group SS or TT is sent, respectively.

If necessary to order a course change, a vector in tens of degrees indicating direction left or right is sent. For instance, to vector 30 degrees to the right, the group V3R is sent. Direction of the vector should always be included, because waves are not necessarily always heading for the beach but may be under control seaward towards the rendezvous area.

The group BS BS is an order to go to BATTLE SPEED.

If needed, the group TA indicates an order to turn away.

The following are examples of grid posits sent visually:

SIGNAL	MEANING
4GPL40T32	Wave Four grid posit is in the left portion of the boat lane 4,000 yards from the beach at time 32.
2GPR32T47SS	Wave Two grid posit is in the right portion of the boat lane 3,200 yards from the beach at time 47 and is to speed up.
1GPLL29T52V2R	Wave One grid posit is outside of the boat lane to the left 2,900 yards from the beach at time 52 and is ordered to vector 20 degrees to the right.
3GPC20T17TT	Wave Three grid posit is in the center of the boat lane 2,000 yards from the beach at time 17 and is ordered to slow down.

Upon touchdown of the first boat/vehicle of each wave, the signal TD TD TD is sent to the control ship. Remember, it's going to be very difficult at times to transmit back or receive from the control ship; you must be proficient and get the job done. Visual communication is a very important part of an amphibious assault, so be prepared to do your best.

QUIET LANDING PROCEDURE

LEARNING OBJECTIVES: Explain the method of control for quiet landing, including visual signals, radio circuit and manning requirements.

Visual signaling (flashing light, flaghoist, and/or semaphore) will be used as the primary means of controlling the movement of surface craft during the initial assault portion of a quiet landing. Radio circuits normally used in controlling the ship-to-shore movement should be checked out before the assault, subject to emission control (EMCON) policy. These radio circuits should be guarded and should be used only when all other means of communicating with surface assault waves have failed and when it is necessary to correct or alter the movement of an assault wave.

It is imperative that experienced Signalmen be embarked in control boating. They must watch the control ship constantly and must be capable of receiving at the rate of eight words per minute. Since embarked craft (LCUs and LCMs) do not normally include Signalmen in deploying boat crews, host ships should ensure that a Signalman is assigned to embarked craft for assault operations.

PCS will transmit a vector and speed signal to each wave at l-minute intervals once the wave has been dispatched from the LOD. The signal will be in three parts: wave identification, vector, and speed. Identification of the wave is signaled by the corresponding numeral. Vector direction is indicated by flashing ROMEO for right and LIMA for left. The amount of vector is indicated by the multiple letters, each representing 10°; for example, R indicates vector right 10°, and RRR indicates to vector right 30°. If vectoring is not necessary, the letter CHARLIE is signaled. Speed orders will be signaled by numerals indicating speed desired. For example, 7 indicates 7 knots. BS is indicated by repeating the letter BRAVO three times. Examples of quiet landing signals follow:

SIGNAL	MEANING
3RR5	Wave Three, vector right 20°; make 5 knots
5C5	Wave Five, maintain course; make 5 knots
2L3	Wave Two, vector left 10°; make 3 knots
1CBBB	Wave One, maintain course; make battle speed

AFLOAT SALVAGE OPERATIONS

LEARNING OBJECTIVES: Explain the purpose of the afloat salvage operation and the craft involved in the operation.

During a ship-to-shore surface assault on a hostile beach, a certain number of casualties among the assault craft are inevitable. The mission of the salvage organization is to keep boat lanes and beachheads clear of disabled assault craft so that movement to the beach is maintained.

HEAVY SALVAGE BOAT	LIGHT SALVAGE BOAT
1 - Salvage officer	1 - BM2/BM3 (salvage rigger)
1 - BMC/BM1 (salvage rigger)	1 - SM3/SMSN
1 - EN1/EN2	1 - HT2/HT3
1 - HT2/HT3	1 - RM3/RMSN
1 - RM3/RMSN	1 - SN
1 - SM3/SMSN	
1 - HM3/HMSN	
1 - SN	

Figure 13-15.—Salvage team personnel.

CRAFT INVOLVED IN SALVAGE OPERATIONS

A heavy salvage boat is normally an LCM converted as stated in BOATALT 19C, dated 05/10/63, and is stationed outside the surf zone but close enough to maintain good visibility of the beach and its approaches.

A light salvage boat is normally an LCPL and is stationed seaward of the surf zone along the boat lanes as required.

Salvage teams should consist of personnel from one ship trained as a team to maintain consistency. Personnel for salvage teams should be assigned as shown in figure 13-15.

NOTE

One team member must be a qualified search and rescue (SAR) swimmer.

The boat equipage for the heavy salvage and the ABGC/light salvage boats is detailed in NWP 22-3.

DISPATCHING VESSELS

The visual signals used to dispatch the boat waves from the LOD are displayed by both the primary and secondary control vessels. Every wave commander has a radio in the boat, and the foregoing signals are paralleled by radio signals.

Wave commanders control their boats by means of hand signals, as shown in figure 13-16.

At night, lighted wands or flashlights are used. The positions are the same as for the day signals. Lights are turned on when the hands are in the starting positions and turned off when the signals has been completed. At the end of start and stop signals the light is blinked several times. Night signals are repeated as necessary. The formations used are illustrated in figure 13-17. Assault boat coxswains should know all of these signals and formations. Those signals concerning starting, stopping, breakdown, towing, and so on, might also prove useful to any coxswain in the event of an emergency.

The naval beach party is landed early in the assault. When they reach the beach, they proceed with their duties of marking channels and hazards to navigation, establishing communications, improving beaches, and so forth.

After a boat unloads on orders from the beach party, it retracts past the surf line and proceeds to a designated flank of the boat lane. Keeping clear of the boat lane, it proceeds to seaward and reports to the control vessel for further orders.

GENERAL UNLOADING PHASE

During the general unloading phase, loaded boats do not maintain a formation on the trip to the beach,

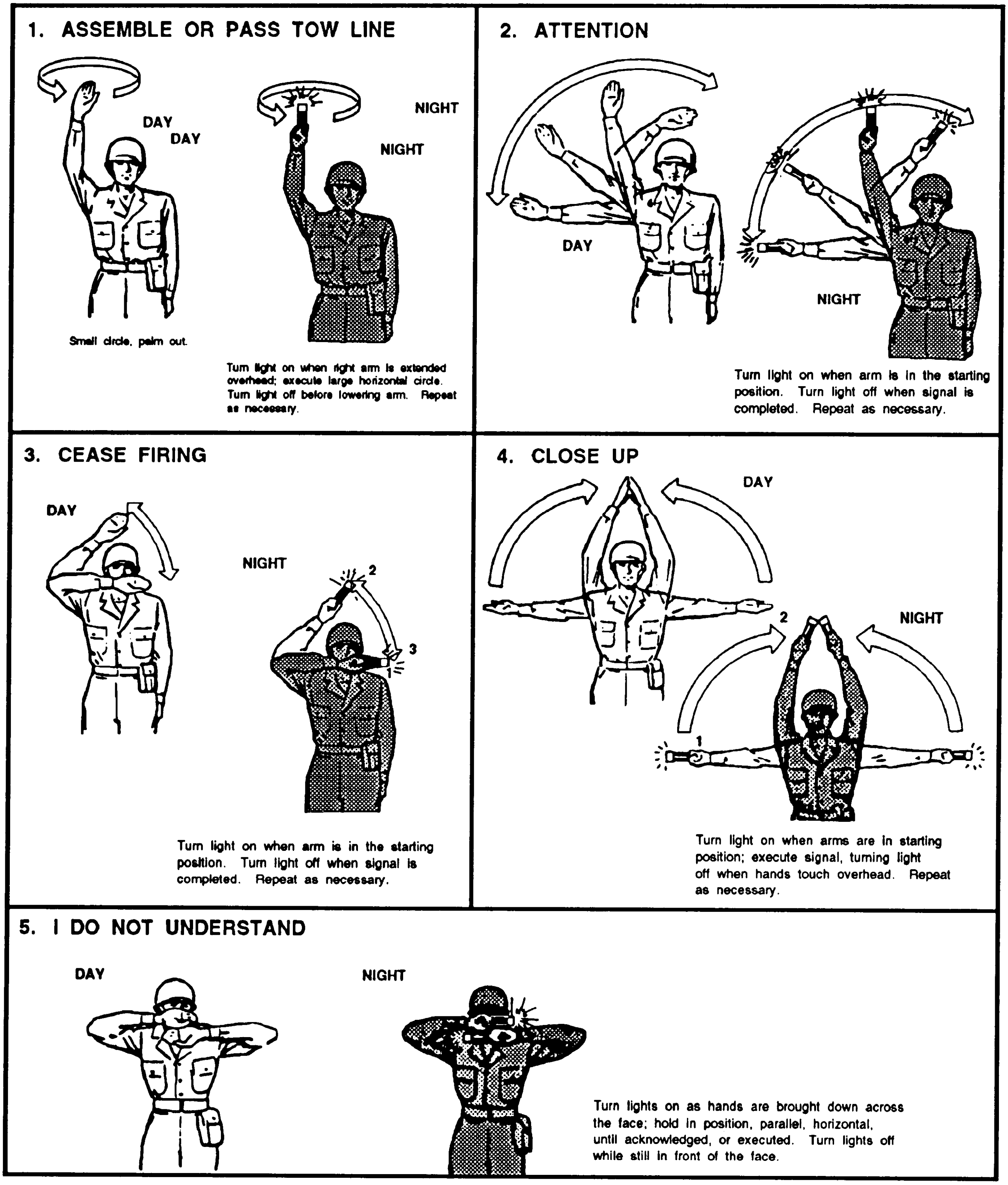

Figure 13-16.—Arm and hand control signal—landing craft and amphibious vehicles.

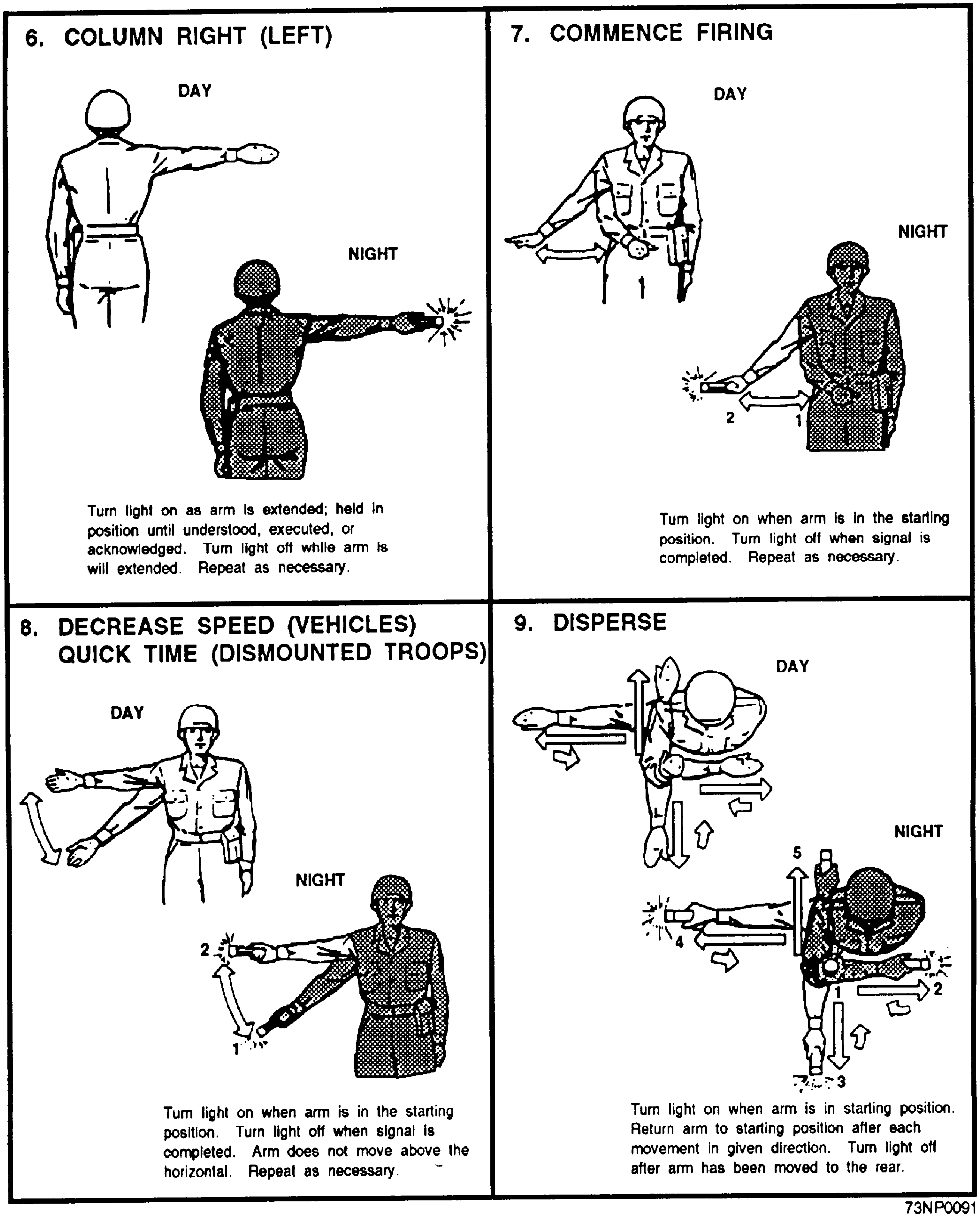

Figure 13-16.—Arm and hand control signals—landing craft and amphibious vehicle—Continued.

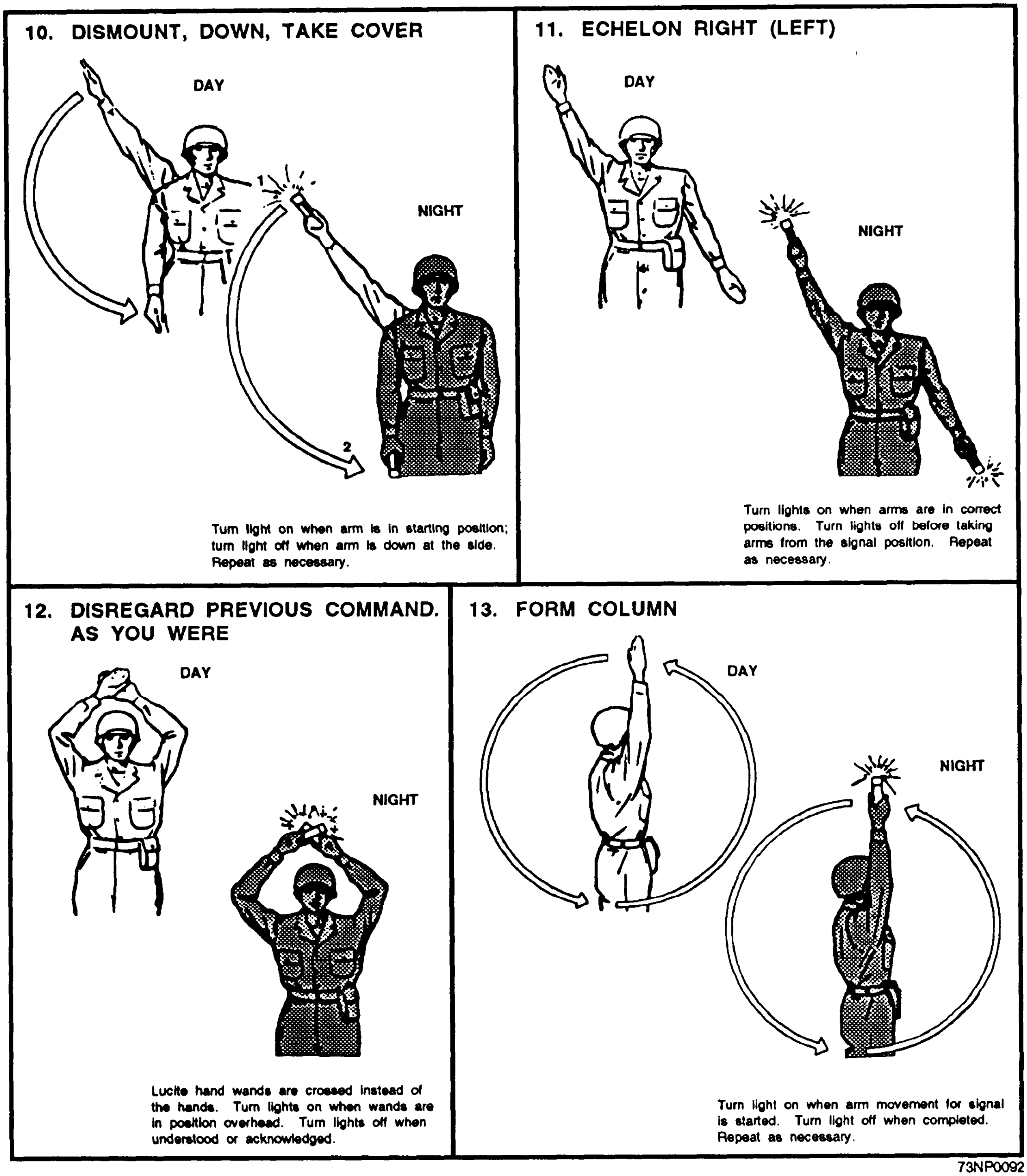

Figure 13-16.—Arm and hand control signals—landing craft and amphibious vehicle—Continued.

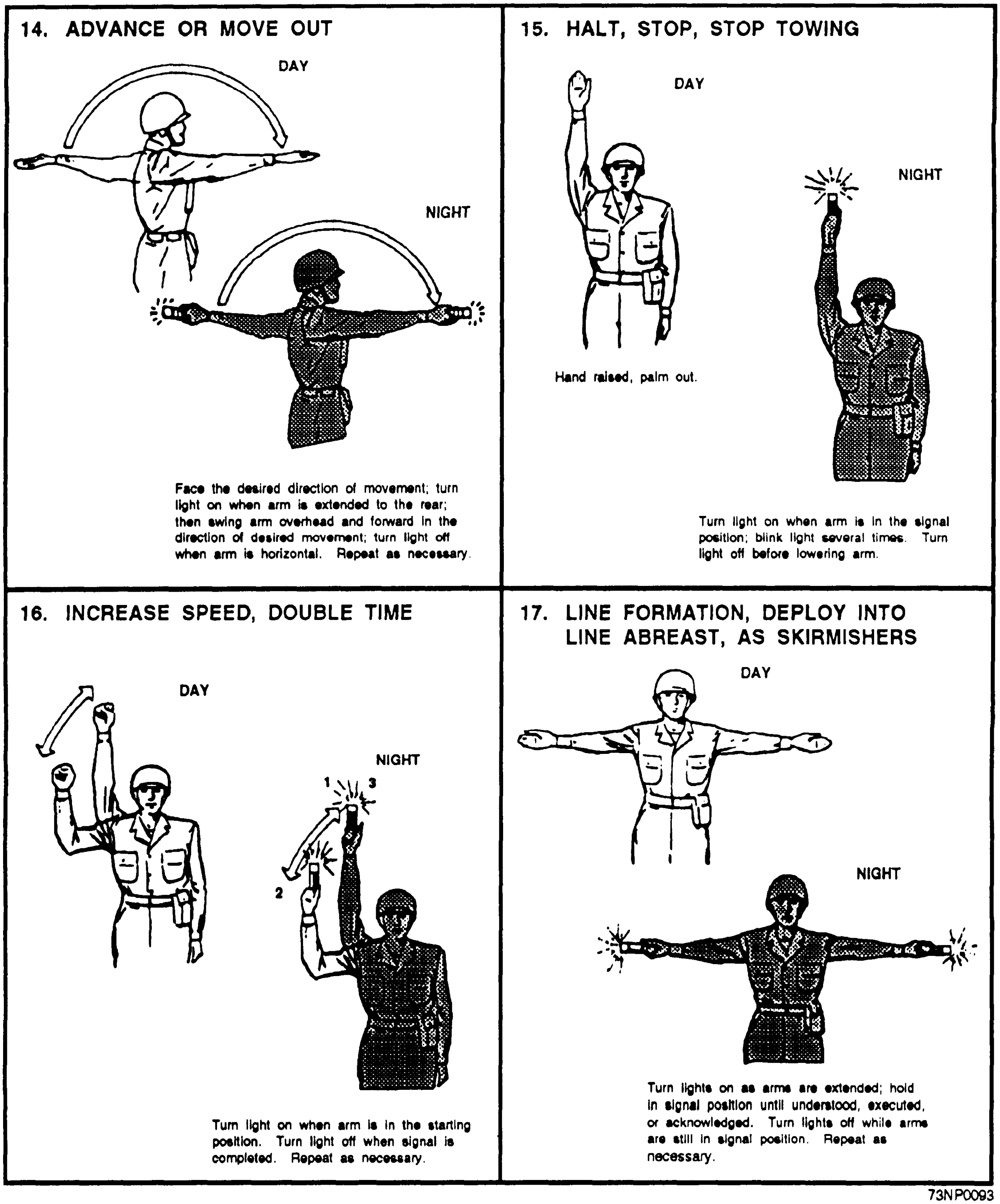

Figure 13-16.—Arm and hand control signals—landing craft and amphibious vehicle—Continued,

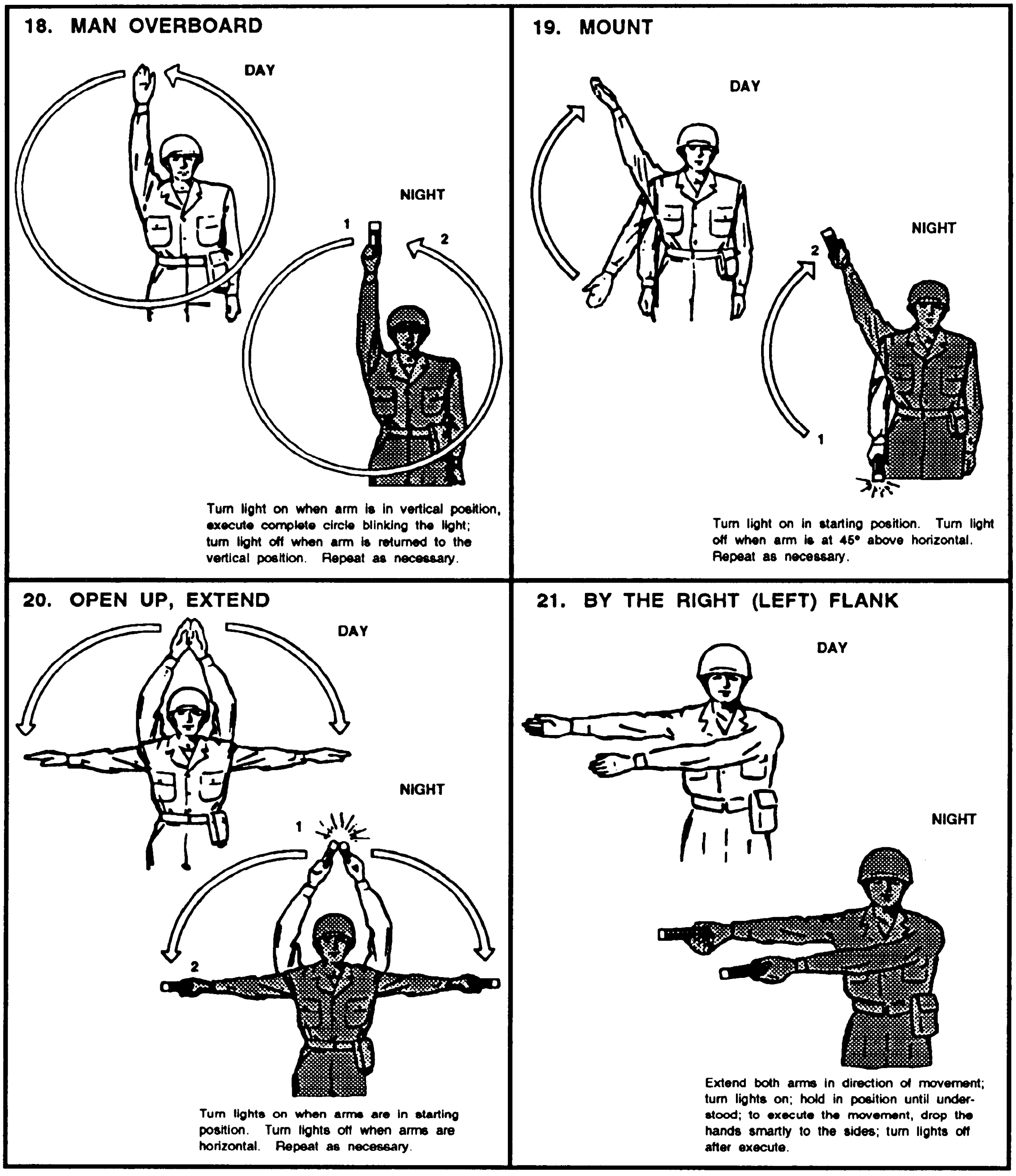

Figure 13-16.—Arm and hand control signals—landing craft and amphibious vehicles—Continued.

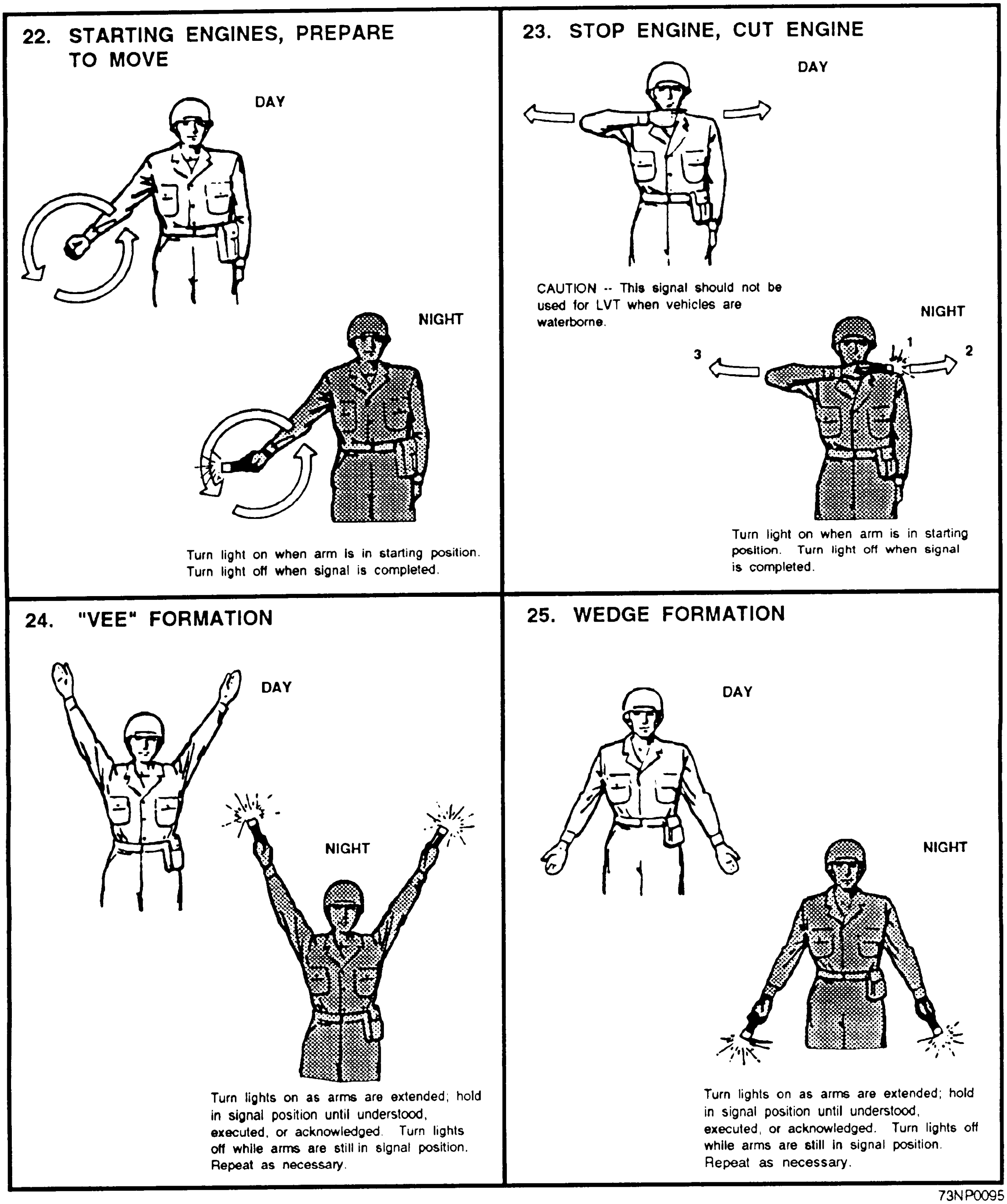

Figure 13-16.—Arm and hand control signals—landing craft and amphibious vehicles—Continued.

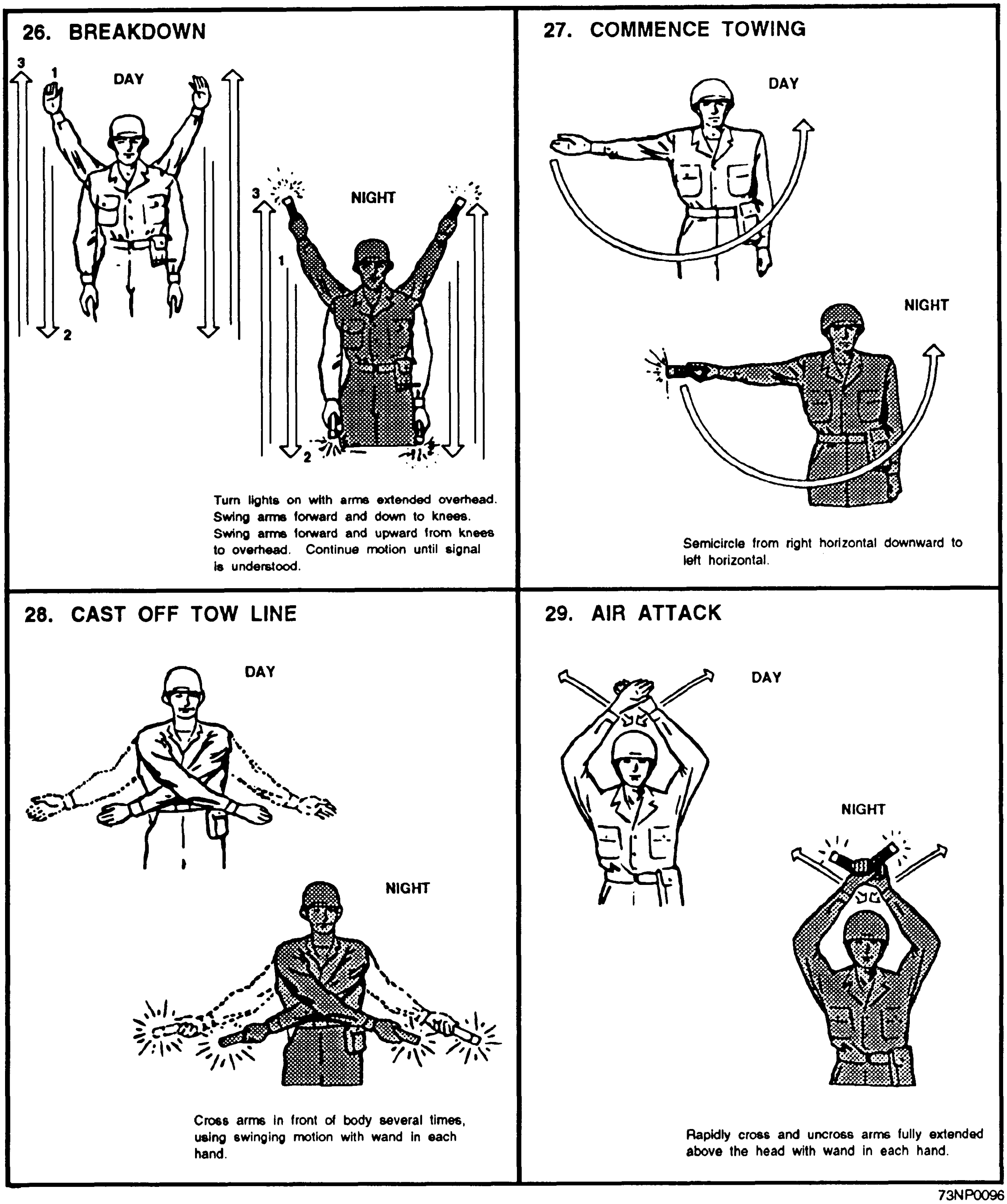

Figure 13-16.—Arm and hand control signals—landing craft and amphibious vehicles—Continued.

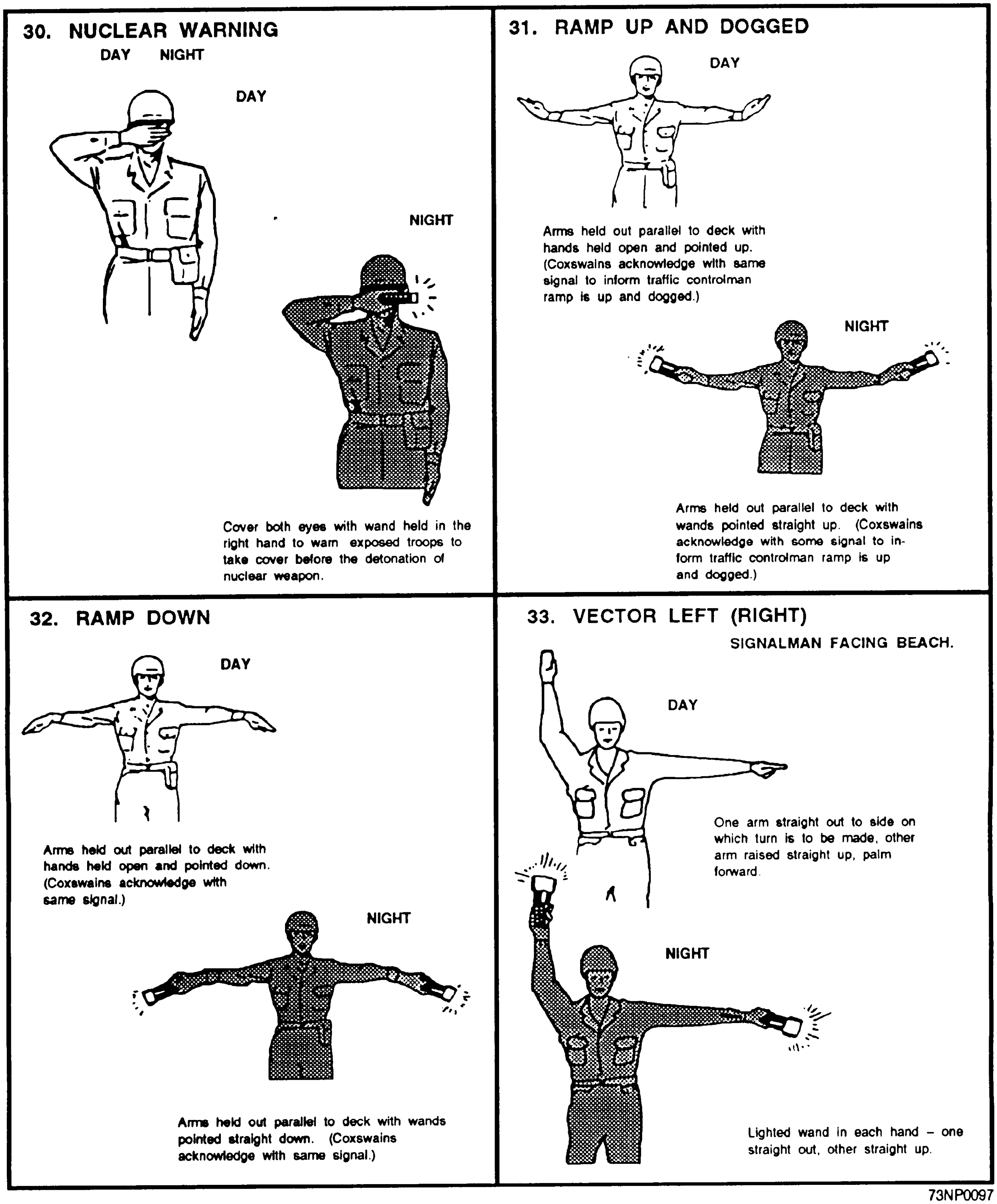

Figure 13-16.—Arm and hand control signals—landing craft and amphibious vehicles—Continued.

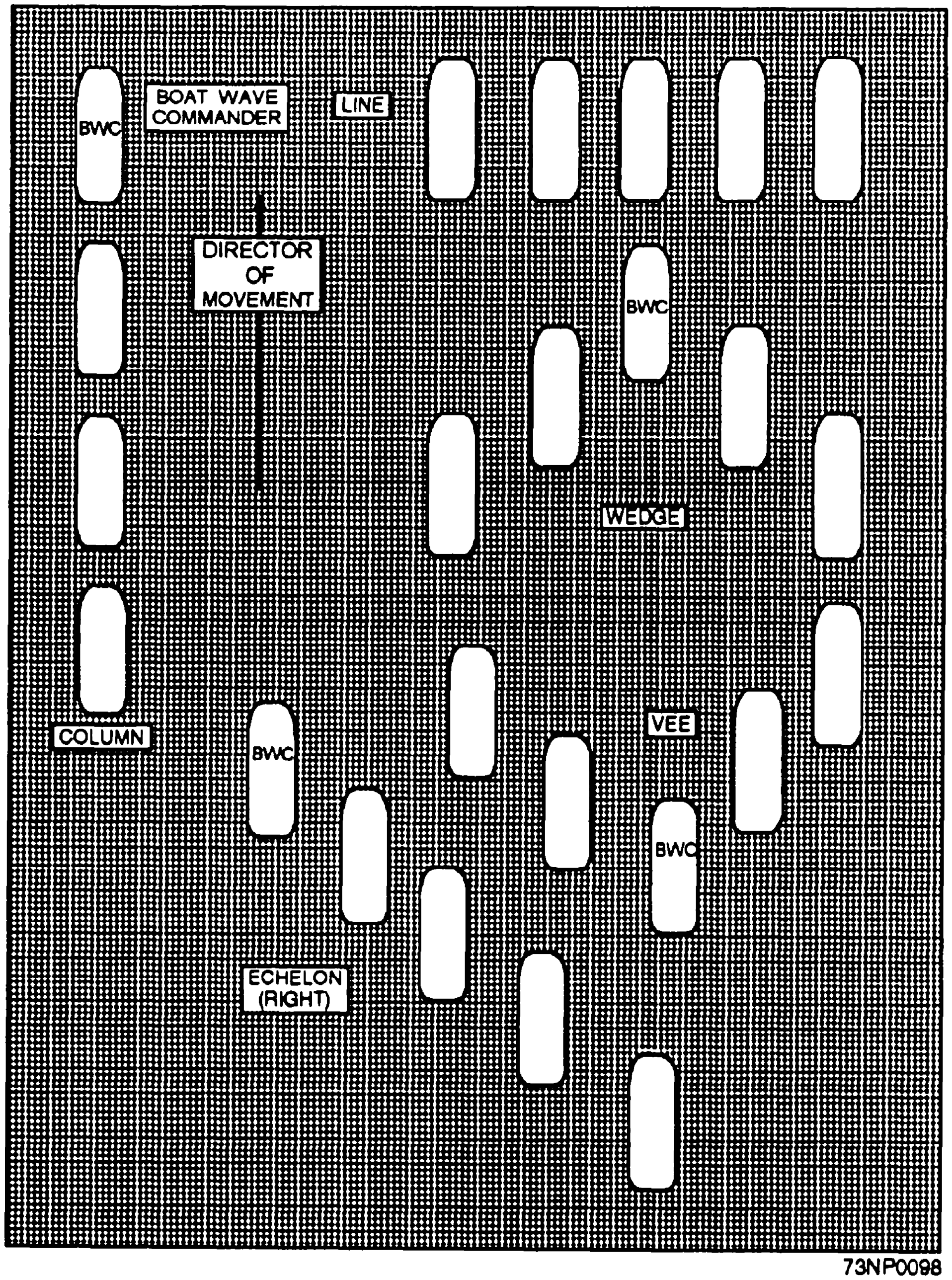

Figure 13-17.—Boat formations.

although several of them may be required to move as a unit. On the way to the beach they must stop for orders at the PCS and the BGC's boat.

The type of cargo in a boat is indicated by the color of special flags flown. Red denotes bulk cargo which needs manpower for unloading; yellow shows the load is such that a prime mover is required; blue denotes self-propelled cargo; and a red burgee shows the boat is a bowser (fuel) boat. A green flag shows a boat belongs to a floating dump, and a numeral flag may be flown under it to indicate the type of cargo carried,

SUMMARY

In this chapter, you learned the general concept of an amphibious operation and the different ships, boats, and landing craft involved. You learned about standard flags and markers, control areas, and debarkations. You also learned how to transmit grid position both by radio and visually and the procedures for dispatching waves to the LOD during daylight and nighttime. You learned the duties of the different personnel associated with an amphibious landing. Although this chapter has a lot of information to learn about amphibious landings, your best source of information is NWP 22-3.

APPENDIX I

GLOSSARY

SAY WHAT YOU MEAN

Life aboard ship requires almost a completely new vocabulary, even new terms for many commonplace items. There are many individual reasons for this, but most of them boil down to convenience and safety. Under certain circumstances, a word or a certain sequence of actions, making it unnecessary to repeat a list of orders or give a lot of explanatory details.

A great deal of Boatswain's Mate's work is such that an incorrectly interpreted order could cause confusion, breakage of a gear, or even loss of life. Avoid this confusion and its unnecessary danger by giving orders that say exactly what you mean.

This glossary is printed here for your convenience. It is not intended to be extensive (you will notice the absence of the most common words), but it does contain many orders and terms the meanings of which every BM should know.

ABAFT THE BEAM—Any direction between either beam and the stem.

Abeam—Bearing 90° or 270° relative from own ship.

ABOARD—Within or on the ship. The sailor's term; landsmen use "on board."

ADRIFT—Loose; not secure to a stationary object.

AGROUND—When any part of a vessel is resting on the bottom. A ship runs aground or goes aground.

ALOFT—Above the decks. On the mast or in the rigging.

ANCHOR AT SHORT STAY—The anchor chain is out at a minimum length with the anchor still holding.

ANCHOR BALL—A black, circular shape hoisted to indicate the ship is anchored.

ANCHOR BUOY—A small float attached to the anchor by a line to mark the anchor's location if the chain is slipped or parted.

ANCHOR IN SIGHT—A report made by the anchor detail to the bridge when the anchor is first sighted when bringing it in.

ANCHOR IS CLEAR—When the anchor is first clear of the water and there is nothing fouling it or on it.

ANCHOR IS FOULED—The anchor has picked up a cable, debris, rock or coral, or is wrapped in its own chain.

ANCHOR IS SHOD—The anchor is covered with mud or bottom.

ANCHORS AWEIGH—The anchor has lifted clear of the bottom.

ANNUAL VARIATION—A change in Earth's magnetic lines of force, varying in different localities.

ARM—The part of an anchor located between the crown and the fluke. The upright or nearly upright strength member of a davit. The act of plastering tallow into a recess in the bottom of a sounding lead; this is called arming the lead and is done for the purpose of bringing up a specimen of the bottom.

ATHWART THE HAWSE—Across the stem.

ATHWARTSHIPS—Anything that extends from one side of the ship to the other, such as an athwartships passageway.

AVAST—Stop; cease; as in "Avast heaving."

BACKSTAY—A piece of standing rigging leading aft.

BARGE—A boat assigned for the personal use of a flag officer. Also, a vessel that carries liquids, munitions, or cargo, which is usually towed.

BATTEN DOWN—The act of making a hatch watertight by wedging the battens against the tarpaulins, or of wedging shut or dogging down a watertight opening.

BEAM—The overall width of a vessel.

BEAM ENDS—A vessel lying on its side is said to be on its beam end. Often used to indicate that a vessel has taken an unusually large roll and was almost on its side.

BECKET—The fitting on a block to which the dead end of the fall is attached.

BELAY—The act of securing a line to a cleat, set of bitts, or any other fixed point. In connection with an order or announcement, express the idea to disregard, as in "Belay that last order."

BIGHT—A loop of rope, line, or chain.

BLOCK—A device consisting of a pulley encased in a shell of wood or metal, through which a line or wire rope can run freely. A snatch block is one in which the shell opens by means of a hinged strap to take a line or wire.

BOAT BOOM—A spar swung out from a ship's side from which boats can be secured.

BOAT FALLS—The rig used to hoist or lower small boats.

BOLLARD—A strong cylindrical upright on a pier, around which the eye or bight of a ship's mooring line is placed.

BOLTROPE—Line sewed around the edge of a sail, awning, or other canvas.

BREAKER—A long, broken sea rolling in on a beach.

BREAKER LINE—The outermost boundary of a breaker area; also called the surf line.

BREAKOFF—When walking away with a line or running in a line, to let go, return to the point from which the line is being hauled, take a new hold, and walk or run away again.

BREAST LINE—A mooring line from the ship to the pier, holding the ship in to the pier.

BROACH—The act of breaking through the surface and jumping out of the water. Sometimes called porpoising.

BROACH TO—The action of a vessel being thrown broadside to the course by some force acting on the stern. A boat thrown broadside on the beach is said to be broached to, or simply broached,

BULL ROPE—Wire used in cargo handling in connection with the topping lift. Also used as the term for the wire from a towing machine.

BULWORK—Asolid fencelike barrier along the edges of weather decks.

CAPSTAN—A vertical shaft machine used for handling lines or wires on its drum.

CARRY AWAY—The act of breaking loose.

CARRY RUDDER—When a vessel requires a constant amount of rudder on one side to maintain a steady course, it is said to be carrying rudder.

CASTINGS—The act of turning a ship through 360° without appreciably changing its position; done by alternately backing and going ahead on engines and repeatedly shifting the rudder.

CAULK—To make a joint watertight.

CHAIN PIPE—Pipe leading from the forecastle deck to the chain locker.

CHECK—Expresses the general idea to slow. To check a line running out under a strain means to allow only enough of it to render around the bitts to prevent the line from parting.

CHOCK-A-BLOCK—Full; filled to the extreme limit.

CLEAR FOR RUNNING—Ready to run out without fouling.

CLEAT—A device for belaying a line or wire, consisting essentially of a pair of projecting horns.

CLOSE UP—The act of hoisting a flag to, or in, its highest position.

COCKLE—A kink in an inner yarn of rope, forcing the yarn to the surface.

COLLAR—The metal ring that steadies the base of a mast or supports the upper end of a boom that is stowed upright.

CONTROL VESSEL—The ship that guides and directs the ship-to-shore movement in an amphibious landing. In underway replenishment this vessel sets the replenishment course and speed and is the guide.

COXCOMBING—Fancy knot work worked around rails, handles, or stanchions. It also provides a secure grip.

CROSS POINTING—Also known as coach whipping. Line, canvas, or leather braided around stanchions for decoration and protection.

CROWN—The rounded part of an anchor below the shank. A knot in the end of a line made by interlacing the strands. In plaited line, the highest part of a pair of strands.

DAY BEACON—An unlighted structure that serves as a daytime aid to navigation.

DAYMARK—The identifying characteristics of a day beacon. Also, the shape or signals displayed by a vessel to indicate a special purpose, such as fishing, laying cable, and dredging.

DEAD RECKONING—Determining position by direction and distance traveled from a known position.

DEEP SIX—Throw an article over the side.

DEVIATION—Magnetic compass error caused by the magnetic properties of a vessel. It is expressed in degrees east or west.

DINGHY—A square-sterned pulling boat that can be rigged for sail.

DIP THE EYE—To arrange the eyes of mooring lines on bitts or bollards so one line dips into the eye of the other so that either line may be removed without disturbing the other.

DOCK—The water space between adjacent piers, or the space in a drydock.

DOCKING KEEL—Keel-like projection between the main keel and the turn of the bilge; used to support the ship on blocks in drydock.

DODGER—A wood, metal, or canvas upward extension of the forward bulwark on a bridge; serves as a windbreaker.

DOG WATCH—One of the two 2-hour watches in a dogged (split) 1600 to 2000 watch.

DOLPHIN—A piling or a nest of piles off a pier or beach or off the entrance to a dock used for mooring.

DOUSE—To lower quickly, as a sail. To put out quickly, as a fire or cigarette.

DOWN BY THE HEAD—Said of a vessel when its draft forward is deeper than its draft aft.

DOWN BY THE STERN—Said of a vessel when its draft aft is deeper than its draft forward.

DOWNHAUL—Any line, wire, or tackle that applies a downward pull. Usually paired with a halyard.

DRAFT—The vertical distance from keel to waterline.

DROUGE—A sea anchor.

DRUM HOOKS—A sling containing a pair of moveable hooks; used for hoisting a drum, cask, or barrel by its chines. Also called chine hooks.

DUNNAGE—Any material used to separate layers of cargo, create space for cargo ventilation, or insulate cargo against chafing. Usually refers, however, to cheap wood boarding used for those purposes.

EASE—Relax the strain.

EBB—That period when the tidal current is flowing from the land.

ELDRIDGE METHOD—A method of mooring with two anchors in which one anchor's chain is dipped through the other's hawsepipe before either anchor is let go.

FAILEAD—A fitting, such as a block, that provides friction-free passage for a line or cable. Also, a clear route for a line or cable.

FAKE—The act of disposing of a line, wire, or chain by laying it out in long, flat bights laid one alongside the other. One of the bights.

FALL OFF—Said of a ship or boat when it drifts away from a desired position or direction.

FANCY WORK—Decorative knots, and pieces of canvas and leather fashioned in patterns or lace. Examples of this work are curtains or mats in admirals* barges, captains* gigs, and quarterdecks.

FIFE RAIL—A rail containing belaying pins.

FISH HOOK—A broken end of wire that is protruding from a wire rope.

FLASHPLATE—The line of plates between the anchor windlass and the chain pipes and hawsepipes, over which the anchor cable runs.

FLEMISH—The method of disposing of a line by coiling it tightly flat on deck with the second coil inside the first, and so on.

FLOOD—That period when a tidal current is flowing landward.

FLOTSAM—General term for articles that float if jettisoned. Floating debris left on the surface by a sunken ship.

FLUKES—Broad arms or palms of an anchor. The part of the anchor that digs into the bottom.

FOOT ROPE—Line by means of which the foot of a hammock is secured to a billet hook. The lowermost line of a set of lifelines. The line hanging in a bight beneath a yard, bowsprit, or jib boom.

FOREFOOT—The part of the keel that curves up to meet the stem, or where the stem joins the keel of the ship.

FORESTAY—A piece of standing rigging leading forward.

FOUL ANCHOR—Anchor chain wrapped about a fluke or the stock, or with some other encumbrance entangled about it.

FOUNDER—To sink as a result of filling or flooding.

FOUR-IN-HAND—The act of preventing a tackle from overhauling by gripping in both hands the parts of the fall between the blocks.

FREEBOARD—That portion of a vessel between the waterline and the main deck.

FRESHEN THE NIP—To set up again. To veer on a cable or pull up a backstay to shift the chafe from a particular spot.

FULCRUM—A prop or support. The point about which a lever turns.

FURL—To roll up snugly and secure, as a sail or awning.

GANGWAY—An opening in the rail or bulwark giving access to the ship.

GANTLINE—Line used as a single whip for hoisting and lowering a boatswain's chair or one end of a stage.

GATE—That part of a collar that opens on a hinge.

GOOSENECK—Universal joints at the heel of a boom that allow the boom to be swung in any direction. Method used by a nozzleman to bend a firehose in such a way that the hose does not kink and the stream of water can be directed to otherwise inaccessible spots, such as inside doors or under floor plates.

GROMMET—A reinforced hole in a sail or awning. A grommet can be fashioned with line or made of metal.

GUDGEONS—Eyes set in the stern or the rudder post to receive the pintles of the rudder.

GUY—Any line, wire, or tackle that provides athwartships support or motion for a boom head or the head of a gin pole.

GYPSY—Cylindrical device at the end of the shaft on a winch or horizontal shaft windlass on which the turns of a line or wire are taken for heaving.

HAND-OVER-HAND—Expresses the idea one hand after the other, as when a line is hauled in rapidly by hand or when a person climbs a line without using the legs and feet.

HATCHBOOM—Cargo boom plumed over the cargo hatch.

HAULING PART—That part of a fall to which power is applied.

HAULOUT—Order given to a boat coxswain to take the boat from the ship's side and secure it at the boat boom.

HAWSER—Any line over 5 inches in diameter.

HEAD—The stem. The upper end of a lower mast, boom, or gin pole. The upper edge of a four-sided fore-and-aft sail. A compartment containing toilet facilities.

HEAD LINE—A mooring line or hawser that is made fast forward of a ship's pivot point, such as a tug passing a head line when working a ship or tow.

HEAVE—To throw, as to heave the lead or heaving line. To haul in, especially by some powered heaving engine.

HEAVE RIGHT UP—Order given to heave the anchor up into the hawse. May be given as "Heave right in."

HEAVE AROUND—Haul in on a line, wire, or chain by means of a powered heaving engine. The call, on a boatswain's pipe, that is the signal to start heaving around.

HEAVE SHORT—The act of heaving in the cable until the anchor is at shot stay. The order usually is given as "Heave round to short stay."

HEAVE TO—The act of stopping the headway of a vessel or of reducing headway to just enough to maintain steerageway.

HITCH—A knot used to bend the end of a line to a ring or to a cylindrical object is usually, but not always, designated as some form of hitch.

HOGGING LINE—Line temporarily used to hold a stage or other object close to the side of the ship.

HOIST—To move an article vertically upward by means of some hoisting rig.

HOIST AWAY—Go right on hoisting until stopped by another order.

HOIST IN—Hoist an object to a required height and swing it in.

HOIST OUT—Swing out and lower away.

HOUSE—Heave an anchor into the hawsepipe.

HULL DOWN—Said of a vessel when, because of distance and the curvature of Earth, only the superstructure is visible.

INBOARD LIFELINES—Temporary lifelines erected inboard of the permanent lifelines during heavy weather. Many smaller vessels, such as destroyers, are provided with regular sets of these lines and the stanchions to support them.

INHAUL—In general, a line used to recover any piece of gear, such as a paravane or a trolley block. When replenishing at sea, the vessel providing the gear retains the inhaul and sends the outhaul to the other ship.

IN STEP—Said of a towing vessel and its tow when both meet and ride over seas at the same time.

IRISH PENNANT—A loose end of line carelessly left dangling.

JACKSTAFF—Upright spar at the stem to which the jack is hoisted.

JACKSTAY—Horizontal support to which articles such as seabags, tackles, coils of line, and so forth, can be lashed.

JIGGER—Light luff tackle for general use about the deck.

JUMBO BOOM—Regularly installed heavyduty swing derrick for handling extra-heavy lifts.

JUMPING ON A LINE—The act of trying to start a stranded vessel with a sudden pull on the towline. Slack is provided in the towline, and the assisting vessel runs ahead under full power, fetching up short when the slack is taken out.

JURY RIG—Any makeshift device or apparatus rigged as a substitute for gear regularly designed for the desired purpose. The act of setting up a jury rig.

KEDGE—A way in which an anchor is carried out by a ship's boats and is dropped; then the ship hauls itself to the anchor.

KEEL—The lowermost, central strength member of a ship that runs fore and aft and from which the frames and the plating rise.

KEEL BLOCK—One of a line of blocks along a drydock bed; used to support the keel or docking keel of a vessel in drydock.

KEEL STOP—Marker on a boat's keel that indicates its proper fore-and-aft placement for lowering into the chocks.

KING POST—One of a pair of short, strong uprights used to support twin cargo booms on some cargo vessels. A short, strong upright supporting the boom of a crane.

KNOCK OFF—Expresses the idea to cease or to desist.

LABEL PLATE—The plate in a boat that contains, among other data, the maximum number of personnel the boat may carry under good weather conditions.

LABOR—The act of a vessel in plunging and buckling heavily in a seaway.

LANDFALL—First sight of land after a voyage.

LANYARD—Any short line used as a handle or as a means for opening some piece of equipment, such as a firing lanyard on a gun. Also, any line used to attach an article of equipment to the person, such as a knife lanyard, pistol lanyard, or a call lanyard.

LASH—To secure by turns of line, wire, or chain.

LASH-UP—Term applied to a rig, device, or system. Usually uncomplimentary, as in "What kind of a lash-up is that?"

LATITUDE—Distance north or south of the Equator, expressed in degrees and minutes.

LAY—Expresses the idea to move oneself, as in "Lay up on the main deck," or "Lay aft." As a noun, lay refers to the direction of the twist of strands in a line or wire, as in right lay or left lay.

LEE—Sheltered area to leeward of a ship or other large windbreaker. As an adjective, lee expresses the idea in the direction toward which the wind is blowing.

LEFT-HANDED—Counterclockwise. Extended to mean not the right way or backwards.

LEFT-LAID—Refers to line or wire in which the strands spiral along in a counterclockwise direction as one looks along the line.

LEG—One of the two or more sections in a span or bridle, boat sling, set of beam hooks, or similar hoisting attachment. One of the sides of a triangle.

LIE OFF—Heave to at some distance away.

LIFELINE—In general, the line erected around the edges of decks. Specifically, the top line. From top to bottom, the lines are named lifeline, housing line, and foot rope.

LIFT—Standing rigging supporting a yard. The term applied to any load to be hoisted.

LIMBER HOLE—Fore-and-aft hole through the frames in a boat's bilges, permitting water to flow throw toward the bilge pump suction point.

LINE—In general, sailors refer to fiber rope as line; wire rope is referred to as rope, wire rope, or just wire. More exactly, line refers to a piece of rope, either fiber or wire, that is in use or has been cut for a specific purpose, such as a lifeline, heaving line, or lead line.

LIZARD—A piece of rope with a thimble or a bull's-eye spliced into the end and used as a fairlead. The line used to retrieve the end of the sea painter and lines used to lash objects to the side of the ship are sometimes called lizards, even though they are not used as fairleads.

LONGITUDE—The distance east or west of the prime meridian, which runs through Greenwich, England.

LONGITUDINALS—Fore-and-aft strength members, running the entire length of the ship, which serve to stiffen and strengthen the frames.

LOOK ALIVE—Admonishment meaning be alert or move faster.

LOWER AWAY—Lower right on down. For example, to lower away a boat from the davit heads down into the water.

LUFF ON LUFF—Combined purchases consisting of a luff tackle with another luff tackle clapped on its hauling part.

MANHELPER—A wooden handle used with a paint roller or a paint brush lashed to it.

MANROPE—A safety line made up with a series of overhand or figure eight knots evenly spaced to assist personnel climbing up and down.

MARLINE—Two-strand, left-laid tarred hemp small stuff.

MARRY—To bring two ropes together, either side by side or end to end, holding or seizing them.

MAST TABLE—Refers to a small compartment or locker on the main deck, built around the base of one of the mast.

MEAN LOW WATER—In regard to tide, the average height of high water measured over a period of time.

MEAN SEA LEVEL—The level midway between mean high and mean low water.

MECHANICAL ADVANTAGE—The number of times that the applied power is multiplied by a purchase or other machine.

MEET HER—Check the swing of a vessel by putting on opposite rudder.

MIDSHIP GUY—Guy between boom heads in a yard-and-stay rig. Also called a schooner guy or a lazy guy.

MOORING STAPLE—Metal fitting on a ship's side to which a chain may be attached for added security in mooring alongside.

MOUSING—Line fashioned around a hook or shackle to prevent the load from falling off or the shackle pin from being undone.

MOVABLE BLOCK—Block in a purchase that is not a fixed block. Block to which the load is applied.

NAVY ANCHOR—Old-fashioned anchor. Anchor with a stock.

NOTHING TO THE LEFT (RIGHT)—Order given to the helmsman not to allow the ship to come to the right (left) of the course because of some danger laying on that side of the course.

OCCULATING LIGHT—A navigational aid in which the period of light is equal to or more than the period of darkness.

OILSKINS—Originally, cotton clothing waterproofed by several coats of linseed oil. Now applied to any wet-weather or waterproof clothing.

ORDINARY MOOR—Method of mooring with anchors in which the upstream anchor is dropped first.

ONBOARD—Word to describe equipment installed aboard a ship, such as onboard computers.

OTC—Officer in tactical command.

OUTER BIGHT LINE—Line sometimes used in the close-in method of refueling. It extends from the receiving ship to the outboard saddle.

OUTHAUL—In general, a line used to haul a piece of gear from a ship.

OVERHAUL—In general, a line used to haul a piece of gear from a ship.

PARBUCKLE—The act of hauling in an object in the bight of a line. One end of the line is fixed and the other end is used as the hauling part. The object acts as a runner, thus the mechanical advantage is 2.

PARCEL—The act of wrapping a line or splice in strips of canvas or cotton to build up a symmetrical surface for serving.

PATENT ANCHOR—A stockless anchor.

PAULIN—Short form of tarpaulin.

PAY—After a seam in a wooden deck or hull is caulked, it is payed by pouring pitch or other caulking compound into the remaining unfilled space.

PAY OUT—Expresses the idea to feed out. Past tense is payed out.

PELICAN HOOK—A hook used to provide an instantaneous release. It can be opened while under strain by knocking away a locking ring that holds it closed.

PENDANT—A single part of line or wire used to extend the distance spanned by a purchase. A single part of line or wire whose purpose is to provide a means for connecting or disconnecting, such as an anchor buoy pendant or a hauling pendant.

PIC—In plaited line, the distance between adjacent crowns.

PIER—A structure, usually built on piles, extending out into the water and providing a means for a vessel to moor alongside.

PIER HEAD—The outboard end of a pier.

PINTLE—A pin fastened to the rubber that fits into the gudgeon on the stem.

PITCH—Vertical rise and fall of a vessel's bow and stem, caused by a head sea or a following sea.

POSITION BUOY—A towing spar used to mark the location of an object towing astern, as the end of a magnetic sweep cable.

PREVENTER—Any line, wire or chain whose general purpose is to act as a safeguard if something else carries away.

PUDDING—A bulky fender attached to a strongback or to the stem or gunwales of a boat.

PURCHASE—A tackle, lever, or device that provides mechanical advantage or power. Also used as an effective hold position for applying power in moving or heaving around.

PUT AWAY—Expresses the idea to leave by water, as in "The boat put away from the ship."

PUT OFF—Same as put away, but usually restricted to putting off from the shore.

QUARTER DECK—That portion of the weather deck designated by the commanding officer for official ceremonies.

QUAY—A loading and discharge place, usually paralleling the shore. Usual construction consists of a masonry wall in the water, with fill between the wall and the natural shore; the fill is paved over.

RANGE—The distance an object is from the observer. A navigational range consists of two markers, some distance apart, located on a known line of true bearing. An area designated for a particular purpose, such as a target range or a degaussing range. In regard to tide, the total rise or fall from low water to high, or vice versa.

RATGUARD—Ahinged metal disk that can be secured to a mooring line to prevent rats from using the line to gain access to the ship.

RATLINE—Three-strand, right-laid, tarred hemp used chiefly nowadays for snaking on destroyer-type vessels.

RAT-TAILED STOPPER—A braided tapering stopper used on boat falls and mooring lines.

REEVE—To pass or thread a rope through a block or hole. Past tense is rove.

RIG—The act of setting up any device or equipment containing rigging. Extended to cover setting up any device or equipment, as to rig for divine services or movies.

RIGGING—A term for the lines and/or wires that support a ship's masts, stacks, yards, and the lines, wires, and tackles that hoist, lower, and otherwise control the motion of its moveable deck gear.

RIGHT-LAID—Refers to line or wire in which the strands spiral along is a clockwise direction as one looks along the line.

RODDLE—That part of a wire rope clip into which the U-bolt is inserted.

ROLLER CHOCK—A chock fitted with one or more rollers to reduce friction on mooring lines. On minesweepers, such a chock provided for the magnetic sweep cable is called an A-frame.

RUN AWAY—Run a line in as fast as possible by taking hold and running down the deck with it.

SEA ANCHOR—Any device streamed from the bow or stem of a vessel for the purpose of creating a drag to hold its end-on to the sea.

SEA LADDER—Permanent ladder secured to the side of the ship's hull.

SEA PAINTER—A line led well forward on the ship to a boat alongside. The sea painter is secured by passing the line around the inboard cleat on the boat and then laying the eye of the line over the standing part; it is then secured by passing a fid or toggle over the eye and under the standing part of the line.

SEA ROOM—A vessel with sea room is well offshore or has plenty of room in which to maneuver.

SEIZING STUFF—Three-strand, right-hand, rope-laid stuff made in 6, 9, or 12 threads of American hemp.

SERVING—A smooth finish on a line or wire, made by winding on close turns of marline or seizing stuff with a serving mallet.

SET—The direction toward which the resultant of the forces of wind and current is acting- is tending to set the ship, in other words.

SET DOWN—Set to shoreward.

SET TAUT—Rake out all the slack. This order is given before "Hoisting away."

SETUP—Tighten up. For example: set up on dogs, gripes, turnbuckles, and so on.

SH—Line made from a mixture of sisal and hemp.

SHAKE A LEG—An admonishment to move faster.

SHANK—The shaft of an anchor, to which the flukes are attached.

SHEARS—Support used in a hoisting rig, consisting of two spars lashed together at the head and set up so as to resemble an inverted V.

SHELL—Vessel's hull from the keel to the main deck.

SHIP—The act of setting a stowed or detached piece of apparatus in operating position, as to ship a steering oar. A large, seagoing surface vessel having a crew quartered on board and capable of extended independent operation. Also used as in to "ship water."

SHORE—The land in general, but usually refers to that part adjacent to the water. A timber or metal member used as a prop. The act of setting up shores to support or steady an article is called shoring up that article.

SHORT STAY—The situation when the anchor cable has been hove in just short of causing the anchor to break ground.

SHOT—One of the lengths of chain that, when joined together, makes up the anchor cable. Astandard shot is 15 fathoms long.

SHROUD—Piece of standing rigging providing athwartship support for a mast.

SIDE LIGHT—One of the colored lights required by law to be shown by a vessel under way. The starboard side light is green, and the port light is red.

SIGHT THE ANCHOR—Heave the anchor up to where it can be seen, and then drop it again. This is done to determine if the anchor is clear or not.

SINGLE UP—Take in the extra parts of doubled-up mooring lines so that only a single part of each line remains on the dock. The act of returning a doubled-up cargo purchase to the stats of a single whip.

SISTER HOOKS—Twin hooks in a thimble or on a hinge that, when combined, form an eye.

SLACK—The opposite of taut; loose. Allow a rope or chain to run out, or feed it out.

SLACK AWAY—Go right on slacking.

SLING—Apiece of line or wire, whose ends are spliced together and passed around an article to be hoisted. Also, two or more legs spliced into a ring, manufactured to hoist a specific article or type of article, such as boat slings and beam slings.

SLIP—When at anchor, disconnecting the cable or letting the end of the cable run out. The space between two piers.

SLUSH—The act of applying a protective coating to line or wire. The substance composing the protective coating so applied.

SMALL STUFF—A general term for any fiber line 1 3/4 inches in circumference or less.

SNAKING—Netting stretched between the deck and the housing line or the foot rope to prevent personnel and objects from being washed overboard.

SNATCH BLOCK—A single-sheaved block with hinged strap that can be opened and the bight of a rope inserted, making it unnecessary to reeve the end of the rope through the block.

SNUB—Check a line, wire, or chain quickly. A ship is snubbed by letting go the anchor, bringing the ship up quickly.

SOUND—Determine the depth of the water. The act of a whale or similar sea creature diving toward the bottom. A body of water between the mainland and a large coastal island.

SOUNDING—A measure of the depth of the water.

SOUNDINGS—Water of limited depth, as over the continental shelf; a ship is off soundings when the hand lead can no longer reach the bottom, and on-soundings when it can.

SPAN—Reach, stretch, or spread between two limits. Also, the item that spans the limits, such as a line or bar between davit heads, the cargo whips in a yard-and-stay rig, and the chain in an anchor moor.

SPAR BUOY—Buoy consisting of a floating spar, or a metal shaped like a spar.

SPOT—Locate or place, as in spotting boom heads for a yard-and-stay transfer.

SPRING—Go ahead or astern on a spring line to force the bow or stern in or out when mooring or unmooring.

SPRING LAY—A rope in which each strand consists partly of wire and partly of fiber.

SPRING LINE—A mooring line leading forward or aft.

STANDARD RUDDER—The amount of rudder angle required to cause a ship to make a turn within a certain diameter.

STAND BY—Be prepared to execute an order or a maneuver. Remain in the vicinity, prepared to render assistance. Assume another's duties.

STAND IN—Head in of a harbor.

STANDING PART—That part of a tackle or line that is made fast. The part on which power is applied in the hauling part.

STANDING RIGGING—The ship's permanent rigging to support structures, mast, and stacks.

START—To induce motion, as to start a grounded vessel.

STAY—A piece of standing rigging providing support fore and/or aft.

STEADY—-Stop the swing.

STEERAGEWAY—Enough headway to provide steering effect. When a vessel no longer answers its rudder, it is said to have lost steerageway.

STEM—The foremost vertical extension of the keel to which the forward ends of the strakes are attached.

STEM BAND—A metal band attached to the stem of a wooden boat.

STEP—The act of erecting a mast. The socket or other recess that holds the foot of a mast.

STERN FAST—A line used to make a boat fast by the stem.

STERN SHEETS—The after passenger space in a boat.

STICK—A familiar term for mast.

STICK OUT—Pay out, as to pay out the cable on a stem anchor winch.

STOP—One of a series of short lines attached to stop the edge of an awning, boat cover, and so forth; used to lash the edge to a ridge rope, jackstay, or other support.

STOP OFF—The act of attaching a stopper to a line, wire, or chain under a strain to hold the strain temporarily while the rope or chain is being belayed.

STOPPER—A line or chain or a patented device used for stopping off a rope or chain.

STOW—The act of packing articles into a storage space or cargo into a cargo space.

STRAIN—Tension.

STRAP—Usually means a short line or wire having an eye in either end. However, a short piece of small stuff with the ends spliced together is sometimes called a strap. Also, that part of a block to which the hook or shackle is attached.

STREAM—The act of permitting a tow to run out the desired distance or to the end of the towline. Similar act with any towed device, as to stream sweep gear from a minesweeper.

STRIKE—To shorten or douse. To lower.

STRINGER—Long lumber between piles at the edge of a pier. The horizontal member attached to the side between frames and serving as a support for the end of a transverse frame.

STRONGBACK—A heavy spar spanning radial davits, against which a ready lifeboat is griped in. Heavy steel clamp bolted across the top of a cargo hatch.

STRUT—A brace supporting the proppler shaft.

STUD—The metal piece in a link of anchor chain that keeps the link from kinking.

SURGE—To slack off a line by allowing it to slip around the object to which it is secured. The act of holding turns of a line on a gypsy in such a manner as to allow the gypsy to rotate without heaving in on the line. Sudden strain on a towing hawser caused by the pitching, sheering, or yawing of the tow and/or the towing vessel. The swell of the sea.

SWING—Progressive change of heading caused by an angle on the rudder or by a ship circling around its anchor.

SWING OUT—To swing a boat from its stowed position to its lowering position. Reverse procedure for swing in.

TAUT—Under tension; the opposite of slack. A taut ship is one that is in a high state of discipline and efficiency.

TENDER SHIP—A ship that heels over easily when under way.

TIDE—The vertical rise and fall of the ocean level, caused by the gravitational force between Earth and the Moon.

TOP HAMMER—General term for a ship's mast, stacks, and other rigging aloft.

TOPPING LIFT—Line, wire, or tackle used to hoist, lower, and support the head of a cargo boom or the outboard end of a sailing boom or a boat boom.

TOPUP—To raise a boom to a working angle by means of its topping lift.

TOWING SPAR—A spar or other wooden device towed astern by ships in formation when visibility is poor to assist in station keeping.

TRANSVERSE—Part of the structure of a ship running athwartships.

TROUGH—The valley between two waves.

TUMBLE—The act of an automatic releasing hook in opening upon release of the weight.

'TWEEN DECKS—Means BETWEEN decks and refers to cargo spaces located between the main deck and the bottom of the hold.

TWO-BLOCK—Round in a tackle all the way so that the blocks come together. Extended to mean hoist an article to the highest position possible. In relation to signal flags, this term has been replaced by close up.

U-BOLT—A U-shaped bolt with threads on each end. The bolt in a wire rope clip.

UNLAY—Untwist and separate the strands of a rope.

UNMOOR—The act of letting go a mooring buoy, letting go mooring lines or, if a ship is moored with anchors, reconnecting each anchor to its own chain and heaving in the anchors.

UNSHIP—The act of detecting or unrigging any piece of apparatus from its operating position.

UP AND DOWN—The situation where the anchor cable and the shank of the anchor lead up and down and the crown of the anchor still is on the bottom.

UP BEHIND—Slack off quickly and run slack to a belaying point. This order is given when a line or wire has been stopped off or falls have been four-in-hand and the hauling part is to be belayed.

VANG—A tackle fitted with one or two wire pendants.

VANG GUY—A vang used to guy a cargo or other boom.

VARIATION—Magnetic compass error caused by the difference between the magnetic pole and the geographic pole and certain local conditions. It is expressed in degrees east or west.

VEER—Allow a line, wire, or chain to run out by its own weight, as to veer cable by slacking the brake on a disconnected windlass.

VERTREP—Vertical replenishment, in which helicopters are used to transfer cargo, personnel, and munitions.

WAIST—The midships section of the main deck.

WALK AWAY—Haul in a line by taking hold of the line and walking down the deck, rather than by using the hand-over-hand method.

WALK BACK—Keeping control of the load, walk toward the belaying point.

WALK OUT—Pay out cable under power.

WARP—Move one end of a vessel broadside by heaving on a line secured on the dock.

WARPING WINCH—Winch on the main deck aft, used to warp in the stem when mooring alongside.

WATERBORNE—Afloat, or in contact with the water's surface.

WEIGH ANCHOR—Hoist the anchor clear of the bottom.

WET DOCK—Where the tidal range is great, basins with gates are provided as docking places. The ships enter at high tide and the gates are closed, keeping the water in the basin when the tide ebbs.

WHARF—Same as a pier.

WHELPS—The raised area on the anchor windlass to engage links if chain.

WILDCAT—The drum of the windlass.

WINDLASS—The machine used to handle the ship's ground tackle. Many times called the wildcat, which is fitted with whelps. On a horizontal shaft windlass, it is usually fitted with gypsy heads on each side to handle lines.

WIRE DIAMETER—Refers to the diameter of a chain measured at the end of a link a little above the centerline.

WISHBONE—A V-shaped brace that supports the upper platform of an accommodation ladder or the platform in the chains.

WORM—To lay marline or other small stuff between the strands of a rope preparatory to parceling.

YARD BOOM—The cargo boom plumed over the ship's side.

YAW—To veer suddenly and unintentionally off course.

YOKE—The athwartship piece atop the rudder stock on a small craft; wheel ropes or tiller ropes are attached to its ends.

APPENDIX II

REFERENCES USED TO DEVELOP THIS NONRESIDENT TRAINING COURSE

NOTE: Although the following references were current when this NRTC was published, their continued currency cannot be assured. When consulting these references, keep in mind that they may have been revised to reflect new technology or revised methods, practices, or procedures; therefore, you need to ensure that you are studying the latest references.

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