NAVAL COMMUNICATIONS

Prepared by

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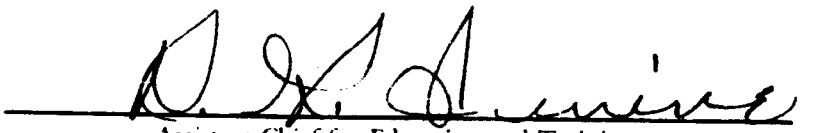

Assistant Chief for Education and Training

PREFACE

Naval Communications has been prepared primarily to provide junior naval officers with general information needed to carry out successfully a tour of duty in a communication billet afloat. It may, however, serve as a refresher for officers with previous communication experience, touching as it does on the procedures and instructions necessary to perform basic communication functions. The content and organization of the text are based upon that of The Communication Officer, NavPers 10780-A, except that all classified material has been deleted.

This publication is intended as a guide. It does not supersede or supplant official publications with regard to doctrine, equipments, shipboard organization, or shipboard operations.

Naval Communications was prepared by the U. S. Navy Training Publications Center, Washington, D. C., for the Bureau of Naval Personnel. Throughout this text, references to other publications, instructions, and so forth, pertain to the effective editions thereof or the latest changes thereto.

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THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future. in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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CHAPTER 1

INTRODUCTION TO NAVAL COMMUNICATIONS

The first known publication to be concerned with U.S. naval communications was the (Commodore Thomas) Truxtun Signal Book, published in 1797. Truxtun's system included nearly 300 basic signals requiring numeral pennant displays in daylight hours and lights or false fires at night. The book was printed a year before the Navy Department was established by act of Congress, and it was used for about 65 years.

An embryo electric telegraph was in service some 15 years before the Civil War, and the forerunner of the present-day flashing light system, based on the Morse code, made its appearance in 1864. Under this system a lantern, ball, or other object was exposed, or a flag was lowered and raised, in dot-dash patterns. In poor visibility, a trumpet was blown in short and long blasts.

In August 1888 Rear Admiral (then Lieutenant) Bradley A. Fiske first experimented with ship-to-ship wireless at the New York Navy Yard. Insulated cable was wrapped around the USS Newark and a Navy tug, and interrupted current was sent into Newark's coils. Lieutenant Fiske listened from the tug with a telephone receiver in series with the coil system, and reported that he received signals a short distance from the ship.

The first official U. S. Navy wireless telegraph message was sent in 1899 from the steamship Conce to the Navy's Highland Station on the New Jersey coast. Guglielmo Marconi, who was given the patent in 1896 for inventing the wireless communication device, was the operator.

With the success of wireless transmission established, naval communications began a period of rapid growth around the turn of the century. By 1904, 18 shore stations and 33 ships were radio equipped. In 1908, one-half of the nearly 400 wireless stations in the world were manned by U. S. naval personnel. The same year saw the first successful test of the wireless telephone—voice radio—between the USS Connecticut and the naval radio station at Point Loma, California. The Naval Radio Service, forerunner of our present Naval Communication System, was established by a Navy General Order issued in December 1912.

In subsequent years, the Navy introduced a number of communication "firsts." President Wilson's historic Fourteen Points were transmitted from the United States to Germany by a naval radio station. In 1919, the Navy was instrumental in helping to create R.C.A.—the Radio Corporation of America—the first wholly U. S.-owned commercial radio communication company. This was a national security measure in which foreign radio interests on U. S. soil were bought out and their operations dissolved. The year 1920 ushered in the beginning of scheduled broadcasting by the first radio broadcasting station in the Nation's capital, at the Anacostia Naval Air Station, Washington, D.C. As a matter of interest, the Anacostia station actually pioneered in the disc jockey field. Reportedly, requests for musical recordings were received from listeners in 28 states. The Navy installed the first radio receiving set in the White House in 1921. The following year, the Navy broadcast for the first time the voice of a President of the United States—that of Warren G. Harding—during the dedication of the Lincoln Memorial in Washington.

In the early 1920s, naval personnel already were investigating and testing radio facsimile equipment. In 1923, pictures of President Harding were transmitted by the Navy from Washington to Philadelphia. Twenty-two years later, photographs of the Japanese surrender ceremonies on board the USS Missouri were transmitted by the Navy more than 5000 miles to the United States and the Nation's press.

During World War II, the east and west coasts of the United States were linked by teletypewriter circuits. The first overseas radio-teletypewriter channel, between California and Pearl Harbor, was opened in 1945. Extensions followed to Guam, Balboa, Adak, and San Juan. These were the first moves that led to the present system that crisscrosses the continent and spans much of the world.

After the landings at Leyte in the Philippines in 1944, a concerted effort was made to utilize

radioteletypewriters in a shipboard environment, extending operational concepts first tested in the 1920s. By 1947, the Navy was ready to establish its first radioteletypewriter broadcast to ships at sea.

Within the United States, the teletypewriter network has been re-engineered into an automatic teletypewriter switching (relay) system. The cutover was completed in 1959. Having only five primary stations, the system serves a basic network of over 200 tributary stations throughout the country. There is a tie-in to the Navy's overseas radio circuits, to ships at sea and to other Armed Forces communication systems. The speed of message delivery is increased greatly through centralized control and relatively simple operations requiring minimum personnel.

Experiments leading to the discovery that the moon can be used as a natural satellite communication relay station began in 1951. The first moon-relayed voice message was transmitted by the Naval Research Laboratory (NRL) in 1954; in 1955, the NRL accomplished transcontinental communication over the moon radio circuit by transmitting a teletype message from Washington, D. C. to San Diego. In 1959 the Navy first sent operational traffic via the moon between Washington and Pearl Harbor when solar disturbances disrupted conventional circuits. Facsimile photographs are sent in the same way, and the quality of reception is improving steadily. Demonstrations in recent years have shown the feasibility of both ship-to-shore and shore-to-ship message transmission using the Communications Moon Relay (CMR) System.

Improvements are being made continuously in the field of manmade satellites for the purpose of communication relay. One of the first big dividends from the U. S. space effort will occur in satellite communications. In general, the Navy's role in this program, which is managed by the Bureau of Ships, has been as a participant in joint projects.

MISSION, POLICY, AND BASIC PRINCIPLES

In the modern missile age, it is a foregone conclusion that a future war would not allow a period of grace during which to procure vast amounts of equipment and to train thousands of new men. It has been stated often that any future general war will be won or lost in hours or days, rather than in years. Naval communications, being a function of command, must always be in a condition of preparedness. In the event of hostilities, the operating forces would depend on communication facilities in existence at the time.

A navy that operates on a worldwide scale requires the services of a global communication network. A commander must be able to pass the word—to communicate—whenever necessary, in any mode, between and among ships separated by varying distances, and from ships to and from shore stations, aircraft, and satellites. The ability to communicate makes possible effective command and control, thus ensuring that every mobile nerve center in the fleet is responsive to the tactical and strategic needs and services of every other element. The major shore stations in today's Naval Communication System form a global network that is the backbone of naval communications, spreading their circuits wherever our mission requires.

A force of ships is never out of touch with its base of operations. In support of the force is a global organization of communication stations with hundreds of radio and landline circuits. Orders and information affecting the successful outcome of the force's mission are exchanged swiftly and accurately throughout every level of command. The direct result of reliable communications is a tightly directed fighting unit.

MISSION

The mission of naval communications—the voice of command—is to provide and maintain reliable, secure, and rapid communications, based on war requirements adequate to meet the needs of naval command; to facilitate administration; and to satisfy, as directed, JCS-approved joint requirements.

POLICY

The policy of naval communications is to—

1. Cooperate with the military services and other departments and agencies of the U.S. Government and Allied Nations.
2. Encourage development of the amateur and commercial communication activities of the United States to strengthen their military value and safeguard the interests of the Nation.
3. Promote the safety of life at sea and in the air, maintain facilities for adequate communication with the U.S. merchant marine,

aircraft over the sea, and appropriate U. S. and foreign communication stations.

BASIC PRINCIPLES

The primary concept of naval communications is to meet the requirements of war. Peacetime organization, methods, procedures, facilities, and training must be such that only minor changes will be required when shifting to an emergency or war status. Based on the foregoing concept, the following basic principles have been proved under war conditions:

1. Reliability, security, and speed are the three fundamental requirements of naval communications. Reliability is always paramount; it must never be sacrificed to achieve security or speed. When there is a conflict between the demands of security and speed, however, one or the other must be sacrificed in the light of the demands of the situation.

2. Effective communications require a basic knowledge and appreciation of how, when, and where to send messages. Instructional publications and the latest equipment in no way lessen the need for initiative, commonsense, and good judgment in the planning and conduct of naval communications.

3. Correct methods of operation and precise use of established procedures are essential to effective communications.

4. Administrative planning and foresight are required to ensure that rapid communications are employed only when other means of communication will not suffice.

5. The proper choice of frequency is of the greatest importance in establishing and maintaining reliable radio communications.

6. Communication media that are susceptible to interception should not be used in wartime when a more secure means will serve.

TELECOMMUNICATIONS

The term telecommunications embraces any transmission, emission, or reception of signs, signals, writing, images, and sound; or intelligence of any nature by visual or oral means, or by wire, radio, or other electromagnetic systems. Telecommunications used in the Navy are of three types: electrical, visual, and sound.

ELECTRICAL COMMUNICATIONS

The means of communicating electrically are by radio and wire. The former uses electromagnetic waves not guided by a physical path between sender and receiver, whereas wire uses electromagnetic waves carried by electrical conductors that connect the sending and receiving equipments. Following is a brief description of the various methods of electrical communications.

Radiotelegraph

Radiotelegraph (continuous wave or CW telegraphy) is a system for transmitting signals by using a wave of radiofrequency (r-f) energy. The radio operator separates the continuously transmitted wave into dots and dashes, based on the Morse code, by opening and closing a telegraphic handkey. Despite the development of automation in electronic communications, manual CW telegraphy still is one of the most efficient and reliable communicating systems used by the Navy.

Teletypewriter

Teletypewriter (TTY) signals may be transmitted by either landline (wire) or radio. The landline TTY is utilized both by the military services and by commercial communication companies. Radioteletypewriter (RATT) is used mainly for high speed automatic communication across ocean areas. The teletypewriter unit is equipped with a keyboard similar to a typewriter. When the operator presses a key, a sequence of signals is transmitted. At receiving stations, the signals are fed into terminal equipments that type the message automatically.

Although RATT can be used for ship-to-ship and between ships and shore stations, the main shipboard use of the radioteletypewriter is for the receipt of fleet broadcast messages. RATT can clear traffic at a rate in excess of 100 wpm. Because the shipboard operator is freed from manual copying, and hundreds of ships may be receiving a single broadcast, the total saving in manpower is considerable.

Radiotelephone

The radiotelephone (voice radio) is considered one of the most useful military communication devices. Because of its directness, convenience, and ease of operation, voice radio is used almost exclusively between ships and between ships and aircraft for short-range (20 to 25 miles) tactical communications. There is

little or no delay while a message is prepared for transmission, and acknowledgements can be returned instantly. The R/T equipment usually is operated on frequencies that are high enough to have line-of-sight characteristics. That is, the radio waves do not follow the curvature of the earth, and this provides a degree of communication security. Because most radiotelephone transmissions are sent in plain language, strict circuit discipline is mandatory.

Facsimile

Facsimile (FAX) is the process used to transmit photographs, charts, and other graphic information electronically. The image to be transmitted is scanned by a photoelectric cell, and electrical variations in the cell output, corresponding to the light and dark areas being scanned, are transmitted to the receiver. At the receiver, the signal operates a recorder that reproduces the picture. The FAX signals may be transmitted by either landline or radio.

VISUAL COMMUNICATIONS

Visual communications are the preferred means for communicating at short range during daylight. In reliability and convenience, they are the equal of radio and are more secure. Visual signaling systems include flaghoist, flashing light, and semaphore.

Flaghoist

Flaghoist is a method of communication in which various combinations of colored flags and pennants are hoisted to send messages. It is the principal means of transmitting brief tactical and informational signals between surface units. Signals are repeated by the addresses to provide a check on the accuracy of reception. Texts of messages sent in this manner usually are limited to those contained in signal books.

Flashing Light

Flashing light is a visual telegraphic system that utilizes visible or infrared light beams; it may be directional or nondirectional.

A directional flashing light is pointed and trained so as to be visible only by the addressee of the message. This method makes use of installed signal searchlights, on which the operator opens and closes the light shutter to form dots and dashes, and portable lights, in which the source of light is switched on and off to form the Morse code characters.

Nondirectional (omnidirectional) lights are located above the superstructure on the yardarm. Because the light beams are visible in every direction from the ship, this method of communicating is suitable for messages destined for several addressees.

In time of war, flashing light communications carried on after dark usually utilize infrared beams that are not visible unless viewed through a special receiver. As a general rule, infrared is the most secure means of visual communications. Directional infrared uses the standard signal searchlights fitted with special filters. For omnidirectional signaling, yardarms are fitted with infrared blinker lamps.

Semaphore

Semaphore is a communication medium by which a man signals with two hand flags, moving his arms through various positions to represent letters, numerals, and special signs. In clear weather, because of its speed, it is the preferred means of short-range (not beyond 2 miles) message transmission.

SOUND COMMUNICATIONS

Sound communication systems include whistles, sirens, bells, and acoustics. The first three are used by ships for transmitting emergency warning signals such as air raid alerts, for navigational signals prescribed by the Rules of the Road, and, in wartime, for communications between ships in convoy.

Provision is made in many search sonar (underwater sound) equipments to permit their use for CW transmission. The term acoustic communications, however, usually pertains to an underwater sonar communication equipment called Sea Talk. Sea Talk (frequently referred to as Gertrude) may be used for either radiotelephone or CW communications. The range of transmission varies with the condition of the sea and the relative noise output of the ship. Under favorable conditions, communications may take place between ships at ranges in the vicinity of 12,000 yards. Unusual machinery noises may create extraneous sounds sufficient to blot out incoming signals. This action, in effect, reduces the effective range, particularly when the equipment is being used for voice communicating.

ELEMENTS OF NAVAL COMMUNICATIONS

The major elements of naval communications are the—

1. Office of Naval Communications.
2. Naval Security Group.
3. Naval Communication System.
4. Communication departments of shore establishment activities.
5. Communication organizations of the operating forces.

OFFICE OF NAVAL COMMUNICATIONS

The Office of Naval Communications, headed by the Director, Naval Communications (DNC), is an organization within the Office of the Chief of Naval Operations. The DNC's full title is Assistant Chief of Naval Operations (Communications)/Director, Naval Communications (ACNO (COMM) /DNC). The office is the headquarters of naval communications, responsible for department level communication coordination and planning. Its objective is to provide efficient communications for the Naval Establishment based on both present and contemplated requirements. The DNC promulgates, among other texts, the communicator's most important doctrinal publication U. S. Naval Communication Instructions, DNC 5.

NAVAL SECURITY GROUP

The Naval Security Group is a worldwide organization that provides for the protection of naval communications by directing the communication security effort. It furnishes cryptographic equipment for the Department of Navy (including the U. S. Coast Guard), administers the Registered Publication System and its registered publication issuing offices (RPIOs), supervises the naval portion of the Armed Forces Courier Service (ARFCOS), performs cryptologic and related functions based on requirements originated by or placed upon the Chief of Naval Operations (CNO), and performs special functions in connection with communication security and communication electronic intelligence.

NAVAL COMMUNICATION SYSTEM (NCS)

The Naval Communication System is a fixed, integrated communication network that includes all shore-based communication activities plus the landlines and radio circuits by which all elements of naval communications are linked. The NCS comprises three types of activities: communication stations, radio stations, and communication units.

A naval communication station (NAVCOMMSTA) consists of the communication facilities and ancillary equipment required to provide the essential fleet support and fixed communication services for a specific area.

A naval radio station (NAVRADSTA), generally a remote component of NAVCOMMSTA, performs either radio transmitting or radio receiving functions. To indicate the function performed, the designation letter T or R is added in parentheses to the activity; e.g., NAVRADSTA(T), Lualualei, Oahu.

A communication unit (NAVCOMMU) is assigned a limited or specialized functional mission, and consequently is smaller in terms of personnel and facilities than its counterpart, the NAVCOMMSTA.

COMMUNICATION DEPARTMENTS OF SHORE ESTABLISHED ACTIVITIES

The organization of an activity of the shore establishment usually provides for a communication department. The communication department maintains and operates communication facilities mainly to afford local communications as necessary for accomplishing the activity's assigned mission. It also may provide general communications in furtherance of the worldwide functions of the NCS.

Where radio transmitting and receiving facilities are required, it is the policy to install the equipments in regularly established transmitter or receiver stations of the Naval Communication System and remotely control these facilities from the communication center of the activity concerned.

COMMUNICATION ORGANIZATIONS OF THE OPERATING FORCES

At the level of the operating forces, communications is the voice of command in a visible and tangible way. The communication organization aboard ship is under the direct and positive control of the commanding officer. Often, the communications provided influence directly and materially the degree of success achieved by the combat unit. In the transmission

and reception of signals and messages, the communication organization participates in the exercise of command.

DEFENSE COMMUNICATIONS

The Defense Communications System (DCS) comprises the major portions of the individual Army, Navy, and Air Force communication complexes brought together under a single system to provide a single system response to the Department of Defense worldwide communication needs. The military departments continue to maintain and operate their assigned portions of the DCS, but are responsive to the overall operational control and supervision of the Defense Communications Agency (DCA), which is the management agency for the DCS.

With certain exceptions, the DCS includes all Department of Defense circuits, terminals, control facilities, and tributaries, regardless of the military department to which they are assigned. Of particular significance to the Navy, the implementing directive states that the DCS normally does not include land, ship, and airborne communication facilities of broadcast, ship-to-shore, ship-to-ship, and ground-air-ground systems. Tactical circuits within a tactical organization usually are excluded from the DCS.

The Defense Communications Agency is an activity of the Department of Defense under the authority and control of the Secretary of Defense. The chain of command runs from the Secretary of Defense through the Joint Chiefs of Staff to the Chief, DCA.

The operational control and supervision of the DCS is accomplished through a complex of communication control centers. The functions and tasks associated with the control centers are to tabulate, assemble, store, and display information on current conditions of the components of the system; allocate channels and circuits to meet requirements of authorized users; and perform continuous system analysis and such other tasks as are necessary. The principal objective of the control center system is to assure the greatest possible responsiveness of the DCS to the needs of its users.

The communication control centers receive and process performance data based on hourly and spot reports made by the various DCS reporting stations on networks, circuits, channels, and facilities of the DCS. These reports provide a knowledge of the status of the DCS at all times. The control centers know of the traffic backlogs, if any; conditions of circuits; status of installed equipment at some 200 switching centers throughout the world; and the status of channels allocated to the various users. With this knowledge and that of alternate route capabilities between any two points, spare capacity, and radio propagation conditions, the control centers restore elements and reallocate channels according to the needs and priorities of users.

The heart of the communication control center complex is the Defense Communications Agency operations Center, located in the Washington, D. C. area. In this automatic processing center, complete information on the communication traffic and system status throughout the world is processed and acted upon.

Information presented on display panels in the Operations Center covers the full range of data required to analyze intelligently this worldwide communication system. Included in this information are trunk status, assignment, and availability of individual circuits, station status, and the scope, priority, and quantity of message backlog.

Subordinate to the DCA Operations Center are four Defense Area Communications Control Centers (DACCCs). These control centers exercise operational control and supervision of DCS components in their geographical areas. The Pacific DACCC is located in Hawaii; the European DACCC at Dreux AFB, France; the Alaska DACCC at Elmendorf AFB, Anchorage; and the Continental U. S. DACCC at Fort Carson, Colorado.

Subordinate elements of the DACCCs include regional control centers (DRCCCs) in the Philippines, Japan, Labrador, England, Spain, and Turkey. Thus, there are a total of 10 area and regional control centers throughout the world to provide control facilities that permit the DCS in their particular areas to be responsive to the changing needs of area commanders.

JOINT AND ALLIED COMMUNICATIONS

The need for coordinated and standardized communications among the military services has been apparent for many years, particularly since the early stages of World War II. Army and Navy facilities occasionally were duplicated locally, and differences in procedures made efficient interservice communications difficult. Communication procedures now are standardized

within the Department of Defense, and the handling of interservice messages no longer is a special problem. Joint procedures are set forth in Joint Army-Navy-Air Force Publications (JANAPs).

Allied Communication Publications (ACPs) are promulgated to meet the need for standardized communications on an allied basis. The ACP series of publications provides the communication instructions and procedures essential to the conduct of combined military operations.

MILITARY AFFILIATE RADIO SYSTEM

The Military Affiliate Radio System (MARS) provides a source of trained operators having a potential for emergency communications in support of the military services. Basically, Navy MARS was established to train amateur radio operators in Navy communication procedures. The Army and Air Force each have their MARS, and with the Navy now form a tri-service MARS. The operators maintain an affiliation with the service of their choice and provide a backlog of competent personnel for use in local disasters or a general emergency.

Navy MARS operators ordinarily operate from their own amateur stations using Navy-assigned calls. They handle personal or semi-official message traffic of a morale nature that does not qualify for regular transmission over Navy circuits.

THE RELIEVING PROCESS

It might be well at this point to deviate somewhat from the subject of communications to suggest certain precautions, practices, and pitfalls to avoid during the process of assuming a shipboard communicator's duties. The way a relieving officer takes over his new responsibilities does not guarantee success. If he does it correctly, however, he may prevent many unnecessary headaches during the first few months. This is particularly true for an officer starting without experience in a new billet. For purposes of discussion, however, it is assumed that the relieving officer has a reasonable time to establish a contact relief.

SHIP/DEPARTMENT ORGANIZATION

Type commanders usually promulgate standard organization and regulations manuals which commanding officers modify to some extent to meet the needs of their individual ships. The modifications are limited in number to ensure uniformity throughout the class of vessel. Before concerning himself with the details of a new job, the newly reported officer should study the ship's organization and regulations manual to get the feel of the ship as a working unit.

As a minimum requirement, the ship's organization book contains (1) a complete written and graphic description of the ship's administrative organization, (2) the organizational bills of the ship, and (3) the ship's regulations. The last are a group of instructions covering the more common recurring events or problems. Such matters as the ship's leave policy, routine for airing bedding, and procedures for dealing with public vendors are spelled out in detail.

The chief purpose of the organization and regulations manual is to provide ship's personnel with a ready source of information concerning their duties, responsibilities, and authority in administering and operating the ship.

In addition to studying the ship's organization, the new communicator should familiarize himself with the organization of the operations department. The operations officer is the immediate superior of the communication officer, and on occasion will assign the latter tasks that require a detailed knowledge of the entire department. In the absence of the operations officer, the communication officer may temporarily take charge of the department. The operations officer may have prepared a departmental organization book containing and amplifying the various sections of the ship's organization and regulations manual applicable to the operations department.

This text treats the subject of communications within the context of a typical destroyer organization. Owing to the limited number of officers available, there is much doubling up of duties. The executive officer may be navigator; the engineer officer may perform the duties of main propulsion assistant. On a large ship the communication officer has several assistants, such as a custodian of registered publications and a signal officer, but in a destroyer the communicator invariably has no officers to assist him. Elsewhere in this text specific tasks are spelled out in some detail, but the fundamental source with which all officers must be familiar is U.S. Navy Regulations, 1948, which includes a chapter on the duties of each officer.

ADMINISTRATIVE CHECKOFF LISTS

Each type commander prepares a detailed administrative inspection checkoff list by which to evaluate the ships under his command. Everything considered important is covered by a question on the list. At intervals of approximately once each year a group of officers from another ship, supplemented by the type, flotilla, or squadron commander's staffs, will come aboard, go through the ship's records and compartments, ask innumerable questions, and finally evaluate the ship's administrative conditions.

The new division officer should request a copy of the checkoff lists that apply to the communication and signal spaces and go through them item by item. Examples of questions appearing on a list might include the following:

1. Is a watch, quarter, and station bill posted? Is it complete? Is it up to date?
2. Are the ship's communication instructions accessible to communication personnel?
3. Are emergency destruction bills posted in the proper spaces?
4. Are periodic drills in destruction procedures carried out?
5. Is an adequate communication training program in effect?
6. Are high-voltage signs posted at appropriate places?
7. Is the required registered publication allowance maintained?
8. Is the general message file complete?

This is a random sampling of a list that might contain well over a hundred questions. If any tangible item required by the checkoff list (the ship's communication instructions, for example) is nonexistent, it should be made a part of the relief letter, discussed later. Close observation of the schedules of required daily, weekly, and monthly checks of equipment will reveal whether required maintenance tests are in fact being performed, or whether someone is merely initialing the records.

Certain periodic reports require that data be gathered systematically throughout the period covered by the report. The relieving officer must determine by sighting whether his predecessor's tickler system effectively ensures that all reports are prepared and filed on time.

REGISTERED PUBLICATIONS

Probably more young officers have gotten into serious trouble because of careless handling of registered publications than for any other reason. The subject is so important that a full chapter of this book is devoted to it. A relieving officer should not accept custody for the registered publications of the ship until he has sighted them, checked them against the inventory, made page checks when necessary, and learned the regulations concerning them.

The basic instructions for custodians are contained in the effective edition of RPS 4. Any officer connected with communications must be thoroughly familiar with the regulations governing the proper handling of registered publications.

MATERIAL

Every division officer is responsible for the accountability and proper maintenance of the equipment and compartments over which he has cognizance.

The only way to be sure that the various articles and equipments that an officer is assuming responsibility for are those on board—no more, no less—is to take a complete inventory. The officer being relieved should have an inventory list showing all accountable articles and containing the type and identification (model and serial) number of every piece of equipment.

Certain items, such as office supplies, are expendable because they are used up in day-to-day operations, and no strict accountability is possible. Major items, however, are inventoried at least annually, usually in conjunction with the supply officer's yearly inventory. If a discrepancy arises between the annual inventory list and the relieving officer's initial inventory, the officer being relieved is responsible for taking corrective action. It may be that an item in question was replaced, the old equipment still being listed on the inventory. On the other hand, maybe another department borrowed a typewriter some months back. If no one except the officer being relieved and an already-transferred chief know where the typewriter actually is, how does the new officer explain the apparent loss when it shows up on the next annual inventory? In any event, if an item turns up missing, the communicator being relieved must initiate a request for survey, stating his reason for its loss. Essentially, a survey is an

investigation of the cause, and a citing of responsibility, for lost or damaged equipment.

In company with his predecessor, the relieving officer makes a thorough inspection of all the areas of the ship for which he is about to assume responsibility. A thorough material inspection furnishes an indication of the standards of cleanliness in the division work spaces. The searchlights and the generators that supply the transmitters present a good insight into the maintenance standards. If the generator zerk (grease gun) fittings are painted over or are dirty, or if there is evidence of corrosion inside the searchlights, the new officer should be suspicious of the way routine maintenance schedules are being carried out. In the division's berthing compartment, he should inspect lockers and bedding for neatness and cleanliness.

EQUIPAGE

The officer being relieved will have signed for equipage. This is material, such as binoculars and typewriters, of such value that individuals having custody of it are required to sign a card that is retained by the ship's supply officer.

Each department head signs the custody cards for all equipage allotted his organization. The department head may require that subcustody cards be signed by the person having physical custody of each item. A relieving officer necessarily assumes custody of those items for which his predecessor has been accountable. He should sight each item before signing the custody card. Once his signature appears on the cards, the presence and condition of the equipment become his responsibility. In the event equipage is lost or damaged, it must be surveyed in the same way that missing or damaged material is surveyed.

CURRENT SHIP'S MAINTENANCE PROJECT

The Current Ship's Maintenance Project (CSMP) is a written record of authorized and required alterations and repairs. Usually part of the CSMP is maintained by the electronics material officer (EMO) and the remainder by the engineer officer. Each part contains information of interest to a relieving officer, who should go over the lists of repairs with both the officer being relieved and the EMO. The new officer must understand the effect that inoperable equipment has on the capability of the ship to furnish the circuits required during fleet operations.

RELIEF LETTER

It is common practice for an officer being relieved to write a letter to the commanding officer; via the relieving officer and the executive officer, stating that he has been relieved, and the condition of the department or division for which he has been responsible. The relieving officer should ensure that anything he does not consider satisfactory is reported in his endorsement.

About 1 month after relieving, the new division officer may be required to prepare another letter to the captain, via the operations and executive officers, stating what he has done to correct the deficiencies found on arrival. The report should include any additional casualties that have occurred or difficulties being experienced.

GETTING THE JOB DONE

Problems do not solve themselves. Ideas and suggestions have no meaning unless they are followed by decisions. An officer must attack each casualty and problem aggressively, determine the facts, and decide what has to be done.

For example, radio central might receive a complaint from a department head that he did not receive his copy of an incoming message rapidly enough to prepare a timely answer. Merely explaining that the routing system in effect should provide efficient service does not solve the problem. If an action message was not delivered promptly, something is wrong. It may be that the action message was placed inadvertently with messages received for information, the latter being delivered periodically during the day rather than upon receipt. On the other hand, the messenger may have stopped somewhere in his travels for a cup of coffee that lasted a half hour. In either case, the communication officer must take corrective action. A leading petty officer may be able to resolve the problem by revamping the delivery procedure. It is entirely possible that the man routing the messages knows more about the situation than anyone else and is eager to try out some of his own ideas.

There is a tendency on the part of some junior officers to believe that additional

manpower is the panacea for all their difficulties. This might be true, but it is the least likely way of resolving a problem because the odds are that additional personnel will not be forthcoming. Every superior must learn to do the job with what he has on hand. Wherever possible, he establishes a system which, after the men have been properly instructed, will run itself with a minimum of personal supervision.

Many officers spend hours working on a number of tasks simultaneously, and in the final analysis rarely complete any of them. Do not become bogged down in too many projects at the same time. Plan each day to work on the most important problems. Report the completion of every task assigned by a superior officer. If an assigned task cannot be accomplished, this fact also must be reported.

In the matter of correspondence, every business has its standard operating procedures, and the Navy is no exception. When preparing a letter for the commanding officer's signature, it is not necessary that all controversial subjects should be omitted but rather that the facts are correct, and the conclusions or recommendations are well thought through. The letter should be in accordance with approved format. Most important, all correspondence forwarded to the captain must be grammatically correct and contain no misspelled words. Except in unusual instances, the letter should be smooth-typed.

Most U. S. Navy ships are deployed periodically to overseas areas. When overseas, the normal supply channels are lengthened, complicating logistics. In addition, the various fleet commanders issue instructions and procedures covering a wide range of subjects that may differ in detail from those in effect while operating from the continental United States. These problems throw a heavy workload on the communication officer. In general, each type commander has an effective instruction wherein all of the predeployment requirements are delineated. Approximately 3 months before sailing, procure a copy of this instruction from the ship's files and initiate action to obtain all required items.

Instructions usually are mailed to each ship in sufficient time to allow thorough study by interested personnel prior to arrival in the forward area. Do not intermingle these instructions in the ship's regular file binders, and keep them readily available to operating personnel. For the instructions which must be returned upon departure from the forward area, ensure that an accounting system is maintained.

Advance planning is necessary to ensure a successful tour of duty as a communicator. Don't wait until a problem arises to start checking effective instructions and publications for correct procedures. Many times it is too late to correct mistakes after the ship is underway.

CHAPTER 2

NAVAL MESSAGES

A message is any thought or idea expressed briefly in either plain or cryptic language, prepared in a form suitable for transmission by any means of communication.

CLASSES OF MESSAGES

For administrative purposes, particularly accounting, messages handled by naval communications are divided into five classes: A, B, C, D, and E. Classes A, B, and C are Government messages; D and E are non-Government (private) messages.

The largest volume of traffic handled by the Navy is class A, which consists of official messages and replies thereto originated within the Department of Defense.

Class B includes official messages of the United States Government, excluding those originated within the Department of Defense. (The U. S. Coast Guard is included under class B except when operating as part of the Navy.) Class B messages take precedence with, but after, class A traffic. They are carried free of charge over naval nets and circuits.

Class C messages consist of broadcast traffic in special forms, available to ships of all nationalities. These messages are concerned with special services, such as oceanographic data, weather, and time. Class C traffic also is handled free of charge.

Class D traffic consists of private messages involving tolls collected from the sender. The group includes radiotelegrams and press messages sent by correspondents aboard ship.

Class E messages are personal messages between personnel stationed on board ship or at overseas naval stations and addressees in the continental United States. This traffic is handled free of charge over naval circuits; charges are collected from the sender only when a commercial communication firm, such as Western Union Telegraph Company, handles the message over part of its route. For example, if a man on a ship in the Atlantic sends a class E message to a man at a naval station in Washington, D. C., the ship transmits the message to Radio Washington, which effects delivery to the station. The message never leaves Navy channels and the sender pays nothing. But if the message were addressed to Louisville, Kentucky, Western Union would handle it out of Washington and the ship would collect tolls from the originator for the distance between Washington and Louisville. The ship would forward the money to the Navy Finance Center, Washington, D. C., for payment to Western Union in accordance with instructions contained in DNC 26.

The class E message privilege is chiefly for purposes of morale. It affords naval personnel at sea a means of communication regarding urgent personal matters without incurring prohibitive expense. In general, the privilege is used sparingly. Subjects ordinarily acceptable for transmittal or delivery are matters of grave personal concern, a birth announcement, important nonrecurring business communication, matters of life and death, and occasional greetings on important anniversaries. Trivial or frivolous messages, those of unnecessary length, and ordinary congratulations are unacceptable.

MESSAGE ADDRESSEES

Most messages have at least one addressee (addee) responsible for taking appropriate action on the contents and for originating any necessary reply. Other addees with an official interest in the subject of the message, but who do not have the primary responsibility for acting on it, receive the message for information. An information addee, although usually concerned indirectly with a message, frequently must take action of some nature within his own command. Some messages have only information addressees.

The originator of a message fixes the address; it may not be altered by any other station, although an addee may readdress a message to others not included in the original address. In the interests of brevity and security, the number of addressees is kept to a

minimum consistent with the requirement that an originator must make every reasonable effort to foresee and include all who need the information. Except in unusual circumstances, messages are addressed to the command instead of to the administrative office of the command.

Messages often are categorized according to the way they are addressed. There are four types: single-address, multiple-address, book, and general messages.

A single-address message is destined for one addressee only.

A multiple-address message is intended for two or more addressees, each of whom is informed of the others. Each addressee must be designated either as action or information.

A book message is directed to two or more addressees, and is of such a nature that no addressee needs to be informed of any others. Book messages are mainly the concern of shore stations. The station initially accepting a book message divides addressees into groups according to the relay stations serving them. A separate message is prepared and transmitted to each relay station; the message is changed only to omit addressees that are the concern of some other station. Upon receipt of a book message, a relay station may further reduce the number of addressees by making up single address messages for each of its tributaries addressed. Because many book messages are destined for scores of addressees, significant time and expense are saved by the shortened headings.

A general message is disseminated widely according to a standard distribution list. General messages are of many types, most of which are shown in table 2-1; each carries an identifying title. All messages of a given general message title are numbered serially through the calendar year, as ALNAV 12-64, signifying the 12th ALNAV sent during 1964. General messages are grouped by type and are filed in a general message file according to serial number. They are retained until canceled or superseded.

The originator of a general message may designate it as a basegram if it is of insufficient operational importance to justify immediate delivery to forces afloat by fleet broadcasts. The basegram system is used to reduce the number of messages transmitted by fleet broadcast so that broadcast facilities are available for messages that must be delivered by rapid means. Forces afloat may obtain copies of basegrams from designated basegram authorities located in ports from which U. S. Navy ships normally operate.

General messages originated by sea frontier commanders, commandants of naval districts, and fleet, force, and ship type commanders for the purpose of publishing information within their respective commands are not included in table 2-1.

CALL SIGNS AND ADDRESS GROUPS

Call signs and address groups are used to identify addressees and to assist in the transmission and delivery of messages. Call signs identify activities having their own communication facilities; address groups normally are used where no communication capability is immediately assigned. The basic purpose of call signs is to establish and maintain communications. The same group also is used as an address when the activity sends and receives messages. Address groups, on the other hand, ordinarily are used to facilitate the sending and receiving of messages, and are assigned to all activities having such a need.

Call Signs

Call signs are letters, letter-number combinations, or one or more pronounceable words used principally to identify a communication activity. This is true in both civil and military usage, but military call signs also may designate the command(s) served by the station. Call signs are of several categories, with some calls belonging to more than one category.

INTERNATIONAL.—International call signs are assigned radio stations of all countries—civil and military, fixed and mobile—according to international agreement. The first letter or first two letters of an international call indicate the nationality of the station. The United States is allocated the first half of the A block (through ALZ) and the whole of the K, W, and N blocks. The U. S. portion of the A block is reserved for Army and Air Force use. The K and W blocks are assigned to commercial and private stations, merchant ships, and others. The N block is for the exclusive use of the Navy, Marine Corps, and Coast Guard.

Naval shore communication stations are assigned three-letter N calls. These calls may be expanded by adding numerical suffixes.

Table 2-1.—General Messages

Type	Originator	Description
ALCOAST	Commandant, USCG	General dissemination within the Coast Guard.
ALCOM	OPNAV	Usually originated by DNC for dissemination to all commands. Designed for, but no longer restricted to, the promulgation of communication information.
ALCOMLANT, ALCOMPAC	OPNAV	Usually originated by DNC. Subdivisions of the ALCOM series for commands in the Atlantic-Mediterranean and Pacific areas, respectively.
ALLANTFLT, ALPACFLT	CINCLANTFLT, CINCPACFLT	Equivalent of ALNAV or NAVOP within the commands of CINCLANTFLT and CINCPACFLT, respectively.
ALMAR	Commandant, USMC	General dissemination within the Marine Corps.
ALMSTS	Commander, MSTS	General dissemination to MSTS commands and offices.
ALNAV	SECNAV	Normally concerns the administrative functions of the entire Naval Establishment, including the Marine Corps.
ALNAVSTA	SECNAV	Similar in content to ALNAV. Requires wide dissemination to the shore establishment of the Navy and Marine Corps, including shore-based elements of the operating forces.
ALSTACON, ALSTAOUT	SECNAV	Contains administrative information requiring wide dissemination to activities either inside or outside the continental United States.
FLTOP	OPNAV	Message concerning fleet units and their operational commanders.
JANAFPAC	CINCPAC	Addressed to U. S. commanders within the Pacific command on matters of joint interest.
MERCAST	OPNAV	Merchant ship equivalent of ALNAV. Distribution includes ships guarding MERCAST (merchant ship broadcast) schedules, naval port control and naval control of shipping offices, and MSTS commands.
NAVACT	SECNAV	Similar in content to ALNAV, but of no interest to the Marine Corps.
NAVOP	OPNAV	Similar in content to ALNAV; attachés, missions, observers, and minor stations are excluded from distribution.

Thus, additional call signs are provided for radio transmitting and receiving facilities located remotely from the parent station. For example:

NAM	NAVCOMMSTA Norfolk.
NAM1	CINCLANTFLT Norfolk.
NAM2	Naval Shipyard, Norfolk.

International call signs assigned to U. S. Navy ships are four-letter N calls used unencrypted. They have no security value, and are utilized for all nonmilitary international communications. Example:

NWBJ USS Renshaw (DD 499).

International call signs for USN, USMC, and USCG aircraft consist of the service designator N, NM, or NC, respectively, followed by the last four digits of the serial or bureau number of the aircraft.

MILITARY.—Most ships of the Allied Nations are assigned military call signs in addition to their international call signs. From the

military call signs are derived the encrypted call signs for CW and RATT communications. Likewise, military call signs form the basis for both encrypted and unencrypted call signs for voice communications. They are never used in their basic form to address messages. Military call signs, consequently, are assigned only to ships capable of encrypting call signs.

INDEFINITE.—Indefinite call signs represent no specified facility, command, authority, or unit, but may represent any one or any group of these. Examples:

NERK	(To) any or all U. S. Navy ships.
NA through NZ	(From) any U. S. Navy ship.
NQO	(To) any or all U. S. shore radio stations.

Indefinite call signs often are used as "dummy" calls in codress message headings (discussed later) to conceal the identity of originators and addressees. In such instances this information is placed in the encrypted text.

The call NQO might be sent by a ship unable to raise a particular shore station. Any Navy shore installation hearing the transmission could answer and accept the traffic.

COLLECTIVE.—Collective call signs pertain to two or more facilities, commands, or units. Examples:

NATA	All U. S. Navy ships copying this broadcast.
NIMK	All U. S. submarines copying this broadcast.

NET.—Net call signs represent all stations within a net, a net being an organization of two or more stations capable of direct communication on a common channel. Examples:

NQN	All U. S. Navy radio stations in the Pacific guarding the ship-shore high-frequency calling series.
OVER-WORK	All U.S. Navy stations on this (radiotelephone) circuit.

TACTICAL.—Tactical call signs, composed of letter-number combinations or pronounceable words, normally are used only for tactical communications.

VOICE.—Voice call signs are words or combinations of words—such as SUNSHINE or HIGH HAT—limited to radiotelephone communications. The Joint Voice Call Sign Book, JANAP 119, lists the voice call signs for use on tactical circuits. On ship-shore administrative circuits, phonetically spelled international call signs are used on ships' voice calls. Under certain conditions, ships' names are used as voice call signs on local harbor circuits. Radiotelephone communications are discussed fully in chapter 8.

VISUAL.—Visual call signs are groups of letters, numerals, special flags and pennants, or combinations of any of these, for use in visual communications. Visual communications are covered in chapter 9.

Address Groups

Address groups are four-letter groups assigned to represent a command, activity, or unit. They are used mainly in the message address, although in military communications they can be used in the same manner as call signs to establish and maintain communications.

In general, call signs and address groups are used by the Navy in exactly the same way. Because address groups never start with the letter N, they easily are distinguished from call signs. Unlike international call signs, address groups follow no distinctive pattern (i. e., three-letter N calls for shore stations, four-letter N calls for ships); the arrangement of the four letters conveys no significance.

Address groups are assigned to all commands afloat except individual ships. They are assigned also to shore-based commands, authorities, or activities not served by their own communication facilities. These include (1) senior commands and commanders, such as the Secretary of Defense, Secretary of the Navy, heads of the bureaus and offices of the Navy Department, and district commandants; (2) fleet, type, and force commanders ashore; (3) elements of those operating forces permanently ashore which are in frequent communication with forces afloat; and (4) elements of the shore establishment (such as weather centrals) having a need for direct addressing and receipt of messages.

Among other uses, address groups facilitate delivery of messages when a communication center serves so many activities that its own call sign is insufficient to identify the addressees. Address groups are divided into types as follows: individual activity, collective, conjunctive, geographic, address indicating, and special operating groups.

INDIVIDUAL ACTIVITY. —Individual activity address groups are representative of a single command or unit, either afloat or ashore.

COLLECTIVE. —Collective address groups represent two or more commands, authorities, activities, or units, or combinations of these. Included in the group are the commander and his subordinate commanders. For example:

DSWN	DESRON 16.
AMGK	SIXTHFLT.

CONJUNCTIVE. —Conjunctive address groups per se have incomplete meanings. They are used only in conjunction with at least one other address group. The conjunctive address group DRHG, for example, represents the naval control of shipping officer at_____. A geographic address group must follow DRHG to complete the meaning.

GEOGRAPHIC. —Geographic address groups are the equivalent of geographical locations or areas, and are always preceded by conjunctive address groups. Assuming the geographic address group for Kodiak, Alaska to be SAAN, the naval control of shipping officer at Kodiak would be addressed DRHG SAAN.

ADDRESS INDICATING. —Address indicating groups (AIGs) represent a number of specific action and/or information addressees. Use of an AIG shortens the message address by providing a single address group to represent a number of addees, thus eliminating individual designators.

SPECIAL OPERATING. —Special operating groups (SOGs) are utilized for passing special instructions in message headings. Unless specifically authorized by CNO, SOGs are not used; when they are used, they must be encrypted.

ROUTING INDICATORS

Routing indicators are unencrypted groups of letters (four to seven) used to identify stations in a teletypewriter tape relay network. They begin with either the letter R or U.

PLAIN LANGUAGE DESIGNATORS

Plain language address designators are the official, abbreviated, or short titles of commands or activities, used in lieu of call signs or address groups in message headings. Some abbreviated titles are written as single words; others have conjunctive titles and geographical locations. Examples: BUSHIPS, NAVCOMMSTA GUAM.

Plain language designators have wide application in messages originated and addressed within the shore establishment. They also are used in joint and allied communications. They are not used in messages originated by or addressed to naval forces afloat.

Call signs or address groups must not be mixed with plain language address designators in the same address component of a message. The address component contains either all plain language designators or all call signs and address groups.

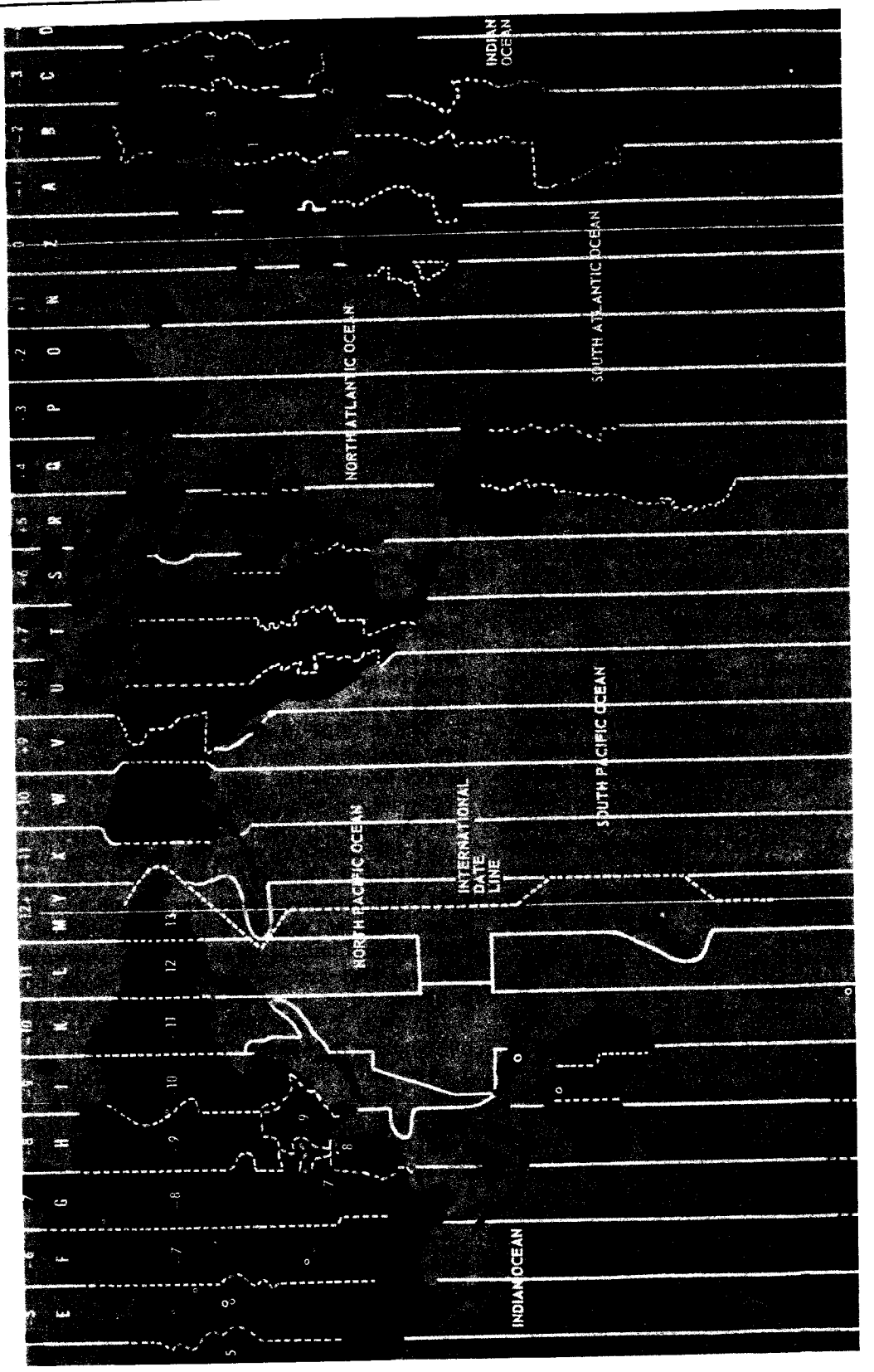
TIME IN MESSAGES

For reckoning time, the surface of the globe is divided into 24 zones, each bound by meridians of 15° of arc, and each 1 hour apart in longitude. The initial time zone lies between 7 1/2°E. and 7 1/2°W. of the Greenwich (England) meridian. It is called ZONE ZERO because the difference between the standard time of this zone and Greenwich civil time is zero. Each zone, in turn, is designated by the number that represents the difference between the local zone time and Greenwich mean time (GMT), as in figure 2-1.

Zones lying in east longitude from zone zero are numbered from 1 to 12 and are designated minus because for each of them the zone number must be subtracted from local time to obtain Greenwich mean time. Zones lying in west longitude from the zero zone are also numbered from 1 to 12, but are designated plus, because the zone number must be added to the local zone time to obtain GMT. In addition to the time zone number, each zone is designated by letter, with letters A through M (J omitted) corresponding to the minus zones, and letters N through Y indicating the plus zones. The designating letter for GMT is Z. (See fig. 2-1.)

The 12th zone is divided medially by the 180th meridian, the minus half lying in east longitude and the plus half in west longitude. This meridian is the international date line, where each worldwide day begins and ends. A westbound ship crossing this line loses a day, whereas an eastbound ship gains a day.

The number of a zone, prefixed by a plus or minus sign, constitutes the zone description. In the vicinity of land, zones often are modified in accordance with the boundaries of the countries or regions using corresponding time.



13.76

Figure 2-1.—Time zone chart of the world.

The approved method of expressing time in the 24-hour system is with the hours and minutes expressed as a four-digit group. The first two figures of the group denote the hour and the second two, the minutes. Thus 6:30 a.m. becomes Ø63Ø (canceled ciphers are used for zero in all naval messages to avoid confusion with the letter O); noon is 12ØØ; and 6:30 p.m. is 183Ø. Midnight is expressed as ØØØØ—not as 24ØØ—and 1 minute past midnight becomes ØØØ1. The time designation 1327Z indicates 27 minutes past 1:00 p.m., GMT. Numbers are prefixed to the time to indicate the day of the month; in other words, to form a date-time group (DTG). The DTG 171327Z means the 17th day of the current month plus the time in GMT. Dates from the 1st to the 9th of the month are preceded by the numeral Ø.

A DTG is assigned to a message by the message center at the time the message is prepared for transmission. For standardization, the time expressed by a date-time group normally is GMT. The DTG in a message heading serves two purposes: it indicates the time of origin of the message, and it provides an easy means of referral.

In addition to the external DTG, an encrypted message has a DTG buried within the text. This is called the true date-time group (TDTG), and it is inserted by the cryptocenter. The true date-time group, instead of the DTG, is used when referring to an encrypted message.

In a general message, a slant sign and additional digits are added to the DTG. The additional digits represent the general message sequential number, e.g., 1Ø2347/35.

When local time is used to indicate the DTG, it is followed by the zone designating letter, as 17Ø821Q. When local time is referred to frequently in the text, the suffix may be omitted if an inclusive expression is used; for example, ALL TIMES QUEBEC.

TIME CONVERSION TABLE

A time conversion table, table 2-2, is useful for converting time in one zone to time in any other zone. Time in each successive zone to the right of zone Z (GMT) is 1 hour later, and to the left of zone Z is 1 hour earlier. Time in each successive shaded area to the right represents the following day; to the left it is 1 day earlier. To calculate the time in zone U when it is Ø5ØØ in zone I, find Ø5ØØ in column I and locate the time (12ØØ) on the same line in column U. Because Ø5ØØ lies in the shaded area but 12ØØ does not, the time indicated is 12ØØ on the previous day.

PROCEDURE SIGNS

Procedure signs, or prosigns, are letters or combinations of letters that convey in standard condensed form certain frequently transmitted orders, instructions, requests, reports, and information relating to communications. Some prosigns are borrowed from various commercial procedures. Others are arbitrary coinages or simply abbreviations of the words they represent, although prosigns themselves are never referred to as abbreviations. Most prosigns have radiotelephone counterparts, called prowords, which are discussed in chapter 8.

PRECEDENCE PROSIGNS

Among the most important prosigns are those used to show precedence. Precedence indicates to communication personnel the relative order in which a message should be handled and delivered, and, to the action officer, the relative order in which he should note its contents. Precedence is assigned by the originator on the basis of message content and how soon the addressee must have it. Because precedence begins as soon as the message is drafted, the drafter and releasing officer should handle the message with the same speed they expect from communication personnel.

Multiple-address messages may be assigned a dual precedence, one precedence for the action addressees and a lower one for information addees.

No message should be given higher precedence than will assure its reaching the addressee in time for action. Unfortunately for communication efficiency, this rule often is disregarded. The importance of the message subject matter does not necessarily imply urgency. Drafters should be reminded by communicators that misuse of precedence tends to destroy the value of all precedence designators. Those who draft messages should be aware that all but the lowest precedence messages are delivered to the addressee immediately upon receipt by the communication center, regardless of the hour.

Joint precedence prosigns, their meanings, definitions, and appropriate handling requirements are tabulated in table 2-3. In addition to

Table 2-2. —Time Conversion Table

PREVIOUS DAY																										SAME DAY
	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	
	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	
	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	
	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	
	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	
	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	NEXT DAY
SAME DAY	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	
	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	
	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	
	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	
	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	
	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	
	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	
	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	
	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	
	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	
	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	
	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	
	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	
	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	
	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	
	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	
	Y	X	W	V	U	T	S	R	Q	P	O	N	Z	A	B	C	D	E	F	G	H	I	K	L	M	
	+12	+11	+10	+9	+8	+7	+6	+5	+4	+3	+2	+1	0	−1	−2	−3	−4	−5	−6	−7	−8	−9	−10	−11	−12	

Table 2-3. —Precedence Table

Prosign	Designation	Definition and use	Handling requirements
Z	FLASH	Reserved for enemy contact messages or operational combat messages of extreme urgency. Brevity is mandatory. Examples: (1) Initial enemy contact reports. (2) Messages recalling or diverting friendly aircraft about to bomb targets unexpectedly occupied by friendly forces; or messages taking emergency action to prevent conflict between friendly forces. (3) Warnings of imminent large-scale attacks. (4) Extremely urgent intelligence messages. (5) Messages containing major strategic decisions of great urgency.	Flash messages are hand-carried, processed, transmitted, and delivered in the order received and ahead of all other messages. Messages of lower precedence will be interrupted on all circuits involved until handling of the Flash message is completed. In automatic systems where automatic interruption of lower precedence messages is not provided, adequate procedures must be prescribed to ensure that Flash messages are not delayed. Time standard: Not fixed. Handled as fast as humanly possible with an objective of less than 10 minutes.
O	IMMEDIATE	Reserved for messages relating to situations that gravely affect the security of national/Allied forces or populace, and which required immediate delivery to	Processed, transmitted, and delivered in the order received and ahead of all messages of lower precedence. If possible, messages of lower precedence are

Table 2-3.—Precedence Table—continued

Prosign	Designation	Definition and use	Handling requirements
O	IMMEDIATE (continued)	the addressee(s). Examples: (1) Amplifying reports of initial enemy contact. (2) Reports of unusual major movements of military forces of foreign powers in time of peace or strained relations. (3) Messages that report enemy counterattack or request or cancel additional support. (4) Attack orders to commit a force in reserve without delay. (5) Messages concerning logistical support of special weapons when essential to sustain operations. (6) Reports of widespread civil disturbance. (7) Reports or warnings of grave natural disaster (earthquake, flood, storm, etc). (8) Requests for, or directions concerning, distress assistance. (9) Urgent intelligence messages.	interrupted on all circuits involved until the handling of the Immediate message is completed. In automatic systems where automatic interruption of lower precedence messages is not provided, adequate procedures must be prescribed to ensure that Immediate messages are not delayed. Time standard: 30 minutes to 1 hour.
P	PRIORITY	Reserved for messages that require expeditious action by the addressee(s) and/or furnish essential information for the conduct of operations in progress when Routine precedence will not suffice. Examples: (1) Situation reports on position of front where attack is impending or where fire or air support will soon be placed. (2) Orders to aircraft formations or units to coincide with ground or naval operations. (3) Aircraft movement reports (e.g., messages relating to requests for news of aircraft in flight, flight plans, or cancellation messages to prevent unnecessary search/rescue action). (4) Messages concerning immediate movement of naval, air, and ground forces.	Processed, transmitted, and delivered in the order received and ahead of all messages of Routine precedence. Routine messages being transmitted should not be interrupted unless they are extra long and a very substantial portion remains to be transmitted. Priority messages should be delivered immediately upon receipt at the addressee destination. When commercial refile is required, assign the commercial precedence that most nearly corresponds with priority. Time standard: 1 to 6 hours.
R	ROUTINE	Routine is the precedence to use for all types of messages that justify transmission by rapid means unless of sufficient urgency to require a higher	Processed, transmitted, and delivered in the order received and after all messages of a higher precedence. When commercial refile is required,

Table 2-3.—Precedence Table—continued

Prosign	Designation	Definition and use	Handling requirements
R	ROUTINE (continued)	precedence. Examples: (1) Messages concerning normal peacetime military operations, programs, and projects. (2) Messages concerning stabilized tactical operations. (3) Operational plans concerning projected operations. (4) Periodic or consolidated intelligence reports. (5) Troop movement messages, except when time factors dictate use of a higher precedence. (6) Supply and equipment requisition and movement messages, except when time factors dictate use of a higher precedence. (7) Administrative, logistic, and personnel matters.	utilize the lowest commercial precedence. Routine messages received during nonduty hours at the addressee destination may be held for morning delivery unless specifically prohibited by the command concerned. Time standard: 3 hours to start of business the following day.

the precedence categories shown in the table for United States joint use, NATO and other Allied Nations utilize the designations Emergency and Deferred. When such traffic enters a United States military communication system, messages carrying an Emergency precedence are handled after Flash and before Immediate; Deferred traffic is handled after messages bearing the joint precedence Routine.

The time standards indicated in the last column of table 2-3 serve as a general guide to the desired overall handling times between points of origin and delivery to the addressee at destinations.

LIST OF PROSIGNS

In addition to precedence prosigns, the following authorized list of prosigns may be used as prescribed. A bar or overscore over a prosign indicates that the latter is transmitted as a single character with no pause between letters. Overscores are ignored in teletypewriter transmissions.

Prosign	Meaning
$\overline{AA}$	Unknown station.
AA	All after.
AB	All before.
$\overline{AR}$	End of transmission; no receipt required.
$\overline{AS}$	I must pause for a few seconds.
$\overline{AS}$ $\overline{AR}$	I must pause longer than a few seconds; will call you back.
B	More to follow.
$\overline{BT}$	Break. (Separates text of message from its heading and ending.)
C	Correct.
CFN	Confirmatory material to follow. (Used only in teletypewriter operation.)
DE	From (used in the call).
EEEEEEEE	Error.
EEEEEEEE $\overline{AR}$	This transmission is in error; disregard it.
F	Do not answer.
FM	Originator's sign.
G	Repeat this entire transmission back to me.
GR (followed by numerals)	Group count.
GRNC	The groups in this message have not been counted.
$\overline{HM}$ $\overline{HM}$ $\overline{HM}$	Emergency silence sign.
II	Separate sign. (Used to separate parts of a message heading.)
$\overline{IMI}$	Repeat, or i am repeating.

Prosign	Meaning
INFO	The addressee designations immediately following are addressed for information.
INT	Interrogative.
IX	Action on the message or signal that follows is to be carried out upon receipt of "EXECUTE." (Used for intended simultaneous tactical maneuvers to be executed by all units in a force.)
IX (followed by 5-second dash	(Signal to execute.) Carry out now the purpose of the message or signal to which this applies.
J	Verify with originator and repeat.
K	Go ahead, or this is the end of my transmission to you and a response is necessary.
NR	Station serial number.
R	I have received your last transmission satisfactorily.
T	Transmit this message to all addressees or to the address designations immediately following.
TO	Action addressee.
WA	Word after.
WB	Word before.
XMT	Exempt. (Used to exempt addees from a collective call or address.)

Procedure signs may be classed according to their particular functions as follows:

Prosigns used to identify portions of a transmission.	AA, AB, WA, WB
Ending prosigns	K, AR
Pause prosigns	AS, AS AR
Separation prosigns	BT, II
Prosigns always followed by one or more call signs and/or address groups.	DE, FM TO, INFO, XMT
Prosigns used in the transmission instructions of a message.	T, G, F
Group count prosigns	GR, GRNC
Prosigns used with the executive method.	IX, IX plus 5-second dash
General prosigns	AA, B, C, EEEEEEEE, EEEEEEEE AR, HM HM HM, IMI, INT, J, NR, R, CFN

OPERATING SIGNALS

Operating signals are designed chiefly for use by communication personnel in exchanging information incident to the handling of messages or in establishing communications. These three-letter signals possess no security and therefore are regarded as the equivalent of plain language transmissions.

Several hundred operating signals are listed in Allied Communication Publication (ACP) 131. It is divided into a Q code and a Z code. The Q signals are prescribed for international use, and may be used for both military and nonmilitary communications. The Z code is designed to cover military communication requirements not adequately provided for in the Q code. Although both Q and Z signals may be used in military communications, the Z code is only for Allied military usage, because Z signals represent meanings not found in the Q code.

USE OF OPERATING SIGNALS

Operating signals are prescribed for every form of electrical telecommunication except radiotelephone. The radiotelephone operator transmits operating information in brief spoken phrases. An exception is made to this rule when a message containing an operating signal is relayed by radiotelephone; in such an instance the operator transmits the group phonetically.

Many operating signals may be used in either of two ways—as a question or as a statement in reply to a question. The prosign INT before the signal places it in the form of a question. As an example, USS Epperson (call sign NTGT) asks USS Renshaw (NWBJ): NWBJ DE NTGT INT QRU K, meaning "Have you anything for me?" Renshaw replies: NTGT DE NWBJ QRU K, meaning "I have nothing for you." The given example pertains to communications with a military station (INT before the Q (or Z) signal). When communicating with nonmilitary stations, an operating signal is given an interrogatory sense by inserting the

prosign IMI after the Q signal and any data used with it, such as call signs or time groups.

Many operating signals contain blank portions in their meanings that are filled in to convey specific information. For instance, INT ZRE means "On what frequency do you hear me best?" In ACP 131 the declaratory meaning listed for ZRE is "I hear you best on _____kc (mc)." The operator fills in the necessary information: NSS DE NIQM ZRE 8578, meaning "I hear you best on 8578 kc."

Other signals have, in their meanings, blanks enclosed in parentheses. Filling in such a blank is optional. To illustrate, INT ZHA means "Shall I decrease frequency very slightly (or_____kc) to clear interference?" The operator receiving the signal INT ZHA without the frequency added knows it means "Shall I decrease frequency very slightly?"

During wartime, operating signals often are encrypted, especially those revealing—

1. Specific frequencies.
2. Cryptographic data.
3. The organization of networks.
4. Ship movements (estimated times of arrival, departure, etc.).

BASIC MESSAGE FORMAT

With a few exceptions, military messages sent by electrical telecommunications are arranged according to a standard joint form called the basic message format. The form is substantially the same whether the message goes by radiotelegraph, radiotelephone, teletypewriter, or by automatic tape equipment. The format exists in four versions, one of which is adapted to the special requirements of each of these primary transmission media.

All messages in joint form have three parts: heading, text, and ending. The three parts are divided into components, which, in turn, are broken down into elements. (See table 2-4.) Although the elements are arranged according to numbered format lines, there is no relationship between the format lines and the number of typed or handwritten lines. Format line 12, for example, which is used for the text of the message, may consist of many written lines.

Of the three parts of a message, the most complex is the heading, which often uses as many as 10 of the format's 16 lines. Each item in the heading has a special meaning, and its relative position is significant.

The prosigns or prowords, call signs, address groups, and other elements that make up a typical heading always appear in the order specified for the means of transmission. The form of the message and its transmission requirements, however, dictate the components and elements actually used in the heading. For example, format line 1 is used only in tape relay communications; and transmission identification is not used in ship-to-ship communications or on harbor nets. Many messages may omit such elements as transmission instructions or on harbor nets. Many messages may omit such elements as transmission instructions, information addressee prosigns, and final instructions because there is no occasion for their use. The average communicator seldom sees a message that utilizes every format line.

MESSAGE ANALYSIS

Before transmitting a radiotelegraph message, the radio operator establishes communications by means of a preliminary call (callup). The callup alerts the intended addee(s) and identifies the station calling to the station(s) for which it has a transmission, or, if not in direct communication, to the station that is to effect relay or delivery of the message.

A simple preliminary call consists of the station called, the prosign DE, the station calling, the precedence (if appropriate), and the prosign K, as follows: NACH DE NKKC R K.

A check of the call sign book shows that NACH is USS Hailey and NKKC is USS Hancock. The callup translates literally, "Hailey from Hancock, I have one Routine message for you. Are you ready to receive?" Hailey's operator inserts a message blank in his typewriter and tells Hancock to go ahead by sending: NKKC DE NACH K.

With communication established, Hancock commences clearing traffic. The transmission may be analyzed as follows:

Format line	Transmission	Explanation
2 and 3	NACH DE NKKC. .	Hailey from Hancock
5	R	ROUTINE precedence.
5	222345Z	DTG.

Table 2-4.—Radiotelegraph Message Format

Parts	Components	Elements	Format line	Contents
H	Beginning procedure	Handling instructions .	1	Not used in radiotelephone and radiotelegraph.
E		a. Call	2 3	Station(s) called; prosign XMT (exempt) and exempted calls. Prosign DE (from) and designation of station calling.
A		b. Transmission identification. c. Transmission instructions.	4	Station serial number. Prosign T (relay; G (repeat this transmission back to me exactly as received); F (do not answer); operating signals; call signs, address groups, plain language.
	Preamble	a. Precedence; date-time group; message instructions.	5	Precedence prosign; date-time group and zone suffix; operating signals; prosign $\overline{IX}$ (execute to follow).
D	Address	a. Originator's sign; originator.	6	Prosign FM (originator of this message is); originator's designation expressed as call sign, address group, or plain language.
I		b. Action addressee sign; action addressee(s).	7	Prosign TO; action addressee designation(s) expressed as call signs, address groups, address indicating groups or plain language.
N		c. Information addressee sign; information addressee.	8	Prosign INFO (this message addressed for information to); information addressee designation(s) expressed as call signs, address groups, or plain language.
		d. Exempted addressee sign; exempted addressee(s).	9	Prosign XMT; exempted addressee designation(s) expressed as call signs, address groups, or plain language.
G	Prefix	a. Accounting information; group count; SVC.	10	Accounting symbol; group count; SVC (this is a service message).
SEPARATION			11	Prosign $\overline{BT}$ (break).
T E X T	Text	a. Subject matter	12	Internal instructions; basic idea of originator.
SEPARATION			13	Prosign $\overline{BT}$.
E N D I N G	Ending procedure	a. Time group	14	Hours and minutes expressed in digits and zone suffix, when appropriate.
		b. Final instructions	15	Prosigns B (more to follow); $\overline{AS}$ (I must pause); C (I am about to correct a transmission error in some foregoing part of this message); operating signals.
		c. Ending sign	16	Prosign K (go ahead and transmit), or $\overline{AR}$ (end of transmission).

Format line	Transmission	Explanation
10	GR9	Group count. This message has 9 groups in the text. (Each plain language word counts as 1 group.)
11	BT	Break. Separation between heading and text.
12	UNCLAS GUARD MAIL FOR YOU RECEIVE AT FIRST LIGHT . .	Text.
13	BT	Break. Separation between text and ending.
16	K	Go ahead.

On receiving K, which is the ending prosign, Hailey's operator checks the message and counts the groups. If the message appears to be correctly received, he gives a receipt for Hancock's transmission by sending NKKC DE NACH R AR. If Hailey's operator is in doubt about some portion of the message, he requests a repetition by transmitting NKKC DE NACH IMI WA AT, meaning "Hancock from Hailey, repeat word after 'at'." If the operator misses a substantial portion of the message, he might frame his request. NKKC DE NACH IMI GUARD TO LIGHT.

In the preceding example two ships are in direct communication and Hailey's call sign has served to address the message to that ship. A message that must undergo relay to reach the addressee requires a somewhat longer and differently constructed heading. It must be apparent to every station handling the message (1) who originated the message, (2) who receives the message for relay purposes, and (3) to whom the message ultimately is destined.

Assume that USS Ranger, steaming off Cristobal, Panama, completes her mission of qualifying carrier pilots and the CO wishes to so report to the Commander Naval Air Force, U. S. Atlantic Fleet (COMNAVAIRLANT) in Norfolk, Va., and to the Commanding Officer, U. S. Naval Air Station, Jacksonville, Florida. Communication is established with NAVCOMMSTA Balboa, the nearest naval shore radio station, and the ship transmits this message:

NBA DE NHKG - T - R - Ø11324Z - FM NHKG - TO YONA - INFO OJWN GR6 BT UNCLAS. CARQUALS COMPLETED. ETA GTMO Ø314ØØZ BT K

Following is an analysis of the message. The short dashes in the heading are mandatory signs used by the sending operator to prevent mistakes in reception that might occur if letters or figures of adjacent groups were run together. Specific instructions for their use are contained in DNC 5.

Format line	Transmission	Explanation
2, 3	NBA DE NHKG -	NAVCOMMSTA Balboa from Ranger.
4	T -	Relay this message to all addressees.
5	R - Ø11324Z -	Routine precedence and DTG.
6	FM NHKG -	Originator Ranger.
7	TO YONA -	Action COMNAVAIRLANT.
8	INFO OJWN	Information to CO NAS JAX.
10	GR6	Group count 6 words.
11	BT	Break.
12	UNCLAS. CARQUALS COMPLETED. ETA GTMO Ø314ØØZ	Text.
13	BT	Break.
16	K	Go ahead.

Certain authorized abbreviations, standard throughout the services, are used in messages for the sake of brevity. The text as sent (format line 12) is about 60 percent shorter than the expanded text, which would read: CARRIER QUALIFICATION LANDINGS COMPLETED. ESTIMATED TIME OF ARRIVAL AT GUANTANAMO BAY CUBA Ø314ØØZ.

Station NBA gives Ranger a receipt for the message, and by so doing assumes responsibility for relay. NBA has no direct links with Norfolk or Jacksonville, but does have a RATT circuit to NAVCOMMSTA WASHDC, which, in turn, has the necessary landline connections. Accordingly, NBA adds routing indicators to the message (using format line 1), telling Washington to relay to Norfolk and Jacksonville. Radio Norfolk, guard for COMNAVAIRLANT, effects delivery to that addee.

Following is an example of a fleet broadcast message from NAVCOMMSTA WASHDC, originated by CNO. Fleet broadcast messages via CW repeat each element of the heading except when the addressees are designated by plain language.

NERK NERK NERK DE NSS NSS NSS W NR522 W NR522 - PP - RR - 11Ø847Z 11Ø847Z - FM FM SSMW SSMW - TO TO YIOX YIOX - INFO INFO AOQW AOQW - XMT XMT NJRS NJRS GR156 GR156 BT (text) BT AR

An analysis of the preceding fleet broadcast message follows.

Format line	Transmission	Explanation
2,3	NERK DE NSS	Any or all U. S. Navy ships from NAVCOMMSTA WASHDC. (This call is sent with the first message of each hourly schedule, and is omitted thereafter.)
4	W NR522	NAVCOMMSTA WASHDC broadcast serial number 522—the 522d message placed on this broadcast schedule since the beginning of the current month.
5	P - R - 11Ø847Z	Priority precedence to action addees; Routine precedence to information addees; DTG.
6	FM SSMW	Originator CNO.
7	TO YIOX	Action to all ships in NAVAIRLANT.
8	INFO AOQW	Information to Naval Air Station, Guantanamo Bay, Cuba.
9	XMT NJRS	USS Saratoga (NJRS) is exempted from the collective address, in this case the action addressee.
10	GR156	Group count.
11	BT	Break.
12	Text	Text.
13	BT	Break.
14	AR	End of transmission; no receipt required.

Plain Language Text

A standard textual format is prescribed for plain language messages. The format (fig. 2-2) is designed to make maximum use of the capabilities of teletypewriter equipment. In addition, it decreases the originator's preparation time and the addressee's comprehension time.

Exempt from the standard format are messages with very short texts, such as tactical messages, and messages employing an otherwise firmly established format. An example of the latter is a standard "reporting type" message that uses letters of the alphabet to indicate a prearranged subject matter. When a message does not require all of the elements shown in figure 2-2, the format is adjusted accordingly by omitting the nonessential elements.

Supervisory Wires, Procedure Messages and Service Messages

Supervisory wires, procedure messages, and service messages are used by communication personnel to expedite the flow of message traffic. These types of messages make maximum use of prosigns and operating signals to shorten message length and transmission time.

Supervisory wires correct traffic-handling errors. They invariably are addressed to the supervisor (SUPVR) of the called station.

Procedure messages are used to obtain or provide corrections, verifications, and/or repetitions. The text of a procedure message contains only prosigns, operating signals, address designations, identification of messages or parts of messages, and any necessary amplifying data.

Service messages pertain to all phases of traffic handling. The majority of both procedure and service messages are used to obtain corrections and repetitions of messages or parts of messages. Service messages, however, are prepared and transmitted as regular messages, and contain all the necessary format lines, including a DTG.

1. FORMAT FOR MESSAGE TEXT

Classification (5 spaces) Special Handling (if required)	CONFIDENTIAL NOFORN
Passing Instructions (if required)	COMTWELVE PASS TO FADM SMITH
Subject, concise and untitled	REVISED CONFERENCE SCHEDULE (U)#
Reference, identified by letter	A. MY 091700Z
Reference, (continued as necessary)	B. COMTHIRTEEN 131530Z
Text	1. REQUEST DESIGNATED COMMITTEE ARRIVE COMTWELVE 24 HOURS PRIOR CNO.
a. Paragraphs are numbered.	2. AGENDA:
b. Subparagraphs are indented and lettered or numbered as appropriate.	A. ADD "LOGISTICS OF PROJECT."
c. In a one-paragraph message, the subparagraphs are lettered.	B. DELETE "POSSIBLE LOCATION FACILITIES."
	3. CNO ITINERARY, 19 AUG, TIMES UNIFORM:

ETA	ETD	LOCATION
0900	1300	SEATTLE
1515	1800	SFRAN
2300		WASHDC

2. EXCEPTIONS

a. The subject line may be omitted if its use will: (1) require an otherwise unclassified message to be classified, (2) noticeably increase the length of an otherwise brief message, or (3) increase commercial charges when the message is addressed to activities served by commercial communication facilities.

b. In a short message requiring only one paragraph, the paragraph need not be numbered and where there is only one reference the reference identification may be included in the body of the paragraph. For example:

UNCLAS
YOUR 190915Z. BUDGET APPROVED SUBJECT CNO CONCURRENCE

3. CHARACTERS AND SPACES. The number of characters and spaces on each teletypewriter line shall be limited to 65, except semi-automatic off-line decrypted messages which are subsequently relayed on-line may use a maximum line length of 69 characters and spaces.

4. TABULATED ENTRIES. A substantial reduction in message preparation and transmission time can be attained by the judicious arrangement of columnar material. In the sample message text above, note the arrangement of the first column at the left margin and succeeding columns spaced to the right of the first. The last column should be for entries of varying lengths, such as place and proper names.

5. PUNCTUATION. Punctuation shall be used when essential for clarity. The use of the letter "X" is discontinued. The punctuation marks used in the drafting of naval messages normally shall be limited to those symbols listed below which have Morse equivalents and appear on the standard typewriter and teletypewriter keyboards:

NAME	SYMBOL	ABBREVIATION	MORSE
Apostrophe	* '		.----.
Colon	:	CLN	---...
Comma	,	CMM	--..--
Hyphen	-		-....-
Parenthesis	( )	PAREN	-.--.-
Period	.	PD	.-.-.-
Question Mark	?	QUES	..--..
Quotation Marks	* " "	QUOTE/UNQUOTE	.-..-.
Slant sign/Virgule	/	SLANT	-..-.

The following symbols, which appear on the standard typewriter and teletypewriter keyboards may be used although they have no Morse equivalents:

Ampersand	* &
Dollar Sign	* $

*These symbols are not agreed for Allied use.

#CLASSIFIED MESSAGES INCLUDE A 1-LETTER ABBREVIATION OF SUBJECT CLASSIFICATION.

Figure 2-2.—Textual format for plain language messages. 105.1

MESSAGE FORMS

A military message may be drawn up in any one of three forms: plaindress, abbreviated plaindress, or codress.

PLAINDRESS

A plaindress message is one in which the originator and addressee designations are indicated externally of the text, i.e., they appear in the heading.

Unless the call serves as the address, the message contains all the components (but not necessarily all the elements) shown in the basic message format, except that the prefix may be omitted. A plaindress message must include the precedence and DTG elements. All the examples of radiotelegraph messages given thus far in the chapter are in plaindress form.

ABBREVIATED PLAINDRESS

An abbreviated plaindress form may be used when operational requirements, such as an enemy contact report, demand maximum handling speed. The abbreviated form may omit the precedence, date, DTG, and/or the group count.

CODRESS

Codress is a security device that conceals the identity of units, and prevents an enemy from making inferences from originator-addressee patterns. It is an encrypted message form in which originator and addee designations (and additional passing instructions, if any) are buried in the encrypted text.

Plaindress and codress encrypted message forms may best be compared from a message prepared in both versions.

Commander Task Group (CTG) 66.1, conducting an exercise in the Mediterranean, wishes to order a new phase of operations. USS Taussig, attached to the group, is on detached duty and not participating. Assume the call signs and address groups to be:

CTG 66.1	E214
TG 66.1	K3M3
Taussig	NFFN

For the plaindress version, the call signs are encrypted in accordance with current instructions:

K3M3 - XMT - NFFN DE E214 - P - 18Ø934Z - FM E214 - TO K3M3 - XMT NFFN GR35 $\overline{BT}$ (text) $\overline{BT}$ K

Using codress, the originator and addressees are given indefinite ships' call signs, as follows:

NERK DE NA - P - 18Ø934Z GR57 $\overline{BT}$ (text) $\overline{BT}$ $\overline{AR}$

The only information an enemy might gain from the codress form is that it was sent from one Navy ship to another, is of Priority precedence, and originated at 18Ø934Z. Moreover, this is the only information available to bona fide recipients, who must decrypt the message to learn for whom it is intended. (Taussig needs to break the message only far enough to learn she is exempt.)

The texts of codress messages are somewhat longer than their plaindress counterparts, because the originator and addees are included in the text; they are designated by plain language, although encrypted, and not by call signs or address groups.

105.1

CHAPTER 3

COMMUNICATIONS AFLOAT

Command in naval operations is exercised through communications, and naval communications are organized to parallel command relationships. Within a command, the communicator serves as the instrument of command.

FORCE ORGANIZATION

The two branches of command within the naval task force organization are an administrative command and a tactical command. Each ship of the U. S. Navy always belongs to some administrative command, but each is not at all times part of a tactical command.

ADMINISTRATIVE COMMAND

An administrative command usually is a ship type command, as shown in figure 3-1. Commander Cruiser-Destroyer Force, U. S. Atlantic Fleet (COMCRUDESLANT) and Commander Amphibious Force, U. S. Atlantic Fleet (COMPHIBLANT), for example, are administrative commands composed of ship types. CRUDESLANT forces consist of cruiser and destroyer types of the Atlantic Fleet; PHIBLANT forces comprise the various amphibious types of the Atlantic Fleet. The type commander is responsible for the manning, equipment, organization, and readiness of the ships under his command.

In the illustration, USS Keith is one of eight destroyers attached to Destroyer Squadron (DESRON) 22. The squadron is divided into two divisions, each composed of four ships. The squadron flagship is USS DuPont. The DuPont also is flagship for the first division of the squadron, Destroyer Division (DESDIV) 221. The second division of the squadron, DESDIV 222, has a commander who is junior to the squadron commander. The flagship for the division commander (COMDESDIV 222) is USS McGowan.

The squadron is under the administrative command of Commander Cruiser-Destroyer Flotilla (COMCRUDESFLOT) 4. He, in turn, is under the administrative command of COMCRUDESLANT. To complete the chain of command, COMCRUDESLANT is responsible to the Commander in Chief, U. S. Atlantic Fleet.

Administrative correspondence forwarded by individual commands is sent via the complete administrative chain of command. Destroyers in DESDIV 221 send controlled exercise reports to COMCRUDESLANT via COMDESRON 22 (who is also COMDESDIV 221) and COMCRUDESFLOT 4. Destroyer COs in DESDIV 222 send their reports to COMCRUDESLANT via COMDESDIV 222, COMDESRON 22, and COMCRUDESFLOT 4. Thus, if the commanding officer of The Sullivans submits a recommendation for a change to a communication publication, he forwards his recommendation with his reasons to the Chief of Naval Operations via COMDESDIV 222, COMDESRON 22, COMCRUDESFLOT 4, COMCRUDESLANT, and CINCLANTFLT.

TACTICAL COMMAND

A tactical command is an organization formed from one or from several ship types, and therefore from different administrative commands, to perform specific tasks. Although the ships of a tactical organization remain under the administrative control of their respective type commanders, they also are part of an operational (tactical) organization, and subject to a tactical chain of command as well. A destroyer operating in the western Pacific as a unit of the Seventh Fleet, for example, is under the administrative control of COMCRUDESPAC and under the tactical command of COMSEVENTHFLT.

Figure 3-2 shows the tactical organization of Task Force 62 of the Sixth Fleet. The task forces of a fleet are numbered in succession as TF 60, TF 61, TF 62, and so on. Divisions within a fleet retain the fleet number (6) throughout the breakdown. A subdivision of a force is a group; a subdivision of a group is a unit; and a subdivision of the unit is an element.

The tactical chain of command within our hypothetical force is headed by Commander

Task Force 62, who is responsible to Commander Sixth Fleet. Because of the scope of tasks to be accomplished, the task force is divided into task groups and units.

In our example, activation of Task Force 62 makes it necessary for COMCRUDESLANT to assign destroyers to fill the needs of the force. As a result, DESDIV 221 is assigned antisubmarine duties as a component of Task Group 62.2. The CTG 62.2 is Commander Carrier Division (COMCARDIV) 14, embarked in USS Wasp. Both DESDIV 221 and DESDIV 342 form Task Unit 62.2.2, a screen unit organized to screen the carrier, act as plane guard, and conduct offensive antisubmarine warfare.

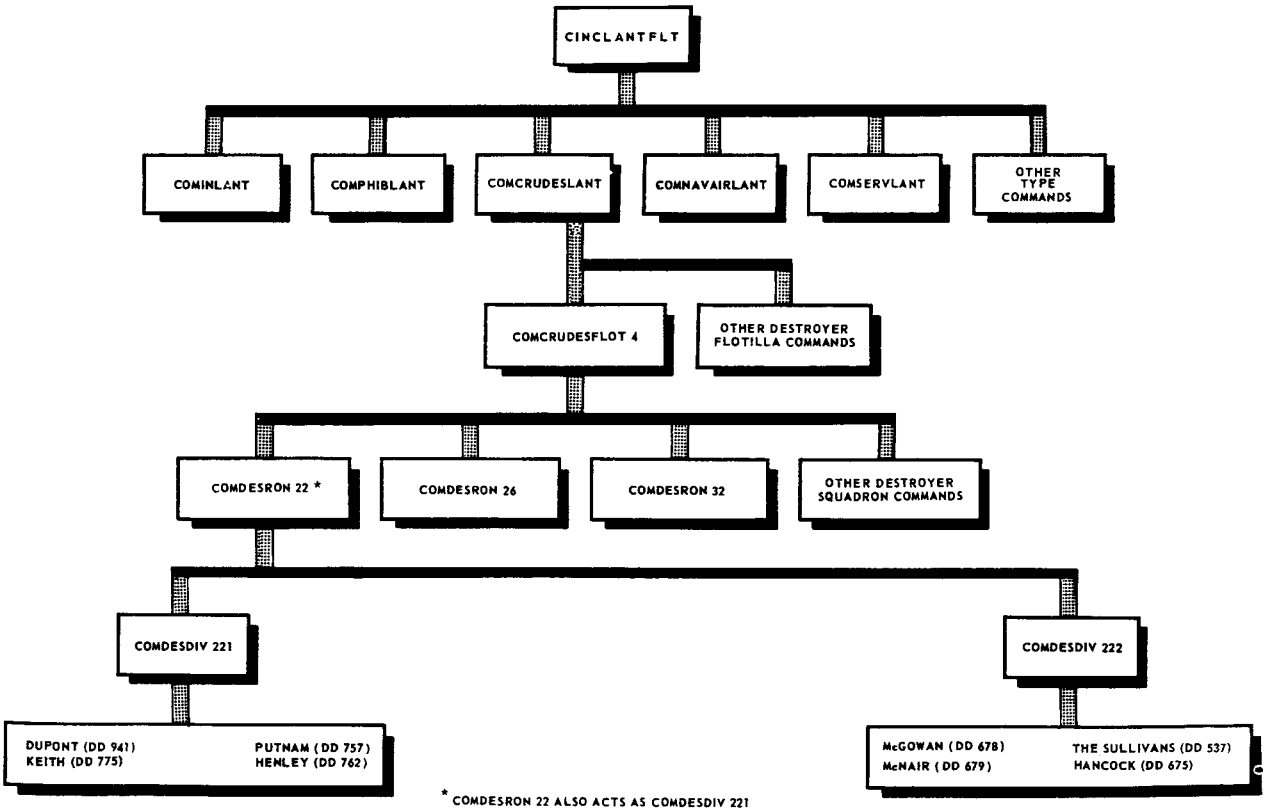
Further division of the fleet is possible through the formation of task elements, which normally are comprised of one or two ships. Ault and Weeks, for example, may temporarily form Task Element 62.2.2.1 to function as a van antisubmarine warfare (ASW) patrol. Subdivision into task elements is limited to the minimum required by essential operational tasks.

FLEET OPERATIONS AND COMMUNICATIONS

The highly complex character of naval operations today and the urgency for accomplishing the required action have resulted in exigent demands for reliable communications. As a result of the speed with which situations develop, there also is a lessening of the former distinction between strategy and tactics.

One important purpose of a fleet exercise is to train personnel to produce the quality of communications demanded by the complexity of modern naval warfare. The efficiency, communications-wise, at which the individual ship operates is a major determining factor in the overall operational performance of the ship. The sum of these individual performances makes or breaks the fleet operation.

A necessary step in achieving efficient communications is officer interest and supervision. Communication officers must give particular attention to the details of communication plans, practices, procedures, and the capabilities and



95.8

Figure 3-1.—Administrative chain of command.

limitations of the communication facilities of the ship concerned.

Net Operations

The communication demands of fleet operations or exercises entail the use of many circuits. A brief description of the categories and types of circuits aids the reader to understand basic requirements considered in establishing the communication annex of an operation order.

Communication traffic breaks down into three broad categories: (1) exercise, (2) administrative, and (3) operational. The first is self-explanatory.

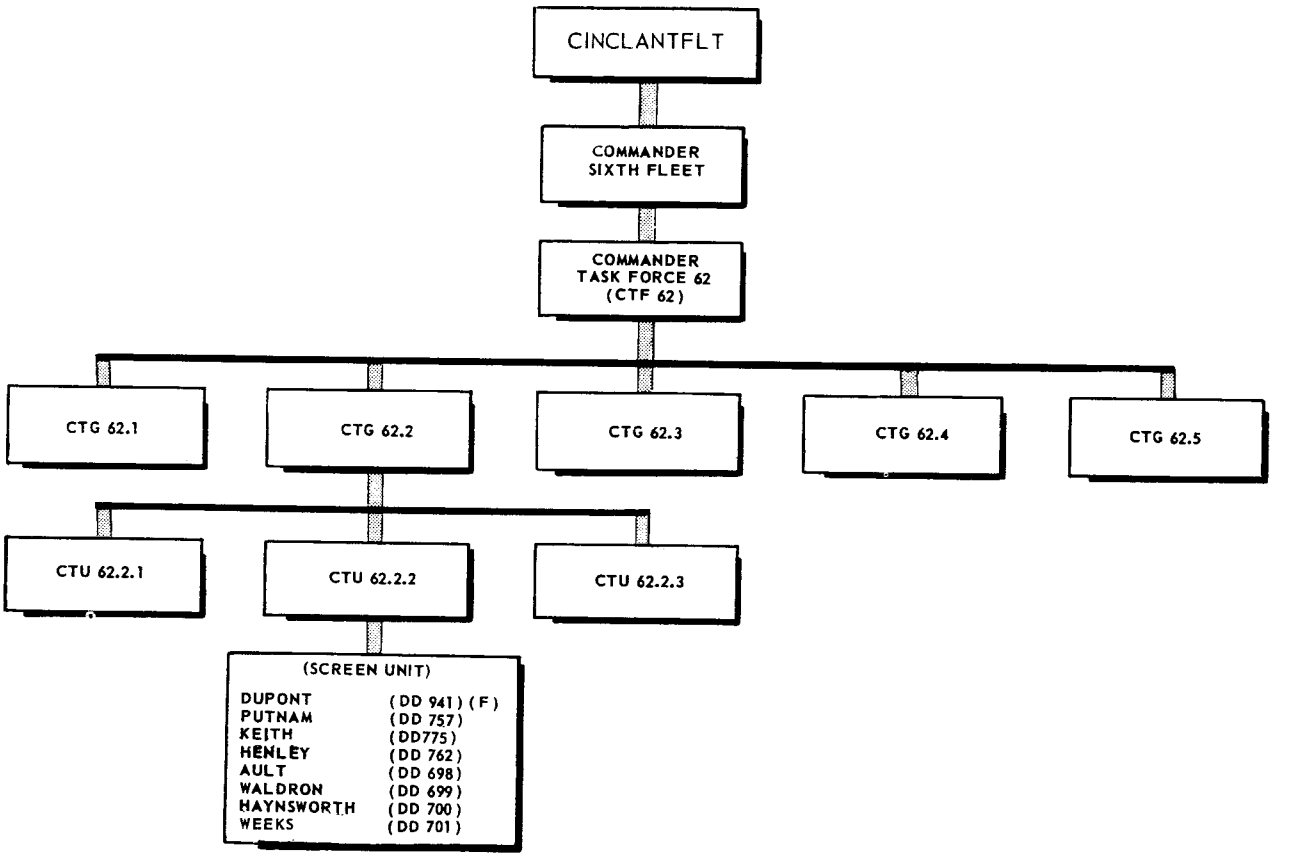
Administrative traffic includes such routine matters as personnel distribution, normal logistics, recurring administrative reports, and similar subjects.

Examples of operational traffic are tactical communications, combat intelligence, strategic or vital weather reports, combat logistics, and so forth. Operational traffic utilizes numerous circuits that are classified by type and use as (1) command, (2) common, and (3) functional.

A command net is one linking any commander with his immediate subordinates in the chain of command, and such other units as may be designated. A task force command net, for example, is used by the task force commander to promulgate tactical signals and other appropriate communications to his task group commanders. The latter, in turn, disseminate significant information received over the TF command net to ships and commands within the groups.

A common net links all ships or troop units of a designated task organization. A task group common net, activated by the TG commander, is guarded by all ships or troop units within the group.

A functional net connects directly the personnel who are delegated control of a specified function for which the net is provided. Functional nets include combat information (CI) nets



95.9

Figure 3-2. —Tactical chain of command.

for passing combat information between all units and commands in the formation, maneuvering and warning (M&W) nets for maneuvering signals and flash warnings for all units and commands in the formation, and ship-to-air nets for communications between ships and aircraft of the task force.

A net control station (NCS) is designated by appropriate authority to direct and control the operation and flow of all traffic on the net. The NCS, normally the station serving the senior command, has these specific responsibilities:

1. Expedite traffic on the net.
2. Maintain circuit discipline.
3. Limit transmissions to the essential minimum.
4. Resolve disputes incident to traffic handling.
5. Monitor traffic to determine procedural discrepancies and initiate corrective action.

A net may be either a free net or a directed net. When operational factors permit the former, the NCS authorizes member stations to transmit traffic to other net stations without first obtaining permission from the NCS. The control station, however, remains responsible for maintaining circuit discipline. Directed nets normally are necessary when complicated traffic patterns or security measures exist, warranting direct control of each transmission by the NCS. When operating on a directed net, net stations obtain permission from net control before any transmission. Transmissions on a directed net may be accomplished in accordance with predetermined schedules.

Stations are required to report to the net control station before leaving the net or securing the net for a period of time, giving the approximate time of reentering the net.

Communication Frequency Plans

The assignment of radiofrequencies is a function of command. Control over radiofrequency assignments is vested where possible in theater commanders in active theaters of operation and in the appropriate national departments or ministries in other areas. For technical reasons, the greatest practicable degree of coordination is necessary in making frequency assignments, and the responsibility for ensuring such coordination rests upon the authorities stated above. The radiofrequency spectrum available for military use is limited. Maximum economy in frequency usage is therefore essential and must be exercised constantly by assignment authorities. Coordination of frequency usage to prevent harmful interference is essential. This coordination, by international agreement, is a responsibility of the constitutional authority of the government concerned. In active theaters of operations, however, when this authority rests with the theater commander or in other areas where the national authorities consider it expedient, coordination of military assignments normally is undertaken by frequency coordination committees. Committees have been established in areas throughout the world to effect speedy and satisfactory coordination of frequency assignments and clearance of interference. For those assignments proposed for use within one theater or area that are considered to be capable of harmful interference to assignments made in another theater or area, the frequency coordination committee concerned coordinates frequency usage with the committees of the other affected theater(s) or area(s).

ASSIGNMENT OF FREQUENCIES.—Task organization basic communication frequency plans are contained in JANAP 195. These frequency plans, for use when a U. S. Navy task force (or portion thereof) is formed, are based on the following principles:

1. Communications follow the established chain of command.
2. The number of functional nets must be held to a minimum.
3. Adequate and economical utilization must be made of the communication facilities available.

Frequency plans provide a basic task organization communication plan that affords all the communication channels required to perform the tasks assigned a tactical organization. JANAP 195 supplements NWP 16, which contains the basic fleet operational communication doctrine. Basic communication instructions are contained in DNC 5. It is suitable for use in war operations and training.

The frequency plan is devised for use by divided or undivided task organizations. A divided task force, group, or unit is one that is separated organizationally into task groups, units, or elements, and may or may not be concentrated geographically. An undivided task force (group) (unit) is one that is not separated organizationally, and normally is concentrated geographically.

The plan is based on the assumption that the task force will be the largest individual tactical organization. In a divided task force, group, or unit that is concentrated geographically, the senior commander prescribes only those organizational circuits that are essential while so concentrated. In a task group that is divided into three task units operating in company, for instance, the task group commander would prescribe those frequencies assigned on the group level. Frequencies assigned for unit and element components of the group normally would not be used while in company.

Included in JANAP 195 are both a frequency list and a list of circuits. The frequency list is a record of radiofrequencies designated by the Chief of Naval Operations for Navy use, and either indicates the circuit or notes where the particular frequency may be found. The list of circuits provides for each a designating symbol and descriptive title, a list of assigned frequencies (where available), and special instructions governing the use of these frequencies.

Two frequencies normally are assigned for each net; one is designated the primary frequency, the other is the alternate. The primary frequency, in the UHF band, is used when line-of-sight communications are practicable. The alternate frequency, in the HF or MF band, is utilized when additional range is required. Selection of the frequency to be used depends entirely upon the range required for effective communications. Normally, concurrent use of one in conjunction with the other is not permitted. Additional frequencies for backup purposes are not assigned, one reason being the resultant economy of frequency utilization. When interference conditions prevent the satisfactory use of primary frequencies, commanders are authorized to use the frequencies of similar though differently numbered tactical subdivisions not operating in the vicinity.

The frequencies required for an operation usually are contained in the communication annex to the operation plan/order. From that annex, the communication officer must organize, write, and distribute the command communication plan. He also checks the feasibility of the plan to ensure ability to meet requirements. Frequently, the operations in which a ship is participating are not governed by a specific communication plan. When this is the case, appropriate frequencies, based on area frequency designators allocated by the fleet or type commander, may be obtained from JANAP 195.

SHIPBOARD ORGANIZATION

The type commander promulgates a standard organization book that each commanding officer modifies only to the extent necessary to meet the needs of his ship. He then publishes for all hands a ship's organization and regulations manual that, among other things, spells out the functional relationships between the billets on his ship—who is responsible for what, who reports to whom, and so on.

Organizational billet assignments must of necessity vary between ships because of equipment limitations, ship size, ship function or mission, and the like. The assignments may vary within ships of the same type, perhaps because of personnel availability or lack of similar equipment. It follows that billet assignments must be flexible if they are to conform to changing requirements.

Figure 3-3 shows the basic administrative shipboard organization. Several departments, notably the operations department, have many specific responsibilities. In a large ship, such as a carrier, it is necessary for most—if not all—department heads to prepare department organization manuals based on the ship's manual; it is not unusual for division officers to prepare supporting division organization books for their division personnel.

Figure 3-4 supplements figure 3-3 by presenting the organizational arrangement of a shipboard communication division. A graphic breakdown of this type is desirable when a large number of functions are performed by many persons. Each man, down to the striker, can tell at a glance to whom he is immediately responsible. In large ships the communication organization is composed of two divisions—R and S—headed by the radio and signal officer, respectively.

Figure 3-5 is suitable as a destroyer-type organization chart, no breakdown being necessary. As compared to the billets in figure 3-4, for example, the DD communication officer may concurrently be the censor, custodian of registered publications, radio officer, and signal officer. Seldom are there more than three radiomen on watch at any one time to perform the functions shown in figure 3-4, and all the men are responsible directly to the senior enlisted radioman on board, who acts as radio officer. A chief signalman usually acts as signal officer.

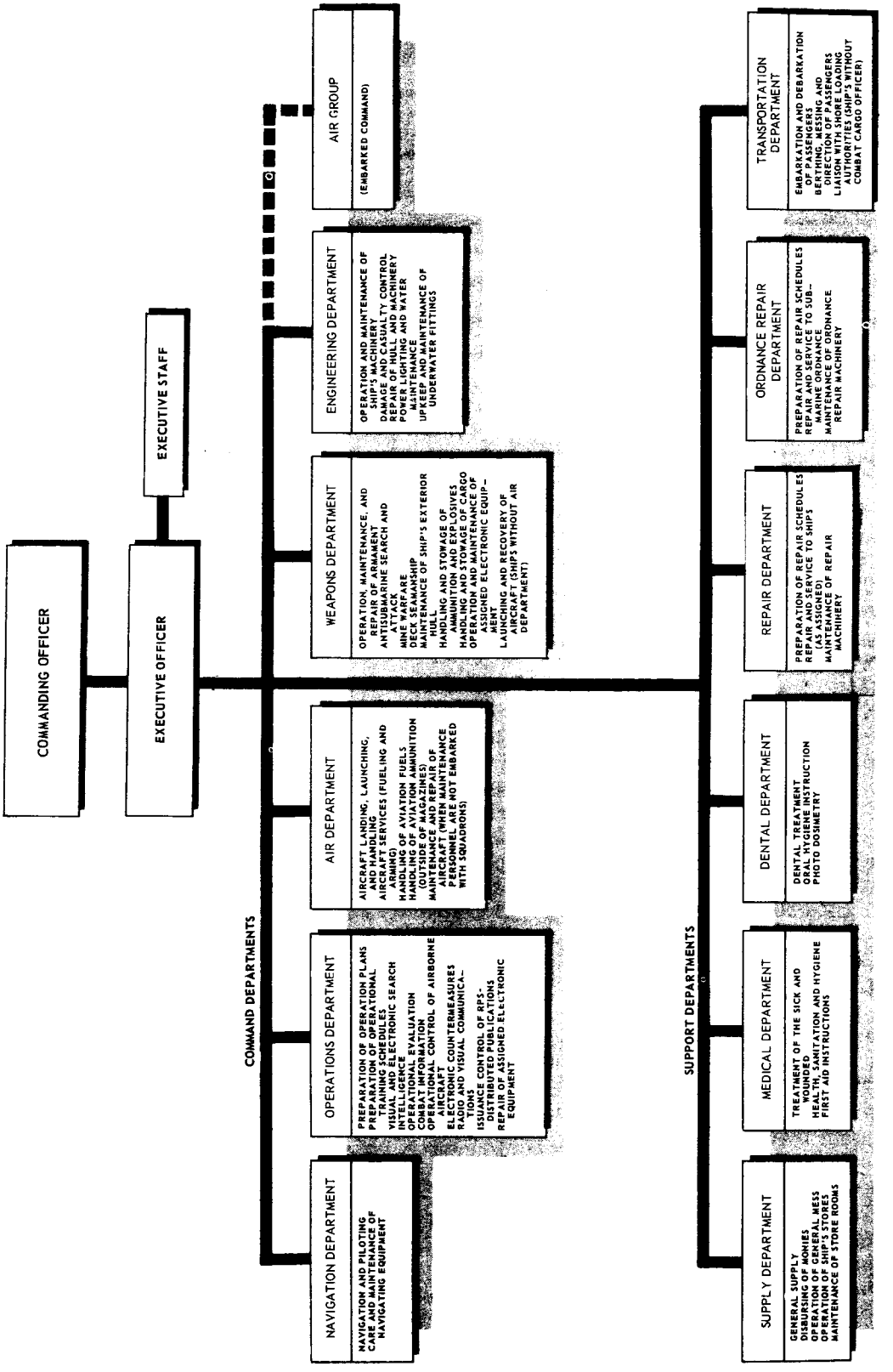


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Figure 3-3.—Standard shipboard organization. On aircraft carriers, the operations department is divided into an operations and a communications department.

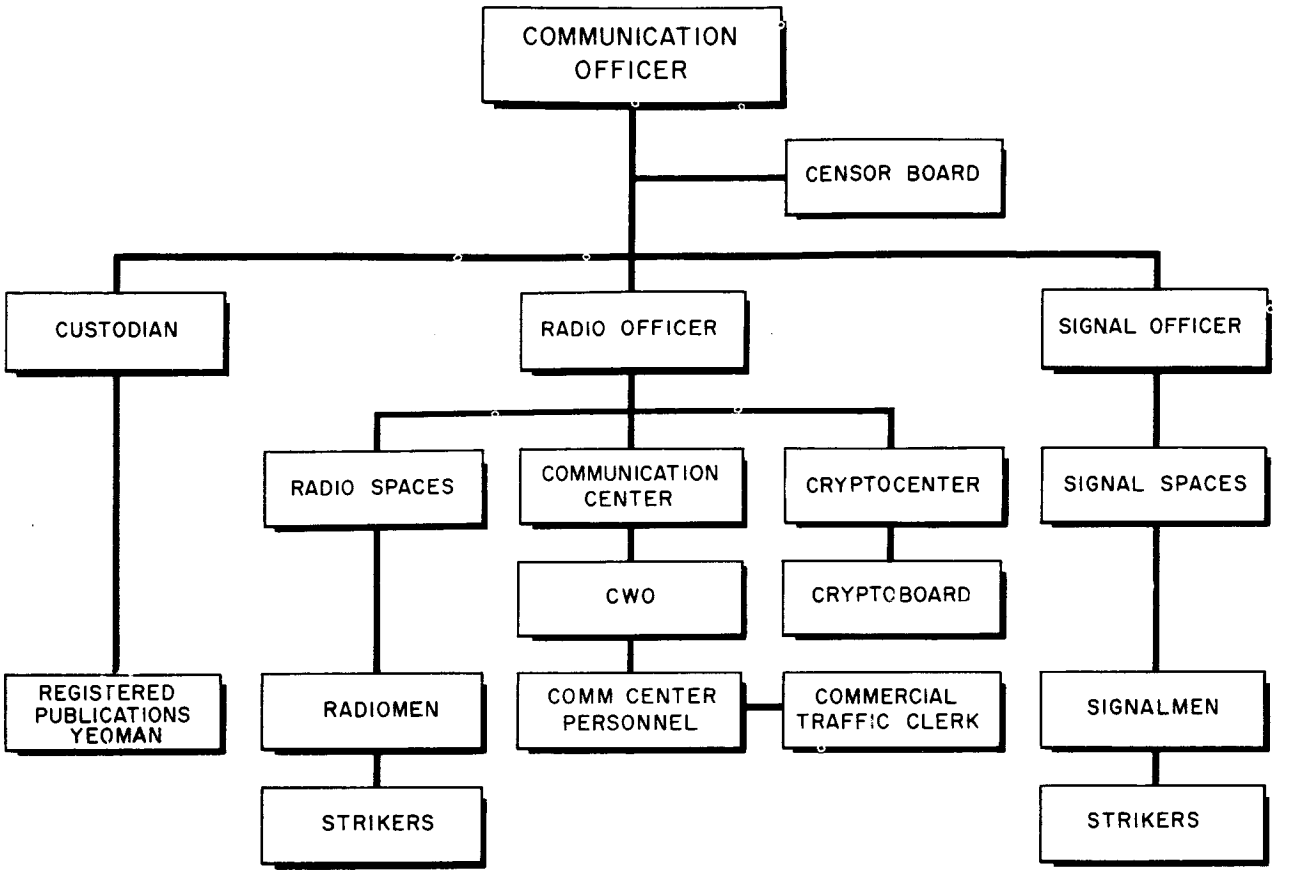


Figure 3-4. —Large shipboard communication organization.

In smaller commands, charts of only the department organizations may suffice to illustrate the details of all executive and supervisory positions.

OFFICER BILLETS

Under the conditions described in the preceding section, it is obvious that most of the following officer billets, although separated by function, apply on board a small ship to one man—the communication officer.

Communication Officer

The ship's communication officer, under the operations officer, is responsible for the organization, supervision, ahd coordination of the ship's exterior communications; the operation, care, and maintenance of all communication equipment not otherwise assigned; and the procurement, custody, distribution, physical security, correction, and reporting of all classified registered publications and devices issued to the ship and of all other classified material assigned to him.

The communication officer is responsible for the routing, filing, and physical security of all messages handled by the ship, ensuring that messages are delivered promptly to the proper persons. He maintains message files and records, disposing of obsolete files in accordance with disposal instructions. He is in charge of all personnel assigned to radio and visual communications. He furnishes the effective recognition and identification signals to cognizant personnel of the watch.

With respect to duties involving equipment, the communication officer is responsible for the cleanliness and preventive maintenance of all electronic, cryptographic, and visual signaling

equipment and for the compartments and deck spaces occupied by such equipment.

Radio and Signal Officers

The radio and signal officers are assistant communication officers in charge of radio and visual signals. Each is charged with the operation and maintenance of assigned equipment. Their duties are to ensure reliable, secure, and rapid handling of radio and visual communications. In addition, the radio officer must know the effective communication plan, understand propagation characteristics, and be familiar with the condition, capabilities, and limitations of the ship's radio equipment, including antennas.

RPS Custodian

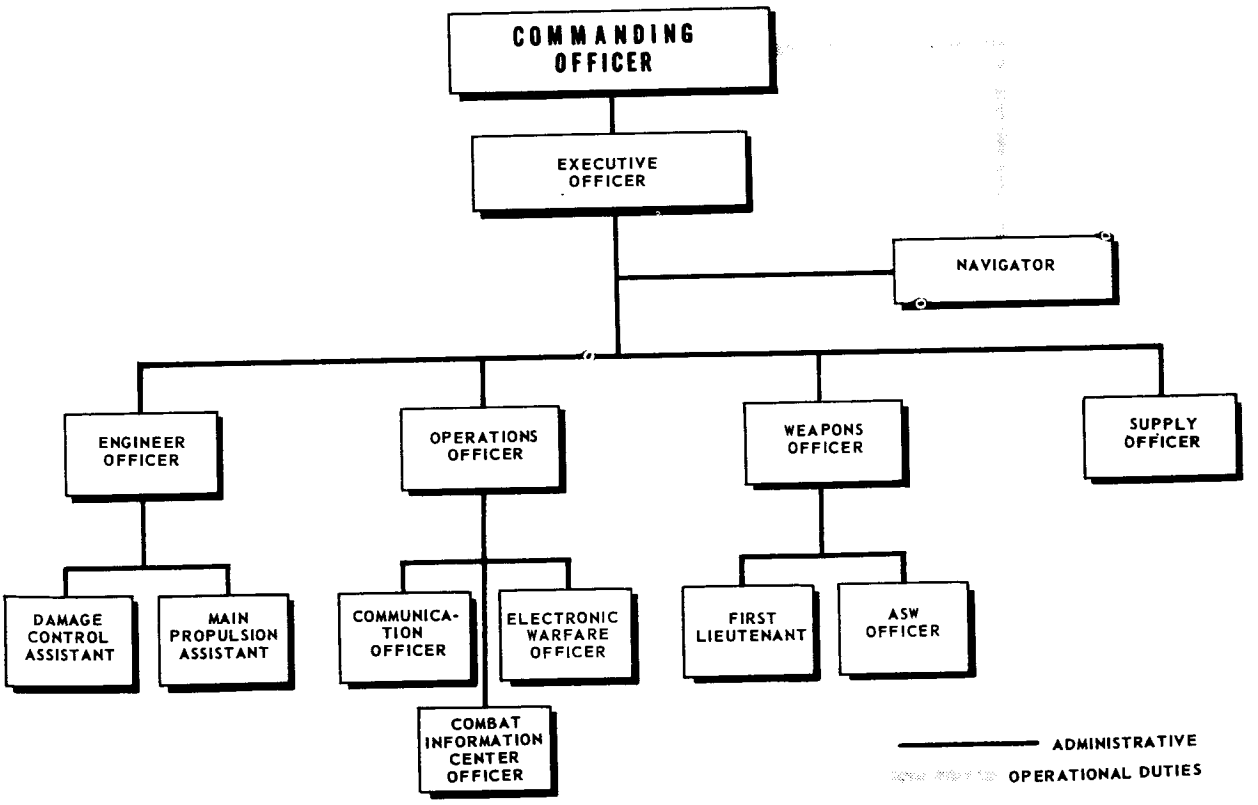
The Registered Publications System (RPS) is a publication distribution system that provides for strict accountability of certain publications by assigned register numbers. Special safeguards against loss or compromise include a system of continuous accountability, periodic inventories, and detailed handling procedures.

The RPS custodian is responsible to the commanding officer for keeping a complete, up-to-date, and correct allowance of registered publications issued to the ship. Under the direct supervision of the communication officer, the tasks of the custodian extend to the drawing, stowage, correction, destruction, submission of reports, and issuance of all registered publications.

Communication Watch Officer (CWO)

In large ships, junior officers may be assigned specifically to the operations department (on carriers, to the communications department) for watch standing duty or training in communications. In smaller ships, CWO duties are performed by the communication officer and his assistants.

While on watch, the CWO is in active and immediate charge of the ship's communications.



36.2

Figure 3-5.—Organization chart for a destroyer.

He is responsible for incoming and outgoing traffic as provided for in the ship's communication organization, ensuring that all messages sent and received are in correct form and are handled promptly and efficiently. During the period of his watch, he is responsible for the proper operation of the cryptocenter.

Cryptoboard Member

Cryptographers—collectively called the cryptoboard—are designated by the commanding officer to assist the CWO in the encryption and decryption of messages when the traffic load warrants. Cryptoboard members may be commissioned officers, warrant officers, and trustworthy and reliable enlisted personnel.

Each commanding officer appoints an assistant communication officer for cryptosecurity who serves as advisor to the CO in all matters relating to cryptosecurity and the physical security of cryptomaterials. The officer so appointed is responsible to the communication officer for the accurate, secure, and efficient operation of the cryptocenter.

ENLISTED BILLETS

The specific duties of enlisted personnel assigned to communication duties (radio operators and signalmen) vary according to the size, location, and mission of the ship. The principal duties of the radiomen are the operation of radiotelegraph, radiotelephone, teletypewriter, and facsimile equipment. Signalmen are concerned primarily with communications utilizing flashing light, semaphore, flaghoist, and other visual means.

The leading petty officers assigned to radio and signal duties are in direct charge of other enlisted personnel so assigned. They prepare all watch lists, organize and conduct adequate training programs, and make frequent checks of traffic files and logs. They are responsible for the cleanliness and preventive maintenance of all equipment assigned.

During the periods of their watches, the supervisors in radio central and on the signal bridge supervise the operations of all other men on watch. The radio supervisor monitors frequencies in use, inspects traffic and logs to detect errors by his operators, makes prescribed frequency checks, and takes immediate action in the event of equipment failure (e.g., notifies the bridge if necessary, and details men to make repairs). The signal bridge supervisor keeps his watch informed of the force's tactical disposition, ensures that watch standers know the effective recognition and identification signals, and maintains all visual equipment in readiness for use.

COMMUNICATION SPACES

The number, size, and arrangement of the communication spaces of a ship depend upon her size and mission. Many large ships, particularly large combatants, have spaces located forward, aft, and amidships. This arrangement has the dual advantage of (1) scattered antennas, which helps to reduce interference, and (2) minimum danger of loss of communications if part of the ship is damaged—each space can carry out at least partial communications. The most important spaces (radio central, message center, and cryptocenter) are located amidships.

Radio Central

Radio central, also called main radio or radio I, is the largest and most completely equipped radio space in the ship. It contains operating positions ofr radiotelegraph, radiotelephone, radioteletypewriter, and fascimile. Normally, it is the location where transmitters, receivers, and remote speakers and keying positions are selected and tied together to provide communication channels for the remote operating stations elsewhere in the ship. Radio central, located in close proximity to the message center and cryptocenter, is the duty station of the watch supervisor and of most radio operating personnel.

Message Center

The shipboard message center is the duty station of the communication watch officer. It is here that outgoing traffic is prepared for transmission, and incoming messages are readied for local delivery. All messages, except tactical signals received and sent direct from shipboard control stations, must clear the message center before internal routing or external transmission. In ships without a message center, the functions of the center are carried out in radio central.

Cryptocenter

The cryptocenter is the exclusive working area of the cryptoboard. Access to the cryptocenter is strictly controlled. There is a single entrance, and an authorized entry list is posted nearby.

Other Radio Spaces

According to the size of the ship, there may be one or more additional spaces containing special equipment, additional equipment, or duplicate facilities. Depending upon their arrangement and intended use, they may be designated as transmitter room, emergency radio room, auxiliary radio, or other appropriate titles.

Most of the ship's transmitters are located in the forward radio space, called the transmitter room or radio II. Watch standers in radio II keep transmitters tuned to prescribed frequencies and connected (patched) to keys, microphones, teletypewriters in radio central, and to remote operating positions in CIC, on the bridge, and in other parts of the ship. Receiving equipment includes one or two emergency receivers and the ship's entertainment receivers.

Radio III, an emergency radio room aft in large combatants, has been converted (on most ships) into an active transmitter room because of frequency demand. Where not so converted, radio III is manned only during general quarters.

Remote Control Facilities

Remote control stations, consisting of receiving outlets and transmitter keying positions, are located on the bridge, in CIC, and other battle control spaces where a need exists for direct radio communication. Receivers in radio central and transmitters in radio II and radio III can be connected to remote control positions as required. Positions on the bridge and in CIC often are paralleled. For example, a tactical maneuvering net can be controlled from either the bridge or CIC by means of remote control units in these two spaces. The remote control units are connected through radio central to the same transmitter and receiver.

Visual Signal Spaces

Equipment and spaces for visual communications are provided in the superstructure of the ship. Signal halyards for flaghoist signaling lead from the yardarm to flag bags abaft the bridge. Signal searchlights and semaphore platforms are positioned where each has the largest arc of vision, and so that the total visual coverage is 360 . Remote control keys for operating yardarm blinkers are placed in protected positions.

COMMUNICATION FILES

Every message handled by a ship (or station) is placed in one or more files to be retained for periods of time, and then to be disposed of as directed by DNC 5. Several files of an optional nature are permissible to fill the needs of particular activities. Those discussed in this section may be mandatory for many commands.

Communication Center File

The communication center file contains a copy of every unclassified message, regardless of means of transmission, addressed to or originated by the command, and an off-line (manually) encrypted copy of each classified message as received or transmitted. When an encrypted copy is unavailable or is nonexistent (for example, unencrypted classified messages transmitted by registered mail), a filler or dummy referring to the cryptocenter file is inserted in place of the message. Messages are filed chronologically by date-time group.

The file should be subdivided into incoming and outgoing sections. Encrypted copies of classified messages in the communication center file contain operator's services and communication watch officers' initials. Plain language outgoing messages contain the foregoing notations plus signatures of drafting and releasing officers.

Cryptocenter File

The cryptocenter file contains the edited plain language version of each classified message addressed to or originated by the command, filed chronologically by DTG. In effect, the cryptocenter file is the classified portion of the communication center file.

The cryptocenter file may be physically subdivided to comply with stowage requirements for classified matter. Top Secret messages always are afforded separate stowage.

Station Files

The radio station file is a chronological record of all radio traffic handled by the command. It consists of a copy of each nontactical message received, transmitted, or relayed by the radio facilities of the command.

The visual station file is a chronological record of all nontactical traffic handled by the command by visual means.

General Message File

The general message file is a chronological record of all general messages addressed to the command. The file normally is subdivided by type of general message, and each type is filed in serial number order. These files are given the classification of the highest classified message in the files. For convenience of access and stowage, the files may be segregated by security classification with appropriate cross references.

Broadcast File

A ship copying broadcast maintains complete broadcast files for a short period of time (1 or 2 months, depending on ship size). Messages in a broadcast addressed to the ship are written up on message books for local delivery, as are other messages. Copies are placed in the communication center and radio station files. Broadcast copies are filed in serial number by month (the serial numbers start with 1 the first day of each month).

Communication Logs

Communication personnel maintain four types of logs: radiotelephone, radioteletypewriter, and visual.

It is never permissible to erase a log entry. A change or correction is made by drawing a single line or by typing slant signs through the original entry, indicating the changed version adjacent to the original entry. Any operator who changes an entry must initial the change.

File Consolidation

New requirements and concepts often result in deviations from accepted standards. The advent of the on-line broadcast (discussed in chapter 7), for example, warrants experimental changes in filing procedures. DNC 5 states that the communication center file and the radio/visual files may be combined as necessary. In the interest of further improving the internal handling of messages, the Director, Naval Communications recommends, by means of an OpNav instruction in the 2110 series, that all commands consider the feasibility of maintaining a single communication center file. This file would contain all messages, except Top Secret, originated by or addressed to the command. To expedite recovery time, the only file division considered necessary is the separation of incoming and outgoing traffic. This procedure results in several tangible benefits. It eliminates at least the cryptocenter and station files. It does away with numerous cross-reference dummies or fillers. In many commands, the need for rewrite would become nonexistent.

The DNC further recommends that the file copy of a message be placed in the communication center file as soon as possible after receipt of the message, and that no file copy be permitted to leave the communication center. These measures make the message quickly available for reference and reduce the possibility of loss.

MESSAGE PROCESSING

Regardless of classification, the contents of messages routed internally are not divulged to any persons except those who need the information. This applies also to personal Class E messages. Official messages for delivery should be placed on covered boards. Messengers must not allow messages they are distributing to be seen by persons other than those authorized. All copies of messages except those required for files are destroyed when they no longer are needed.

Incoming Messages

All CW, RATT, and FAX messages, and nontactical visual and radiotelephone messages addressed to the ship are processed through the

message center. Typically, an incoming message is processed through these steps:

1. The radio operator copies the message on a message form or takes it off the RATT. He passes it to the supervisor, who resolves any discrepancies and, in turn, passes the message to the message center.

2. In the message center, the CWO or one of his assistants translates the call signs and address groups in the heading, records the identifying information (e.g., TOR, precedence) in the appropriate incoming message log, and indicates the internal distribution. Except for the security classification and the internal distribution, messages as received normally contain all of the information needed by the ultimate recipients. Items such as the TOR, precedence (spelled out), and briefs of references all require manual entry and need not be shown on the message unless absolutely necessary.

When no procedures exist that eliminate the need for rewrite, the message is passed to the communication clerk, who makes a smooth copy and as many carbons as are required.

3. The CWO gives the message to the messenger, retaining one copy until delivery is completed.

4. The messenger delivers the traffic first to action and then to information officers, who receipt for classified messages by initialing the master copy. The commanding officer, executive officer, and communication officer see copies of all messages. The CO, however, may exempt himself from the routing of certain types of messages, such as those dealing only with routine supply matters.

5. After distributing all copies and obtaining any required initials, the messenger returns the master to the message center. The master copy becomes a permanent part of the communication center file.

For high-precedence messages, the CWO employs the most rapid means of delivery available, particularly to action officers. He may resort to direct delivery over a telephone circuit, delivery of an advance copy before writeup, or other expedients.

To ensure expeditious handling, time limits should be established to complete the processing of each precedence of message. The senior supervisor (CWO) on watch should check the time of receipt (TOR) entries in the incoming message logs at frequent intervals. Any message that has not been cleared within the prescribed time limit is then located and its processing expedited.

Classified messages require security measures in handling. Some, or all, information officers do not receive personal copies, but see and initial the original copy, which then is returned and placed in the cryptofile.

Top Secret messages are processed by a Top Secret control officer, who may or may not be a regular communicator, appointed by the captain.

INTERNAL ROUTING.—The call signs in the heading of a message usually provide no indication of the officers aboard who are to receive the message, either for action or information. The CWO must decide who the action or cognizant departments are, based on guidance provided by the various departments. Special care is needed in the handling of Class E messages to ensure that the privacy of their contents is not violated.

It is important that the correct number of copies be distributed. If a message is underrouted, the result may be unnecessary delay. The other extreme, preparing a copy for everyone aboard who might have even a remote interest in the message, is equally bad; it would take too much time and often circulate classified information too widely.

Before a message is delivered, the CWO should ensure that he has not left himself open for questions from the recipient. If there is dual precedence, is it shown? Are there any references in the text? If so, are clarifying excerpts required on the face of the message?

Figure 3-6 shows the type of message (gale warning) that properly should receive wide distribution within the ship. The operations officer (indicated by the No. 3 routing box) acts for the CO in matters relating to the ability of the ship to carry out her assigned mission; he therefore is the action officer. Routing boxes numbered 1, 2, and 3 normally indicate information (I) to the CO, XO, and communication officer, respectively.

Other recipients of the gale warning message include the navigator, the meteorological officer, and such department heads as the weapons officer (who must take measures to protect exposed ordnance equipment), engineer officer (responsible for damage control and ship stability), and the medical officer (responsible for the comfort of bedridden patients and security of medical spaces for weather

damage). All recipients notify personnel within their departments.

Outgoing Messages

The originator of a message is the command by whose authority a message is sent. A message from the USS Weeks, for example, is referred to in just that way—not as from the "CO of the Weeks." Unless otherwise indicated, the originator in all instances is understood to be the commander of the originating station.

Within a command, the term "originator" often is used to indicate the person who originally prepared a message for transmission. This, however, is the function of the drafter.

A releasing officer is an individual within a command designated by the commander to authorize message transmissions for and in the name of the originator; the releasing officer may also be the drafter. All outgoing message forms provide for the initials or names of the drafter and the officer authorizing release (transmission) of a message.

A message is not used unless other means of corresponding will not suffice. For example, U. S. mail or airmail always are utilized when the addressees are in the continental limits of the United States and action is not required for 72 hours. In other instances, the necessity for a message is left to the discretion of the originator. When an officer authorized to draft

NAVAL MESSAGE (SHORT FORM)
OPNAV FORM 2110-29 (10-58)
Reorder from FPSO Cog. "I" Stock Points

SECURITY CLASSIFICATION: UNCLASSIFIED

DRAFTED BY	PRECEDENCE	DATE/TIME GROUP	MESSAGE NR.
	IMMEDIATE	11Ø4Ø3Z	31

FROM:
FLEAWEACEN WASHDC

TO:
ALL SHIPS COPYING THIS BROADCAST

INFO:
COMEASTSEAFRON / FLEWEAFAC NORVA / FLEWEAFAC MIAMI

UNCLAS

11Ø4ØØZ GALE WARNING. BETWEEN FORTY TWO AND FORTY FIVE NORTH FROM THIRTY FIVE WEST TO EUROPEAN COAST. WIND WESTERLY TWENTY FIVE TO THIRTY FIVE KNOTS

WR NR3365 WU/JN

RELEASE	TOR	TOD	CWO	WO	DATE
	11/Ø417Z		LW		11 OCT 64

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	DATE/TIME GROUP
I	I	A	I		I	I	I	I	I		I		I										I	11Ø4Ø3Z

SECURITY CLASSIFICATION
UNCLASSIFIED

31.47

Figure 3-6.—Incoming message. Internal routing is indicated by numbered blocks.

messages determines that a message is necessary, he prepares it, assigns the proper classification and precedence, and sends it to the releasing officer. Typically, the outgoing message then is processed through the following steps:

1. The releasing officer (on a small ship the commanding officer or executive officer) checks the message for content, precedence, classification, brevity, and clarity, making any changes he thinks necessary. When he believes the message to be unnecessary, he returns it to the drafter. If he approves the message, with or without changes, he sends it to the message center.

2. In the message center, the CWO determines, if possible, whether all addressees hold copies of any messages referenced in the message being processed. When they do not hold them, he adds the suffix NOTAL to appropriate references, indicating that the latter were "not to, nor needed by, all addressees."

3. After the enlisted watch supervisor enters the appropriate information in the outgoing message log and adds the heading, the CWO sends the message to the radio room for transmission. If the message is classified, however, he first sends it to the cryptocenter. The heading is then added before the encrypted version goes to the radio room.

4. In the radio room the message is placed on the air. The time of delivery (TOD), identification of accepting station, frequency used, and the operator's sign are noted on the face of the form. The message is returned temporarily to the message center for completion of the CWO's outgoing message log.

5. When the drafter has not prepared a sufficient number of copies, the original draft is given to the communication clerk, who prepares file and internal routing copies for interested officers.

6. When separate files are maintained, the original draft is placed in the rough file; the original encrypted copy, if any, goes to the radio supervisor for the radio station file; a filler, dummy, or encrypted copy is placed in the communication center file; and a plain language copy goes into the proper section of the cryptocenter file.

BROADCASTS

The broadcast method of transmission is a method of delivery by which a station transmits serially numbered messages at scheduled times. The principal advantage of this method is that the station addressed does not answer, thus avoiding disclosure of position. Another advantage is that it often is possible to avoid the use of individual call signs, which serves to conceal the identity of addressed stations. This topic is discussed more fully in chapter 4.

FLEET BROADCASTS

Fleet broadcasts are the primary means of delivering traffic to the fleet. All ships not exempt must copy all messages transmitted on the appropriate area broadcast. They are responsible for maintaining a complete file of the serially numbered messages. The fleet broadcast is broken down into the CW, RATT, FAX, and submarine broadcast. The last, however, usually is integrated with the regular CW broadcast unless an independent fleet submarine broadcast is established in the area. The submarine broadcast ordinarily occurs only during wartime.

All fleet broadcasts normally are transmitted on several frequencies to allow a choice for best reception, considering the time of day or night and the atmospheric conditions.

The operating schedule for each type of fleet broadcast is given in JANAP 195. For example, the fleet broadcast (CW) commences every hour on the hour, unless otherwise indicated, and normally does not exceed 50 minutes in duration, except the general message schedule, which may be extended to 1 hour and 50 minutes. Submarine schedules, when included as a submarine component of the fleet broadcast, usually are transmitted every odd hour.

GENERAL BROADCASTS

General broadcasts include scheduled transmissions of the following material:

1. Messages to U. S. Navy controlled merchant ships (MERCAST).
2. Hydrographic information.
3. Weather.
4. Time signals.
5. Press.

Like the fleet broadcast, the general broadcast has CW, RATT, and FAX components. Operating schedules for each of these can be found in JANAP 195, as can the various operating frequencies.

COVERED BROADCASTS

A radioteletype broadcast may be utilized to disseminate classified as well as unclassified information to the fleet, in plain language copy, by using cryptographic devices at the sending and receiving terminals. This method is referred to as a covered broadcast.

CORONETTING

Provisions are available so that a primary or major communication center (described in the next chapter) in a specific geographical area may key the transmitters of one or more of the communication stations in the same area simultaneously with its own. This procedure is called coronetting, and results in identical information being broadcast to several areas at the same time.

As an example, the transmitter at NAVCOMMSTA Guam is equipped to key the transmitters of the COMMSTAs in Japan and the Philippines. A message can be broadcast from the three stations simultaneously, providing blanket coverage of the entire WestPac area over a wide range of frequencies. This is an advantage when a particular broadcast area is subject to disruption of communications because of meteorological conditions or heavy weather. A ship having reception difficulty in the Guam broadcast area may shift to the Philippine or Japan broadcast and receive the same information on a different frequency.

SHIP-SHORE COMMUNICATIONS

Ship-shore radio circuits are the principal means for delivery of traffic from ships at sea to shore radio stations. These circuits fall within three general categories: primary, secondary, and special.

Primary circuits provide for long-distance communications. Prior to transmitting, ships should determine the best frequency to be used by referring to the propagation tables in DNC 14 or by listening to the HF fleet or general broadcast from the shore radio station the ship desires to contact. Shore stations customarily guard radioteletypewriter and radiofacsimile ship-shore circuits only on a request basis. Ships desiring to transmit on these circuits should send a CW service message to the station concerned, using the appropriate radiotelegraph ship-shore circuit.

Secondary circuits normally utilizing medium frequencies are used in lieu of the primary circuits when a ship is within reliable range of the shore station. These circuits also may serve as warning nets by ships in or near established harbors. When in harbors, all ships except those guarding district or sea frontier frequencies guard the frequency employed as harbor common, or make guardship arrangements.

Special ship-shore circuits may be established by CNO, based on recommendations of fleet or force commanders, with a view to providing adequate circuits to fulfill the missions of forces under their commands. When traffic is of extreme urgency and importance, ships may be authorized to use point-to-point circuits (fixed radio and wire circuits established for communications between shore facilities) to pass traffic to shore stations that usually do not guard a ship-shore circuit.

COASTAL HARBOR/HIGH SEAS RADIOTELEPHONE SERVICES

During peacetime, as a contribution to the morale of personnel afloat, fleet commanders and district commandants may authorize Navy ships to use commercial radiotelephone services. Such services provide two-way telephone conversations between a ship and any telephone on land through commercial land radiotelephone stations. U. S. Navy ships utilizing this service are limited to calls originating on the ship; incoming calls cannot be accepted. The commercial companies concerned are the Coastal Harbor Radiotelephone Service and the High Seas Radiotelephone Service.

Coastal Harbor stations provide communications to a few hundred miles offshore. Numerous stations are established on the Pacific, Atlantic, and Gulf coasts and in Oahu, Hawaii. High Seas stations located in Oakland, California, New York City, and Miami should be used only by ships operating beyond the normal range of the Coastal Harbor stations. Call signs, operating frequencies, and the names and addresses of company representatives are listed in DNC 26.

To initiate service, a form letter is submitted to the telephone company representative nearest the home port of the ship. The company sets up an account in the name of the ship and thereafter accepts calls through any of its

stations. A change in the home port assignment of the ship requires a new letter of request to the company representative nearest the new home port.

The communication officer is responsible for the shipboard arrangements for use of the telephone service. Included in his responsibilities are the preparation of the form letter to initiate service; provision of locally prepared forms to be filled out by users of the service; selection and adjustment of the shipboard transmitter and receiver; collection of charges and transfer of money to the disbursing officer; verification of telephone company bills before payment by the disbursing officer; and maintenance of technical liaison with the telephone company.

The charge for service depends upon the location of the ship as well as the land telephone. Calls may be either station-to-station or person-to-person, the charge being the same for either.

For Coastal Harbor Service, the coastal waters are divided into rate areas that are defined by latitude and longitude and are illustrated in DNC 26. The initial rate is for 3 minutes or less, with overtime charges based on one-third of the initial rate for each minute of overtime. All charges are subject to 10 percent Federal excise tax. Collect calls are permitted and, if accepted by the person or station called, no charge is collected from the user on the ship.

For High Seas Radiotelephone Service, the United States is divided into three land rate areas by groups of states, and the oceans are divided into three ocean rate areas defined by latitude and longitude. A chart in DNC 26 shows the land and ocean rate areas.

Practically all standard Navy transmitters and receivers designed for voice amplitude modulation emission and reception are suitable for this R/T service. The transmitter must be on the exact frequency specified, otherwise the carrier will not actuate the calling device at the telephone company marine operator's desk and the call will be unanswered. To prevent the calling device from being actuated unintentionally, it is best to tune the transmitter before coming into range.

The best microphone to use is the push-to-talk (release-to-listen) type; the microphone should be demonstrated to the user before he goes on the air. Ship and shore station transmit on different frequencies, but when the microphone switch is pressed, receiver blockage may nevertheless occur if the transmitting and receiving antennas are close together.

To place a call, the user fills out a form (provided by the communication officer) giving his name, serial or file number, rank or rate; city, telephone number, and individual to be called; whether the call is collect; and the time the call is to be made. (The commanding officer normally designates the hours during which service is available.) Charges are entered and the communication officer signs the completed form. The caller keeps one copy as a receipt.

Assuming that preliminary arrangements were made and the equipments are tuned properly, the shipboard operator listens to make certain the circuit is not in use. Then, if the circuit is clear, he calls the marine operator by voice:

NORFOLK MARINE OPERATOR—THIS IS USS FREMONT

When the operator responds, he is given the name of the ship, the coastal rate area in which the ship is located, the city and telephone number desired, and, if the call is person-to-person, the name of the individual called. He then is requested to quote the rates for the call.

THIS IS USS FREMONT—RATE AREA 2B—CALLING WASHINGTON DC—LUDLOW 4-5400—STATION TO STATION—QUOTE TIME AND CHARGES

When the marine operator makes the telephone connections, the circuit is ready for the caller. Best results are obtained by speaking plainly and naturally. Instruct the caller not to speak until the other person finishes. When the conversation is over, the shipboard operator notifies the marine operator: THIS IS USS FREMONT—CALL COMPLETED

The marine operator then quotes the time and charges. Actually, the Coastal Harbor and High Seas Radiotelephone Service channels are like party lines and are shared by a large number of ships. Courtesy and discretion are necessary if everyone is to share the service equally. Observe these rules:

1. Avoid chains of calls. Space them out so other ships can use the circuit without too much delay.
2. Keep conversations brief.
3. Plan calls for slack hours. The hours between 1900 and 0700 local harbor time are least busy.

4. Be discreet in conversation. Anyone with a shortwave set can monitor half the transmissions.

STANDARD COMMUNICATION PLANS

The communication officer on every ship should prepare, in advance of the need for them, standard communication plans to be used in frequently recurring or emergency situations. These include type or situational plans, such as a standard frequency plan for search and rescue operations, in-port frequency plans used for various harbor warning nets and other secondary frequencies designated, and local frequencies on which a watch must be maintained in the event emergency sortie (attack) procedures are instituted. These standard plans vary according to the area and type of operations. When prepared ahead of time and made readily accessible to all personnel who have need of the information, a great deal of time can be saved and embarrassment avoided.

In most instances, the movements of a ship (ports of call, scheduled exercises, and the like) are known well in advance of the movements. Early preparation of the standard communication plans becomes a matter only of advance preparation for a scheduled event. For example, there are four methods of maintaining a radio watch: (1) guard, (2) cover, (3) copy, and (4) listen. To guard a circuit, a continuous radio watch is maintained. A transmitter is ready for immediate use, and a complete log is mandatory. When a frequency is covered, the watch also is continuous. The transmitter is calibrated and available, but it does not have to be available for immediate use. A complete log is maintained. To copy means to keep only a continuous receiver watch and a complete log. Listening is similar to copying except that a complete log is optional. The frequencies to be guarded, covered, copied, or listened to when in port depend on port regulations and operational commitments.

Usually, the frequencies on which a watch must be maintained in a given port are contained in JANAP 195. The senior officer present afloat (SOPA), however, may designate a secondary frequency; this information probably would be disseminated by a SOPA instruction or notice to ships concerned. In addition, the area commander may order, by another instruction, other frequencies guarded. A ship in port retains its force or group identification, and this may result in other watch requirements. All these separate orders (which must be up to date) should be studied before arrival, if possible, and a complete compilation of frequencies on which watches must be maintained should be set up in the form of a communication plan. Just as important, before arrival the plan should be broken out and studied, and equipment calibrated, to ensure readiness of the ship to assume its in-port communication commitments at a moment's notice.

The alternative to having a plan ready for each port, or possible recurrent underway situation, is repeated confusion caused by the last-minute need for studying, on a crash basis, all the pertinent publications and local, fleet, or force regulations. The usual embarrassing result of this lack of preparedness is tuning in on a designated frequency in 2 hours instead of 2 minutes. Your performance is judged by results accomplished, not by the effort expended.

ENTERING AND LEAVING PORT

When entering and leaving port, the communication officer is responsible for exercising specific functions as prescribed by the commanding officer. While the ship is in port, SOPA instructions usually apply.

This section of the chapter is intended as a guide to assist the communicator prior to entering, upon arrival in, and departure from port.

PRIOR TO ENTERING

It is mandatory that two reports be made before or upon arrival in port—an arrival (movement) report and a logistics requirements report.

Although the arrival report is not filed until the ship physically arrives in port, it should be prepared beforehand. The logistics requirements report is sent 48 hours preceding the ship's arrival at any United States, British, or Canadian port. Both reports normally are transmitted as messages.

ENTERING PORT

The following items, as a minimum, must be considered while the ship is entering port.

DEGAUSSING: Many naval bases have a degaussing range. Some are so located that a ship cannot pass through the main channel

without running the range. Ensure that a guard is set on the proper frequency to communicate with the degaussing station and that your signal force knows the visual call. Prepare a message giving the ship's coil settings, which can be obtained from the navigator. The message is sent to the degaussing station and, shortly after running the range, the ship will receive an answer stating whether the equipment is functioning properly.

HARBOR NETS: Ensure that a watch is set on the prescribed harbor frequencies (radiotelegraph and/or radiotelephone). These frequencies are listed in JANAP 195, the appropriate fleet guide, and SOPA instructions. The latter, of course, usually are unavailable before entering port.

The general rule is to check out on the harbor nets when the ship is near enough for effective communication. Although berthing instructions usually are included in the answer to the logistics requirements report, you sometimes may receive last-minute changes. The harbor net is available for this type of traffic.

SPECIAL SEA DETAILS: Certain communication personnel man special sea detail stations, reporting to the bridge when the stations are manned and ready.

A ship entering (or leaving) port literally is on parade. Make sure that the men of your division contribute constructively to the appearance of the ship. Fly the ship's best set of colors during the time the special sea detail is set. The ensign must be close up and not fouled in the halyards. Ensure that the ship's international call sign is flying from the yardarm. Ascertain that no flags are torn, their frayed ends whipping in the breeze.

The bridge watch is required to provide certain equipment during special evolutions—a portable electric megaphone, for example. Ensure that everything needed is on hand. Have the batteries of the megaphone checked a day in advance by the ship's electrician. Even then, supply a standard cone megaphone as a backup.

Signalmen should be alert for visual signals. Be sure that all sectors are watched closely, and permit no skylarking.

Those of your division not on watch and not assigned a specific special sea detail station assemble at quarter with an officer or petty officer in charge. The men should be at division parade, in ranks at all times. They must know how to render passing honors. Uniforms should be immaculate.

VISUAL COMMUNICATIONS: Each naval base has a visual communication tower and its call is included in the fleet guide. Messages can be addressed to the naval port control officer (NAVPORCO) either visually or by the harbor radio net. Where possible, visual means should be used.

During time of war, most harbors are protected by antisubmarine nets and various listening devices that can detect a submarine attempting a sneak submerged entry. The activities of the various harbor defense units are coordinated at a harbor entrance control post (HECP). Ships must receive permission to pass through the nets from the HECP. Warn signal personnel to be prepared to establish communications with HECP if required.

ARRIVAL IN PORT

Usually, most of the following are specific responsibilities of the communication officer.

ARRIVAL REPORT: File the arrival report (already discussed) in accordance with existing directives.

SECURITY OF MATERIALS: Remove all classified materials from the bridge and from communication spaces. Classified matter includes extracts of recognition signals, authentication systems, call sign and task organization data, and publications necessary for maneuvering the ship at sea. These items should either be stowed in an acceptable safe or destroyed, as appropriate. Tactical and communication publications and operation orders and plans not needed in port must be accounted for before stowage. Binoculars, long glasses, sextants, and other pilferable items should be accounted for and placed under lock and key. All spaces containing classified equipment must be locked.

SOPA INSTRUCTIONS: SOPA instructions cover almost every detail of in-port activities. These instructions, together with other useful information, usually are delivered by a boarding officer.

The communication officer must become familiar with any instructions devoted to the various communication facilities available at the base. At some ports the communication guard is assumed by the communication station for the ship. The location and hours of the registered publication issuing office (RPIO) are

indicated. Availability and means of obtaining electronic repair assistance usually are included. Drill circuits and ship's responsibilities for manning them are delineated also.

WATCHES: Unless the shore communication station assumes radio guard for the ship, watches must be maintained on all designated harbor frequencies. It is common practice for destroyers to moor in nests with several other destroyers. Invariably arrangements can be made for each ship to stand communication guard watches for the whole nest, rotating the duties daily. In small ships this should be done when possible. It allows equipment to be shut down for preventive maintenance or repairs, and, as an important morale boost, it gives communication personnel a respite from round-the-clock operations.

Depending on instructions of the SOPA, a voice guard may be required on the harbor net. Check SOPA instructions before securing any net.

Communication personnel may be required to stand petty officer or messenger watches on the quarterdeck during in-port periods. In general, the in-port enlisted watch bill is coordinated by the weapons officer. Make sure a copy of the bill is posted on the division bulletin board.

In addition to the harbor frequency watches, set a signal bridge watch or arrange for guard.

BASEGRAMS: Send a messenger to the basegram authority at the naval base to obtain any general messages transmitted by that system that have not yet been received aboard.

REGISTERED PUBLICATIONS: Immediately upon arrival, require the custodian of registered publications to visit the RPIO and make the necessary draw to bring the ship's allowance up to date. On extended stays, have frequent visits made. While in port, the custodian should be required to enter all changes and corrections to the publications. This task is simplified while in port because the publications are not needed elsewhere (e.g., the bridge or CIC).

EQUIPMENT REPAIRS: Arrange with the operations or electronics material officer for necessary repairs to communication equipment in ample time to permit repairs before departure.

At many naval bases, mobile technical units (MOTUs) are organized. These units consist of enlisted technicians or civilian engineers who are available to ships for both training and repairs. The basic function is training, however, and no work is performed unless your repair personnel are present. If you have a transmitter casualty, for example, that the ship's electronics technicians are unable to repair, MOTU personnel may come aboard and help the ETs repair the equipment. In this way, the equipment is made operative and at the same time the shipboard ETs learn how to repair a similar casualty should one occur.

TELEPHONE SERVICE: Immediately after mooring, arrange to have a landline telephone installed on the quarterdeck and in the captain's cabin. If the installation cannot be made, determine the location of the nearest telephone ashore and publish the information to all hands.

CRYPTODEVICES: Arrange for the inspection of the ship's cryptodevices and establish a cryptoguard.

Cryptodevice repair personnel are few in number; most ships do not have a qualified repairman on board. Take advantage of every opportunity to have equipment inspected and tested.

The general rule is that a preventive maintenance inspection is made at quarterly intervals and an overhaul is preformed annually. More frequent inspections should be scheduled under unusual conditions, or when cryptodevices are subjected to exceptionally heavy usage. The important point is that with technicians at a premium, you should obtain their services whenever and wherever you can.

TRAINING: Schedule vigorous drill circuits and other supervised training, and take advantage of shore training facilities as much as practicable.

Training does not take care of itself. You must plan it, direct it, and evaluate it. Your objective is to attain that level of accomplishment that will help your department attain a high mark in the competitive overall communication exercise.

Check SOPA instructions for the schedule of drill circuits. Arrange visual drills within the division. Check the local training group officer for availability of schools. Some CW operator schools tailor their courses to any number of weeks you desire. Depending on the ship's operating schedule, you may arrange 1 week, 2 weeks, or even 16 weeks of operator training.

DEPARTURE

Preparation for getting underway include a number of important steps. After an extended in-port stay, there is a psychological disadvantage because the men face a complete change in routine. The operation will run smoothly only if careful attention is given to detail. The following pointers should be observed.

DEPARTURE REPORT: Unless the report of departure is included in an arrival report (they may be combined when a ship is to remain in port for fewer than 4 days), a departure (movement) report must be sent to the appropriate AIG at least 24 hours, if possible, before the ship's departure. File the movement report in accordance with existing directives.

REGISTERED PUBLICATIONS: A publications draw should be made just prior to sailing. If all the corrections have been made from the previous draw, and too much time has not elapsed between visits to the RPIO, the custodian should be able to make last-minute corrections before sailing. A point to remember: It is inadequate that the publications only be corrected; those who have need to know should be made aware of the changes and their effects on past doctrine.

BASEGRAMS: Obtain the latest basegrams from the local basegram authority.

TELEPHONE SERVICE: Arrange for removal of the landline telephone(s).

CALIBRATION OF EQUIPMENT: Before departure, ensure that all radio equipment is calibrated, particularly on frequencies to be used in forthcoming operations. Unless specifically authorized by the operational commander, however, do not allow testing signals to be radiated.

It sometimes happens that a transmitter or receiver fails just prior to getting underway. Although this may seem insignificant if other equipment is available covering the same frequency range, report the casualty to the department head immediately.

WATCHES: Confirm underway communication guard arrangements with either the SOPA or the OTC, depending on the type of scheduled operation. If in-port guardship arrangements on the fleet broadcast were made, resume own guard at least 4 hours before departure. Set the radio watches and have operators test all assigned circuits and nets on the designated frequencies. Set a guard on the degaussing station frequency as required. Set the signal bridge watch. During wartime, communication with the HECP will be required; ensure that the signalmen know the call sign and location of the HECP.

PUBLICATIONS FOR UNDERWAY USE: Distribute tactical and communication publications, orders, and plans to the navigation bridge and the communication and operations spaces.

CALL SIGNS: Prepare a list of the tactical call signs required during the forthcoming operation.

As task groups join or break up, there often is a need for an entirely new set of call signs. A complete list of all the call signs is useful, but of far greater importance is a list showing only those the captain and officer of the deck need to know during each phase of an operation. Prepare the call sign lists and have them posted in a conspicuous place on the bridge well ahead of time.

SPECIAL SEA DETAIL: At the proper time, have communication personnel man their special sea detail stations and report when the stations are manned.

PASS THE WORD: For all but the most routine operations, a presailing conference of all officers usually is held in the wardroom. On many occasions the task force commander conducts a presailing briefing in his flagship. The communication officer invariably attends. The purpose of both conferences is to give key officer personnel an appreciation of what the problem is, how it is to be carried out, and what is hoped to be accomplished.

Pass to all communication personnel any pertinent information regarding the operation plan or order.

Generally, the men will respond favorably to a presailing briefing covering the many facets of communications. Within the limits of security, tell the men the mission of the force and how they can contribute to its successful conclusion. Explain the schedule of events. Show them how the ship's communication plan will help to accomplish the communication phase of the mission. It is insufficient that a radioman knows he is supposed to set up a particular frequency on the bridge at 1015. He will cooperate more willingly if he knows what the circuit is for and what is happening to require it.

CHAPTER 4

COMMUNICATIONS ASHORE

The activities of the Naval Communication System (NCS) are located strategically ashore throughout the world to provide complete radio coverage of the major portions of the earth. These activities are linked to each other by point-to-point radio and landline circuits. They are linked to the operating forces by broadcasts, ship-shore circuits, and special circuits as required.

The NCS consists of the following components:

1. Naval Communication Station (NAVCOMMSTA), which provides all the communication facilities and ancillary equipment required for essential fleet support and fixed communication services for a specific area.
2. Naval Radio Station (NAVRADSTA), usually a remote subcomponent of a NAVCOMMSTA that performs radio transmitting or radio receiving functions. To indicate the function performed, a type designation letter (T or R) is added in parentheses.
3. Naval Communication Unit (NAVCOMMU), assigned a limited or specialized functional mission.

Each component of the NCS is organized into one or more of the following operational integrated elements:

1. Message center;
2. Cryptocenter;
3. Relay station;
4. Wire room;
5. Radio transmitter and radio receiver stations;
6. Control center;
7. Visual signal station as required;
8. Classified relay station; and
9. Facsimile and radiophoto center.

These elements are integrated and controlled at any geographical location by a communication center. Depending on function, a communication center may be classified as primary, major, minor, or tributary (user) message center.

The NAVCOMMSTA is discussed in the following section. Major, minor, and tributary centers maintain facilities and perform limited functions, similar to the primary centers, within their geographic areas. Major centers, linked by radio and landline circuits to the primary centers, maintain the circuits necessary for interconnection with areas where the traffic volume does not justify a larger (primary or major) center. They handle local communications, and relay messages between tributary stations and the major or primary center with which they are associated. A tributary is a small station serving a local command.

NAVAL COMMUNICATION STATION

The NAVCOMMSTA is the largest component of the NCS. Currently there are 19, of which 5 are classed as primary communication centers: NAVCOMMSTAs Washington, D. C., San Francisco (Stockton), Calif.; Honolulu; Guam; and Port Lyautey, Morocco. These 5 form the nucleus of the Naval Communication System.

Primary communication centers are linked by multichannel single sideband (SSB) or RATT, voice, and FAX trunk circuits. (SSB is discussed in chapter 7.) Each center operates and maintains—

1. A fleet broadcast for the delivery of traffic to all U. S. naval ships in each ocean area. These broadcasts consist of a high-power VLF or LF transmitter keyed simultaneously with several high-power HF transmitters.

2. A fleet radioteletypewriter broadcast, similar to the fleet broadcast except that a VLF transmitter is not utilized.

3. A general broadcast, also similar to the fleet broadcast except that a VLF transmitter is not used. These broadcasts provide time signals, weather (RATT and CW), hydrographic warnings and notices, press (RATT and CW), and merchant ship broadcast schedules.

4. A fleet facsimile broadcast.

5. A high-power, high-frequency ship-to-shore circuit, manually keyed.

6. A high-power, high-frequency radioteletypewriter ship-to-shore circuit available for use with fleet commanders.

7. Local MF, UHF manual, radioteletypewriter, and voice ship-to-shore circuits as required.

8. Multichannel radio and landwire teletypewriter, voice, and facsimile trunk circuits to major or minor communication centers throughout the world.

9. Radio or landwire teletypewriter circuits to tributary activities.

10. Other radio or landwire circuits as may be required to meet specific requirements.

11. Radio and landwire link control.

12. Visual signaling facilities as required to meet specific requirements.

The NAVCOMMSTAs also provide communications for naval district and river command commandants; commanders or naval bases, stations, and shipyards; and Marine Corps support establishment commanders. Other tasks assigned to certain NAVCOMMSTAs are the operation and maintenance of one or more of the following: security group facilities; communication facilities for the headquarters of a specific major command; primary and secondary air operational communication facilities; and communication facilities and services for the Army, Air Force, Coast Guard, Federal Aviation Agency, or other Government agency as economically feasible.

ORGANIZATION

Figure 4-1 shows the standard organizational structure of a primary NAVCOMMSTA. Minor deviations from the basic organization are permitted to meet the local situation. Departments or functions for which support is received from other activities may be omitted. An example might be where the NAVCOMMSTA is close enough to a naval station so that it may utilize the public works and supply departments of the naval station without difficulty, or where the public works functions are performed by a public works center. Otherwise it will need public works and supply departments of its own. Two or more departments are combined where one or all are of insufficient size to warrant separate departments.

The buildings and spaces of NAVCOMMSTAs vary so widely in location and arrangement that generalization is difficult. Usually, the components discussed in this chapter are present, but at some stations they are scattered over a large area. Often, the transmitting and receiving radio stations, in particular, are several miles from the remainder of the activity.

The commanding officer of a NAVCOMMSTA usually is of the grade of captain or commander. He is responsible for the station's successful fulfillment of its mission. To this end, he establishes policies and procedures for its operations, and initiates and enforces local directives for its upkeep and security.

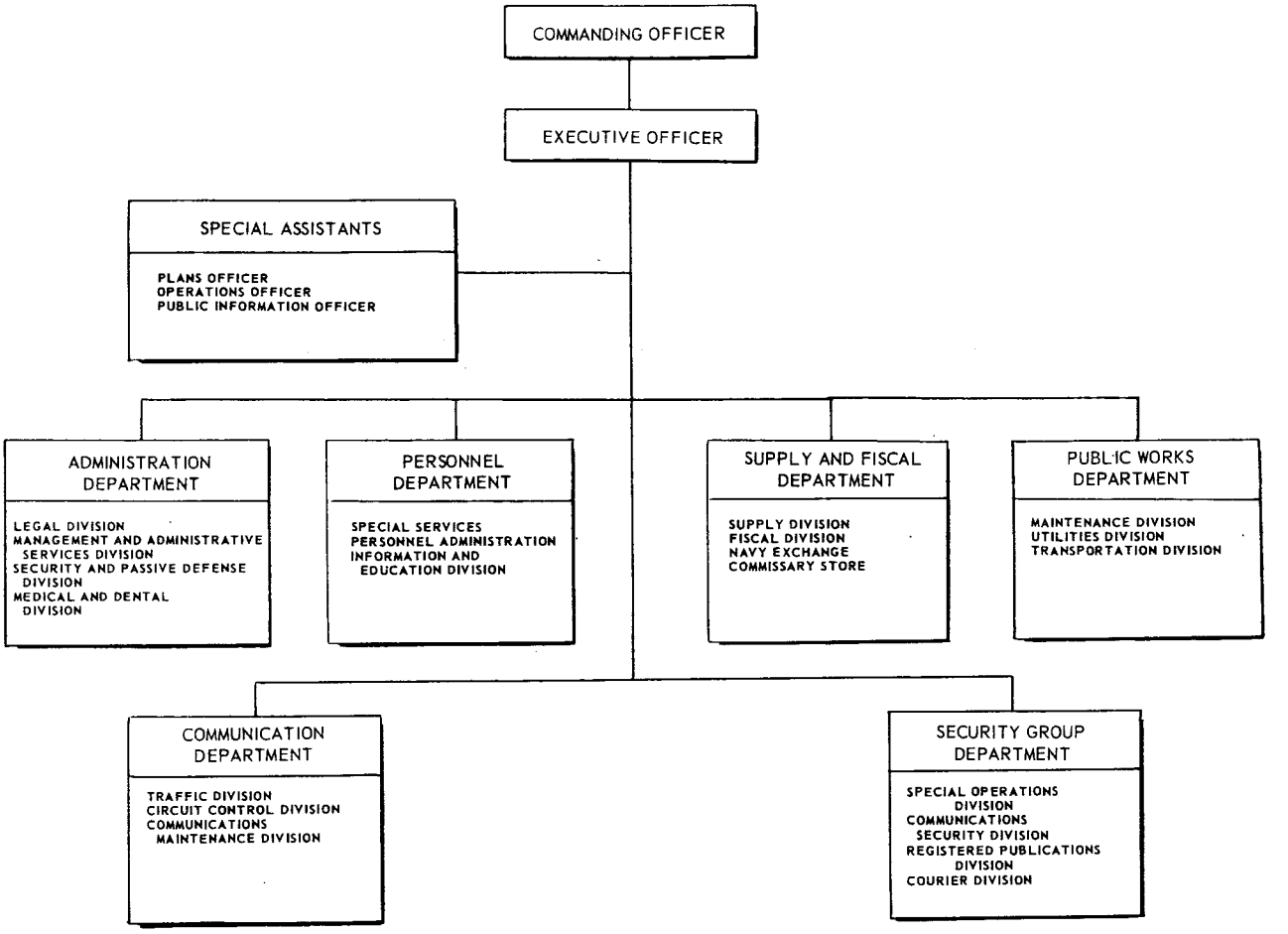
The responsibility of the commanding officer includes functions of a management nature. Budget requirements must be determined, fiscal control exercised, and measures of performance developed and applied to ensure the most effective use of available manpower and funds. The efficient and economical operation of the station is a major responsibility of the commanding officer.

In addition to his station command, the commanding officer may be the staff communication officer for the naval district commandant or force or sea frontier commander of the area within which the NAVCOMMSTA is located. As such, he is responsible for coordinating naval communications within the district or area.

As aboard ship, the commanding officer is assisted in the discharge of his responsibilities by an executive officer who coordinates the activities of the department heads in accordance with the general policies promulgated by the commanding officer. The executive officer organizes the activities of the station, plans the details and procedures of the training and discipline of personnel, and prepares and issues operating orders, notices, and directives as required. When the commanding officer of the station also is the district or area communication officer, the executive officer may be the assistant communication officer of the district or area.

Special assistants to the commanding officer and the executive officer are the plans officer, operations officer, and the public information officer. These billets are not directly in the chain of command and may be assigned as collateral duties.

Depending upon its functions and the scope of its operations, a naval communication station may have a complement ranging from a hundred to several hundred officers, men, and civilians. In addition to personnel for communications and electronics, the complement



6.2

Figure 4-1. —Standard organizational structure of a primary NAVCOMMSTA.

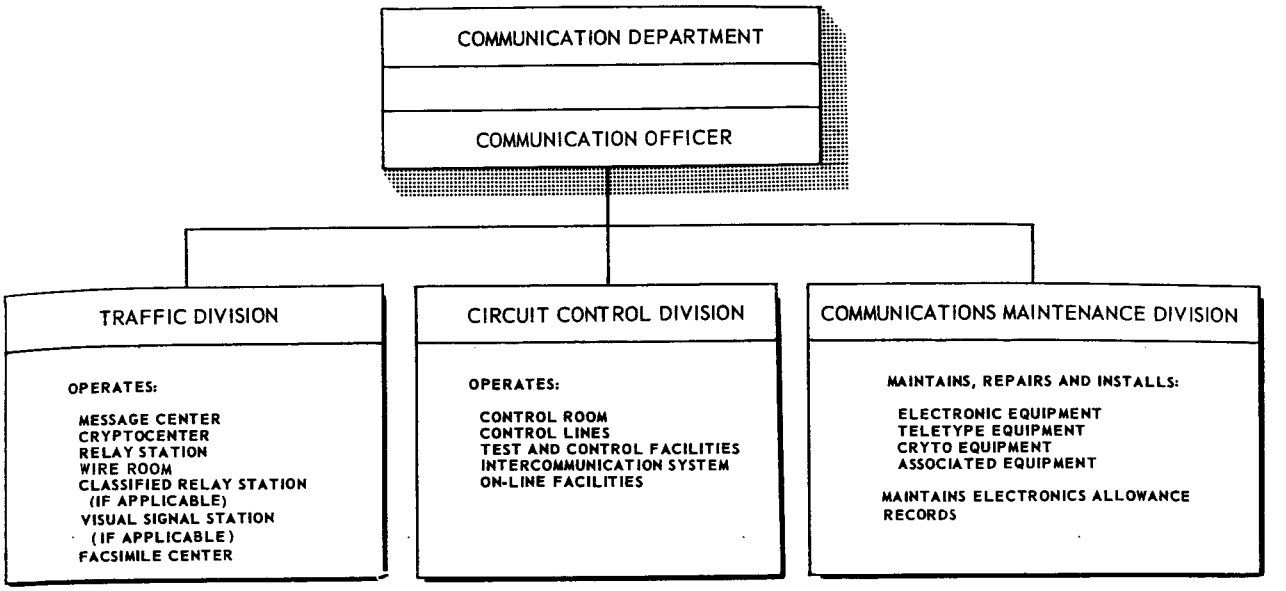
includes those needed for supply, administration, transportation, and other supporting services.

Communication Department

Of the various departments constituting the NAVCOMMSTA, the communication department (fig. 4-2) is by far the largest. Again, deviations usually are made from the basic organization plan to meet the local situation. In addition, the terminology for identifying the components of the communication department may vary from station to station. Basically, the divisions of the communication department are the traffic, circuit control, and communications maintenance divisions. When a receiver station is at the same location, the department may include a receiver division.

The communication officer of a NAVCOMMSTA usually is of the grade of lieutenant commander. He has direct supervision over the responsibility for most of the personnel and functions of the communication department of the station. He serves as manager of the local communication program and determines its budgetary requirements. In addition, he is responsible to the commanding officer for—

1. Formulating communication plans and directives.
2. Establishing an internal routing and filing system.
3. Providing for the physical security of messages and maintaining monitoring facilities.
4. Supervising the operation of the NAVCOMMSTA registered publications library through the command's appointed RPS custodian.



6.3

Figure 4-2. —Basic organization plan for a NAVCOMMSTA communication department.

5. Supervising the training of communication personnel and cryptoboard members.

6. Operating and maintaining electronic and visual communication equipment.

7. Conducting inspection and inventories.

8. Maintaining records and forwarding abstracts and statements of the usage of naval communication funds.

TRAFFIC DIVISION. —Within the communication department, the traffic division is that section in which all incoming and outgoing messages (including FAX) are processed. The components of the traffic division include a message center, wire room, cryptocenter, relay station, classified relay station, visual signal station (when applicable), and a facsimile center.

Message Center—When an outgoing message from a local activity is received for transmission, the message is time-stamped and the releasing signature is checked against the master file of the authorized releasing officers to ensure that transmission of the message is properly authorized. A date-time group is assigned to the message and a check is made to determine if all security requirements have been met. Routing indicators, call signs, and address groups are assigned to the message and the heading is prepared. If the message is classified, it is sent to the cryptocenter for processing before transmission.

Messages received by electrical means for local delivery are also handled in the message center. The time of receipt is stamped on the incoming message. Next, it is scanned for garbles. It is prepared for further relay over local radio and/or wire circuits when required. The call signs and address groups are decoded and duplicate copies are made for internal distribution. Messages then are routed to the delivery desk where they are logged for delivery by messenger pickup, pneumatic tube, and telephone to the local activities served by the NAVCOMMSTA.

It is the responsibility of the message center to maintain current message routing and information facilities to expedite routing messages to proper circuits or transmission. Close liaison is maintained with the movement report center for ship locations. In addition, the message center should maintain the message files and a service section for obtaining and making prompt corrections to messages.

Wire Room. —The wire room operates those radio or landwire circuits that are off-net or not a part of the integrated tape relay network, such as—

1. Circuits to commercial companies.
2. Circuits to other Government agencies.

3. Fleet and general broadcast.
4. Certain ship-to-shore circuits.
5. Cables.

The wire room usually is located close to the message center; at some NAVCOMMSTAs it is considered part of the message center.

Cryptocenter.—At small stations, the proximity of all components of the traffic division enables message traffic to and from the cryptocenter to be passed by hand. Large stations require a more complex arrangement, both because of the greater volume of traffic and because of the physical separation of the various components. The cryptocenter at large stations is a tributary station of the relay station.

The routing of decrypted traffic from the cryptocenter is facilitated by the maintenance of a card file arranged according to subject matter. Each card lists those activities interested in a particular subject, and the action activity can be determined readily from this listing. The other activities are put on the routing sheet as activities interested for information only. A message is routed only to those activities that require it for their proper functioning. The number of copies made of a message of any classification is limited to the number required by the activities to which it is routed.

Authorized messengers from the activities served by the cryptocenter pick up copies of messages routed to their activities at the classified delivery desk. Carrier authorization cards for these messengers are retained at this desk. After presenting suitable identification, a messenger signs for and receives the messages for his activity. The messenger's receipt for a Secret message must indicate the copies (or copy numbers) of the messages received. A separate receipt is required for each copy of a Top Secret message. Top Secret messages are delivered to the Top Secret control officer of the activity. A continuous chain of receipts must be maintained for all individual items of Top Secret information. Responsibility for accounting for Top Secret information originated or received by the activity rests with the Top Secret control officer.

For outgoing messages requiring encryption, the original, signed by the releasing officer, is time-stamped at the time of receipt, and is retained in the cryptocenter as evidence of authorization to transmit the message. After the message is processed and the encrypted version is transmitted, a smooth copy containing the DTG, time of delivery, and special markings required is returned to the originating office for proof of delivery; other copies are routed as necessary to any local addees. Other than normal local distribution, if required, is indicated by the originator at the bottom of the last page of his message.

Relay Station.—The function of a relay station is to forward messages in tape form by means of automatic or semiautomatic teletypewriter relay equipment. The relay station is the communication center's link with the Defense Communications System.

At the present time five automatic switching stations link the naval activities in the United States. For services to east coast and midwestern activities they are at Cheltenham, Maryland; Norfolk, Virginia; and Trenton, New Jersey; and at San Diego and Stockton, California for activities in the western area. The system handles almost 100 percent of the Navy's command and administrative messages in the continental United States.

In the semiautomatic (torn tape) system, the incoming circuits of the NTX terminate in typing reperforators that automatically perforate and print messages on tapes. Message tapes are removed by hand (torn) from the receiving consoles by an operator who checks the tape for legibility of the routing indicators and station serial numbers. He also scans the remainder of the tape for garbles and multilation.

If the tape is found to be correct, the operator crosses off its channel number on his received numbers sheet for that circuit and enters his personal sign in the S-T (sign-time) column. Each operator and supervisor at a teletypewriter station is assigned a two-letter sign, usually his initials. No two persons at a single station are given the same sign, nor can the sign conflict with channel designators or prosigns.

When the tape is mutilated, garbled, without a channel number, missent or misrouted, or is in any other way unfit for relay, it is passed to the service desk.

Opening and closing notices (messages sent to commence or cease transmissions on a given channel), stop and go ahead (GA) notices (signals sent to suspend or recommence transmissions on a given channel), and other service and procedure messages are called to the supervisor's attention after checkoff.

After the receiving operator removes the tape from the console, checks it, and makes the proper entries on his numbers sheet, he delivers it to the routing line segregator.

The automatic relay system utilizes a method of routing multiple-call tapes (messages having 2 or more routing indicators in the routing line) known as routing line segregation. This means that routing indicators in the routing line are segregated or distributed in accordance with the desired transmission channel in the switching process. Under this system, only the routing indicators applicable to a particular circuit appear in the routing line. Messages received at a station which has further relay responsibility contain the routing indicators for which that station has relay responsibility.

Routing line segregation does not affect the tape preparation at the originating station; it is accomplished at the relay stations. At the automatic relay stations, the relay equipment (multiple address processing unit (MAPU)) automatically segregates the routing indicators according to the required transmission path.

In order to make the semiautomatic relay system compatible with the fully automatic system, relay stations which are not directly connected to the automatic system also must use routing line segregation procedure on all relayed messages. Semiautomatic relay stations require an operator using special equipment to perform the routing line segregation.

Figure 4-3 shows the page copy of a multiple-address message received by the message center at Guam (RUMGC) for processing in the NTX format and introduction into the relay station RUMG for onward relay.

The first line that appears in the message is line 2, line 1 being reserved for channel numbers between relay centers. Line 2, the basic routing line, consists of the precedence prosign RR (repeated) and the routing indicators identifying stations that are to affect refile or delivery of the message.

Before proceeding, you recall from chapter 2 the explanation of three- and four-letter call signs beginning with N. In addition to these type calls there are address groups composed of four random letters identifying various commands (e.g., EZLE—Commander Fleet Activities, Sasebo, Japan). In teletypewriter procedure, each shore communication center is identified by a group of four or more letters starting with the letter R; this is know as a routing indicator group, and is explained later in the chapter.

(line 2)	RR RUWSC RUHPC RUATAF RUECPA
(line 3)	DE RUMGC 098 10/1430Z
(line 4)	ZNR
(line 5)	R 1Ø14ØØZ
(line 6)	FM NFDR
(line 7)	TO RUWSC/NALK/USS CARPEN
	RUHPC/NARL/USS LYONEL
(line 8)	INFO RUATAF/COMNAVFORJAPAN
	RUECPA/NAS PAX RIVER
(line 10)	GR 75
(line 11)	BT
(line 12)	Text
(line 13)	BT

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Figure 4-3.—Multiple-address message.

In line 3, the prosign DE means "This transmission is from the station whose routing indicator follows." RUMGC 098 is the routing indicator and the station serial number of the station processing the message tape. The time shown is the local filing time.

The letters ZNR in line 4 constitute a security warning indicating, in this case, that the message may be forwarded without change.

Line 5 shows the precedence and DTG of the message.

Line 6 contains the call sign of the originator.

In line 7, TO indicates the message is for action to addees following TO. RUWSC and RUHPC are the routing indicators that are to protect delivery to the ships having call signs NALK and NARL. The call signs are followed by the plain language version for the two mobile units.

Line 8 contains the information addressees. Again, the routing indicators shown are to protect delivery to the commands indicated.

Line 9, reserved for exempted addees when a collective call sign appears in either line 7 or line 8, is not applicable in this message.

Lines 10 through 13 are self-explanatory.

Line 14, when utilized, is reserved for corrections to the message.

If the relay station, RUMG, has direct circuits with the four routing indicators in line 2, four tapes are reproduced for onward transmission. In relay stations equipped with an MAPU, the tapes are cut automatically. In stations not so equipped, the routing line segregation operator determines the need for, and makes, the required tapes.

Next, the tapes are put into the tape holder at the transmitting position. The transmitting operator selects them in order of precedence. Tapes of the same precedence are selected in order of time of arrival or receipt. High-precedence traffic is transmitted at once, lower-precedence messages being removed from the transmitter if necessary. After selecting the tape, the operator inspects the routing indicator to decide the proper transmitter in which to insert the message.

Supervisory duties may be performed by one man, as is done at many smaller tape relay stations, or by several. Regardless of the number of supervisors, the basic responsibilities are the same.

The relay station supervisor must work in close coordination with watch officers at the radio stations. He is charged with the operation of all circuits and equipment, and with the movement of traffic through the relay station. He assigns personnel to the various sending and receiving positions. The relay supervisor keeps informed of all current operating instructions and changes to them. When an unusual event occurs, he notifies, in turn, the officer in charge, the CWO, and the section chief, making reports as necessary.

The relay station supervisor also maintains the relay station log, which records the opening and closing of circuits and any pertinent information regarding the watch, such as defective circuits, equipment casualties, and abnormal delays to traffic.

Supervision of the transmitting operations of the relay station is the responsibility of the sending supervisor. He instructs operators in the proper methods of inserting tapes and operating transmitters. He ensures that number comparisons are sent at designated times, and that stop and GA messages are complied with. He watches for the faulty operation of sending, automatic numbering, and monitoring equipment. If such a casualty occurs, he immediately notifies the relay supervisor and sends for the maintenance man.

Service operations of the relay room are under the direction of the service and monitor supervisor. These operations include—

1. Locating missent, misrouted, or lost messages and transmitting them correctly.
2. Retransmitting messages that were not delivered to an addressee because of equipment failures.
3. Preparing new message tapes when existing tapes result in faulty transmission.
4. Clearing up garbled or overlined (obliterated) message tapes.
5. Investigating claims of delay or nondelivery of messages handled by the station.
6. Investigating and correcting failures of automatic numbering equipment.

The receiving supervisor is responsible to the watch supervisor for the operation of the receiving positions. He checks the received message records for completeness of the required data (such as circuit designation and date), and inspects and endorses the records every half hour, reporting any open numbers to the service desk. He instructs personnel in the correct handling of tapes, the checking of channel numbers, the special handling of messages of high precedence, and in the general routing of messages.

Classified Relay Station. — The classified relay station operates a high-command (on-line crypto) teletypewriter relay network consisting of classified relay stations linked by channels and circuits of the DCS, utilizing on-line crypto equipment for handling high-precedence classified and unclassified traffic between the commands served by the network. The methods, procedures, practices, techniques, and functions of the classified relay stations are similar to those of the relay stations.

Visual Signal Station. —The visual station, when required, is responsible for the visual branch of communications at the NAVCOMMSTA. The station handles receipt, transmission, and relay of traffic to or from ships entering or leaving port or at anchorage. It parallels the shipboard signal division.

Facsimile Center. —Facsimile is the established system of telecommunication for the transmission of fixed images with a view to their reception in a permanent form. Facsimile transmission consists of sending pictorial-graphic intelligence by wire or radio, and is made via broadcasts to the fleet, from ships to

shore, and by point-to-point circuits. Facsimile transmissions have no inherent security as such, requiring ancillary security equipment to effect secure transmissions. Aside from purely naval FAX facilities, there is also a joint facility maintained by the U. S. Weather Bureau, Navy, and Air Force, called the National Facsimile Network.

The facsimile center of a NAVCOMMSTA has the functions of operating area facsimile broadcasts, working point-to-point facsimile circuits, and receiving ship-to-shore facsimile traffic. It may maintain a drop on the National Facsimile Network.

The equipment used by a facsimile center includes receiver-converters and facsimile transmitter-receivers (transceivers). In addition, the facsimile center has complete darkroom facilities.

The major facsimile operations are the fleet broadcasts, such as the broadcast from Washington (designator WP). Broadcasts are composed mainly of weather and radio propagation charts, but infrequently also may include photos, blueprints, drawings, charts, and other graphic material. At the present time, written messages are not transmitted on facsimile circuits, nor do they carry classified material.

Weather maps originate in a fleet weather central. Transmissions from weather central are carried by wire or radio carrier control link (CCL) to the radio transmitting station, where they are broadcast.

Each item of facsimile traffic carries an identification block, usually in the lower left corner. The identification block contains the standard message heading format, modified as indicated in table 4-1.

Table 4-1.—FAX Traffic Standard Format

Element	Line No.	Explanation
WP NR 115 R 101515Z	3 & 5	Station or broadcast identifying letters; station serial number; precedence prosign; DTG.
FM YASM	6	Prosign FM; originator's designation.
TO NERK	7	Prosign TO; action addressee designation (any or all U. S. N. ships).

Stations in the Naval Weather Service add headings to the weather maps they originate. All other headings are prepared in the message center.

Incoming point-to-point and ship-to-shore facsimile is received at the NAVRADSTA(R), and is carried by landline or radio CCL to the traffic division. Weather traffic goes directly to weather central, and a line monitor in the facsimile unit makes a copy. Material intended for activities served by the traffic division is sent by the facsimile unit to the incoming routing desk of the message center. Facsimile traffic is handled at that position in the same manner as other incoming traffic.

CIRCUIT CONTROL DIVISION.—Personnel in the circuit control division are responsible for operating the equipment in the control center of the NAVCOMMSTA. The control center (fig. 4-4) is a space that, in outward appearance and function, is comparable to a large telephone exchange. It is the entry point for the landlines and the central control point for the intercommunication facilities of the NAVCOMMSTA. Within the control center, all components of the communication center can be interconnected.

The radio and landwire link facilities for remote control of the equipment at the naval radio stations by the other components of the communication center are terminated in the control center. Personnel in the center operate equipment for testing all circuits or channels. Malfunctions are analyzed and remedial action is taken before returning the circuit or channel to its appropriate terminal or user.

Control center personnel operate the equipment for patching circuits or channels to alternate terminals or users, the telephone switchboard, and the associated facilities of the point-to-point telephone channels. They operate the intercommunication system between the control center and the naval radio stations and other components of the communication center and terminal users. Close surveillance is maintained over conditions existing on all circuits and channels, and emergency changes or adjustments to all circuits are directed by personnel in the center.

Control center operators maintain and operate the terminal equipment of the multichannel radio circuits. They operate the frequency measuring equipment in coordination with distant stations and direct frequency shifts. In addition, the facilities required for on-line

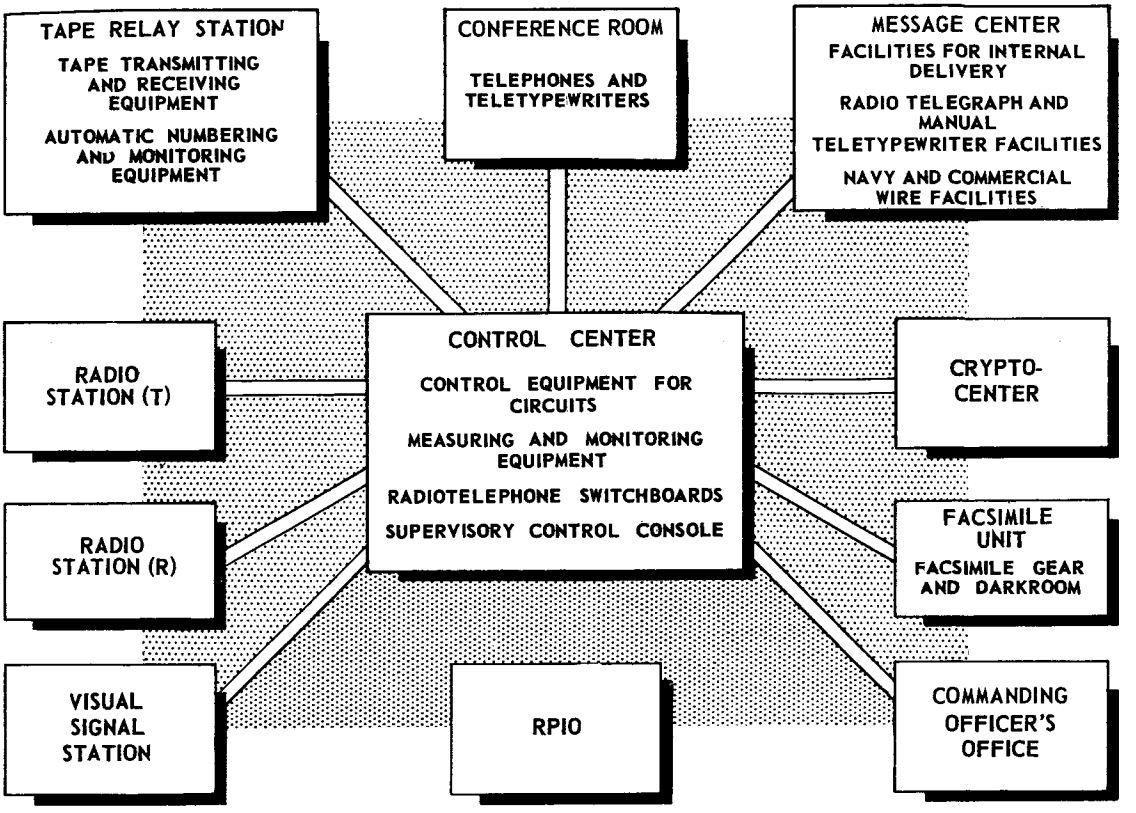

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Figure 4-4. —All components of a communication center are interconnected in the control center.

operation are maintained and operated in the control center.

COMMUNICATIONS MAINTENANCE DIVISION. —Personnel in the communications maintenance division are responsible for maintaining, repairing, and installing the electronic, teletype, and crypto equipment for the entire NAVCOMMSTA and for keeping the electronic allowance records up to date.

NAVAL RADIO STATION(R). —Radio receiving sites normally are located at some distance from both the communication station and the transmitting station. The location of the site is limited by the requirement for a quiet electrical environment permitting best receiving conditions.

Incoming signals usually are received and relayed to the communication station by landline or microwave facilities.

Certain receivers, particularly on ship-shore circuits, frequently are remotely tuned and controlled by the communication station operators. Receivers on long-haul point-to-point links are tuned and monitored by receiving station personnel.

All major communication stations maintain continuous watches on the primary ship-shore CW circuits. When a ship desires to pass traffic, contact is first established by this means. The shore station then directs the ship to a specific RATT frequency for passing teletype traffic.

At the shore station, ship-shore RATT is received on a teletypewriter and reperforator. The page copy made by the teletypewriter is kept for the station file, and the reperforator's tape is used to relay the message by direct wire to the traffic division. A typing reperforator is used to make a tape of CW ship-shore traffic from the receiving operator's copy, and this tape is relayed to the traffic division in the same manner as the RATT traffic.

Messages forwarded to the traffic division are relayed exactly as received, except that they are preceded by a station serial number assigned by the receiving station. As each message is received in the traffic division, the number is checked off on a "received numbers sheet."

The radio receiving station receives point-to-point radio signals and forwards them directly to the traffic division by either landline or a carrier control system. This procedure is used also for both point-to-point and ship-to-shore FAX traffic.

Because the receiving station has facilities for accomplishing special tasks, such as those performed by the communications security division, the security division usually is located at or near the radio receiving station.

NAVAL RADIO STATION (T). — The radio transmitting station usually is separated from the radio receiving station of the communication station. Personnel of the NAVRADSTA(T) operate and maintain 60 or more transmitters for the NAVCOMMSTA. The transmitters vary in capability from less than 1 kw up to a 2-million-watt output.

The circuits requiring transmission from the traffic division to the radio transmitting station go either by landline or by microwave radio link. Instructions concerning transmitting frequencies are passed from the control center to the transmitting personnel via a direct teletypewriter line (order wire). A log is maintained at the transmitting station listing the circuits, frequencies, transmitters in use, changes in any of these, outages, and any other pertinent data. The traffic division usually is notified by telephone of an outage, its expected duration, the reason for it, and other necessary information. (Outage denotes a circuit that is unusable for any reason—atmospheric conditions, equipment failure, and the like.)

A number of equipments are designed for shore radio stations to handle high-power, low-frequency broadcasts, other high-power broadcasts, and point-to-point transmissions. Some of these are link receivers, single-sideband transmitters, frequency shift keyers, and high-power, high-frequency transmitters for shore radioteletype communication. There also is a high-power transmitter of special design for low-frequency broadcasts.

The communication control link (CCL) receiver and its associated transmitter have a frequency range in the VHF or UHF band. It is used to receive signals originating in the traffic division of the radio receiving station, and is transmitted either there or at a special radio link station between the traffic division and the transmitting station. The signals employed may be multichannel telegraph signals using voice frequency tones, voice signals, or a combination of voice and telegraph signals. The audiofrequency range of the link channel is 300 to 12,000 cycles.

Single-sideband transmitters in the high-frequency band are used for long-distance, point-to-point, multichannel, tone, and voice communications.

A frequency shift keyer unit shifts a constant amplitude carrier between two extreme fixed frequencies representing the marking and spacing conditions of the radioteletypewriter signal, or, as with FAX, through a chosen variation of frequencies between two fixed frequency points. There also is a frequency shift keyer designed solely for use on facsimile circuits.

Also in use are special high-frequency, high-power transmitters for radioteletype transmission for shore-to-ship and point-to-point communications. These transmitters have a power output on the order of 40 kw. They have an internal water-cooling unit, as well as motors and blowers, and weigh almost 40,000 pounds. Frequency shift keyers or single-sideband transmitters may be used in conjunction with them.

DUTIES OF OFFICERS. —Because of the many and varied facets of the activities of the NAVCOMMSTA, it may be helpful to acquaint you with some of the particular duties and responsibilities of officers attached to the communication department of the station. Many of the functions discussed are performed to a lesser degree in most communication activities, including shipboard stations.

Traffic and Circuit Control Officer. —The traffic and circuit control officer operates and controls the radio and landline facilities at a major communication activity. He performs the following functions:

1. Supervises communication personnel, such as routing clerks, radio and teletypewriter operators, relay station operators, maintenance technicians, and messengers.

2. Determines workloads and effects personnel distribution to meet prevailing conditions.

3. Provides adequate facilities and circuits to meet communication requirements.

4. Interprets and applies communication procedures and regulations.

5. Conducts traffic studies and analyses to ensure efficient use of facilities and circuits.

6. Maintains current communication guard lists of forces afloat.

7. Investigates causes of delayed or lost messages, and takes appropriate corrective action.

8. Supervises preparation and submission of reports.

9. Controls security of assigned spaces and classified material contained therein.

Communication Watch Officer.—While on watch, the CWO is responsible for all incoming and outgoing traffic. It is his duty to ensure that all messages transmitted or received are handled rapidly and accurately in accordance with existing regulations and orders. The CWO controls communications as the direct representative of the communication officer for the period of his watch. In addition to the knowledge required of all officers performing communication duties, the CWO must have a particularly thorough knowledge of communication methods and procedures, including the internal handling of messages. Primarily, the CWO is responsible for—

1. Ensuring that messages are routed correctly and delivered promptly.

2. Ensuring that messages are prepared and transmitted in accordance with the procedures set forth in the current edition of DNC 5.

3. Maintaining the necessary records of incoming and outgoing traffic.

4. Proper filing of incoming and outgoing messages.

5. Proper operation of the cryptocenter during his watch period.

The CWO maintains a CWO notebook, and ensures that it is not removed from the message center. Immediately upon receipt of special orders, instructions, and information, the CWO notes in the book all data that should be passed on to his relief. The oncoming CWO reads and initials all new entries before relieving the watch.

Cryptosecurity Officer.—The cryptosecurity officer is responsible, under the commanding officer, for the accurate, secure, and efficient operation of the cryptocenter. To this end, he is charged with the following duties:

1. Provides for and supervises the training of all crypto personnel, ensuring that each member of the cryptoboard is thoroughly familiar with the provisions of ACP 122, with such other local service directives as may be issued by competent authority, and with the operating instructions for each cryptosystem he will use.

2. Ensures that all suspected violations of instructions or compromises of cryptosystems are reported promptly. This applies both to those suspected within his own cryptocenter, and those noted in incoming traffic.

3. Ensures that there is present in the cryptocenter at all times during its operation at least one person competent to select the proper cryptosystem for outgoing messages.

4. Requests drafters to make changes in messages, or their classification or precedence, when he believes that errors have been made.

5. Is responsible for the detailed performance of duty by crypto personnel, the assignment of tasks to them, and the supervision thereof.

6. Ensures that there is present in the cryptocenter at all times during his absence a person qualified and specifically designated to have responsibility for the performance of the foregoing duties.

7. When higher authority declares a particular system compromised and directs a review of messages encrypted in that system, the cryptosecurity officer brings to the attention of the commanding officer all such messages encrypted in his command. After reviewing these messages, the commanding officer takes such action as he deems necessary and feasible so far as his own operations may be concerned, and reports to the next higher headquarters any compromise of information involving major operations, strategic intelligence, or significant military planning.

Cryptoboard Members.—Cryptoboards always include commissioned officers as members, but in addition may include warrant officers and competent and reliable rated enlisted personnel who possess communication or general administrative training and are of unquestionable loyalty. All members must have an appropriate security clearance

in their records, and must have the commanding officer's permission for access to the cryptocenter.

Warrant officers and enlisted personnel thus employed, however, must be under the supervision of a commissioned officer who is a qualified cryptoboard member. The supervising officer furnishes the direction and guidance necessary to ensure the efficient and secure operation of the cryptocenter and of the cryptoaids and materials used therein. He must be physically present or immediately available at all times when the cryptocenter is in operation.

Station Relay Officer.—The relay station officer is directly responsible to the communication officer for the organization, administration, and supervision of the relay station. The station relay officer, usually a lieutenant, has two principal assistants: the chief in charge of the relay station, and a civilian administrative assistant.

In addition to supervising operation of the relay circuits and station relay terminal facilities, the station relay officer administers a training program for station relay personnel, provides adequate control of message accountability, and works with other components of the NAVCOMMSTA and with communication officers of other activities to ensure satisfactory service and operation of the station.

Facsimile Officer.—The facsimile officer plans and administers the operations of facsimile receiving and transmitting facilities. He performs the following functions:

1. Directs the location, installation, and maintenance of fixed and mobile facsimile equipment.

2. Supervises the training of communication personnel in all phases of maintenance and operation of facsimile and related auxiliary equipment.

Electronics Material Officer.—The electronics material officer is in charge of the maintenance of the electronic equipment. His primary responsibilities are—

1. Installation, maintenance, and repair of electronic equipment crypto equipment, and teletypewriter equipment.

2. Allowance and plant accounting (i. e., maintenance of records and filing of reports for all installed electronic equipment).

Signal Officer.—The signal officer is in charge of the NAVCOMMSTA visual station. His duties are to—

1. Organize, coordinate, and supervise his personnel to ensure accurate, secure, and rapid handling of communications.

2. Record and report all discrepancies noted.

Security Group Department

The Naval Security Group (NAVSECGRU) protects the area of naval communications by directing the communications security effort. Most of the special functions involved are handled by components of the Naval Security Group located at NAVCOMMSTAs and naval security group activities (NAVSECGRUACTs). Certain operations may be performed, however, by special teams or detachments assigned to the fleet or to other activities of the Navy.

The direction, administration, and coordination of the operations of the NAVSECGRU are the direct responsibility of the Head, NAVSECGRU under the supervision of the Assistant Director, Naval Communications for NAVSECGRU matters. Communication officers should be aware of the following functions performed by NAVSECGRU:

1. Safeguarding U. S. Navy communications against foreign intelligence.

2. Administering the Registered Publications System.

3. Supervising and administering the naval portion of the Armed Forces Courier Service (ARFCOS), including manning and operation of specified ARFCOS courier transfer stations.

4. Supervising the organization and administration of and training within the Naval Reserve NAVSECGRU program.

In addition to the special operations division, which is not covered in this text, the security group department usually is composed of a communications security division, a registered publications division, and a courier division.

COMMUNICATIONS SECURITY DIVISION.—The functions of the communications security division are—

1. Monitoring circuits to find evidence of improper circuit procedures, poor circuit discipline, off-frequency operation, and violation of rules for communication security.

2. Examining and analyzing all message traffic to determine errors.

3. Examining and analyzing all U. S. naval message traffic to ascertain what cumulative intelligence is available to foreign intercept.

4. Issuing communication improvement memorandums (CIMs) to the commands responsible for errors and malpractices in communications.

5. Effecting liaison with communication officers of naval activities on all matters pertaining to communication security.

6. Making training visits to fleet and shore-based activities.

The communication improvement memorandums are designed to invite the attention of communication personnel to procedural errors. They are not official letters to reflect upon the performance of any individual. An exception is made, however, when flagrant violations of communication discipline are uncovered, such as use of obscenity, unauthorized conversations between radio operators, and serious violations involving physical or cryptographic compromises. CIMs should not be used as a basis for determining the winner of a communication competition or for assigning penalties to personnel.

Communication personnel of naval activities should have liaison with communication security personnel and consult on all matters pertaining to communication security. Communication officers of staffs, ships, and stations are urged to utilize the technical knowledge and experience of communication security personnel.

Training visits, designed to improve overall communication procedures, are made by communication security personnel when requested by an activity. The visits are not official investigations or tests. A report of each training visit is made only to the commanding officer of the activity visited. Requests for training visits should be sent directly to the nearest NAVCOMMSTA, NAVCOMMU, or NAVSECGRUACT. All commands should make arrangements for at least one communication security training visit a year, if practicable.

REGISTERED PUBLICATIONS DIVISION.—The registered publications division is responsible for the operation of the registered publications issuing office. The RPIOs, responsible for supplying RPS-distributed publications, are located at points chosen to give maximum support to the Naval Establishment. Although normally components of NAVCOMMSTAs, they may be independent detachments or mobile units. Registered publication mobile issuing offices (RPMIOs) serve under appropriate service force commanders and operate at sea. Sometimes they are temporarily based ashore at a remote location when such location will best serve the fleet.

COURIER DIVISION.—The courier division is charged with the operation of a station of the Armed Forces Courier Service (ARFCOS). The ARFCOS is responsible for the secure and expeditious delivery of authorized classified material to military addressees and certain civilian agencies throughout the world. It is designed to eliminate duplication of effort and expense through the use of strategically located interservice courier transfer stations.

Officer messenger mail (OMM) centers, formerly operated within RPIOs, have been designated as courier transfer (CT) stations. Although OMM facilities still are frequently located within RPIOs and are operated by RPIO personnel, this no longer is an assigned mission of the Naval Communication System. The establishment and maintenance of facilities for handling officer messenger mail is the responsibility of the local commander.

The Naval Communication System is charged with operating the Navy's proportionate share of the approximately 60 courier transfer stations located throughout the world. The operation of local courier systems is the option and responsibility of local commanders.

NAVCOMMUS; TRIBUTARY STATIONS

Although much of the work of the Naval Communication System is done by the NAVCOMMSTAs and independent facilities, important functions are performed by naval communication units. The two departments in a NAVCOMMU are the communication department and the administration department.

A NAVCOMMU is under an officer in charge rather than a commanding officer. The assistant officer in charge has collateral duty as head of the administration department.

The communication department includes the message center, the cryptocenter, relay station, control room, classified relay station, visual signal station (if applicable), receiver station, and transmitter station. The functions of the communication department are the same at a NAVCOMMSTA and a NAVCOMMU.

The communication departments of naval bases, naval stations air stations, and other shore activities primarily provide local communication support for the activity of which they are an organic component. They furnish fleet support facilities air operational support facilities, and such extra-local service as may be required. They disseminate information and convey reports, progress data, current status information, and similar intelligence to the command or activity. In addition to providing local communication support, a communication department usually is a tributary of the Naval Communication System.

A communication department normally consists of a communication center, including wire and radio transmitting and receiving equipment, associated control equipment, cryptocenter, and such other equipment as local circumstances and requirements may dictate.

NETWORKS AND CIRCUITS

For point-to-point communications ashore, the NCS uses both radio and landline circuits. The largest share of traffic between these fixed stations, however, is carried by the teletypewriter (tape) relay network. This network includes certain channels of the radio trunk circuits, particularly overseas circuits, and practically all landline circuits.

The three principal methods used for transmitting messages to the fleet via radio circuits are broadcast, intercept, and receipt. These methods are discussed following the next section on point-to-point relay communications.

RELAY NETWORK

Stations comprising the worldwide relay network are designated as primary relay, major relay, minor relay, and tributary (terminal) stations. These designations are synonymous with the designations of their respective communication centers.

Traffic is handled in the network by tape relay, i.e., messages are both received and routed to their destinations or next relay points in tape form by means of either semiautomatic or automatic equipment.

Routing Indicators

A tape is routed in the network by means of a routing indicator, which is a predesigned group of letters assigned to identify a station (addressee) within the teletypewriter network. The proper assignment of a routing indicator is particularly important because of the possible relay by completely automatic equipment. Figure 4-5 shows the routing indicators for the relay stations and several of the tributary stations of the naval teletypewriter network.

It can be seen in figure 4-5 that the routing indicators are combinations of four or more (usually four to seven) letters. The first letter (R) identifies each group in the illustration as a worldwide relay network routing indicator, and distinguishes the group from a call sign, address group, or theater routing indicator. (The last is a self-contained localized network within a command or theater.)

The second letter of the indicator group identifies the nation or international alliance to which the group is alloted. In each group illustrated, the letter U indicates United States. In general (but not always), the second letter identifies the country by association—U for United States, D for Denmark, I for Italy, and so on.

The third letter identifies the geographical area in which a particular station is located or from which it is served. This is necessary for relay purposes because in a number of instances the second letter indicates a large nation with a number of stations (as the U. S.) or a group of small nations.

As you can see in figure 4-5, stations in the United States are designated by the third letter C, E, or W, based on the geographical position of the station. On the other hand, stations in Guam and the Philippines are blanketed by the letter M because of their proximity and a RATT trunk circuit.

The fourth and subsequent letters of a routing indicator designate relay and tributary stations.

Theater teletypewriter routing indicators are those used within a command or theater of operations, or which support a homogeneous purpose or activity. They are distinguished from the indicators used in the worldwide relay system in that the first letter is U instead of R. The meanings of subsequent letters are the same as those used in the worldwide system indicators. Local routing indicators, however, may not be used in the headings of messages transmitted over the worldwide relay system.

SUFFIX LETTERS. — Suffix letters may be added to routing indicators to aid the routing of

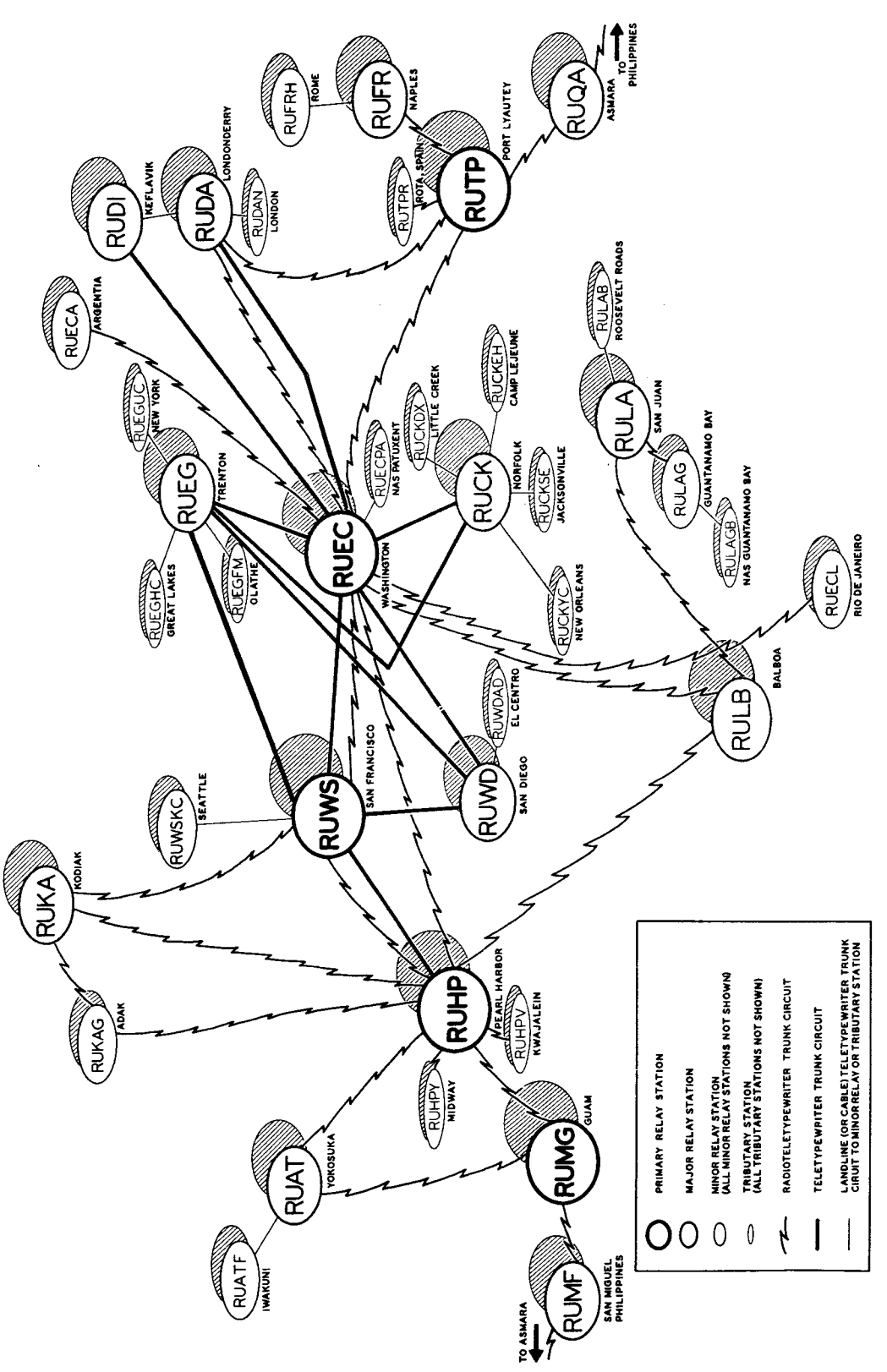

Figure 4-5.—Routing indicators used in the Naval Teletypewriter and Tape Relay Network.

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tapes for processing purposes or for other localized action by the relay station, including its supplementary sections or facilities. The authorized suffix letters are the letter C alone and certain two-letter combinations from CA through CZ. The use of these suffixes for intraservice messages is optional, but they are not used in joint or combined messages unless they appear in the routing columns of the encode sections of the combined worldwide routing indicator book. The meanings of authorized suffixes follow:

C—Local delivery of refile in page form is required.
CF—Section that accomplishes delivery by broadcast methods.
CI—Section that coordinates routing information.
CM—Section that prepares tape copies for retransmission.
CN—Electrical conference facility or section.
CP—Circuit/facility control point.
CR—Cryptocenter.
CS—Section dealing with service messages.
CT—Section that accomplishes delivery or traffic by telephone.
CU—Section that accomplishes delivery of traffic to commercial carriers.
CW—Section that relays traffic by radiotelegraph (CW).
CX—Section that uses tape relay methods for delivery of traffic to activities served by a military or commercial teletypewriter exchange system.

LEASED TELETYPEWRITER EXCHANGE SERVICE

Commercial teletypewriter exchange service (TWX) is employed by the Naval Communication System for communication with activities for which there is insufficient traffic to justify a full-time teletypewriter line.

The TWX service is supplied by a telephone company. The equipment is owned, installed, and maintained by the company. Teletypewriter communications are available to any TWX subscriber; subscribers and their TWX numbers are listed in a TWX directory. Connections for TWX communication are made by the telephone company TWX operator in a manner similar to a long-distance telephone call. The company is paid for the time used in actual communication with another station.

Normally, traffic for naval activities served by TWX is routed to a designated relay station rather than transmitted directly to the addressee by TWX, unless the TWX addressee is within a certain distance of the originator. This method of routing results in a considerable saving because the long-haul portion of the traffic travels over Navy-leased lines. The only cost is for the short-distance transmission between the nearest relay station and the addressee.

Relay of TWX messages to naval activities is facilitated by the assignment of routing indicators to facilities served by TWX. Activities equipped only with TWX facilities are designated by a routing indicator ending with the letters CX. The letters preceding CX in the indicator identify the relay station that transfers traffic routed via the relay network to and from the TWX-served activity. Because a particular routing indicator ending in CX may apply to several TWX-served activities, messages (including service messages) to the TWX-served activities must bear a complete address. The CX at the end of the message routes the message to the TWX section of a communication center, where the operator must read the address portion of the tape to determine the destination.

CIRCUIT TYPES

In discussing circuits, it should be noted that the word has a different meaning as a communication term than as an engineering term. When employed in the latter sense, it refers to a number of components connected electrically for the purpose of performing some desired function. As a communication term, a circuit is an electronic path between two or more points capable of providing one or more channels for the transmission of intelligence.

The four types of teletypewriter circuits are as follows.

A HALF-DUPLEX (or simplex) circuit is a landline circuit used for one-way communication between stations. It permits transmission in both directions, but not simultaneously.

A DUPLEX (or full duplex) circuit is a radio or landline circuit over which transmissions between stations may take place in both directions simultaneously.

MULTIPLEX (MUX) is a circuit capable of transmitting and receiving multiple teletypewriter messages simultaneously. Each

message is placed on a separate channel, and the channels are combined by using time division on a single carrier frequency.

A SINGLE-SIDEBAND (SSB) circuit is capable of transmitting and receiving simultaneously the information contained in up to 16 teletypewriter or RATT channels and one or more voice channels on both the upper and lower sideband frequency. (See chapter 7.)

RADIO TRANSMISSIONS TO THE FLEET

Three principal methods are used for transmitting messages to the fleet: broadcast, intercept, and receipt. When either of the first two methods is used, fleet units copy all transmissions but do not answer, thus avoiding the disclosure of their positions as happens when the receipt method is used. The broadcast and intercept methods have one common disadvantage in that there is no positive assurance that the message, as transmitted, has been received by the station called. This disadvantage is minimized by using transmitters of adequate power, careful choice of frequencies, good operating technique, monitoring transmissions for accuracy, and sequential serial numbers.

Broadcast Method

The broadcast method of transmission, as already stated, is the primary method of delivering traffic to the fleet. With this method, information transmitted is contained in sequentially numbered messages addressed to ships concerned. Communication personnel on each ship ensure that they have a complete message file (this is mandatory for all units and commands) by checking the sequential serial numbers.

A broadcast message serial number consists of the letter designating the broadcast area (as shown in fig. 4-6). Transmissions other than CW consist of a letter indicating the type of broadcast (RATT—R, facsimile—P (photo)), the abbreviation NR (number), and the sequential number of the message issued by the appropriate broadcasting station. For example, WR NR 105 is the one hundred fifth message broadcast during the month by RATT (R) from NAVCOMMSTA Washington (W); G NR 7 is the seventh CW fleet broadcast transmitted during the month by NAVCOMMSTA Guam. (The transmission is understood to be by CW unless otherwise indicated.) The serial number appears as the first item of the procedure component of the message. The first message of the month is number 1. Succeeding messages are numbered sequentially until the end of the last day of the month, at which time a new series is begun.

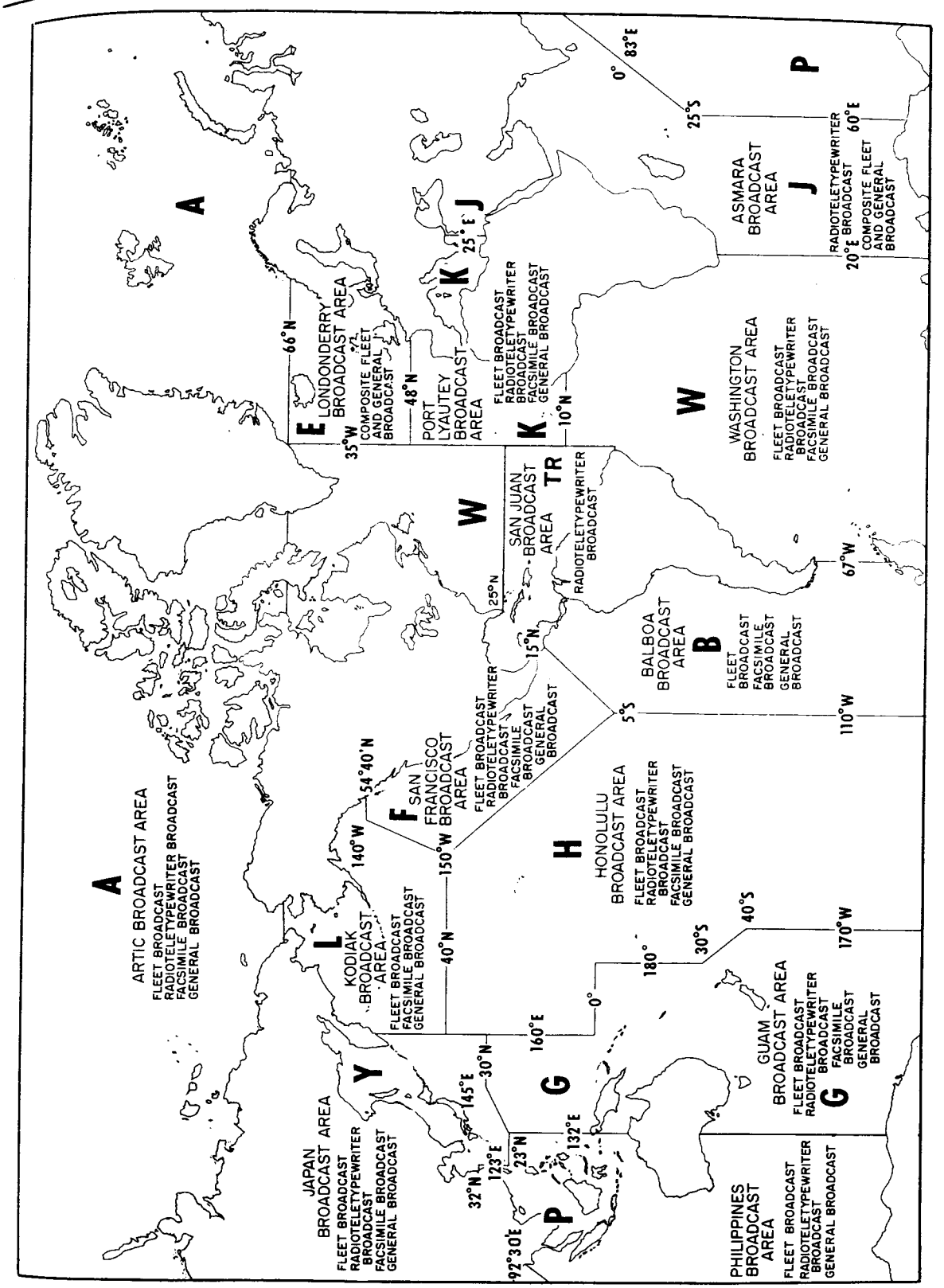
Fleet units and commands are required to guard a designated broadcast frequency that usually, but not always, is the frequency of the broadcast area within which they are operating.

On CW circuits, broadcasts follow regular schedules; no deviation is made without previous notification to the fleet. Messages are placed on these schedules in order of precedence. If a message with a precedence of immediate or higher is given to the transmitting station while a message of lower precedence is being broadcast, the lower precedence message is interrupted (unless only a short portion remains to be transmitted), and the high-precedence message is sent out. On RATT circuits, which have continuous broadcasts, a device may be keyed to ring bells on all receiving teletypewriters to call the attention of personnel to an incoming high-precedence message. It is possible that a long, low-precedence message that was interrupted may not be completed until the next schedule. Messages usually are not repeated on subsequent schedules. All ships copy schedules and maintain a complete file of all broadcast messages, but only the addressee takes action on any message.

To ensure reception by all units, the broadcast station employs several transmitters simultaneously—normally one very-low-frequency or low-frequency transmitter, and as many as five high-frequency transmitters. Most ships copying a broadcast tune to a low frequency and a high frequency, or to two high frequencies.

Broadcasts employ automatically keyed radiotelegraphy, radioteletypewriter, and radio facsimile. In the first method, messages are perforated on tape, and fed into a machine that keys them at a speed no greater than 29 words per minute. Ships with RATT equipment copy the RATT broadcasts, and do not copy the CW schedules. Facsimile broadcasts usually are limited to weather maps and similar material.

In addition to the fleet broadcasts, broadcast stations also transmit general broadcasts. General broadcasts include hydrographic warnings, notices to mariners, merchant ship traffic (MERCAST), and weather reports. In some



76. 1

Figure 4-6.—Broadcast areas.

areas, general broadcasts also include press and time signals.

Intercept Method

Using the intercept method, the transmitting shore station sends to a second shore station. The latter obtains necessary repetitions to ensure correct reception, and repeats back. Messages thus transmitted are actually intended for third stations or ships, which are required to copy the transmissions but do not receipt for them or use their transmitters for any other purpose directly in connection with these transmissions.

The intercept method has an advantage over the broadcast method in that the necessary verifications can be pointed out and corrections obtained. In addition, the third party has two opportunities to copy the same transmission. Despite these advantages, the broadcast method is superior in that it affords a higher degree of security and greater amounts of traffic can be handled in a given period. For this reason, the intercept method is not currently employed within the U. S. Navy.

Receipt Method

The receipt method of transmitting messages is a system of delivery in which the receiving station indicates that it has received each transmission. This may be done by the receiving station transmitting a receipt after each message or sequence of messages, or by making a periodic station serial or channel number comparison with the transmitting station.

The receipt method is the normal method of handling radiotelegraph point-to-point, ship-to-ship, ship-to-shore, and aircraft traffic. It also may be authorized by responsible commanders for shore-to-ship communication in peacetime and, under exceptional circumstances, in wartime.

The receipt method is the most reliable way of handling traffic because no doubt exists concerning the addressee's receipt of the message. Repetitions and corrections may be obtained as desired at the time of transmission.

A decided disadvantage in using the receipt method in wartime is that the location of both stations may be disclosed to the enemy through direction-finding equipment. In addition, the identity of the station using this method may be disclosed because of the use of individual call signs.

SHIP-SHORE RADIO CIRCUITS

Besides their responsibilities for operating fleet and general broadcasts, NAVCOMMSTAs are the principal agents in receiving radio traffic from the fleet. The primary means for delivering this traffic from individual ships to shore stations is via the ship-shore radio circuits. Certain NAVCOMMSTAs maintain a continuous guard on the fleet ship-shore circuit. Stations that do not guard the primary ship-shore circuits may guard special area ship-shore circuits instead. At many communication stations, a guard also is maintained on secondary ship-shore and harbor common circuits. These ship-shore frequencies are not used for point-to-point transmission, but rather as contact frequencies, the station then shifting to the working frequency.

CHAPTER 5

CONVOY COMMUNICATIONS

Although now generally accepted, convoys were once the subject of bitter but sincere arguments by professional seamen, many of whom felt that concentrating the targets in one area merely made it easier for the enemy. Statistics prove the worth of the convoy system of ocean transit and, in the event of future wars, resort to their use again, although probably modified somewhat because of nuclear warfare capabilities, seems inevitable.

When many ships steam in company, the communication problems are difficult. In a convoy the predicament is even more extreme because merchant vessels as well as naval vessels are involved. One must remember that the naval officer spends most of his years at sea steaming in company with other ships, whereas the merchant marine officer, during peacetime, is steaming independently almost constantly. Communications are further complicated by the language barrier. Convoys usually are made up of ships of many nations, traveling in company for mutual safety but manned by people who speak in different tongues. To be able to solve the problems, one must first understand the basic characteristics of convoys. Let us start by discussing the peacetime merchant ship communication systems.

PEACETIME MERCHANT SHIP COMMUNICATIONS

The naval communication network is vast, complicated, and expensive. No privately owned shipping company could afford to support such a network or, for that matter, have need for such extensive facilities. Yet, the need for rapid communications between masters and shipowners is apparent. In the same way that corporations and individuals ashore obtain access to rapid communication facilities by subscribing to commercial telegraph and telephone companies, so the merchant shipping companies contract with radio service companies. There are a number of such companies, but the majority of U.S. flag vessels subscribe to one of four. They are RCA Communications, Inc. (RCA), a subsidiary of Radio Corporation of America; Mackay Radio and Telegraph Company (MRT); Globe Wireless; and Tropical Radio Telegraph Company (TRT).

The four radio service companies have shore stations located throughout the areas of the world served by them. They have contracts with other radio companies in foreign lands, enabling a merchant ship to remain in communication with its company office. As a ship steams about the oceans, it always has available—depending on atmospheric conditions—a shore-based communication facility to which its messages may be sent. Once a message is received ashore, it is retransmitted through the radios and landlines of the radio service company and its affiliates until it reaches its ultimate destination. Messages to the ship are handled in much the same way.

Communication procedures practiced by merchant ships, regardless of nationality, are comparatively similar to U.S. Navy procedure but less formal, chiefly because of language differences. Operating (Q) signals have extensive application in merchant ship communications. The Q signals are international in the sense that they have the same meaning in any language, enabling radio operators of different nationalities to talk among themselves. (ACP 131 contains both operating Z signals (already discussed) and appropriate Q signals.) Normally, the receipt method of communicating is used, both transmitting and receiving stations being required to use their transmitters. Such a system obviously is reliable, but is unsafe in wartime.

CONVOY PERSONNEL ORGANIZATION

Like any operating force, a convoy must have some sort of organization. From the standpoint of the communication officer, the primary interest is in the personnel organization.

OFFICER IN TACTICAL COMMAND (OTC)

The officer in tactical command of the convoy, who also is the escort force commander, is responsible for the safe and timely arrival of the convoy at its destination. His responsibilities include defense of the convoy, stationing of escorts, employment of aircraft escorts, ordering courses and evasive steering, ordering the convoy commodore to execute emergency turns, liaison with the convoy commodore regarding safety of navigation, and establishment and control of an effective communication plan.

CONVOY COMMODORE

The convoy commodore usually is a naval officer preselected and assigned to the position. If a suitable officer is unavailable, a commodore is selected from among the masters of the ships constituting the convoy. He is designated to command the ships within the convoy subject to the orders of the OTC. The commodore is responsible for the internal arrangements of the convoy, tactical control subject to orders from the OTC, assignment of stations and station keeping, issuing instructions regarding safe navigation (usually in conjunction with the OTC), readiness for action, and conduct of action by the convoy. In the absence of an escort, he is in complete command.

Masters of merchant ships are notoriously independent individuals who, at best, tolerate the restrictions imposed upon them by the rules of the convoy. They have spent most of their lives at sea steaming independently and usually are not expert at station keeping. Many masters take a critical view of young naval officers coming alongside and issuing terse orders for them to "Stop making smoke" or "Douse those lights." Thus, the convoy commodore enters the scene.

During World War II commodores usually were retired Navy captains, recalled to active duty and assigned to permanent duty as commodores of convoys. Their ages and years of experience as sailormen, together with the natural brotherhood of all who make the sea a profession, particularly suited them for command of a convoy. The convoy commodore passes many orders to the various masters from the escort force commander. As naval officers, the commodores more readily accepted the logic of the escort force commander being in tactical command, although possibly junior in rank.

The convoy commodore may be assisted by a vice commodore and rear commodore, each of whom would assume the duties and responsibilities of the commodore in the event of his removal from the scene. If the convoy consists of more than one section, the vice commodore and rear commodore usually are ordered to command those sections.

When vice commodores or rear commodores are not designated previously, the convoy commodore appoints special commodores, as necessary, to head leaver sections of the convoy; their duties commence when their sections break off from the main convoy.

MASTERS

The escort force commander is designated OTC of the convoy. Masters are obligated, therefore, to obey his commands as well as those of the convoy commodore. A master, notwithstanding, always retains primary responsibility for the safe navigation of his ship, including the ship in which the commodore may be flying his pennant.

In general, commodores and escort force commanders are not answerable for the action or inaction of individual ships, even though they may be responding to a signal ordered by either the commodore or the OTC. Escorting ships and convoy formations are designed to provide military security and defense against enemy attack, but none of these measures relieves the master from responsibility for his ship.

Under the International Rules of Warfare, a distinction is made between a merchant ship and a warship. The latter is designed to seek out the enemy and destroy him in the Nelsonian tradition. A merchant ship may not attack aggressively. She may, however, exercise her right of self-protection by defending herself. In the event of attack by enemy forces, the decision to resist lies with the master. His decision to resist carries with it responsibility for the consequences of his action. The master is not permitted to ignore the safety of the passengers or crew when escape has been prevented or resistance overcome.

RADIO OFFICER

Each merchant ship carries at least one radio officer. Large passenger liners have

many more. If there is only one, he holds an officer's rank and prerogatives but does not have executive authority. When more than one is aboard, the senior radio officer has executive authority over the junior radio officers. The radio officer is responsible to the master and receives his orders from him or his designated subordinates, such as the first mate and the watch officer.

To qualify for his position, a radio officer must have attended radio school and must have a second class radiotelegraph license. Where radiotelephone equipment is installed, he also must hold a second class radiotelephone ticket. These licenses are issued by the Federal Communications Commission after successful completion of a comprehensive examination. During peacetime, the operator is required by law to display his licenses in the radio room.

No watches are stood in port during peacetime. Harbor regulations in some ports require that antennas be disconnected or that some other means be used to prevent transmissions. During wartime the standing of radio watches is governed by orders issued by the local naval authority.

Agreements between shipping companies and unions require a radio officer to stand watch no more than 8 hours a day. When only one operator is aboard, it is obvious that continuous watches cannot be maintained. The master may designate the hours of the watch, but he usually defers to the radio officer's greater knowledge, letting him set his own working periods. Working schedules vary, depending somewhat on the location of the ship. The radio officer adjusts his routine to allow transmission of messages during that period of the day when atmospheric conditions are most favorable, yet not prevent him from carrying out his other routine duties, such as taking radio bearings or time ticks.

NAVAL COMMUNICATION LIAISON OFFICER

U.S. convoy ships may have a U.S. naval communication liaison officer (NCLO) assigned. His duties include the efficient conduct of all communications and supervision of all communication personnel. In detailed terms, the NCLO is responsible for—

1. Setting communication and radar watches.
2. Efficient performance of the personnel on watch.
3. Proper logkeeping.
4. Preserving radio silence.
5. Aiding the master in drafting messages that must go by Navy channels.
6. Supervising the delivery of incoming messages.
7. Attending presailing convoy and communication conferences.
8. Preventing unauthorized persons from entering the radio rooms.
9. Making nonapproved private broadcast receivers inoperative at sea.
10. Supervising the upkeep of visual signaling gear (but not the radio equipment, which is maintained by the ship's radio operator).
11. Arranging for the emergency disposal of classified matter.
12. Assuring that identification signals are available on the bridge (if the ship is sailing independently).
13. Seeing that the radio room receives the information and publications necessary for its efficient operation.
14. Assuring that communication and radar personnel are familiar with pertinent publications; that they know the communication plan, distress procedure, the often-used call signs, and appropriate MERCAST information; and that they follow security measures.

In the execution of his duties, the NCLO should display a spirit of courtesy and cooperation with the merchant marine officers, and do everything he can to promote harmony between the Navy and maritime personnel. In supervising radio watches, the NCLO should see that there is no discrimination against either merchant radio officers or Navy radiomen.

Certain merchant vessels have radar equipment for use in navigation. The master of the vessel, in consultation with the NCLO, decides when the equipment should be used. The supervision and security of the radar equipment are the direct responsibility of the NCLO. Radarmen are a part of the Naval communication liaison unit. Security arrangements must be made for the gear, and unauthorized persons are not permitted access to radar equipment either at sea or in port. Detailed instructions and information are promulgated to NCLOs and masters by the Chief of Naval Operations.

Relations With Master

The NCLO is directly responsible to the master of a merchant ship for the performance

of his communication duties. He may have other tasks assigned by the Navy, but none of the collateral duties may be construed as giving the NCLO the right to disregard the ultimate authority of the master.

In accordance with law, the master of a merchant ship commands the vessel, is charged with her safe navigation, and is responsible for everything connected with the operation of his ship, except for certain functions of the armed guard commander.

The Navy holds the master accountable for violation of merchant ship communication instructions; he is required to make all such instructions available to the NCLO.

The NCLO is required to call the master's attention to any breach of wartime instructions for merchant ships or other official instructions concerning the security of the ship. If the master decides to disregard the advice of the NCLO, the latter's responsibility in the matter is ended, unless the problem is of sufficient importance to warrant mention of it in the NCLO's voyage communication report. In this respect corrective action is taken by the Naval port control officer.

The liaison officer is responsible for procuring VHF radio equipment and for providing the master with a list of other needed items before the ship reaches port.

Relations With Armed Guard Commander

The armed guard commander is responsible to the escort force commander for the administration and discipline of naval personnel permanently assigned to the ship. The NCLO, although subject to the military administration of the armed guard commander, is responsible for effective operational communications.

Unless a state of emergency exists at sea, communication personnel are assigned only to communication duties. In planning personnel requirements for gun stations, the armed guard commander consults the NCLO. The NCLO makes provision for emergency communication stations on the bridge and in the radio room, and designates the remainder of the communication personnel as available for gun stations. It is well for all communication personnel to be trained for gunnery duty in emergencies.

The NCLO provides the armed guard commander with copies of incoming messages that concern the safety and defense of the ship.

In port, the armed guard commander sets the security watches, and the NCLO sets required communication watches. Security watches must not interfere with the signal and radio watches. Communication and radar personnel are not assigned gunnery duties while in port. After consultation with the NCLO, the armed guard commander arranges leave and liberty for communication and radar personnel.

Relations With Commodore's NCLO

When an NCLO is attached to the staff of the convoy commodore, each convoy NCLO is responsible for his performance of communication duties to the staff NCLO as well as to individual masters. Should there be no staff NCLO, the liaison officer of the flagship acts in that capacity.

Administration

Naval personnel are quartered in their own spaces aboard a merchant ship. They are provided with their own mess and are fed from merchant ship stroes provided by the steward's department; the Navy is billed for the food. The NCLO is a member of the wardroom mess and is provided with a cabin in officers' country. Just as aboard Navy ships, he pays a monthly mess bill.

It is vital that the NCLO develop a cordial working relationship with the officers of the ship. Mutual understanding and cooperation make everyone's job easier. The ship's officers will give the NCLO a helping hand when he needs it, and look to him for advice on naval matters.

For certain invasion and support-invasion movements, specially trained communication teams, known as XAK and XAP teams, are assigned to some merchant ships. In communication matters, the NCLO is subject to the authority of the officer in charge of the team.

The NCLO has responsibility over the advancement in rating of quartermasters, signalmen, radiomen, and radarmen. The armed guard officer handles advancements within the gun crew.

MERCHANT SHIPPING CONTROL

In time of war or national emergency, effective control of merchant shipping assumes paramount importance. Indiscriminate sailing of merchant ships presents the enemy with an

enormous number of ill-protected targets. The demands of military authority on the use of the available ships override their purely economic use.

A future war might develop with such rapidity that many U.S. merchant ships would be at sea. Such shipping would require protection, and at the same time should be available to naval commanders for implementing evacuation and emergency plans.

Should it become necessary, the Chief of Naval Operations, using every available communication system, will broadcast in the clear an emergency message directing masters of U.S. merchant ships to (1) proceed in accordance with instructions included in the message, or (2) proceed to the nearest U.S. or friendly port along their projected route, and (3) place in effect wartime procedures affecting the safety of their ships. At the various ports the masters will report to the appropriate shipping control authorities for further instructions.

U.S. NAVAL CONTROL OF SHIPPING ORGANIZATION

Worldwide direction of naval control of shipping is exercised as the result of agreements between the Allied Governments. The present U.S. Naval Control of Shipping Organization (NCSORG) was established, under the Chief of Naval Operations, shortly after the outbreak of the Korean conflict.

The mission of the NCSORG is to provide for the safety of movement of merchant ships in time of war or national emergency. In peacetime, it prepares to execute that mission. The operational control and protection of merchant shipping are delegated to certain naval theater and area commanders, who are designated as operational control authorities (OCAs). The in-port phases of shipping control are administered by naval control of shipping officers (NCSOs), reporting officers (REPTOFs), consular shipping advisers (CONSAs), and naval control of shipping liaison officers (NCSLOs). Their official titles in the NCSORG are determined by their geographical locations, e.g., NCSO San Francisco or REPTOF Hong Kong. These officers are responsible to their OCAs through the normal chain of command.

An OCA has many responsibilities, among which are—

1. Maintaining a system of communications, intelligence, and plotting to ensure adequate dissemination of antisubmarine information.
2. Coordinating all convoy schedules for his area.
3. Coordinating shipping movements with OCAs of adjacent areas.
4. Ensuring that ships are sailed in accordance with instructions of the theater commander.
5. Diverting shipping.
6. Designating routes, breakoff positions, joiner positions, and rendezvous positions for convoys sailing from ports in their area.
7. Maintaining operational control over shipping control authorities at ports and bases within their area.
8. Reporting reductions in capacity of ports within their area to the theater commander.

Naval Control of Shipping Officer

It can be seen that the OCA is an area authority concerned with problems of great scope. The merchant ship masters and officers attached to escort vessels, however, are concerned most with the NCSO, who administers the NCSORG for the particular port to which he is assigned. When under naval control, a merchant ship master normally receives his orders from the NCSO at the port from which he is sailing, and reports to the NCSO at his destination promptly upon arrival.

In general, the NCSORG staff is made up of personnel of various Allied Nations, the NCSO himself being senior and normally of the nationality of the country in which the port is located. Under the supervision of his OCA, the NCSO discharges the following duties:

1. Organizes and routes ocean and coastal convoys leaving his port.
2. Routes merchant ships sailing independently.
3. When ordered, routes warships and task forces.
4. Instructs and briefs convoy commodores, their staffs, and masters of independents.
5. Convenes convoy conferences.
6. Issues charts and publications needed for convoys.
7. Reports arrivals and departures.
8. Reports overdue shipping.
9. Maintains shipping plots and convoy records.

10. Prepares convoy communication plans in cooperation with the escort force commander and convoy commodore.

11. Instructs convoy communication personnel and ensures that equipment is in good order.

By means of direct inspections and personal interviews, the NCSO familiarizes himself with the various ships to be convoyed, their destinations, and cargoes. He then decides which ships should proceed in a particular convoy, assigns the flagship for the convoy commodore, and prepares sailing orders.

The basic responsibility of the NCSO is to organize and route both transocean and coastal convoys. Included in organizing and routing are dissemination of the actual routes to be followed and the details of departure, rendezvous, and convoy breakoff into leaver sections. Strict attention to considerable detailed work is required to perform his basic task. Particulars are worked out in the convoy conference held immediately before departure of the ships. The NCSO makes all the necessary arrangements for this conference. It is his duty to conduct the agenda so that there is a free interchange of information and ideas between the commodore and his staff, the OTC and his individual commanding officers, masters of the merchant ships, and the NCSO himself.

Reporting Officers

Other in-port administrators (REPTOFs, for instance) primarily are reporting links assigned to small ports in the NCSORG. They are either appointed officers or designated agents performing, on a smaller scale, the functions of an NCSO. Ships sailing to small ports usually are given return routes in advance, necessitating only arrival and departure reports by the in-port official.

CONVOY CONFERENCE

A convoy conference is held at the last practicable hour before the ships sail. The NCSO provides a suitable place to hold the conference and notifies, well in advance, all personnel who should attend. Attending the conference should be the escort force commander and his staff; escort force commanding officers and their operations and communication officers; commanding officers of supporting units or activities; convoy, vice, and rear commodores and their staffs; masters of all ships; all NCLOs; and the senior communication personnel of each ship. The major purpose of the conference is to promulgate the plans adopted for the sailing of the convoy and to resolve any difficulties that may exist.

The NCSO explains the command organization and responsibilities of the various commanders, the procedure for departure, instructions for keeping the various logs and records, and the convoy diagram showing the stationing of each ship. Communication procedures are discussed, as are navigational problems. The NCSO is followed by the convoy commodore and the escort force commander, who elaborate on the convoy maneuvering instructions and ensure that all the masters are familiar with the tactical and communication publications. Methods for transferring and replenishing at sea and special action to take in the event of enemy attack are emphasized. Instructions in recognition and identification are given. The masters are encouraged to ask questions, and the meeting does not terminate until all personnel understand their duties and responsibilities.

A communication conference, conducted by the NCSO or his staff communication officer, is held as part of the convoy conference or immediately thereafter. The conference is attended by the NCLO, the chief radio operator, and the senior Navy radioman of each ship, and by the communication officers of the commodore's staff and the escort ships. It is held to acquaint those attending with the detailed contents of the convoy communication plan, and to resolve any difficulties or misunderstandings concerning requirements and procedures. Communication problems are discussed, and detailed radiotelegraph, radiotelephone, and visual procedures are explained. It is imperative that the communication plan be studied and understood before departure, because it contains instructions vital to the safety of all units in the convoy.

MERCHANT SHIP BROADCAST

The MERCAST (broadcast to merchant ships) system is used for delivering official messages originated by Government agencies and addressed to merchant ships. Personal messages are filed with a commercial carrier.

Under the MERCAST system, a number of naval shore radio transmitting stations are assigned areas of broadcast responsibility. In peacetime, these areas conform closely to fleet

broadcast areas. (See fig. 4-6.) In time of war, when the Navy may have control over U.S. flag merchant ships, the broadcast areas are augmented to provide both worldwide and local-area coverage through the use of MERCAST coastal stations.

Area stations broadcast at scheduled periods simultaneously on one medium frequency and one or more high frequencies. This broadcast method ensures that each ship in the area can copy the schedule on whichever frequency is most favorable, taking into account the atmospheric conditions and the time of day. The transmission of traffic commences precisely at the scheduled time and continues within the scheduled limits until all traffic is cleared. During the international silent periods (from 15 to 18 minutes and from 45 to 48 minutes past each hour, reserved for listening for distress signals) the MERCAST schedule is interrupted so that ships may shift to 500 kc (the international distress frequency).

The initial part of each MERCAST transmission includes a preliminary callup, a traffic list consisting of the radio call signs of ships to which messages are addressed, and the DTG of each message. All ships at sea are required to copy the traffic list. A ship (except a MERCAST guard ship) for which no traffic is scheduled is not required to copy the remainder of the broadcast and reverts immediately to the normal guard of 500 kc. Messages ordinarily are transmitted at a speed no greater than 18 words per minute, and normally they are sent only once. Flash and Immediate precedence messages, however, are transmitted on each of two consecutive schedules. Unless specific instructions to the contrary are contained in the text of a message, ships must not break radio silence to respond to, or in any way acknowledge, MERCAST traffic. Except for MERCAST, messages for an individual ship in a convoy usually are addressed to the escort force commander, with instructions to pass to the ship concerned.

Merchant ship general messages are transmitted on MERCAST by means of collective call signs in the traffic list. All merchant ships under Allied control must copy these messages and maintain them until they are cancelled or superseded.

Sailing orders received by each ship before sailing include instructions on the date and time to shift from one area MERCAST broadcast to another. The time usually is such that no difficulty is experienced in copying the appropriate broadcasts. When convoys or independents are diverted, the OCA must include instructions amending the time(s) of shift.

INTRACONVOY COMMUNICATIONS

The remainder of this chapter deals mainly with communications within a convoy. It might be beneficial, however, to first mention some important aspects of convoy communications in general. The term "convoy communications," of course, implies a state of national emergency or wartime conditions.

The CW frequency common to all ships in a convoy is 500 kc. The voice radiotelephone frequency common to all ships in a convoy, and between the convoy and the escort, is determined before sailing and is stipulated in the convoy communication plan.

Safety from enemy attack at sea demands radio silence by all ships of the convoy. Except in the most unusual circumstances, all traffic destined for addressees outside an escorted convoy is transmitted via the escort force commander. If it is necessary—and authorized—for a merchant ship to make direct radio contact with units beyond the convoy or with shore stations, transmissions are on 500 kc, if possible. Otherwise, they are on other frequencies specified in the radio section of the convoy communication plan.

Except in certain well-defined instances, then, transmission by radio is forbidden. Included in the exceptions are contact reports, distress messages, messages in accordance with a special order from some naval or military command, and whenever, in the opinion of the master or the convoy commodore, the necessity for breaking radio silence outweighs the risk of disclosing the ship's position. It should be borne in mind that the use of a radio transmitter endangers all other ships present. Enemy activities and units equipped with direction-finding (DF) receivers can take a bearing on a transmission of very short duration. Two such bearings allow an accurate determination of the transmitting ship's position to be obtained.

To maintain communication discipline, the ship in which the convoy commodore is sailing is usually designated as transmitter ship for the convoy. If a ship in the convoy has a requirement to send a message, the text is transmitted to the convoy commodore by visual means, if feasible, or by VHF/UHF radiotelephone if the

ships are properly equipped. The commodore, provided he concurs that the message is of sufficient importance, arranges for the escort force commander to send the message via Navy channels. In the absence of an escort force commander, only the commodore has authority to break radio silence except in those instances cited previously.

When it becomes essential to break radio silence and transmit a message, UHF, VHF, HF, or LF, respectively, should be used to reduce the probability of detection. Even high frequencies, however, can be detected by proper equipment; therefore lengthy transmissions should be avoided. Transmissions of contact reports and distress messages always should be made initially on 500 kc to ensure receipt by ships in the vicinity. Maintenance of radio silence is meaningless within visual range of the enemy.

All messages transmitted at sea are sent encrypted unless they are contact reports, distress messages, or message of similar extreme urgency. In order to have sufficient personnel available to process coded traffic, a selected number of reliable ship's personnel, cleared to handle the requisite degree of classified material, should be trained in encryption and decryption procedures.

The master is personally responsible for the custody and safeguarding of all classified documents and all cryptographic material, publications, and files. They may be kept by the senior radio officer at sea and must be kept by the master in port; when not in use, they must be retained in a safe or under strong lock and key. These materials have first priority if emergency destruction of classified material becomes necessary. They should be burned, if possible. In deep water, they may be thrown overboard in a weighted and perforated metal box, one of which is kept on the bridge and one in the radio room.

The use of private ship or company codes is expressly forbidden to ships sailing under the NCSORG.

RADIO COMMUNICATION READINESS

Naval control of shipping officers may promulgate special conditions of radio communication readiness to meet unusual or special requirements of a particular convoy. Basically, however, there are only two distinct conditions of readiness for ships in convoy: conditions A and B.

Condition A is the normal steaming condition. Insofar as equipment and personnel permit, guards are maintained as follows:

Station	Guard
Commodore	500 kc. MERCAST, and convoy radiotelephone (R/T) net continuously.
Vice commodore . .	500 kc and MERCAST continuously. R/T net continuously (listening watch on the bridge).
Ships with three radio operators.	Same as vice commodore.
Ships with two radio operators.	500 kc and MERCAST during watch keeping periods. R/T net same as vice commodore.
Ships with one radio operator.	500 kc during watch keeping periods, shifting as necessary to copy MERCAST. R/T net same as vice commodore.

Condition B is placed in effect on orders of the commodore during alarm, enemy attack, exceptionally heavy weather, or reduced visibility resulting from snow, heavy rain, and the like. During condition B, both the convoy commodore and vice commodore guard 500 kc, the MERCAST schedule, and the convoy R/T net continuously. Individual merchant ships give priority to guarding 500 kc; they do not copy MERCAST unless 500 kc can be guarded simultaneously. The flagship of the commodore acts as MERCAST guard for the convoy.

CALL SIGNS

Merchant ships utilize both radio and visual call signs. The former are explained in detail in ACP 149.

Visual

A merchant ship's international call sign is displayed by flaghoist (1) when entering or leaving port other than an Allied-defended port, (2) when ordered to do so by signal, (3) for

identification to an escort when joining, or (4) when reporting to Lloyd's Signal Stations located in the United Kingdom.

Convoy visual call signs are formed by numeral pennants rather than alphabet flags. For other than individual merchant ships, the answering pennant is suffixed to the numeral pennant(s) as part of the call sign. Thus, the commodore's visual call sign is pennant 1 ANS (written p1ANS), the convoy collective call sign is p3ANS, and that for the escort force commander is p8ANS. When signaling by light, the prosign MM is substituted for ANS. The visual call for an individual ship is its station number, as p1p4 (first column, fourth ship). The collective call for each column is the column number preceded by zero, as shown in figure 5-1.

Convoy visual call signs are displayed—

1. When the convoy is forming up or reforming after being scattered.
2. Any time the convoy meets an escort (in addition to displaying international call signs).
3. Upon orders of the commodore.

When a ship leaves a convoy permanently or for a considerable period of time, no change is made in the convoy visual call signs of the remaining ships unless specifically ordered. Ships in the rear of a vacated position are required to close up without additional instructions. Ships that are directed to change or exchange their positions in the convoy on orders of the commodore must change their call signs accordingly.

EXECUTIVE METHOD OF MANEUVERING

Whenever possible, the commodore maneuvers the convoy by means of visual (flaghoist) communications. For routine changes, this is standard procedure. It does, however, require an element of time. Before the maneuver is executed, each ship indicates by appropriate signal that it has received and understands the signal. Merchant ships without an armed guard attached have no visual communication personnel assigned, and visual signaling normally is the responsibility of the officer on watch in addition to his other duties.

The occasion often arises when the commodore must maneuver the whole formation as quickly as possible. This task is difficult at best, because a convoy generally is large and unwieldly, and any change in its direction of movement is limited to 45° in one step. These considerations bear on any decision to break radio silence in order to transmit a maneuvering

COLUMN	1	2	3	4	5
DISTINGUISHING SIGNALS OF COLUMN	01	02	03	04	05
DISTINGUISHING SIGNALS OF SHIPS	11 12 13 14	21 22 23 24 25	31 32 33 34 35	41 42 43 44 45	51 52 53 54 55

105.2

Figure 5-1.—Individual ships are allotted call signs according to their stations.

signal. Once the decision is made, the executive method invariably is employed.

The executive method is characterized by two procedure signs (see chapter 2) to accomplish simultaneous action by all units: $\overline{IX}$ (execute to follow) and $\overline{IX}$ followed by a 5-second dash (execute now).

The prosign $\overline{IX}$ alone is a preparative or warning signal indicating that the signal following will be a tactical maneuver. The same prosign followed by a 5-second dash is the executive signal, the maneuver being executed at the end of the dash. The text of each signal is transmitted twice, separated by the prosign $\overline{IMI}$. To ensure effective communications, at least one ship receipts for each maneuvering signal.

Message Cancellation

On occasion the commodore may decide that an executive method signal already sent out should be canceled, or that a series of unexecuted signals may be extraneous due to a change in the tactical situation. If it is desired to cancel all signals outstanding, the commodore sends: ..... $\overline{BT}$ NEGAT $\overline{IMI}$ NEGAT $\overline{BT}$ K. Again, the text is sent twice separated by IMI; and, because the message ends with K, all ships answer in turn.

If a particular message among the unexecuted signals is to be canceled, leaving the remainder in force, the text of that message is included with the NEGAT signal. Similarly, when the commodore decides to execute only one of a group of outstanding signals, he includes the text of that message in the executive signal to prevent misunderstanding.

Signal Repetition

Some convoys are so widely dispersed that a maneuvering signal must be repeated by a ship some distance from the flagship. To accomplish this, the commodore designates a repeating ship by including that ship's call sign and the procedure sign G before the ending K.

SIGNALING BY FLAGHOIST

Flag signaling in a mercantile convoy is similar in most respects to that in common use throughout the U. S. Navy (see chapter 10). The code of signals, however, is contained in ACP 148 rather than in the Allied Naval Signal Book. The encode/decode sections of ACP 148 should be familiar to communication personnel and others concerned with maneuvering ships in convoy. The signals listed therein may be supplemented by those included in the International Code of Signals, Volume I.

As a rule, the commodore originates all visual signals to ships in the convoy, and all acknowledgements are made to him. When he finds it necessary to use an international signal, the commodore displays that signal inferior to (below) the international CODE pennant. Addressees also hoist the CODE pennant to indicate their understanding. The CODE pennant when used in this way is referred to as CODE. This is the same pennant we met previously as the answer (ANS) pennant when it is flown in a position other than above a signal to indicate a convoy visual call sign.

When the commodore addresses a signal to the whole convoy, all hoists are repeated at the dip immediately, flag for flag. Ships repeat the signal at the dip as soon as it is seen and close it up when it is understood. In a convoy of any size, visual responsibility is an important function. Each ship in a column is responsible for ensuring that the ship astern as well as the lead ship in the next column outboard from the commodore fly the proper hoist as originated by the commodore.

Signals from the commodore to a part of the convoy are preceded by a collective visual call sign for that part of the convoy. To expedite transmission, the signal is repeated by all lead ships between the commodore and the part of the convoy addressed. Signals made to an individual ship are prefaced by the convoy visual call sign of the ship addressed. Signals to the commodore are acknowledged by the ANS pennant.

The signals contained in ACP 148 which convey orders do so in nearly all cases in a positive sense. To impart some other sense to a signal, it is preceded by a "governing flag," of which there are five:

A flag—Immediate execution;
C flag—Affirmative;
N flag—Negative;
P flag—Preparative;
Y flag—Interrogative.

In all instances, the governing flag is hoisted superior to the signal and separated from the latter by a tackline. A tackline (usually spoken as TACK) is a length of halyard about 6 feet long used to separate flags on the same halyard which, if not separated, would

convey a different meaning than that intended. Assuming that the signal PD2 means "Proceed in execution of previous orders," governing flags alter the sense of the signal as follows:

A TACK PD2: Proceed in execution of previous orders at once. (In other words, proceed as soon as the signal is understood, without waiting for the signal of execution.)

N TACK PD2: Do not proceed in execution of previous orders.

P TACK PD2: Prepare to proceed in execution of previous orders.

Y TACK PD2: By a senior—Are you prepared to proceed in execution of previous orders? By a junior — May I proceed in execution of previous orders?

C TACK PD2 or C alone are correct replies by a senior to the junior's request immediately above and signify "Affirmative" or "Approved."

It should be emphasized that the meanings of the governing flags do not apply when the Allied Naval Signal Book is followed; the flags are used only in conjunction with ACP 148. Signaling procedures otherwise are essentially similar to those contained in chapter 9.

FLASHING LIGHT PROCEDURE

Signaling by flashing light in time of war is restricted as much as possible. The light is of minimum practical brilliance and at night must be screened and covered by a colored filter. It may be used during daylight only when it is inexpedient to use flaghoist or semaphore. It is used at night only in an emergency or if more secure means of communication do not exist. When using any type of directional light, it is most important to keep the light trained accurately on the receiving ship throughout the transmission of a message. Failure to do this makes it difficult, and perhaps impossible, for a receiving ship to read the message.

The flashing light signaling procedure in convoy is similar to methods used in the fleet. Generally, however, the process is considerably slower to ensure understanding and prevent errors in transmissions.

To send a message using directional procedure, the sender (not necessarily the originator, as seen later) calls the receiving ship by making, until answered, the latter's convoy visual call sign. Example: 35 35 35 until answered by a long dash meaning "I receive you" (written as TTTT).

The identity of the calling ship usually is apparent. When it is necessary for her to identify herself, she does so by sending her visual call after receiving the answering sign from the ship called. The ship called repeats the identity. Example:

Ship 23 (sender)	Ship 35
35 35 35	TTTT
DE 23	DE 23

If several ships are being called in the same general direction, so that there might be some doubt of who is answering, the answering ship may identify itself. For example, 23 has called 35. To answer, 35 sends: 23 DE 35 TTTT.

The heading of a visual message may include many of the prosigns used in radio procedure. Except for messages sent to guardships for retransmission by radio, however, the abbreviated form usually is used. The receiving ship acknowledges receipt of each plain language word with a short dash (Morse code T) on the light. In transmitting a code signal (one taken from a signal book), each letter is spelled out using the phonetic alphabet.

To illustrate the foregoing, consider these two examples:

Ship 23 sends to ship 35:

Ship 23	Ship 35
35 35 35	TTTT
DE 23 (may be omitted)	DE 23 (may be omitted)
BT	BT
URGENTLY	T
NEED	T
DOCTOR	(Does not T; missed the word.)
DOCTOR	T
BT	BT
AR	R

In the second example, 6ANS transmits to a screen ship whose international call sign is NBGC:

6MM	NBGC
NBGC NBGC NBGC	TTTT
BT	BT
KILO	T

ALFA	T
$\overline{BT}$	$\overline{BT}$
AR	R

Message Relay

A message for part of the convoy or a column is passed to the leading ship(s) of the column(s) concerned. Having visual responsibility, they relay the message down their column(s) and or to the adjacent lead ship. This continues until all ships addressed have received the message.

So that the lead ship of a column may know when all ships of the column have received the message, the visual call sign of the last ship addressed, preceded by R DE, is passed back up the column. The same reverse-route procedure is followed by column leaders to inform a senior officer that a message has been received, the outboard leaders informing the next leader inboard. If the commodore, in ship 51 of a nine-column convoy, sends a message to all ships, acknowledgments flow back in this way:

Ship 91 receipts for column 9 to ship 81; R DE Ø9.
Ship 81 receipts for columns 8 and 9 to ship 71: R DE Ø8 Ø9.
Ship 71 receipts for columns 7, 8, and 9 to ship 61: R DE Ø7 to Ø9.
Ship 61, in turn, receipts to 1$\overline{MM}$ for all four columns.

The same system is used for ships on the other side of the convoy, Ø1 to Ø2, and so on.

Figure 5-2 shows graphically how the relay system operates. In the example, the commodore (in ship 51) sends a message to all ships in column 3, the latter consisting of three ships.

All-Around Procedure

To send a message by all-around (nondirectional) procedure, the commodore transmits the international general call AA on a light visible in all directions. After a short pause he sends the message straight through slowly. After transmitting the text, the commodore sends $\overline{UD}$ (equivalent of $\overline{IMI}$), AA, a complete repeat of the message, and finally $\overline{AR}$. Example:

AA AA AA (pause) DE 1$\overline{MM}$ (may be omitted) 0857Z $\overline{BT}$ UNIFORM HOTEL $\overline{UD}$ AA DE 1MM 0857Z $\overline{BT}$ UNIFORM HOTEL $\overline{AR}$

No ship gives any indication that the message is being read. Light repeating ships receipt for the message directly to the commodore (e.g., R DE 73 R DE 73) using a directional light. Any ship failing to copy correctly obtains the message from the responsible light repeating ship.

SIGNALING BY SOUND

Convoys may be maneuvered and messages transmitted by sound signals, a system having no parallel in the U.S. naval service. The procedure is outlined in the International Code of Signals, Volume I, and as contained therein is intended primarily for signaling between two ships. In convoys, however, sound signals generally are intended for all ships, signals between individual ships being comparatively rare.

The lead ship of each column repeats all signals except those addressed to an individual ship. In addition, the NCSO or the commodore may designate other ships as sound repeating ships. Only ships so designated repeat sound signals except when a ship relays a message between two other ships that are out of sound range of each other.

General Signals

General signals normally are confined to emergency (other than alarm) situations and in practice are seldom used. These signals commence with the general call AA AA AA on the ship's whistle. On hearing this call, all ships should listen attentively for the signal which will follow. The signal itself is transmitted twice, with a short pause between the call and each transmission; e.g., AA AA AA (pause) WN1 (pause) WN1.

Column leaders and sound repeating ships repeat the message. Column leaders repeat, in order, outboard from the flagship beginning to port. The starboard column leaders start repeating when the signals to port no longer can be distinguished clearly. Each leading ship is responsible that both the leading ship next outside her and the first sound repeating ship in her own column repeat the signal correctly. Sound repeating ships repeat signals immediately after the leading ships of their columns. When there are two or more repeating ships in a column, they repeat in sequence from front to rear of the convoy. A request for a repetition is made by sounding UD. Although usually this signal is made by a repeating ship, it may be made by any ship missing a signal.

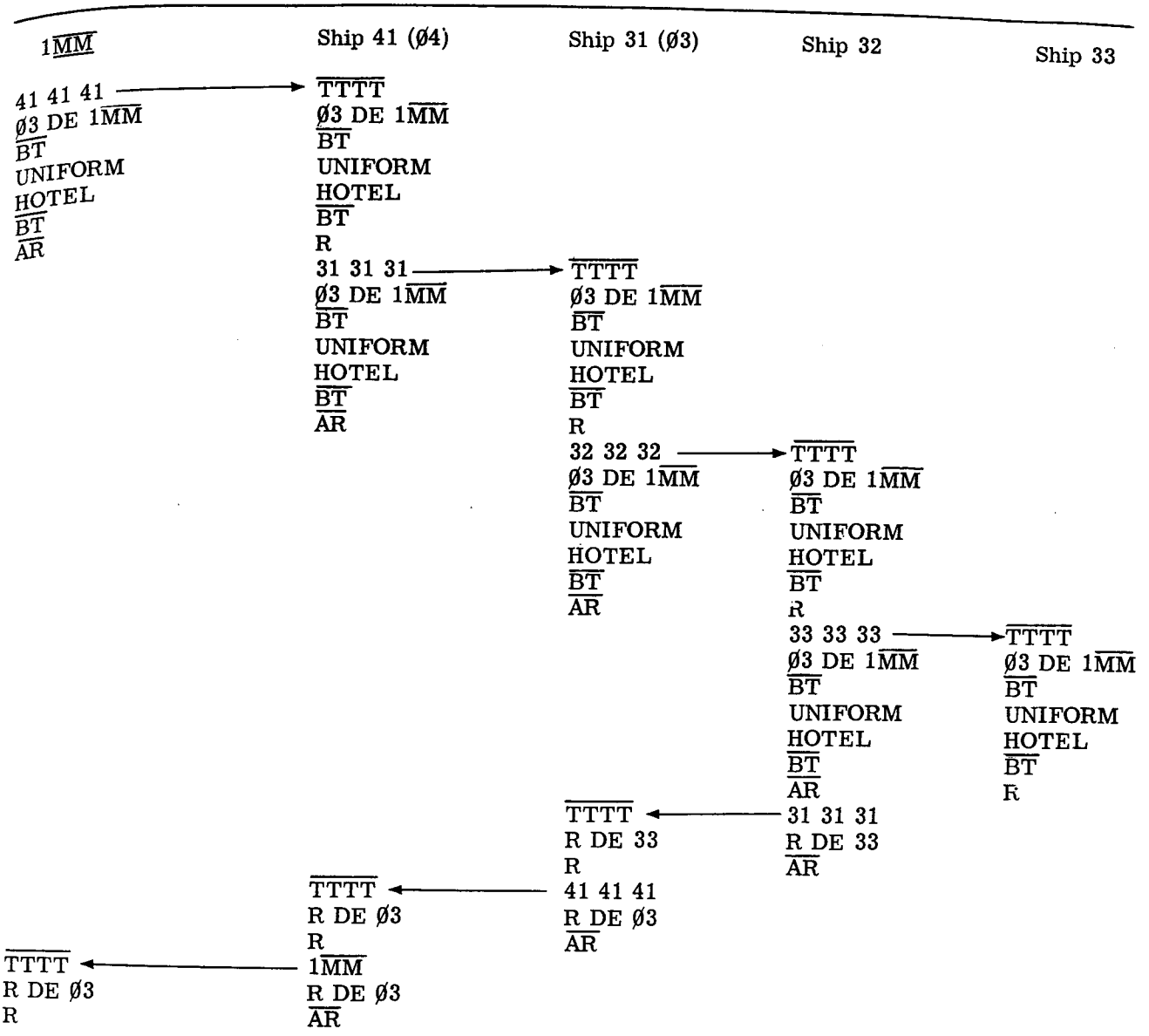


Figure 5-2. —Relay system in operation.

Alarm Signals

An alarm signal is not used with a call or ending sign. Such a signal contains a single-digit number that indicates the type of danger. The number is sounded twice in groups of three, followed by the call of the sounding ship.

If alarm signal 4 means that any enemy ship has been sighted, detecting ship 35 immediately sounds 444 (pause) 444 (pause) DE 35.

Maneuvering Signals

Certain emergency maneuvers may be transmitted by sound signals. For example, if the commodore decides to make an emergency convoy turn of 45°, he sounds a preparative 15-second continuous blast, which is repeated by the sound repeating ships. The direction of turn is indicated by the appropriate international turning signal, one short blast for a

starboard turn and two short blasts for port. Each ship starts her turn as soon as the turning signal is heard, repeating the turn signal as the rudder is put over.

The whistle may be used to send signals by the executive method in the same way as by flashing light.

SIGNALING WITH PYROTECHNICS AND COLORED LIGHTS

Pyrotechnics can be seen at great distances and their use is limited to extreme emergencies when, in all probability, the enemy already knows the location of the convoy. Colored Very lights are used for urgent maneuvering, and their use is left entirely to the discretion of the commodore.

No fewer than two white rockets or roman candles are fired by a ship to signal that she has been torpedoed by a submarine or surface ship, or that a submarine or torpedo boat is in the area.

From an aircraft, a single white Very light or yellow star indicates that a submarine is held below.

A special list of colored light signals, included in ACP 148, allows the commodore to maneuver the convoy rapidly at night. The same considerations of security are applied as with pyrotechnics. Lights are exposed as briefly as possible and their visibility is limited to 2 miles. Only designated colored light repeating ships repeat the signals. Signals are executed the moment the lights are switched off, or, for flashing lights, when the flashing ceases.

RADIOTELEPHONE COMMUNICATIONS

Radiotelephone communication procedures of a convoy are, for all practical purposes, identical to those that apply for the fleet as explained in chapter 8.

The escort force commander is the control for voice radio communications on the convoy common frequency. Masters and the ship's officers must be made aware of the need for strict compliance with the escort force commander's orders, adherence to prescribed procedure, and good circuit discipline. Before sailing, the master and the ship's officers must be informed of the contents of ACP 149 and its coverage of radiotelephone procedure.

CHAPTER 6

PROPAGATION OF RADIOFREQUENCY ENERGY

A radiofrequency current flowing in a wire of finite length produces electromagnetic fields that may be disengaged from the wire and set free in space. If another wire is placed in the path of the electromagnetic field, electrons within the second wire are set in motion. The characteristics of the electron motion with respect to frequency, degree, and direction are similar to those of the original field. If intelligence in some form is being carried by the electromagnetic field, it is reproduced in similar form in the second wire.

RADIOFREQUENCY ENERGY

The whole function of radio communication is to deliver intelligence. In any radio system, r-f energy in the form of electromagnetic waves is generated by a transmitter and fed to a transmitting antenna, the latter radiating this energy out into space. A receiving antenna in the path of the traveling radio wave absorbs part of the energy and sends it through a transmission line to a receiver. The transmission of r-f energy (radio waves) through space is known as wave propagation.

It can be seen that the major components required for transmission of intelligence by means of radio waves are a transmitter, a transmitting antenna (the initial wire), the medium through which the waves travel (the atmosphere), a receiving antenna (the second wire), and the receiving equipment. Successful communications depend chiefly on the power of the transmitter, the distance between the transmitting and receiving antennas, and the sensitivity (ability to amplify weak signals) of the receiver. As will be seen, however, propagation is also affected by such things as the condition of the atmosphere, the type of radio wave transmitted, and the path of the transmission.

GENERAL NATURE AND PROPERTIES

The fundamental nature of electricity has always been a mystery. We know little more about electricity than did the ancient Greeks, who experimented with amber by rubbing it with a cloth to induce forces of attraction and repulsion. Elaborate theories concerning its nature have been postulated, however, and these have gained wide acceptance because of their demonstrated workability. Although electricity never has been defined clearly, rules of behavior exist based mainly on the fact that electricity and electric current always seem to react in a constant and predictable manner.

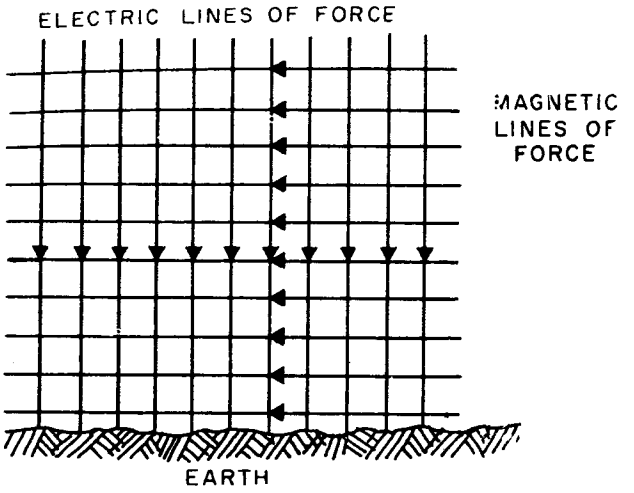
The propagation velocity of r-f energy through free space is approximately 186,000 miles per second—the speed of light. Put another way, it takes 6.1 microseconds (μs) (a microsecond is one-millionth of 1 second) for a wave of radiofrequency energy to travel 1 nautical mile, or 2000 yards. The r-f velocity becomes important when determining antenna length, which is discussed in chapter 7.

A moving electric field always creates a magnetic field, and vice versa. The created field is perpendicular to the parent field, and both are perpendicular to the direction of motion through space. A cross section of the wavefront, then, is composed of moving fields of electric and magnetic lines of force that are at right angles to each other, and both of which are at right angles to the direction of travel, as shown in figure 6-1. (The front can be imagined as moving either toward or away from the reader.)

The general concept of a radio wave is that it radiates outward from the antenna in the same manner that a wave travels across still water into which a rock has been thrown, and that it consists of a series of crests and troughs similar to a water wave. The analogy is not exact, but it serves a useful purpose in that it makes a comparison with a familiar physical action.

POLARIZATION

The lines of force of the electric field are propagated perpendicular to the earth when the transmitting antenna is oriented perpendicular to the earth. In this case the radio wave is said to be polarized vertically. If the transmitting antenna is horizontal, the electric lines of force



20.241

Figure 6-1.—Cross section of a radio wave.

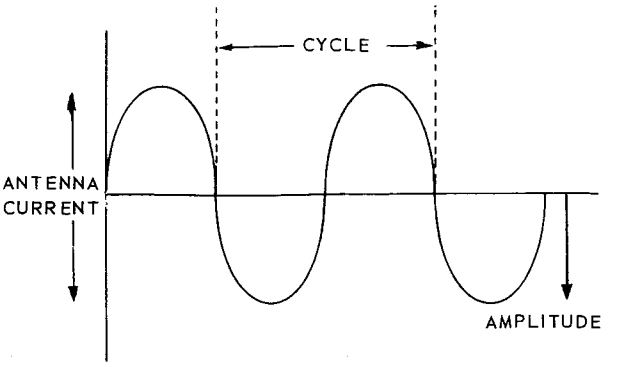
are horizontal and the wave is polarized horizontally. The polarization of the wave may be altered somewhat during travel, but regardless of its position with respect to the earth, the electric and magnetic lines of force always are perpendicular to each other and to the direction of travel.

Polarization of the wavefront is an important consideration in the efficient transmission and reception of radio signals. If a single-wire antenna is used to extract energy from a passing radio wave, maximum pickup results when the antenna is so placed physically that it lies in the same direction as the electric field component. Consequently, a vertical antenna should be used for the efficient reception of vertically polarized waves, and a horizontal antenna should be used for the reception of horizontally polarized waves. In both, it is assumed that the wavefront is traveling parallel to the earth's surface from the transmitting to the receiving antennas. Such a condition does not always prevail, however, as we shall see when we consider the effects of the atmosphere on the behavior of radio waves.

WAVE CHARACTERISTICS

Figure 6-2 illustrates four important aspects of the radio wave: amplitude, wavelength, cycle, and frequency.

The amplitude is the distance from the average level to the peak or trough of the wave, and is the measure of the energy level of the wave. A wavelength is the space (usually measured in



105.4

Figure 6-2.—Characteristics of the radio wave.

meters) occupied by 1 cycle; it may be measured from crest to crest, trough to trough, or from any point to the next corresponding point.

Each cycle is made up of two reversals, the wave moving first in one direction, reversing itself, then returning to the first direction to begin the next cycle. The frequency of a radio wave is the total number of complete cycles the electromagnetic wave goes through in a unit of time; the accepted standard measurement of frequency is in cycles per second (cps). For a radio receiver to obtain useful intelligence, it must be tuned to the same frequency as the transmitter.

FREQUENCY SPECTRUM

Frequencies within the range of 15 to 15,000 cycles per second are called audiofrequencies because vibrations of air particles at any of those frequencies can be heard by the human ear. Above 15,000 cycles per second are the radiofrequencies. Two units are used in speaking of frequencies: kilocycle for 1000 cps, and megacycle for 1,000,000 cps. These are abbreviated kc and mc, respectively. Table 6-1 illustrates the general frequency bands used in communications.

The characteristics of low-frequency propagation differ from those of high-frequency propagation. The choice of a given frequency as the point of division between bands, such as between VHF and UHF, is more or less arbitrary and is agreed upon for convenience.

PROPAGATION OF R-F ENERGY

Characteristics of the atmosphere through which waves of radiofrequency energy pass

Table 6-1. —Designation of Radio Waves According to Frequency

Description	Abbreviation	Frequency
Very low	VLF	Below 30 kc
Low	LF	30 to 300 kc
Medium	MF	300 to 3000 kc
High	HF	3 mc to 30 mc
Very high	VHF	30 mc to 300 mc
Ultrahigh	UHF	300 mc to 3000 mc
Superhigh	SHF	3000 mc to 30,000 mc
Extremely high	EHF	30,000 mc to 300,000 mc

affect the manner of their transmission. Thus, although it sometimes is assumed that radio waves follow perfectly straight paths, properties of the atmosphere are such that the waves are bent and made to follow curved paths.

ATMOSPHERIC PROPAGATION

Propagation of radio waves is affected by reflection, refraction, diffraction, and trapping.

Reflection

Unless the transmitting antenna has a narrow vertical beam that can be elevated, some of the radiated energy must hit the surface of the earth and be reflected. In most instances, energy leaving the antenna follows two paths, one direct to the receiving antenna and the other from the antenna to the surface of the earth and thence to the receiving antenna.

The reflection of a radio wave is like that of any other type of wave, such as light or sound. The amount (efficiency) of reflection depends on the reflecting material. Smooth metal surfaces of good electrical conductivity, such as copper, are efficient reflectors of radio waves. The surface of the earth itself is a fairly good reflector.

Refraction

Refraction occurs whenever there is a change in the medium through which radio waves are passing. The quantity that indicates the degree of bending from a straight-line path is the index of refraction. In homogeneous material, the index of refraction is constant because the waves travel in a straight line; the atmosphere, however, is not a homogeneous medium. Changeable characteristics of the atmosphere are temperature, pressure, and humidity; and these elements vary with altitude. A wave of r-f energy is refracted a small amount in passing from one level of the atmosphere to the next.

In order to establish a reference for the purpose of investigating the effect of atmosphere on propagation, a standard atmosphere has been established. In the standard condition, the temperature, pressure, and moisture content of the air decreases uniformly with height, so that there is a gradual change in the amount of refraction of a wave of r-f energy. Refraction bends the waves downward, thereby increasing the horizontal distance to which the waves can travel. Because of this phenomenon, the distance to the radio horizon is somewhat greater than the distance to the geometric horizon.

Under standard conditions, the change in physical properties of the atmosphere is normally gradual and continuous, the index of refraction changing gradually with increasing height. Consequently, there is no sudden change in the direction of the r-f waves. The standard atmosphere, however, is not necessarily the normal atmosphere at any particular location. Above 10,000 feet the atmosphere almost always is of standard composition, but nonstandard propagation conditions often may exist at a lower altitude.

When nonstandard atmospheric conditions exist, we encounter "anomalous propagation." Under these conditions, the amount of change of temperature, pressure, and moisture varies with altitude at a different rate than normal. As a result, the radio waves undergo greater or less bending than normal, causing the radio horizon to be extended or shortened, depending on the existing conditions.

The temperature may, for example, first increase with height and then begin to decrease. Such a situation is called a temperature inversion. More important, the moisture content may decrease markedly with height just above the sea.

This latter effect, called a moisture lapse, may produce, either alone or in combination with a temperature inversion, a great change in the index of refraction of the lowest few hundred feet of the atmosphere.

Altered characteristics of the atmosphere may result in an excessive bending of radio waves passing through the lower atmosphere. In certain regions, notably in warm climates, excessive bending is observed as high as 5000 feet. The amount of bending in regions above this height usually is that of normal atmosphere.

A knowledge of refraction characteristics is important to the communicator because radio waves, particularly in the VHF and UHF bands, may be refracted and thus detected hundreds of miles beyond the visible horizon. This point must be borne in mind when a ship is in waters where radio security is essential.

Diffraction

Another consideration from the standpoint of communication security is diffraction, the natural bending of radio waves over the geometric horizon.

The bending effect caused by diffraction can be observed in shadows cast by sunlight. Light rays from the sun are essentially parallel, yet the shadow of a ball does not have sharp, clear edges, as in part A of figure 6-3, because of diffraction. When the waves pass close to the surface of the ball, they are bent inward slightly and penetrate the shadow, partially illuminating its edges as in part B of figure 6-3. The wavelengths of r-f energy are much longer than those of visible light, and the amount of bending caused by diffraction also is greater.

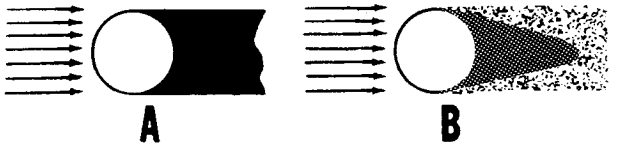


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Figure 6-3.—Bending effect caused by diffraction.

Although r-f energy diffracted around the curve of the earth usually is weak, it may be detected by a suitable receiver. Because low-frequency radio waves are bent more than high-frequency waves, a low-frequency transmission can be intercepted by the enemy at a greater distance than can a microwave transmission, provided the two sets transmit comparable power. The principal effect of diffraction, then, is to extend beyond the radio range of your ship the range of possible interception by enemy surface ships and aircraft of your r-f transmissions.

Figure 6-3 helps explain why radio waves of the proper frequency can be received on the far side of a hill. In the propagation of radio waves at a distance, diffraction is an important consideration because the largest object to be contended with is the curvature of the earth itself.

Trapping

Normally the warmest air is near the earth's surface, but when a temperature inversion occurs, the index of refraction is different for the air within the inversion than for the air outside the inversion. These differences cause the formation of a channel or duct that acts as a waveguide within which transmitted signals are trapped. The result is that the signals are piped many miles beyond the assumed normal range, as shown in figure 6-4.

At times these ducts are in contact with the water and may extend a few hundred feet into the air. At other times the duct starts at an elevation of 500 feet or more and extends an additional 500 to 1000 feet upwards.

A necessary feature of duct transmission is that both the transmitting and receiving antennas must be inside the duct. A transmitting antenna above a surface duct will not operate into the duct. Hence, a receiving antenna below a duct receives no signals from an aircraft flying in or above a duct, even though line-of-sight conditions prevail.

The peculiar structure of the atmosphere that produces trapping occurs fairly often in many parts of the world. Several types of meteorological conditions can produce the temperature and humidity gradients necessary for trapping to take place.

SURFACE DUCT.—Warm continental air blowing over a cooler sea leads to formation of a duct by causing a temperature inversion as well as by evaporation of water from the cooler sea into the lower levels of the warm, dry air. The base of such a duct is usually the sea surface with the trapping region extending several hundred feet upward.

Over the open ocean, a surface duct may be formed by cool air blowing over a warmer sea. No temperature inversion is associated with this

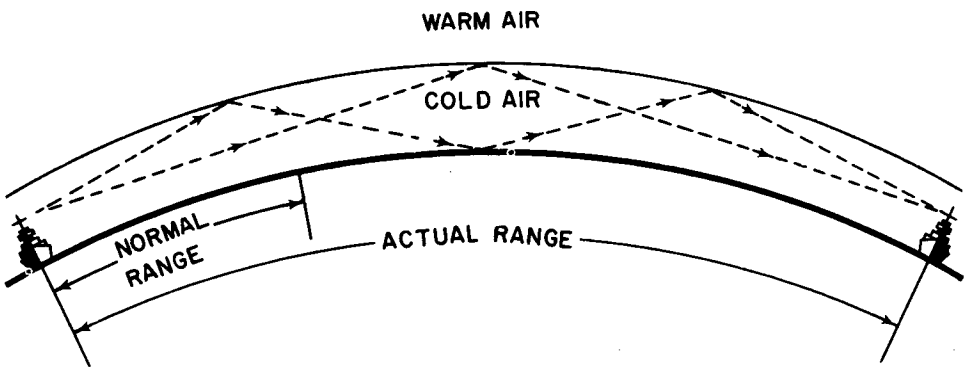

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Figure 6-4. —The duct acts as a signal waveguide.

phenomenon, and the entire effect is caused, apparently, by evaporation of water into the lower levels of the atmosphere. Ducts of this sort are often created by trade winds that have blown for a long distance over the open sea.

ELEVATED DUCT. —An elevated duct may form in an area of high barometric pressure because of the sinking and lateral spreading of the air, termed subsidence. When the air is warm and dry and subsidence takes place over the sea, water is evaporated into the air, forming a moisture gradient that leads to formation of a duct. Such ducts always are formed above the sea, with the base of the trapping layer ranging in elevation from a few thousand to 20,000 feet. Subsidence trapping nearly always can be found in the tropics.

Other meteorological conditions that may produce trapping are cooling of land at night by radiation and mixing two masses of air, as at a warm or cold front. Ducts formed by these effects are likely to be of such limited extent that they are unable to modify propagation by any appreciable amount.

Prediction of Nonstandard Propagation

Sometimes it is possible to predict formation of ducts from observation of weather conditions, coupled with simple measurements that can be made on board any ship.

For a number of reasons, meteorological conditions in a region of high barometric pressure are favorable for forming ducts. Among favorable factors are (1) subsidence, which creates temperature inversions, and which occurs in areas where the air is very dry so that evaporation can take place from the surface of the sea; (2) calm conditions that prevent mixing the lower layers of the atmosphere by turbulence, allowing thermal stratification to persist; and (3) clear skies, which permit nocturnal cooling over land.

Conditions in a barometric low, on the other hand, generally favor standard propagation. A lifting of the air, the opposite of subsidence, usually occurs in such regions and is accompanied by strong winds. The combined effect is to destroy any local stratification of the atmosphere by a thorough mixing of the air. Moreover, the sky usually is overcast in a low-pressure area, and nocturnal cooling is therefore negligible. Rains fall very often in a low-pressure area, and falling drops of water have the effect of destroying any nonstandard humidity or temperature gradients that may have been established.

In all weather conditions that produce trapping, the atmosphere must be sufficiently stable to allow the necessary stratification of the atmosphere to be established and to persist. Thus, continued calm or moderate breezes are necessary. It must be emphasized, however, that even if weather conditions favor formation of ducts, they do not always produce them.

The following weather conditions, which are readily obserable, may favor trapping:

1. A moderate breeze that is warmer than the water, blowing from a continental land mass.
2. Clear skies, little wind, and high barometric pressure.
3. A cold breeze blowing over the open ocean far from large land masses, especially in the tropical trade wind belt.
4. Smoke, haze, or dust that fails to rise but spreads out horizontally, which indicates

quiet air, in which a temperature inversion may exist.

5. When the air temperature at bridge level on a ship definitely exceeds that of the sea, or when the moisture content of the air at bridge level is considerably less than that just above the water, and the air is relatively calm.

RADIO WAVE FORMATION

When a radio wave leaves an antenna, part of the wave moves outward in contact with the ground, the remainder of the wave moving upward to form a skywave, as in figure 6-5. The ground and sky portions of the wave are responsible for two different methods of carrying messages from transmitters to receivers.

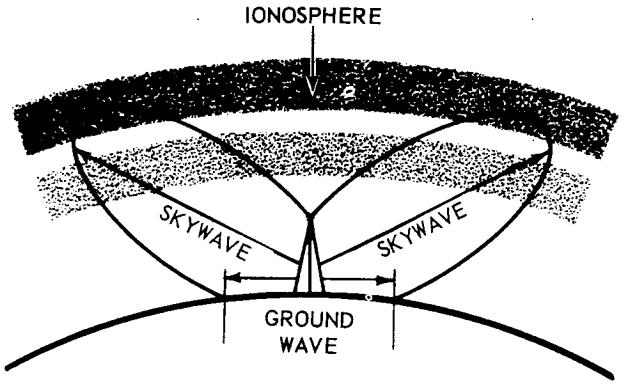

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Figure 6-5. —Formation of the groundwaves and skywaves.

Groundwave

The groundwave normally is used for short-range (line-of-sight) communications, although it may be utilized for long-range communications in the low-frequency bands using high power.

A groundwave is composed of two parts, a surface wave and a space wave. The surface wave travels along the ground, while the space wave follows two paths—one through the air from transmitter to receiver, the other reflected from the ground to the receiver. Because the space wave follows two paths of different lengths, the two components may arrive in or out of phase. As the distance from the transmitter changes, the two components may add or cancel.

As it passes over the ground, the surface wave induces a voltage in the earth, setting up eddy currents. The energy to create these currents is taken away from the surface wave, which is weakened as it moves away from the antenna. Increasing the frequency results in a rapidly increasing rate of attenuation. Because of this increased attenuation with increased frequency, surface-wave communication generally is limited to the lower frequencies. The surface-wave component is not confined to the earth's surface, but extends to considerable heights, diminishing in field strength with increased height.

Shore establishments are able to furnish long-range surface-wave communication by using frequencies between 18 and 300 kc with extremely high power.

The electrical properties of the earth over which the surface wave travels are relatively constant, hence the signal strength from a given station at a given point is nearly constant. This holds true in practically all localities, except those that have distinct rainy and dry seasons. In those regions, the difference in the amount of moisture causes the soil's conductivity to change

The best type of surface for surface-wave transmission is sea water. Next in order of desirability are large bodies of fresh water, wet soil, flat loamy soil, dry rocky terrain, desert, and jungle. Because of the superiority of surface-wave conductivity by salt water, high-power, low-frequency transmitters are located as close to the edge of the ocean as practicable.

Not all groundwave communication employs the lower part of the frequency spectrum. For example, VHF-UHF communications use so-called line-of-sight transmission. At these frequencies the direct wave component of the groundwave is increasingly important. It should be noted that whereas the range of the groundwave at low frequencies can be increased effectively only by increasing radiation power, the range of frequencies of 30 mc or higher can be increased effectively by increasing antenna height as well as by increasing radiation power.

Skywave

In high-frequency communications, the skywave is used for long ranges.

The behavior of the skywave is quite different from that of the groundwave. Some of the energy radiated is refracted by an ionized layer of atmosphere, called the ionosphere, and is bounced or relayed back toward the earth. If a receiver is located in the area where the

returning wave strikes, it is possible to detect the signals clearly even though the receiver is located several hundred miles beyond the range of the groundwave. The ability of the ionosphere to return a radio wave to earth depends upon the angle at which the skywave strikes the ionosphere, the frequency of the transmission, and upon the ion density.

In figure 6-6 the skywave is assumed to be composed of three rays. The angle at which ray 1 strikes the ionosphere is too nearly vertical for the ray to be returned to earth. The ray is bent out of line, but it passes through the ionosphere and is lost. The angle made by ray 2 is called the critical angle for the frequency. Any ray that leaves the antenna at an angle greater than the critical angle will penetrate the ionosphere. Ray 3 strikes the ionosphere at the smallest angle that will be refracted and still return to earth. At any smaller angle, the ray will be refracted toward earth but will miss it completely. The antenna lobes in figure 6-6 show the generally accepted concept of a beam, or wave, of radiated electromagnetic energy.

As the frequency decreases, the critical angle increases. Low-frequency fields can be projected straight upward and will be returned to earth. The highest frequency that can be sent directly upward and still be returned to the earth is the critical frequency. At sufficiently high frequencies, the wave will not be returned to the earth, regardless of the angle at which the ray strikes the ionosphere.

In figure 6-7, note the relationship between skip zone, skip distance, and the groundwave. The skip zone depends on the range of the groundwave; it disappears entirely if the range of the groundwave equals or exceeds the skip distance. The skip distance, which depends on the frequency and the degree of ionization present, is the distance from the transmitter to the nearest point at which refracted waves return to earth. If the skywave returns to earth at a point where the groundwave and skywave are of nearly equal intensity, the skywave alternately reinforces and cancels the groundwave, causing severe fading of the signal. This is caused by the phase difference between the two waves resulting from the longer path traveled by the skywave.

Frequently a skywave has sufficient energy to be refracted and reflected more than one time. It then is known as a double-hop or multiple-hop transmission, and results in the valuable "skip" needed for long-range communications.

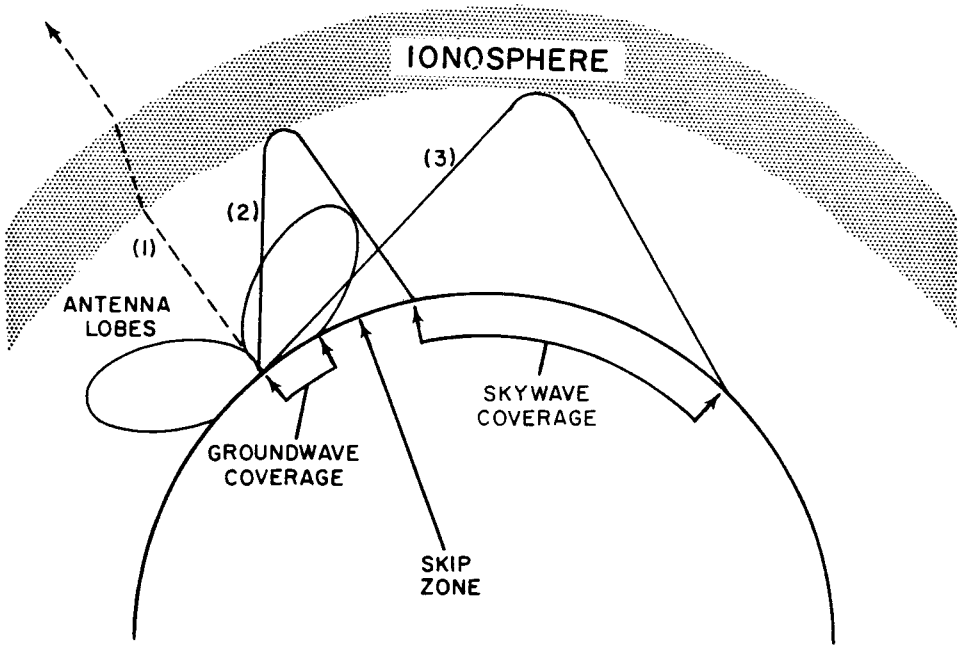

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Figure 6-6. —Comparison of skywave transmission paths.

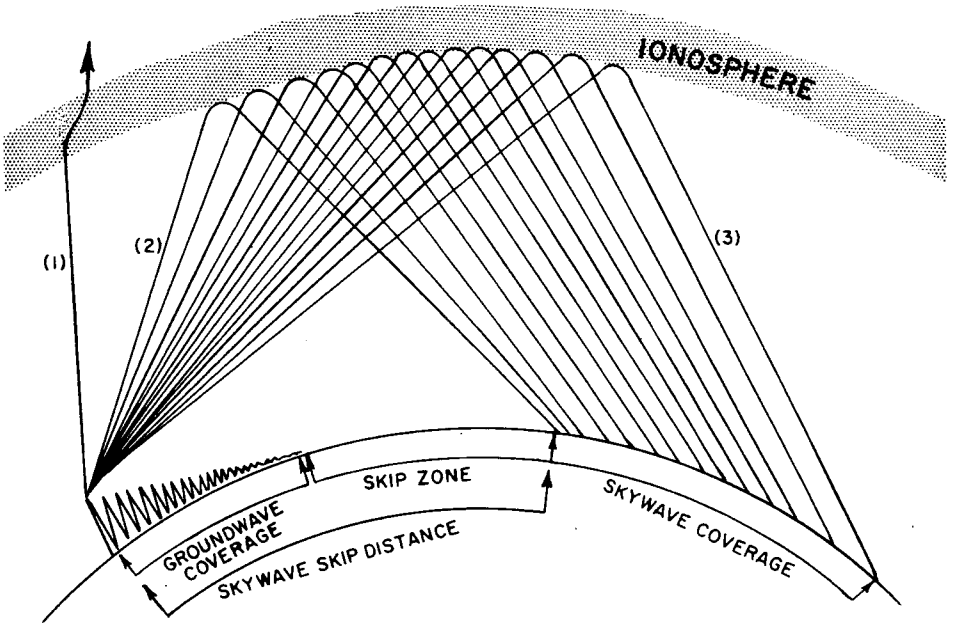

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Figure 6-7.—Relationship between skip zone, skip distance, and groundwave.

IONOSPHERIC PROPAGATION

The study of wave propagation is concerned chiefly with the properties and effects of the actual medium through which radio waves must travel between a transmitting antenna and a receiving antenna. The atmosphere about the earth is not uniform, changing with a change in height or geographical location, or even with a change of time (day, night, season, year). This lack of uniformity influences the passage of radio waves through it, thereby adding many new factors to complicate what at first might seem to be a relatively simple problem. A knowledge of the composition of the earth's atmosphere is extremely important in solving this problem, and therefore, for purposes of understanding wave propagation, various layers of the atmosphere have been distinguished. These are the troposphere, the stratosphere, and the ionosphere.

The troposphere is the portion of the earth's atmosphere extending from the surface of the earth to heights of about 6 1/2 miles. The temperature in this region varies appreciably with altitude. A tropospheric wave is that portion of the groundwave that is refracted in the lower atmosphere by changes in humidity, pressure, and temperature.

The stratosphere lies between the troposphere and the ionosphere. It extends from about 6 1/2 miles to approximately 30 miles above the surface of the earth. The temperature in this region is considered to be almost constant. The stratosphere, because of its constancy, has relatively little effect on radio waves.

The ionosphere is that portion of the earth's atmosphere above the lowest level at which ionization affects the transmission of radio waves. The ionization of this layer is large compared with that near the surface of the earth. For the purpose of study, the ionosphere extends from about 30 miles to 250 miles above the earth. Actually, the outer limit is many miles farther away.

The ionosphere differs from the other atmosphere in that it contains a much higher number of positive and negative ions. In the atoms of many substances, such as gases, one or more of the outer electrons, which revolve around the nucleus of the atom somewhat as the planets revolve around the sun, are detached from the atom, thus leaving the atom as a whole with a net positive charge. In this situation, the atom is said to be ionized. The negative ions (electrons) are produced by ultraviolet and particle radiations from the sun. The rotation of the earth on its axis, the annual course of the earth around the sun, and the development of sunspots all affect the number of ions present in the

ionosphere, and these in turn affect the quality and distance of radio transmission.

The ionosphere is changing constantly. Some of the ions are recombining to form neutral atoms, while other atoms are being split to form ions. The rate of formation and recombination of ions depends upon the amount of air present and the strength of the sun's radiations.

At altitudes above 250 miles, the particles of air are too sparse to permit large-scale ion formation. At altitudes less than 30 miles, too few ions exist to affect materially skywave communication.

Beyond the ionosphere lies the exosphere, which, without the aid of satellites, has no effect on communications.

Ionospheric Layers

Different densities of ionization at different heights make the ionosphere appear to have layers. Actually there is thought to be no sharp dividing line between layers, but for the purpose of discussion a sharp demarcation is indicated. In order of increasing heights and intensities, the layers of the ionosphere are identified as the D, E, F1, and F2 layers. The relative distribution of the layers is indicated in figure 6-8. As can be seen, all four layers are present only during the daytime, when the sun is directed toward that portion of the atmosphere. During the night, the F1 and F2 layers seem to merge into a single F layer, the D and E layers fading out or at least becoming noticeably weaker. This is only a general concept, however. The actual number of layers, their heights, and their relative intensities of ionization apparently vary constantly, even from hour to hour.

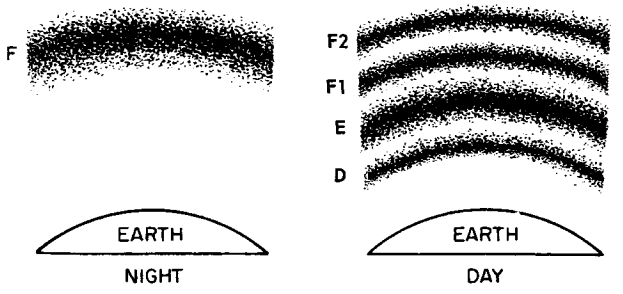

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Figure 6-8.—Relative distribution of ionospheric layers.

The ionized atmosphere at an approximate altitude of between 30 and 50 miles is designated the D layer. Its ionization is low and has little effect on the propagation of radio waves except for the absorption of energy from the radio waves as they pass through it. The D layer is present only during the day. This reduces greatly the field intensities of transmissions that must pass through daylight zones.

At heights between 50 and about 100 miles lies the band of atmosphere containing the E layer. The ionization of the E layer follows the sun's altitude variations closely, reaching a maximum at about noon local time. During the middle of the day, however, ionization of the E layer may be sufficiently intense to refract frequencies up to 20 mc. Thus the E layer is of great importance to daylight transmissions for distances up to 1500 miles. Ionization fades to such a weak level during the night as to be practically useless as an aid to high-frequency communication.

The F layer extends approximately from the 100-mile level to the upper limits of the ionosphere. At night, only one F layer is present; but during the day, especially when the sun is high, this layer often separates into two parts, F1 and F2, as shown in figure 6-8. The F2 layer is the most highly ionized of all the layers, and is the most useful for long-range communication. The degree of ionization of this layer exhibits an appreciable day-to-day variation in comparison with that of the other layers. The intensity of ionization reaches a maximum in the afternoon and gradually decreases throughout the night. The rise of ion density is very rapid in the morning, and the low recombination rate permits the high ion intensity to persist.

Ionospheric Variations

Because the existence of the ionosphere depends on radiations from the sun, it is obvious that the movement of the earth about the sun, or changes in the sun's activity that might cause an increase or decrease in the amount of its radiation, will result in variations of the ionosphere. These variations include (1) those which are more or less regular in their nature and therefore can be predicted in advance, and (2) irregular variations resulting from abnormal behavior of the sun. The regular variations may be divided into four classes: daily, seasonal, 11-year, and 27-day variations.

DAILY.—Daily ionospheric variations were discussed in the description of the F layer. The increased ionization during the day is responsible for important changes in skywave transmission. For one thing, it causes the skywave to be returned to earth closer to the point of transmission. Another consideration is that the extra ionization increases the absorption of energy from the wave, resulting in greater wave attenuation.

To compensate for daily variations, it is suggested that higher frequencies be employed during the daytime than at night. The main reason for this is that the greater daytime ionization of the F2 layer refracts waves of higher frequency than the same layer does at night. Further, the higher the frequency employed, the less attenuation occurs as the r-f energy passes through the D region.

SEASONAL.—As the apparent position of the sun moves from one hemisphere to the other with changes in season, the maximum ionization in the D, E, and F1 layers shifts accordingly, each being greater during the summer. The F2 layer, however, does not follow this pattern in seasonal shift. In most localities, the F2 ionization is greatest in winter and least in summer, the reverse of what might be expected. The separation of the F1 and F2 layers is not so well defined in summer, because the height of the F2 layer is less during that season.

11-YEAR SUNSPOT CYCLE.—Sunspot activity varies according to an 11-year cycle. Sunspots affect the amount of ultraviolet radiation and hence affect the ionization of the atmosphere. During periods of high sunspot activity, ionization of the various layers is greater than usual, resulting in higher critical frequencies for the E, F1, and F2 layers, and higher absorption in the D region. This permits the use of higher frequencies for communication over long distances at times of greatest sunspot activity. The increased absorption in the D region, which has the greatest effect on the lower frequencies, requires that higher frequencies be used, but the overall effect is an improvement in propagation conditions during years of maximum sunspot activity.

27-DAY SUNSPOT CYCLE.—The 27-day sunspot variation is caused by the rotation of the sun on its axis. As the number of sunspots changes from day to day with rotation of the sun or the formation of new spots or the disappearance of old ones, absorption by the D region also changes. Similar changes observed in the E layer cover a wide geographic range. Fluctuations in the F2 layer are greater than for any other layer, but generally are not of a world-wide character.

IRREGULAR VARIATIONS.—A number of transient and unpredictable events bear on skywave propagation. Some of the more prevalent are: sporadic E ionizations, sudden ionospheric disturbances and storms, and scattered reflections.

Sporadic E ionizations are erratic patches of ionized cloud that appear in the area of E layer heights. These ionized clouds vary greatly in density. At times, they reflect so much of the radiated wave that reflections from the other layers of the ionosphere are blanked out completely. At other times, the sporadic E may be so thin that reflections from the upper layers can be received easily through it. The sporadic E layer may occur during the day or night; its occurrence is frequent, although more prevalent in the tropics than in the higher latitudes.

The most startling of all the irregularities of radio wave transmission is the sudden type of ionospheric disturbance causing a radio fadeout. This disturbance, caused by a solar eruption, comes without warning and may last for several hours. All stations on the sunlit side of the earth are affected. At the onset of the disturbance, receiving operators are inclined to believe that their radio sets suddenly have gone dead. The solar eruption causes a sudden increase in the ionization of the D region, frequently accompanied also by disturbances in the earth's magnetic field. The increased ionization of the D region usually causes total absorption of the skywave at all frequencies above 1000 kc.

An ionospheric storm may last from several hours to several days and usually extends over the entire earth. High-frequency skywave transmission is subject to severe fading, and wave propagation is erratic. Often it is necessary to lower the frequency to maintain communications during one of these storms.

Scattered reflections often occur from irregular layers in the ionosphere and may occur at all seasons, both day and night. A radio wave can reflect from either the top or bottom of one of these scattering ionospheric clouds, causing signal distortion and so-called flutter fading. In general, the fading is of short duration, and usually no compensation by the radio operator is required.

FADING AND FREQUENCY BLACKOUTS

Fading is a term used to denote variations in signal strength at the receiver. There are several causes; some are easily understood, others are more complicated. Frequency blackouts are related closely to some types of fading. In reality, a blackout is a complete fade, blotting out the entire transmission.

Fading

One cause of fading is the direct result of interference between single-hop and double-hop transmissions. If the two waves arrive in phase, the signal strength is increased; if the phases are opposed, they cancel each other and weaken the signal. This is called interference fading.

Interference fading also is severe in regions where the groundwave and skywave are in contact with each other. This is especially true if the two are approximately of equal strength. Fluctuations of the skywave with a steady groundwave can cause worse fading than the skywave transmission alone.

The variations in absorption and the path of the wave in the ionosphere are responsible for absorption fading. Occasionally, sudden ionospheric disturbances cause complete absorption of all skywave radiations.

Receivers located near the outer edge of the skip zone are subjected to skip fading as the skywave alternately strikes and skips over the area. This type of fading is so complete sometimes that signal strength falls to near zero level.

Additional variation in the field intensity affecting the receiving antenna occurs as a result of changes in the state of polarization of the downcoming wave relative to the orientation of the antenna. This variation is called polarization fading. The result is random and constantly changing values of the amplitude and orientation of the electric field with respect to the receiving antenna. The state of polarization of skywaves varies more rapidly the higher the frequency, which accounts in part for the rapid fading of higher frequencies.

Frequency Blackouts

Changing conditions in the ionosphere shortly before sunrise and after sunset may cause blackouts at certain frequencies. Higher frequencies may pass through the ionosphere, while the lower ones are absorbed by it. Ionospheric storms often cause erratic communications. Some frequencies are blacked out, although others are reinforced.

When frequency blackouts occur, radio operators must be alert to prevent complete loss of contact with other ships or stations. In severe storms, critical frequencies are much lower and absorption in the lower layers of the ionosphere is much higher.

MUF AND FREQUENCY TABLES

You know that for any fixed distance of transmission there is an upper limit of frequency that returns to earth at that distance. The existence of this upper-limit frequency depends on the ionization in the ionosphere reflecting only waves of frequencies less than a certain critical value; this value is referred to as the maximum usable frequency (MUF). The critical frequency is not constant. It varies from one location to another, with the time of day, the season of the year, and according to the sunspot cycle. Despite these variations in the critical frequency, usually it is desirable to transmit on a frequency as near the MUF as possible. Because there is a direct relationship between the MUF, the condition of the ionosphere, and time, it is possible to predict the MUF for any transmission path.

The National Bureau of Standards receives and analyzes ionospheric data from many stations throughout the world. This ionospheric information, in the form of MUF predictions, is made available to the Armed Forces and many other users.

To assist the Navy communicator, the DNC 14 series, entitled Recommended Frequency Bands and Frequency Guide, is published quarterly, 3 months in advance. This publication contains hourly predicted readings for the FOT (frequency for optimum traffic—approximately 85 percent of the MUF) and the lowest usable frequency (LUF) for communications on an area-by-area basis. Communications frequency predictions are available from 0 to 2400 miles. Directions for selection of working frequencies are contained in DNC 14.

To the Navy communicator an important part of the frequency spectrum lies in the medium- and high-frequency bands (2000 to 18,000 kc). These bands are used for long-distance naval communications from ship-to-ship and ship-to-shore. Standard transmitters found on most ships operate within this range of frequencies.

RADIOFREQUENCY PROPAGATION DETERMINATION AND PREDICTION SYSTEM

During periods of high solar activity, ionization of the ionosphere increases markedly. The range of MUFs for a particular long-range HF transmission path extends upward, occasionally reaching into the VHF band.

Low solar activity has the opposite effect. Ionospheric electron density decreases, and the ionosphere iwll not support the higher frequencies in the HF position of the r-f spectrum. As a result, congestion in the HF band becomes acute during periods of low solar activity because the usable portion of the HF spectrum is greatly reduced.

In addition to the adverse effects of low solar activity, communications are affected by solar-magnetic disturbances. These are caused by solar flares—nuclear explosions in the vicinity of the sun—and are cataloged according to their origin and effect on propagation. The more extreme disturbances are called "sudden ionospheric disturbances (SIDs)." Following a solar flare, radio circuits must await restoration until nature restores the equilibrium or successful alternate routing is accomplished through a time-consuming trial-and-error process.

Long-range frequency predictions are based in part on an ionospheric model in which the index of solar activity is on a statistical basis under assumed conditions of normal magnetic activity. Unfortunately, then, the DNC 14 series is deficient in at least one important respect: Predictions are predicated upon data based on undisturbed ionospheric conditions that exist only about 85 percent of the time. The predictions thus are suspect when conditions of ionospheric disturbances prevail. Even under so-called normal conditions, long-range frequency predictions provide only an average long-range guide to frequency selection.

From the preceding discussion, we can see that there is a vital need for an instrumental system to improve the reliability of HF communications by furnishing propagation data on an instantaneous basis. Ideally, such data would include the commencement, duration, and expected degree of circuit outages resulting from solar-magnetic disturbances. There should be an automatic correlation of factors affecting communication systems to permit the optimum utilization of frequencies in meeting operational requirements. To meet this demand, the Radio Frequency Propagation Determination and Prediction System has been established.

The underlying theme of the System is the development of a synchronized best frequency selection method to improve the overall reliability of naval communications. Present prediction methods are based on long-term propagation conditions, and the inability to determine short-term conditions is a major cause of circuit outages.

One result of the System was the introduction into the fleet of a facsimile propagation map. With the use of transmitted FAX broadcast contour maps, ships at sea are provided with up-to-date information on the best ship-to-shore frequencies during a specified period. A general 48-hour radio condition forecast is included as an integral part of the FAX map.

A project under development is the backscatter/oblique ionospheric sounding system. The backscatter principle provides for the return of a signal to the transmitting station over relatively the same path along which it was transmitted. The information obtained, displayed visually on electronic scopes, will give a presentation of the signal amplitude and area of illumination (estimated frequency coverage). The transmitting station thus will have real-time (instantaneous) knowledge regarding the adequacy of its transmission. Reception of the same transmission by the receiving station, in what is called the oblique mode, will provide a visual display yielding information concerning the best usable frequency for reception.

Ultimately, computer techniques will be employed to intercept and record backscatter/-oblique sounding data, thereby establishing short-term propagation trends. Selected NAVCOMMSTAs and fleet units will be able to correlate prerecorded information with a control computer located at a frequency control center. Following a request from the operating forces for information expressed in terms of traffic load, bandwidth requirements, and time of desired operation, the control center will correlate the requirements with available information such as station equipment characteristics, propagation prediction and ionospheric-disturbance data, ship movement information, and available frequencies. The computer process will culminate in the automatic assignment of a portion of the spectrum to the operating unit in question.

SATELLITE COMMUNICATIONS

It should be apparent by now that one of the paramount problems facing the communicator is selecting the optimum operating frequency. Our usable portion of the r-f spectrum for long-range (HF) communications is confined to a frequency range of between 2 and 28 mc. To aggravate the problem, there are times when frequency blackouts occur and no usable frequencies are available.

One solution to the crowded HF spectrum difficulty lies in the field of satellite-relayed communications. Frequencies in the UHF band or above are considered (groundwave) line of sight frequencies because the nearly horizontal skywave passes through the ionosphere and the r-f energy is lost in space. If we substitute a satellite for the ionosphere or beyond the ionosphere to either reflect signals back to earth or amplify and retransmit the signals, we can utilize frequencies higher than those in the HF band. Longer ranges are available, depending on the height of the satellite, and we no longer depend on the ionosphere for long-range communications. More important, we are able to relieve the crowded area of the HF spectrum, thereby increasing greatly the amount of information that might be passed.

An interesting sidelight to the satellite relay of high-frequency transmissions is the proven feasibility of meteor burst communications. This technique utilizes the ionized trails of meteors as reflecting mediums for VHF transmissions. Meteor burst communications are difficult to jam, relatively secure from interception, and are not affected seriously by ionospheric disturbances.

In view of the known benefits obtainable by the use of frequencies above the HF spectrum, experiments also are being made utilizing lower frequencies. The U. S. Naval Research Laboratory's LOFTI (low-frequency transionospheric) satellite, for example, conformed the belief of some scientists that the ionosphere is not nearly as opaque at low frequencies as was generally assumed.

Although much of a radio wave is reflected by the ionosphere, LOFTI demonstrated that in the VLF area some of the r-f energy passes through the ionosphere into the exosphere with relatively little attenuation. The satellite's orbit ranged between an apogee of 600 miles and a perigee of 100 miles. The VLF signals (18 kc) to the bird were received both day and night at all heights. Further, the signals were of much greater density than anticipated. Even at a distance of some 10,000 miles from the transmitting station, remarkably strong signals are apparent in the telemetry records of the flight. Within LOFTI, received signals were amplified and retransmitted by telemetering equipment to ground stations on a frequency of 136 mc.

Communication satellites are of two types—passive and active.

A passive satellite is an object in orbit capable of reflecting a transmitted signal back to earth. It contains no energized electronic circuitry of its own. The Navy has developed the Communications Moon Relay (CMR) system using the passive reflection method for communications between Washington, D. C. and Pearl Harbor. The totality of the satellite need not be a solid surface; dispersed metallic particles may be utilized as reflectors. If these particles are of the proper length, they become resonant to a particular frequency, and reradiate any signals on that frequency. A disadvantage of the passive satellite is that effective communications using the satellite as a reflecting medium require large, sophisticated, high-gain antennas, and fairly high-powered transmitters.

An active satellite contains electronic receivers, power sources, amplifiers, and transmitters that receive an incoming transmission, amplify it, perhaps change its frequency (as in the LOFTI), and retransmit it to another ground station. Because the active satellite boosts the energy level of a relayed signal, it performs a function similar to a microwave relay tower on the ground. For this reason, ground transmitters need less power and smaller antennas as compared to the requirements of a passive satellite. This is an advantage to shipboard structure. Active satellites are the less reliable of the two types because they contain electronic circuitry and are, therefore, subject to equipment and circuit malfunctions.

Active satellites are further divided into two groups: delayed repeaters and real-time repeaters. Information received by a delayed repeater satellite is stored in a memory device, such as a tape recorder, and later is transmitted either on demand or automatically according to a planned sequence. The delayed repeater is useful at low altitudes when the satellite is not in the line of sight of the sending and receiving stations simultaneously. A real-time repeater, of course, repeats instantaneously with no time lag.

One of the most interesting methods of communications via active satellite is being experimented with in the Defense Communication Satellite Program, in which the Navy is a participant. This high-capacity global communication system calls for several satellites equally spaced around the world in 24-hour equatorial orbits. If the satellite is in an equatorial orbit and at sufficient altitude (19,300 miles from the earth's surface), its orbit will match the rotation of the earth and appear as a stationary satellite permanently fixed over a predetermined location. Ships and stations located anywhere on the earth from 70° N. to 70° S. should be able to view one of these satellites and conceivably could transmit at any time of the day to any place on the globe, within the foregoing latitude limits. Any number of methods of transmission will be available to this system, including digital data, SSB, and possible reconnaissance television. Because the frequency will be between 2000 and 8000 mc, the capacity of the system will be very high. Terminals for the eventual communication system will include fixed and mobile ground stations, aircraft, ships, and submarines.

CHAPTER 7

PRIMARY COMMUNICATION EQUIPMENT

The most important equipments within the purview of the communication officer are receivers, transmitters, and antennas, teletypewriters, and their associated equipment. The most technical knowledge an officer has of his equipment the better prepared he is to solve his operational problems. Obviously one cannot delineate the degree of knowledge which is sufficient to assure excellent performance as a communication officer. Some technical knowledge is necessary. This chapter discusses, to a limited degree, some functionary aspects of communication equipment.

EQUIPMENT DESIGNATING SYSTEMS

The system used by the military services to identify most electronic equipment is the Joint Electronics Type Designation System, more commonly called the "AN" system. The basic equipment nomenclature consists of five indicator letters and a number. The basic designation may be supplemented by letters and numerals that indicate modifications or changes to the equipment.

The system is designed so that its indicators tell, at a glance, important information pertinent to the item: whether the item is a set or only a component, where it is to be used, what kind of equipment it is, and what it is for.

For example, AN/SRT-15 indicates a radio transmitter designed for installation in a surface ship. The designation is broken down as follows (refer to table 7-1): AN tells us that the identification of the equipment is assigned under the AN system. The AN is followed by a slant sign and the three letters SRT. Letter S means the equipment is designed to be carried by a surface ship, R signifies that the item is a radio, and T indicates that the equipment is used for transmitting. The figure 15 is the model number. A modification to the current model would be shown as 15A, a second model would be 15B, and so on.

Although most equipments are identified by the AN system, a considerable number are marked and identified according to the older Navy Model System. This system utilizes three (in isolated cases, two) letters that indicate (1) the application or function of the unit and (2) the approximate order of tis development. For the initial letter(s), the following is the key to the application of the unit:

- D Radio direction finding.
- FS Frequency shift keying.
- L Precision calibrating (such as frequency meters).
- R Radio receiving.
- T Radio transmitting (includes combination transmitting and receiving).

Under the older system, RA is the first radio receiver designated, RB is the second, etc. When the alphabet is exhausted, three-letter designators are assigned as follows: RA. . . RZ, RAA . . . RAZ, RBA . . . RBZ and so on. A numerical suffix (e.g., RB-1) indicates an improved model of a designated unit.

ELECTRON TUBES

The electron tube is considered mainly responsible for the rapid evolution of electronics to its present stage. It is one of the basic components of almost every electronic equipment. Without the discovery and development of the tube, elaborate yet compact equipment such as radio, radar, and sonar would not be possible. A knowledge of electron (vacuum) tubes is basic to understanding the operation of radio receivers and transmitters.

Electron tubes perform many functions. In the field of radio, their greatest usefulness lies in the ability to amplify weak signals. The strength of a signal picked up by the antenna of a radio receiver is in the microvolt region, and signal amplification is required if the human ear is to hear the transmitted intelligence.

The tube is made up of a highly air-evacuated glass or metal shell that enclosed several elements: a cathode (emitter), a plate or anode (collector), and sometimes one or more grids.

Electricity is the flow of free electrons through a conductor. In various ways this flow of electricity can be controlled. Electrons,

Table 7-1. —Equipment Indicator Letters

Installation	Type of Equipment	Purpose
A—Airborne (installed and operated in aircraft)	A—Invisible light, heat radiation	A—Auxiliary assemblies (not complete operating sets)
B—Underwater mobile, submarine	B—Pigeon	B—Bombing
C—Air transportable (inactivated; do not use)	C—Carrier	C—Communications (receiving and/or transmitting)
D—Pilotless carrier	D—Radiac	D—Direction finder
F—Fixed	E—Nupac	G—Fire control or searchlight directing
G—Ground, general ground use (includes two or more ground installations)	F—Photographic	H—Recording (photographic, meteorological, or sound)
K—Amphibious	G—Telegraph or teletype	L—Searchlight control (inactivated; use "G")
M—Ground, mobile (installed as operating unit in a vehicle which has no function other than transporting the equipment)	I—Interphone or public address	M—Maintenance and test assemblies (including tools)
P—Pack or portable (animal or man)	J—Electromechanical (not otherwise covered)	N—Navigational aids (including altimeters, beacons, compasses, racons, depth sounding, approach, and landing)
S—Water surface craft	K—Telemetering	P—Reproducing (photographic and/or sound)
T—Ground, transportable	L—Countermeasures	Q—Special, or combination of purposes
U—General utility (includes two or more general installation classes, airborne, shipboard, and ground)	M—Meteorological	R—Receiving, passive detecting
V—Ground, vehicular (installed in vehicle designed for functions other than carrying electronic equipment, etc., such as tank)	N—Sound in air	S—Detecting and/or range and bearing
	P—Radar	T—Transmitting
	Q—Sonar or underwater sound	W—Control
	R—Radio	X—Identification and recognition
	S—Special types, magnetic, etc., or combinations of types	
	T—Telephone (wire)	
	V—Visual or visible light	
	W—Armament (peculiar to armament, not otherwise covered)	
	X—Facsimile or television	

which are negatively charged particles, always flow toward any area which is positively charged. Here, as in all of nature, the maxim that opposites attract is true.

Certain metals, when heated, emit free electrons. In most cases the electrons fall back into the metal. However, if we change the conditions somewhat, we can cause the electrons to leave permanently.

DIODES

Figure 7-1 shows a simple two-electrode or two-element schematic of a diode (di, the prefix signifying two, combined with the suffix ode from Greek "hodos," meaning way or path, found in such words as cathode, electrode, and anode. The cathode is made of a material, such as tungsten or oxide-coated nickel alloy, that gives off electrons when heated. In the illustration, the cathode is heated by battery A. If the cathode is encased in a container with

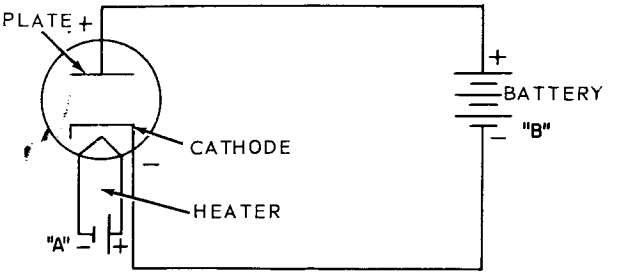

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Figure 7-1. —Diode schematic.

another piece of metal and the air is removed, proper conditions are present to cause the electrons to flow. Evacuation of air from the tube is required to (1) prevent destruction of the cathode and heating element by oxidation or burning, and (2) permit the uninterrupted flow of current from cathode to plate (anode). The lightest gas particle is approximately 1800 times the weight of an electron. Molecules of air would divert electrons upon impact and make the current flow erratic.

To start the flow of electrons, heat is applied to the cathode by the filament. Then voltage is applied to the plate (in our example using battery B), and the cathode is caused to be negatively charged with respect to the plate. The heated cathode emits electrons that move across the open space toward the anode (plate). Because a positive potential exists on the anode with respect to the cathode, the movement of electrons is continuous so long as voltage is applied, causing a flow of current. The higher the plate voltage, the stronger the force, and the more electrons are pulled from the cathode. Eventually a plate voltage value is reached at which all the electrons being emitted are in transit to the plate. The tube has then reached its saturation point, and any further increase in plate voltage can cause no further increase in plate current flowing through the tube.

TRIODES

The triode, or three-element electron tube, is similar in construction to the diode, except that a grid of fine wire is added between the cathode and the plate. The grid usually is in the form of either a spiral helix with the cathode at the center, as in figure 7-2, or a mesh screen.

The plate current in a diode depends on plate voltage and cathode temperature. The number of electrons (i. e., the current) flowing through the tube can be controlled in two ways: by changing the plate voltage and by changing the temperature of the cathode. In a triode, the flow of current to the plate also is controlled by applying voltage directly to the grid.

Electrons leaving the heated cathode (filament) fill the space between cathode and plate, and exert a repelling force on the electrons that follow. This results in a relatively large cloud of electrons, called a space charge, near the cathode. The space charge, in effect, is a

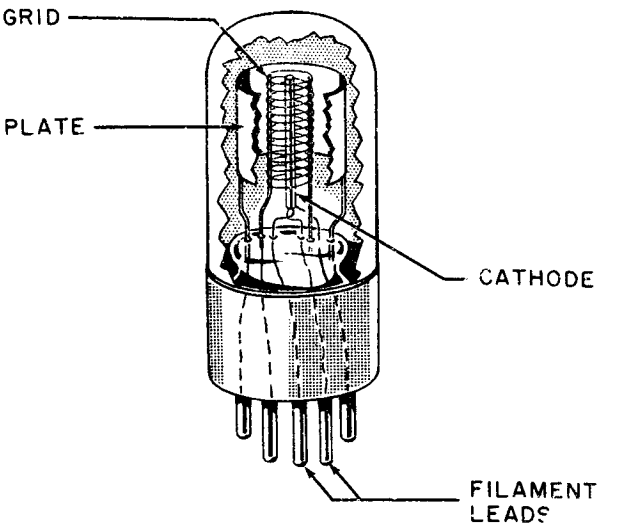

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Figure 7-2.—The third element of a triode is a wire grid.

negatively charged electrode near the filament that limits the amount of current that can flow for a given plate voltage, opposing the attraction of the positive plate.

By placing a metallic grid near or within the negative space charge, it is possible to control the plate current without changing either plate voltage or filament temperature. The open spaces of the grid mesh must be sufficiently large not to block the flow of electrons. On the other hand, the spaces must be small enough to control effectively the flow of plate current when the proper voltage is applied between the grid and cathode.

To control the current by means of the grid, the grid voltage is made less or more negative with respect to the cathode by means of an electrical lead in the base of the tube. When the grid is made more negative than the cathode, it blocks the flow of current because the higher negative charge repels the electrons back toward the filament (cathode). As long as the grid is negative with respect to the cathode, no grid current flows and no power is consumed in the grid circuit. The smallest voltage between grid and cathode that will cut off the flow of plate current, the grid being negative, is called the cutoff bias.

When the grid is made positive with respect to the cathode, the electrons in the space charge are accelerated toward the plate. Consequently, cathode-to-plate potential being the same, more

current can be made to flow than is possible when no grid is present. Because the grid is so close to the space charge, the grid-to-cathode voltage has a much greater effect on current flowing through the tube than does voltage between the plate and cathode.

The addition of the grid gives to the electron tube its most useful function—the ability to amplify an input signal. Because of the grid's boosting action, a small change in the grid input signal is accompanied by a relatively large change in plate output signal. To amplify a received signal, therefore, it is more efficient to apply a small change in voltage directly to the grid rather than to apply a large change in voltage to the plate. The grid signal is said to be amplified in the plate circuit. The grid itself may be considered as an electronic control valve that regulates the flow of electrons through the tube and through the load in the plate circuit.

Amplification of the signal is necessary because the r-f energy arriving at the antenna is a very small portion of the total energy transmitted. The received energy, or signal, is applied electronically between the grid and the filament of a triode. By selecting the proper tube, a change of a few volts or microvolts (plus or minus) in grid voltage can result in a large change of current flow to the plate. In this way a small variation in grid voltage can be multiplied 10, 20, or more times in the output signal. This signal may be fed to another triode for further amplification. For example, a 0.2-volt input signal may be amplified 20 times in tube A, resulting in a plate voltage of 4 volts. If the amplified signal is routed to a second tube capable of amplifying 20 times, the result is a second-stage amplification of 80 volts (20 x 4), or a total amplification of 400 (80/.2).

Figure 7-2 shows the construction features of a typical triode. Electrical connections to the grid and plate are made through the base pins and support wires of the tube. The cathode sleeve is insulated from the filament and is connected by means of a short lead to one of the base pins. The grid is much closer to the cathode than to the plate.

MULTIELEMENT TUBES

Many desirable characteristics may be attained in electronic tubes by the use of more than one grid. Common types include tetrodes and pentodes, which contain four and five electrodes, respectively. Tubes containing as many as eight electrodes are available for certain applications. Other refinements include beam-power tubes, gas-filled tubes, and variable-mu tubes, the technical details of which need not be discussed.

To reduce the number of tubes in radio circuits, the electrodes of two or more tubes frequently are placed within one envelope. Known as multiunit tubes, they generally are identified according to the way the individual types contained in the envelope would be identified if they were made as separate units. A multiunit tube may be identified, therefore, as a duo-diode, a diode-pentode, a diode-triode-pentode, and so on.

OSCILLATORS

In out discussion of frequencies, it was pointed out that a transmitter sends out intelligence on a specific frequency, and that a radio receiver, if it is to capture that intelligence, must be tuned to the same frequency. In the transmitter the basic frequency is generated by some form of oscillator.

Basic to an understanding of an oscillator's function is a knowledge of the principles of resonance. Every substance has a natural frequency at which it vibrates. If a singer raises the pitch of his voice to a certain level, he can shatter glass. The vibrations of the sound wave produced by his vocal cords reach the natural frequency of the glass, and the glass in turn vibrates so much that it breaks. Two objects vibrating at the same frequency are said to be in resonance.

When a transmitted radio wave strikes a receiving antenna, the wave of r-f energy sets up a current (vibration) through the antenna. The current is strongest when the frequency of the receiving antenna is the same as (is resonant with) that of the transmitting antenna. The induced current under this condition meets the least amount of opposition in the circuit. If the two antennas operate on different frequencies, a current also may be induced in the receiving antenna, but it will meet with greater opposition.

If, therefore, the resonant frequency of transmitter A is 150 kc, and that of B is 450 kc, and if the resonant frequency at the receiver happens to be—at the time—150 kc, the receiver offers minimum opposition to frequency A. In effect, the receiver rejects the signal from

transmitter B and accepts the signal from transmitter A.

The primary function of an oscillator is to generate a flow of r-f energy and to maintain that frequency within certain limits. In addition to their use as amplifiers, electron tubes are used as oscillators for the generation of alternating, or oscillatory, voltages. The tube itself, however, is not an oscillator. The oscillations actually take place in the tuned circuit. The electron tube functions mainly as an electronic valve that amplifies and automatically delivers to the grid circuit the proper amount of energy to maintain oscillation and, therefore, resonance.

An important requirement of an oscillator is that it accurately maintain the frequency to which it is adjusted. The ability of an oscillator to maintain a constant frequency under variable operating conditions is referred to as frequency stability. Variations in plate voltage, stability of mechanical parts, loading, and temperature are some of the factors that influence frequency stability. Dynamic instability is the term used to describe sudden frequency changes. Gradual frequency changes are referred to as drift.

Some of the precautions usually taken to ensure frequency stability are: (1) the use of a regulated power supply, (2) reduction of the r-f load to a minimum, (3) provision of a warmup period before setting the oscillator to the desired frequency, and (4) stable mounting of the oscillator components so that changes in circuit constants resulting from mechanical motion are minimized.

Many variations of self-controlled, or self-excited oscillator circuits are in use. In general, these built-in oscillators are placed within the tube between the grid and cathode. Most of these have the disadvantage of a slight frequency drift resulting from temperature and load changes. In order to have a source of r-f energy that is constant and subject to practically no frequency changes, substances called crystals are used in the oscillator. When so used, the crystal determines the oscillating frequency. To change the frequency of a crystal-controlled oscillator, it is necessary only to replace the crystal with one that will vibrate at the desired frequency when electrically energized.

Several crystalline substances such as Rochelle salt, tourmaline, and quartz have the property of vibrating mechanically at a particular frequency when an electromotive force is applied to them. The magnitude of the response obtained from the crystal depends on the type of crystal employed, the way it is cut, and the manner in which the emf is impressed. For several reasons, mainly stability and ruggedness, quartz-crystal oscillators are preferred.

The crystals must be cut and ground to close tolerances. For example, the dimensions for a typical quartz crystal resonant at 1000 kc is approximately 1 x 1 x 0.1125 inch. For use at higher frequencies, some crystal elements are disk shaped or cut in the form of a flat ring. Crystals usually are rated according to the maximum r-f current which they can tolerate without heat fracture.

Electrical contact with the crystal is made by a crystal holder consisting of two metal plates, between which the crystal is placed, and a spring device that places mechanical pressure on the plates. Contact also may be made by soldering connecting wires to a metallic film deposited on the surface of the crystal.

TRANSMITTERS

Radio transmitters used by the U. S. Navy range from the largest in the world, which is the million-watt VLF installation at Cutler, Maine, to the 0.027-watt handie-talkie. Most ships are equipped with transmitters rated at between 100 and 500 watts for use in the LF band through the UHF band. There are no shipboard VLF transmitters because of the prohibitive size required to generate the necessary operating power.

CLASSIFICATION OF EMISSIONS

Radio wave transmissions originally were classified, by international agreement, only according to the type of transmission (modulation). The classification for CW telegraphy was simple A1, telephony was A3, FAX A4, and the like. This system of classification proved inadequate because of the introduction into the field of communications of such systems as pulse-time modulation, frequency-shift keying, and multiplexing.

In 1947, the International Telecommunication Convention (ITC) prescribed designators, revised in 1959, that provide more detailed descriptions of emissions. Emissions now are designated according to their classification and necessary bandwidth; they are classified

according to their characteristics. An emission designator normally has four parts, consisting of—

	Symbol
1. Bandwidth occupied (in kc).	
2. Type of modulation of main carrier:	
a. Amplitude	A
b. Frequency and phase	F
c. Pulse (for radar transmission)	P
3. Type of transmission:	
a. Absence of any modulation intended to carry information	0
b. Telegraphy without the use of modulating audiofrequency	1
c. Telegraphy by the on-off keying of a modulating audiofrequency or audiofrequencies, or by the on-off keying of modulated emissions	2
d. Telephone	3
e. Facsimile	4
f. Television	5
g. Four-frequency duplex telegraphy	6
h. Multichannel voice-frequency telegraphy	7
i. Cases not covered by the above	9
4. Supplementary characteristics:	
a. Double sideband	None
b. Single sideband:	
(1) Reduced carrier	A
(2) Full carrier	H
(3) Suppressed carrier	J
c. Two independent sidebands	B
d. Vestigial sideband	C
e. Pulse:	
(1) Amplitude-modulated	D
(2) Width-(or duration) modulated	E
(3) Phase-(or position modulated	F
(4) Code-modulated	G

Under the foregoing system, the designator 3A3A indicates—

3—bandwidth 3 kc (part 1);
A—amplitude-modulated (part 2);
3—telephony (part 3);
A—reduced carrier (part 4).

The following types of emissions are representative of some of those now applicable to naval communications:

3A3A	AM SSB telephony.
6A3	AM telephony.
36F3	FM telephony.
0.1A1	CW telegraphy, 25 wpm.
1.5A2	Tone-modulated RATT, 60 wpm.
1.08F1	Single-channel RATT, 60 wpm.
4F4	Facsimile.

HARMONICS

It is difficult to design and build a stable oscillator for use at higher frequencies; and, if a crystal is employed to control an HF oscillator, it must be ground so thin that it may fracture while vibrating. To overcome the problem, HF transmitters utilize oscillators that operate at comparatively low frequencies. The oscillator frequency then is raised to the required output frequency of being passed through one or more frequency multipliers, which are special power amplifiers. Multipliers that double the freqeuncy are doublers, those which multiply by three are triplers, and so on.

Harmonics are the exact multiplies of the basic, or fundamental, frequency generated by the oscillator. Even harmonics are even multiplies times the fundamental; odd harmonics are odd multiplies of the fundamental. If an oscillator has a basic frequency of 2500 kc, harmonically related frequencies are—

2d harmonic . . . . . 5000 kc.
3d harmonic . . . . . 7500 kc.
4th harmonic . . . . . 10,000 kc.

The series ascends indefinitely until the signal is too weak to be detected. The r-f energy remaining in frequencies above the third harmonic usually is insignificant.

The main difference between many LF and HF transmitters is in the number of frequency-multiplying stages employed.

TRANSMISSION OF INFORMATION

The r-f energy radiated by a transmitting antenna conveys no intelligence in itself. It

simply "carries" intelligence superimposed upon it. The power wave is referred to as the carrier wave, or carrier.

Continuous Wave (CW) Transmission

In CW radiotelegraph transmissions, information is transmitted by alternately starting and stopping the flow of power from transmitter to antenna by means of a telegraph key. Messages are sent by means of short and long pulses that correspond to letters and numerals of the Morse code. The carrier is merely turned on and off; it is not changed in either frequency or amplitude.

For other than CW transmissions, the process of superimposing useful information on the carrier is called modulation.

Amplitude Modulation

Let us consider the problem of sending audible signals so that one may speak directly into a microphone at the transmitting station and be heard and understood at the receiving station.

We have stated that a radiofrequency is above 15 kilocycles and an audiofrequency is below that frequency. Actually, voice frequencies run considerably below that figure. Against a similar time scale we can illustrate the comparative sizes of radiofrequency waves and audiofrequency waves as in figure 7-3. Many cycles of radiofrequency waves are completed within 1 cycle of audiofrequency. For instance, 1000 cycles per second is audible, and within the time of 1 cycle (1/1000 second), a 50-kc radiofrequency would complete 50 cycles.

To transmit an audible signal, the carrier waveform may be modulated in accordance with the variations in the audio tones to be transmitted. The source of the modulating signal is the output voltage of the microphone. A microphone is essentially an energy converter that changes acoustical energy into corresponding electrical energy. Speech, music, or any other form of intelligence is first converted into alternating voltages. The voltages, in turn, are electronically superimposed on the carrier before its transmission in order to modulate the amplitude of the carrier. This method of impressing modulating frequencies on the carrier waves is called amplitude modulation (a-m).

STAGES WITHIN AN A-M TRANSMITTER.—An audio signal entering the microphone is amplified by one or more audiofrequency (a-f) speech amplifiers and by the a-f modulator, as seen in figure 7-4. The a-f voltage supplied by the microphone usually is less than 1 volt. The addition of such a low a-c voltage to the comparatively high d-c potentials in the tube results in a very small variation in the power output. It is necessary, therefore, to amplify the audiofrequencies from the microphone to a level high enough to cause considerable variation in the power output of the transmitter.

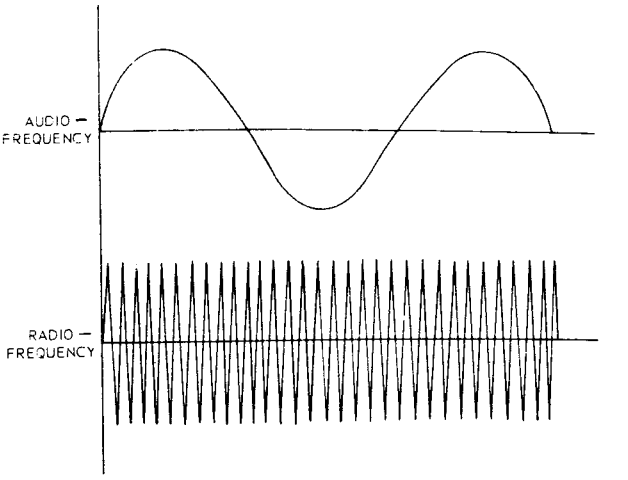

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Figure 7-3.—Comparison of audiofrequency and radiofrequency waves.

The oscillator produces the r-f carrier wave which is amplified by the r-f buffer amplifiers (see fig. 7-4). Buffer amplifiers, in most cases located between the oscillator and the r-f amplifiers, isolate the oscillator from the load to improve frequency stability. The outputs of the a-f modulator and the r-f buffer amplifiers are mixed in the final r-f amplifier to produce the modulated carrier wave. Frequency multipliers raise the oscillator output frequency of the transmitter to the desired carrier frequency.

The stage that the modulator feeds is known as the modulated r-f amplifier. If the modulation voltage is sent into the power amplifier stage such a transmitter is said to be using high-level modulation; if the modulation is accomplished in an earlier stage, the transmitter is said to use low-level modulation. High-level modulation is more efficient; low-level modulation requires less power. Navy transmitters

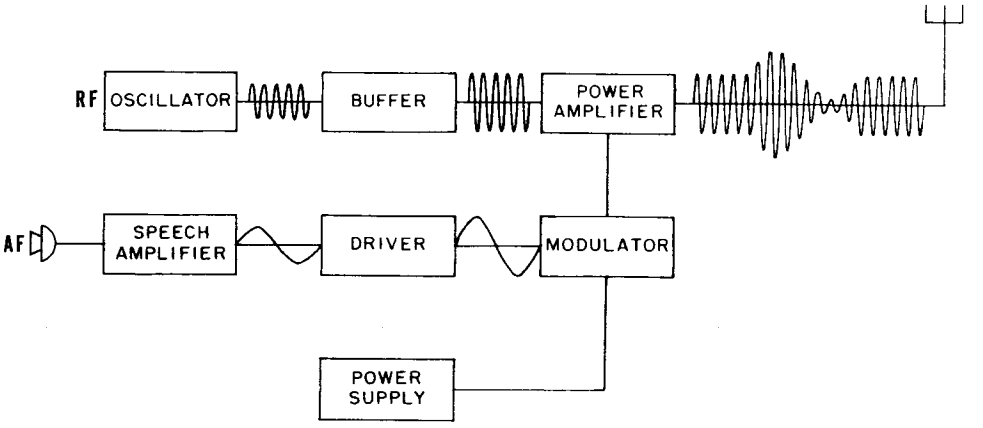

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Figure 7-4. —AM radiotelephone transmitter.

employ high-level modulation except when weight is an important consideration, as it is in aircraft and portable equipment.

Figure 7-5 shows an amplitude modulated radiofrequency. The top envelope of the r-f conforms to the shape of the audio signal below it. The lower part of the a-m signal is just the opposite of the upper part. The mixing of the radiofrequency and audiofrequency is accomplished in a transmitter by means of a modulator circuit. The modulated frequency then goes to the antenna, which radiates the electromagnetic wave into space.

As an aid to understanding the modulator circuit, figure 7-6 shows a simplified schematic of a modulator of the grid-bias type.

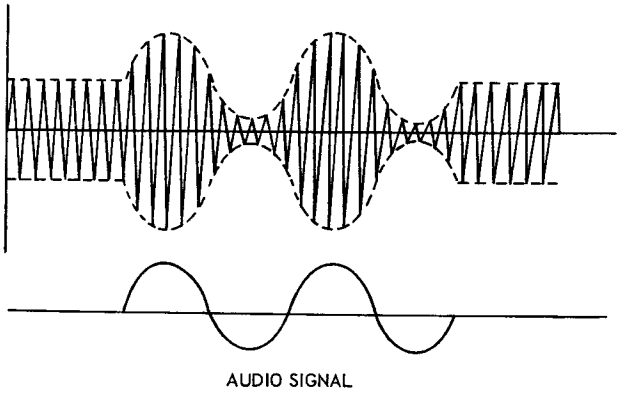

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Figure 7-5. —Amplitude modulated radiofrequency.

The modulator varies the grid voltage of the triode in accordance with the audiofrequency. The current passing through the tube increases as the audio wave becomes more positive and decreases as it becomes more negative. At the same time, the radiofrequency is being coupled to the grid by the capacitor shown to the left of the grid in the drawing. Instead of the r-f signal being amplified without change, as we saw earlier in this chapter, the varying of the grid charge by the audio signal varies the current passage, and the output signal on the plate is the modulated r-f signal shown in figure 7-6. The audio signal is coupled to the grid by a transformer, and the output signal is coupled to the antenna in the same way. The two batteries maintain the charge on the grid slightly less than on the cathode, and the cathode charge is much less than that on the plate.

In practice, the batteries are replaced by electronic power supplies, and many additional components are needed to control the circuit.

ANALYSIS OF AMPLITUDE MODULATION. —An inherent disadvantage of the a-m method of transmitting is frequency extravagance. When an audiofrequency is employed to modulate a radiofrequency, the width of the r-f spectrum needed for communicating is twice the highest modulating frequency because of the introduction of sidebands.

When an r-f carrier is modulated by an audio note, two additional (side) frequencies are produced: an upper side frequency and a lower side frequency. The upper frequency equals the sum of the carrier frequency and the

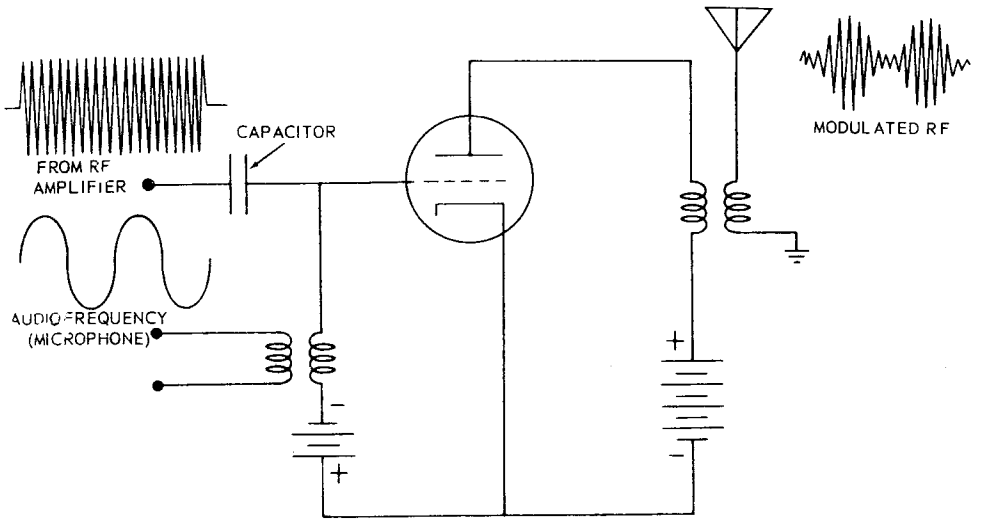

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Figure 7-6.—Grid-bias modulator.

frequency of the audio note, while the lower frequency equals the difference between the two. The side frequencies, then, occupy a band of frequencies lying between the carrier and both the upper and lower limits of the modulating frequencies, as in figure 7-7. When a modulating signal is made up of complex tones, such as those caused by speech, each individual frequency component of the signal produces its own upper and lower side frequencies.

The bands of frequencies containing the side frequencies are referred to as sidebands, and the space that a carrier and its associated sidebands occupy in the r-f spectrum is the bandwidth. The bandwidth, therefore, is equal to twice the highest modulating frequency.

In figure 7-7, a 5000-kc carrier is modulated by a band of frequencies ranging from 200 to 5000 cycles (0.2 to 5 kc). The upper sideband extends from 5000.2 to 5005 kc; the lower sideband extends from 4999.8 to 4995 kc. The bandwidth, 10 kc (4995 to 5005), is twice the value of the highest modulating frequency, which is 5 kc.

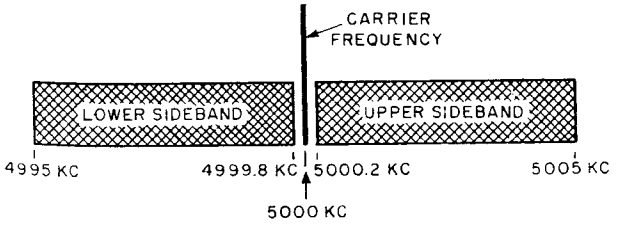

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Figure 7-7.—Sidebands produced by amplitude modulation.

Modulated Continuous Wave

Another mode of operation provided by many medium— and high-frequency transmitters and nearly all VHF-UHF equipment is known as modulated continuous wave (MCW) telegraph transmission. These transmitters are designed for both CW radiotelegraph and a-m radiotelephone transmission.

An MCW transmitter has an audiofrequency oscillator generating a note of constant frequency that is used to modulate the r-f carrier. The received sound is at the frequency of the audio oscillator. Modulated CW telegraphy has a slightly greater distance range than voice modulation for the same transmitter. The range of MCW, however, is always less than that of CW transmission of the same transmitter and, for this reason, is seldom used.

Modern shipboard medium- and high-frequency transmitters also provide other modes of operation, such as frequency-shift keying for radioteletypewriter transmission. This subject is treated fully in a later chapter.

Frequency Modulation and Phase Modulation

In addition to its amplitude, a carrier wave has two other characteristics that can be varied to produce an intelligence-carrying signal. These are its frequency and its phase. The process of varying the frequency in accordance with the audiofrequencies of voice or music is called frequency modulation (FM), and the process of varying the phase is phase modulation. The two types of modulation are closely related. When either is employed, the other is indirectly affected.

The primary advantages of FM are improved fidelity and increased freedom from static. Because of these qualities, it is of considerable use in commercial broadcasting, but its shortcomings—frequency extravagance, short range on available frequencies, and others—severely limit its naval communication applications. The Navy has, however, found FM satisfactory for other purposes, among them altimeters and some radars.

Single Sideband Transmission

Conventional amplitude modulation is often referred to as double sideband (DSB). A mode of radio wave emission that is increasingly important to the fleet is known as single sideband (SSB). The SSB has been employed extensively in shore communication systems for many years. Technological developments that have reduced the physical sizes of equipments now make it feasible to utilize SSB for fleet communications as well.

In DSB transmissions, modulation of the carrier produces a complex signal consisting of three individual waves: the orginal carrier and two identical sidebands. This is an uneconomical means of transmission, because both sidebands carry the same intelligence. The theory of the SSB is that by suppressing the carrier and one of the sidebands as in figure 7-8, the same intelligence can be sent at a saving in power and frequency bandwidth.

In SSB, the carrier is eliminated at the transmitter. This usually is the most difficult or troublesome aspect in understanding SSB. In single sideband suppressed carrier transmissions, there is no carrier present under modulation conditions. As a result, all the r-f energy appearing at the transmitter output is concentrated in "talk power." In addition,

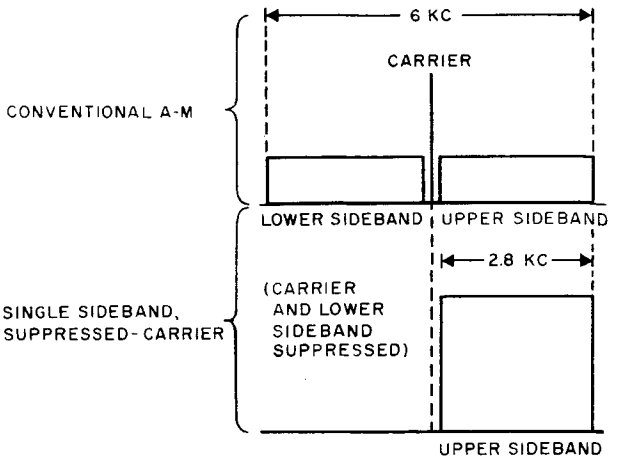

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Figure 7-8.—Comparison of bandwidths of conventional AM and SSB voice channels.

one of the two sidebands is filtered out before it reaches the power amplifier stage of the transmitter. The desired intelligence is then transmitted only on the remaining sideband.

ADVANTAGES OF SSB.—It has been pointed out that in DSB there are two sidebands which are heterodyned (mixed) with the transmitted carrier. If these sidebands are not received in phase (usually because of multipath skywave propagation conditions), the signal heard is fuzzy, distorted, and possibly quite loud. One sideband may experience a slight phase shift due to the multipath transmission, thereby nearly canceling the other sideband. This produces distortion and lose of intelligibility. Fading or slight phase shift of the carrier can produce similar results. However, with the suppressed-carrier type of SSB, these problems are minimized. There are several other important advantages.

In a conventional DSB system, approximately one-half of the transmitter's power goes into carrier, assuming 100 percent modulation, and the remaining one-half is divided equally between the two sidebands. However, with the suppressed-carrier SSB system, virtually all of this power goes into a single sideband which carries the useful voice intelligence.

Because one sideband is eliminated, the bandwidth required for SSB voice circuits is approximately one-half of that needed for DSB. The number of available voice channels utilizing the same frequency in the radio spectrum therefore is doubled. With the scarcity of

frequencies available for new assignments in the spectrum, particularly in the 2- to 30-mc range, this is an important advantage in fleet communications.

In normal voice DSB communication systems, the carrier of the transmitting station remains on the air until the transmitter is turned off. If an additional station transmits while the carrier of the other station is on, squeals and howls result. These are caused by the heterodyning of two or more signals transmitting at the same time. In SSB, as soon as the individual stops speaking into the microphone, talk power in the single sideband leaves the air. Even though two stations may transmit at the same time, it may be possible for a receiving station to read through the interfering station the same way we are able to listen to more than one conversation at the same time.

The range of standard shipboard voice circuits is relatively limited because transmitters do not have the power for voice modulation that they have for CW telegraphy. Because the effective power of the SSB transmissions are concentrated in one sideband, SSB offers the best method of increasing the range of reliable voice communications.

RADIATION HAZARDS

Biological hazards, such as blindness, sterility, or internal burns are possible results of high-energy radiation fields. This radiation also can be hazardous to EED (electroexplosive device) ordnance and during aviation refueling operations. In the case of ordnance, radiation may cause accidental firing or dudding of the electrically initiated devices.

Reports of ignition of gasoline vapors by r-f induced arcs during aircraft refuelings fortunately are rare. In recent years, however, there has been a significant increase in radiated energy from improved high-power communication and radar equipments. This increase, in turn, raises the potential hazard of r-f induced ignition of volatile fuel-air mixtures. Minimum safe handling distances for fueling operations have been promulgated to the fleet, and this problem will not be discussed here.

Biological Radiation Hazards (RADHAZ)

Until recently the power generated by electronic equipment was low enough that it was not considered a serious biological hazard. The development of r-f transmitting systems with high-power transmitting tubes and high-gain antennas has increased the possibility of biological injury to personnel.

When a man goes aloft to work on an antenna, a basic rule of safety demands that all radio transmitters be secured and that all transmitting antennas be disconnected and grounded. If the proper precautions are carried out, no RADHAZ exists. This discussion is intended mainly to acquaint the communicator with the personnel hazard that exists for men working in the vicinity of equipments radiating at high frequencies.

When considering the biological effects produced by r-f radiation, the wavelength (frequency) of the energy and its relationship to the physical dimensions of the object exposed to radiation become important factors. For any significant affect to occur, the physical size of the exposed object must be the equivalent of at least a tenth of a wavelength at the frequency of radiation. Neglecting other physical measurements of the body, if a man is considered to be a vertical receiving antenna, his electrical length (height) depends entirely upon the radiated frequency. As you know, the higher the frequency of radiation the shorter the wavelength. As the frequency increases, therefore, the wavelength decreases, and the man's height represents an increasingly greater number of electrical wavelengths. Thus the likelihood of biological effects increases with an increase in radiation frequency, particularly when the frequency is in the microwave region.

When electromagnetic energy is absorbed in tissues of the body, it produces heat in the tissues in much the same manner as does infrared radiation or direct sunlight. If an organism cannot dissipate this heat energy as fast as it is produced, the internal temperature of the body will rise. This may result in damage to the tissue and, if the rise is sufficiently high, in destruction of the organism. Temperature regulation in the human body is accomplished mainly through the action of sweat glands (cooling through evaporation) and by heat exchange resulting from peripheral circulation of the blood. Because the body has a limited ability to lose heat through sweating and blood circulation, it can tolerate only a moderate increase above normal body temperature.

Certain organs of the body—such as the eyes, the gall bladder, and the urinary bladder—are

more susceptible than others to the effects of r-f radiation. The eyes, in particular, are very susceptible to thermal damage because they have an inefficient vascular system to circulate blood and exchange heat to the surrounding tissues. Unlike other cells of the body, the transparent lens cells of the eyes cannot be replaced by regrowth. When the cells making up the lens become damaged or die, a cataract may be formed.

Although every effort must be made to protect personnel from exposure to r-f radiation, it is not practicable for the commanding officer to impose blanket restrictions on the use of transmitting antennas. Such a policy would needlessly restrict maintenance and checkout procedures, and might well endanger the ship at a critical time.

The following precautions, as a minimum, should be taken to keep men clear of hazardous intensity levels:

1. Permit no visual inspection of any opening, such as a waveguide, that is emitting r-f energy unless the equipment is definitely secured for the purpose of such an inspection.
2. Operating and maintenance personnel must observe all r-f hazard signs posted in the operating area to ensure that the equipment is operating in such a manner that nearby personnel are not subjected to hazardous levels of radiation.
3. Ensure that all personnel are aware of and observe r-f warning signs in a specific area.
4. When the possibility of accidental exposure exists while the antenna is radiating, require technical personnel to have a man stationed topside, within view of the antenna (but well out of the beam), and in communication with the operator.
5. Ensure that radiation hazard warning signs are available and used, not only where required to be permanently posted, but also for temporarily restricting access to certain parts of the ship while radiating.

Hazards of Electromagnetic Radiation to Ordnance (HERO)

Electrically initiated explosive devices are utilized to initiate booster rocket igniters and warhead detonators, for stage separation in multistage rockets, for high-speed operation of switches and valves, and for many other purposes. Some weapons contain more than 75 EEDs. At the same time, the power of both radar and communication transmitting equipments is being constantly increased.

These trends produce an apparently incompatible situation. Transmitters and their antennas have only one purpose—to radiate electromagnetic energy. On the other hand, the initiating elements of certain ordnance items need only to be supplied with the proper amount of electrical energy for an explosion to take place.

Radiofrequency energy can enter a weapon in one of two ways: as a wave radiated through a hole or crack in the weapon skin, or by conduction through firing leads or other wires that penetrate the weapon enclosure. The degree of hazard to specific devices under all operational conditions is difficult to establish. The precise probabilities of EED actuation depend upon variables of frequency, field strength, geometric orientation, r-f environment, and metallic or personnel contacts with ordnance and aircraft.

The most likely effects of premature actuation are dudding, reduction of realibility, or propellant ignition. In the very worst environments there is a low, but finite, probability of warhead detonation. The most susceptible periods are during assembly, disassembly, loading, unloading, or testing in an r-f field.

To meet the growing need for new shipboard procedures to reduce the hazard to ordnance equipment for r-f radiation, the Bureau of Naval Weapons has sponsored tests which, coordinated with studies by other agencies, has enabled the formation of new guidelines and restrictions for handling electrically initiated ordnance equipment. These guidelines have been published to the fleet by a BUWEPS instruction in the 5101 series, Radio Frequency Hazards Manual. In compliance with that instruction, commanding officers are to establish a procedure whereby radiation from radio and radar antennas is positively controlled and coordinated between personnel handling ordnance and personnel operating the transmitters to ensure the observances of the prescribed operating restrictions.

UHF/HF RELAY.—Measures are being taken to eliminate HERO and RADHAZ to a degree where r-f silence will be unnecessary. Meanwhile, restrictions are placed on the use of HF transmitters under certain conditions involving HERO/RADHAZ effects.

As a partial solution to the restrictions, a UHF/HF relay system has been established whereby a ship having a HERO problem that normally requires emission controls can utilize a UHF transmitter to automatically key long-range HF transmitters in nearby ships. (UHF communication transmissions are permissible under these circumstances because the UHF antennas usually are located high in the ship, away from the HERO danger area.)

The relay system, which may be employed for either voice or teletype transmissions, permits the utilization of one or two long-range HF circuits during HERO conditions. Destroyers, cruisers, and carriers have all equipments required for this system in their normal allowance except for a voice-actuated keyer used for voice communications. This unit has been distributed only to destroyers and cruisers.

Radiation is permitted at frequencies below 540 kc during HERO EMCON. Below 1 mc the radiation resistance of incidental antennas that may be attached to weapons (e.g., aircraft) become vanishingly small, and antenna efficiency drops more rapidly than the capture area increases.

RECEIVERS

Because the signal that is picked up by a receiving antenna is in the range of a few millionths of a volt, the signal must be amplified considerably if it is to be of any value. In addition, the audiofrequency signal, if voice is being received, must be removed from the r-f signal. The purpose of a receiver is to reproduce, usually in the form of sound, the intelligence contained in an intercepted radio wave.

To change the received r-f energy into a form of energy that can be recognized, radio receivers perform the following functions:

SIGNAL INTERCEPTION: Although measured in microvolts, the signal voltage extracted by the receiving antenna is sufficient for subsequent amplification if the noise energy intercepted by the antenna or within the amplifying system is substantially less than the intercepted signal.

SIGNAL SELECTION: The receiver must differentiate between a desired signal frequency and other frequencies intercepted by the antenna. Selection is made by tuned circuits that pass only their resonant frequency (frequency to which the receiver is tuned).

R-F AMPLIFICATION: One or more r-f amplifiers increase the intercepted signal to the level required for recovery of the transmitted intelligence.

DETECTION (DEMODULATION): A detector, or demodulator, circuit separates the modulation signal from the r-f carrier of a received a-m signal. In CW reception, a beat-frequency oscillator is utilized in the receiver circuit. The bfo provides an r-f signal that beats or heterodynes against the frequency injected into the detector. This results in an audiofrequency that can be heard in the headset.

A-F AMPLIFICATION: The signal frequency in the output of the detector usually is very weak. One or more stages of a-f amplification are required to strengthen the audio output of the detector to a level sufficient to operate the headset or loudspeaker.

SOUND REPRODUCTION: The amplified a-f signal is applied to the headset or loudspeaker which translates the electrical a-f variations into corresponding sound waves. For a-m, the sound output of the speaker is a close replica of the original audio sounds at the transmitter. For CW, the sound is a tone the frequency of which depends upon the frequency of the local oscillator (bfo). This tone is heard whenever the key is depressed at the transmitter, and, consequently, it reproduces the interruptions of the r-f carrier in accordance with the Morse code.

FIELD STRENGTH

The amount of voltage induced in an antenna depends upon the length of the antenna and the strength of the carrier wave. The carrier wave, strongest when it leaves the transmitting antenna, it attenuated as it travels until its energy level, called field strength, is too weak to be received.

SENSITIVITY

The sensitivity of a receiver is a measure of how well it can amplify weak signals.

In an area of strong local interference, a receiver needs a strong signal to provide good reception. If local interference has a field strength of, say, 100 microvolts per meter, a signal strength of from 500 to 100 microvolts per meter is required to read through the noise. The same receiver, free from local interference, may give good reception on a

signal strength of 100 microvolts per meter. It is hard to state the exact minimum field strength needed to operate a receiver satisfactorily, but many sets under ideal conditions can function on a signal strength of from 1 to 3 microvolts per meter. To bring such a signal to an audible level, however, requires an amplification of many millions.

SELECTIVITY

Selectivity is the ability of a receiver to respond to one particular signal (frequency) and reject all others. The degree of selectivity varies with the type of receiver. A radiotelephone receiver tunes more sharply than a commercial broadcast receiver, and a CW communication receiver is more selective still. For a comparison of the three tuning curves, see figure 7-9.

Carrier waves from commercial broadcast stations contain sideband frequencies which extend 5 kc on either side of the carrier frequency. If a station is transmitting on 1140 kc, the complete carrier wave contains frequencies from 1135 and 1145. If a receiver tunes too sharply, some of the sideband frequencies are lost, with a corresponding sacrifice of fidelity. The commercial broadcast receiver tuning curve shown in figure 7-9 is optimum. The top is broad and flat and the sides are steep. Actually, most a-m broadcast receivers have tuning curves resembling the broken line, and many frequency components of voice and music contained in the signal are not reproduced by the set.

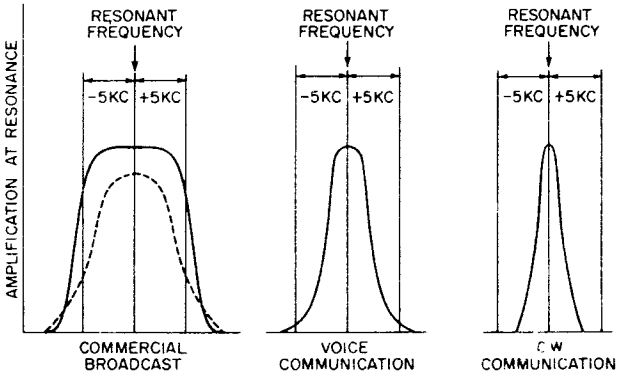

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Figure 7-9.—Comparison of receiver bandwidths.

Although sharp tuning in a home radio set would make for poor listening, it is desirable in military sets for the sake of frequency economy and reduction of interference. Radiotelephone messages can be sent on frequencies that extend only 2 kc on either side of the carrier frequency.

The CW sets tune so sharply that, unless an operator is careful, he can turn his dial through the signal without hearing it.

TYPES OF RECEIVERS

There are two major types of communication receivers: the tuned radiofrequency (TRF) and the superheterodyne.

Tuned Radiofrequency Receiver

In the TRF receiver, all frequency amplification takes place at the frequency of the incoming signal, and all tuned circuits must be adjusted to that frequency.

Without going into the technical aspects of the reasons, the TRF has several disadvantages. It is difficult to obtain uniform amplification of the r-f stages over the entire frequency range of the receiver. At the higher frequencies, the sensitivity of the receiver is reduced. The most serious drawback is that the selectivity of the tuned circuits cannot be kept uniform over the frequency range, selectivity decreasing at the high end of the frequency band.

Because of their inherent limitations, TRF receivers have largely been replaced. They are mentioned here only for familiarization purposes.

Superheterodyne Receiver

Most modern receivers are of the superheterodyne type. The main limitation of the TRF receiver is its inability to receive signals over a wide range of frequencies and at the same time to provide both high sensitivity and adequate selectivity. The ideal receiver would be one which had a different set of TRF circuits for each frequency to be received. The idea is for the most part impractical because such a set would be both expensive and bulky. But the reason such a receiver would be ideal is because each circuit could be set for maximum sensitivity and selectivity at the frequency it was designed to receive.

Once set, the resonant frequency of each tuned circuit would not be varied.

The superheterodyne receiver fills the gap between the TRF and what might be called a multiple TRF. All incoming signals are converted to one frequency, and at this frequency they are amplified before detection and audio amplification take place.

When a particular modulated radio wave is picked up by a superheterodyne receiver, it is sent through a stage called a mixer where it is changed to a new, preset frequency. The stages which then follow are tuned r-f amplifier stages, but they are tuned to one frequency only—the frequency to which all signals are converted by the mixer. The fact that these stages are always set to one frequency means that they can provide optimum sensitivity and selectivity regardless of the frequency of the carrier wave.

The frequency to which all signals are converted by the mixer is called the intermediate frequency (i-f). The i-f is considerably lower than the transmitted frequency, although still well above the audio range. The tuned r-f stages that amplify the i-f are referred to as i-f amplifiers.

An incoming r-f signal is combined in the mixer stage with another signal produced by a local oscillator. The i-f amplifier is tuned permanently to the frequency difference between the local oscillator and the incoming signal.

When the receiver tuning dial is set to receive on a particular frequency, the local oscillator is varied simultaneously. If the i-f stages are tuned to 500 kc, the oscillator is designed to oscillate at a frequency 500 kc above the incoming signal. Thus, if the tuning dial is set to receive a transmission of 1500 kc, the oscillator automatically adjusts to a frequency of 2000 kc. Actually, when the two frequencies are mixed, four frequencies result. The original frequencies remain and, in addition, the sum and difference frequencies are produced. When the two given signals (1500 and 2000 kc) beat against each other in the mixer, the four predominant signals are 1500, 2000, 3500, and 500 kc.

The i-f amplifiers, tuned to 500 kc, accept and amplify the difference frequency at the mixer output, and reject the other frequencies.

In cases where CW is received and Morse code signals are read directly by an operator, a beat-frequency oscillator produces a frequency differing from the i-f frequency by approximately 1000 cps. The difference frequency then is amplified to the audio range and fed to the operator's headset.

VOLUME CONTROL

Volume or gain controls are provided in receivers to permit changing the receiver sensitivity. These controls are necessary in order to compensate for differences in the strength of incoming signals.

Volume control can be manual or automatic. Automatic volume control (AVC)—sometimes called automatic gain control (AGC)—is used in all superheterodyne receivers and is desirable for several reasons. It prevents extreme variations in loudspeaker volume. When a receiver is tuned from a weak station (for which the volume has been turned up), to a strong station, the loudspeaker (or headset) will blast unpleasantly. The variations in signal strength due to fading also cause wide fluctuations in loudspeaker volume. Furthermore, variations in signal strength at the antenna, if not compensated for, can cause serious trouble by overloading the r-f, i-f, or detector stages of the receiver. Overloading causes distortion of the signal.

The AVC keeps the output volume at a constant level by reducing the amplification of certain stages in the receiver as the amplitude of a receiver signal increases. It affects weak as well as strong signals. When a receiver is tuned, the AVC usually is switched off to afford maximum amplification of weak signals. After tuning, the AVC is turned on, provided the signal is not too weak.

In some receivers a special type of AVC, called delayed automatic volume control (DAVC), is used. The DAVC-equipped receivers do not reduce amplification of a signal until a certain level is exceeded. In this way weak signals are not further weakened.

NOISE DISCRIMINATION

Highly sensitive superheterodyne receivers always have some background noise which appears in the output as hiss and crackles. Some noise arises in the receiver itself, while other noises are produced by lighting and manmade interference such as that caused by electric motors. Noise interference is bothersome at best, and at worst causes fragmentary reception. There are a number of devices designed to minimize the effects of interference.

The noise suppressor is similar to the tone control on a home receiver. When this control is tuned for bass reception, much of the noise is filtered out and is not permitted to reach the earphones. The noise suppressor, however, reduces the volume. On weak signals, it may be necessary to disconnect the suppressor from the circuit.

The output limiter is a safety device that prevents crashes of static from injuring the operator's eardrums. When the volume of sound reaches a certain level, the limiter is activated to prevent the sound from rising any higher.

Some receivers have silencer circuits that keep the set quiet when no signal is coming in. This is a convenience when standing by for a message, and it also eliminates the discomfort of standing a slack watch listening to static.

ANTENNAS

The function of a receiving antenna is to intercept a portion of the energy radiated from a distant transmitting antenna. The magnitude of the received signal depends mainly on the intensity of the radiated wave.

The function of a transmitting antenna is to convert the r-f energy generated by the transmitter into the form of an electromagnetic wave, so that the energy may be propagated to distant points on the earth. The strength of the magnetic field surrounding a wire is proportional to the amount of current flowing through it. It follows that the strength of the field radiated from an antenna is proportional to the amount of current flowing through the antenna. The amount of current, and consequently the intensity of radiation, is maximum when the antenna is resonant to the applied frequency.

The shortest wire (antenna) which is resonant to a particular frequency is one whose length is equal to one-half the wavelength at that frequency. The reason for this is demonstrated in figure 7-10.

Alternating current (a-c) travels in cycles. In the time that elapses during the first half-cycle of an applied wave, the electrons move from the transmitter to point Y where, having no further path to follow, they bunch up.

At the end of the first half-cycle, the current reverses. The electrons travel back to point X, where they again bunch up. Points X and Y are the points of maximum impedance. Impedance (symbol Z) is the total opposition (resistance (R) and reactance (X) to the flow of alternating current. The antenna in this case is just enough to permit an electric charge to travel from one end of the wire to the other end back again in the time of 1 cycle. The complete distance traveled by the charge is 1 wavelength. Because the charge travels in length of the wire twice, the length of wire needed to have a charge travel 1 complete wavelength in 1 cycle is one-half a wavelength. This length of wire, known as a half-wave antenna or dipole, is the shortest resonant length for a given frequency.

As the alternating current changes direction, there is an infinitely small interval when no current flows. The electromagnetic field at once begins to collapse; but, even though the energy is moving at the speed of light, the outermost part of the field cannot return to point X before the next one-half alternation throws up a new field of opposite polarity. The returning field then is pushed away from the antenna and becomes a free wave of electromagnetic energy radiating through space. The

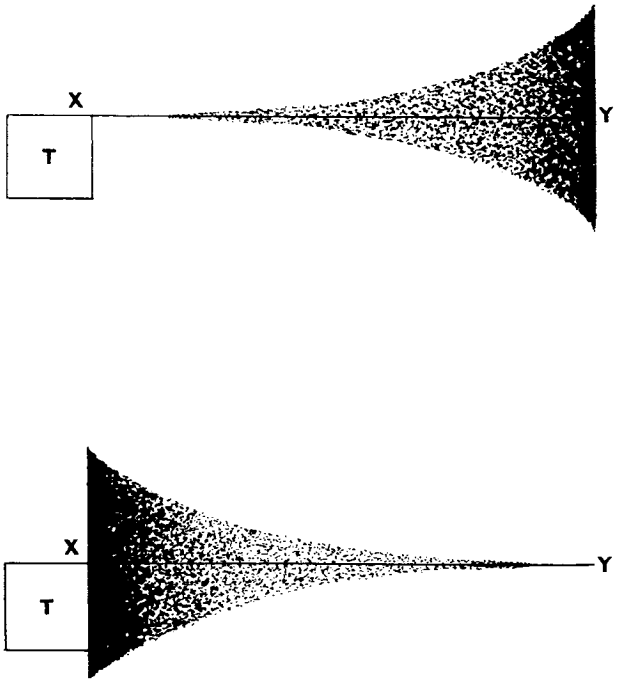

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Figure 7-10.—With a half-wave antenna, the electric charge travels the length of the wire twice. The complete distance covered by the charge is 1 wavelength.

returning field then is pushed away from the antenna and becomes a free wave of electromagnetic energy radiating through space. The principle of the half-wave antenna is the basis for all antenna theory.

If the frequency of a dipole is doubled, the length remaining unchanged, the antenna will be resonant to the double frequency because the electron flow keeps step with input energy. The antenna then is said to be operating at its second harmonic; it can be resonant at harmonics several times the fundamental frequency. A resonant condition also results if the length of the antenna is doubled, so that it becomes a full wavelength long.

The wavelength of a radiofrequency may vary from several miles to a fraction of an inch. We stated previously that a radio wavelength usually is measured in meters rather than in feet and inches. Because a radio wave travels at a constant speed of 186,000 miles (300,000,000 meters) per second, the length of 1 cycle, or 1 wavelength, is determined by dividing wave velocity by wave frequency. By conversion, the formula holds whether the frequency is given in cycles, kilocycles, or megacycles. In the following formulas, the figure 984 is derived from the fact that a meter is equal to 3.28 feet. Frequency is indicated by f, wavelength by W.

1. When frequency is expressed in cps:

$$\frac{300,000,000}{f \text{ (in cps)}} = W \text{ in meters}$$

or

$$\frac{984,000,000}{f \text{ (in cps)}} = W \text{ in feet}$$

2. When frequency is expressed in kc:

$$\frac{300,000}{f \text{ (in kc)}} = W \text{ in meters}$$

or

$$\frac{984,000}{f \text{ (in kc)}} = W \text{ in feet}$$

3. When frequency is expressed in mc:

$$\frac{300}{f \text{ (in mc)}} = W \text{ in meters}$$

or

$$\frac{984}{f \text{ (in mc)}} = W \text{ in feet}$$

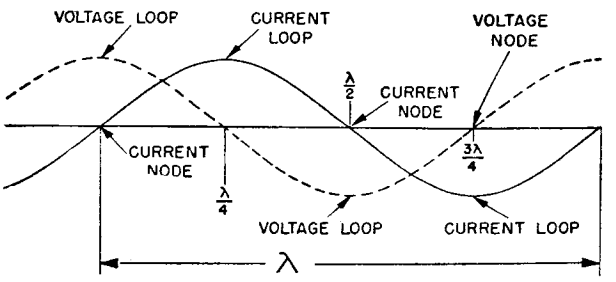
The required physical length of the antenna in each example is one-half the wavelength.

STANDING WAVES

If an antenna is energized by an alternating current of a frequency equal to the antenna's frequency, the current and voltage values along the length of the wire, and are always 90° out of phase. In a dipole, current is maximum in the center and minimum at the ends. The points where voltage or current are maximum are called voltage or current loops. The points of minimum voltage or current are known as voltage or current nodes. Figure 7-11 shows the location of loop and node points along a full-wave antenna. Current and voltage nodes appear every one-half wavelength, but are separated by one-quarter wavelength.

The wave of energy sent out by the transmitter travels to the end of the antenna, from where it is reflected back along the length of the wire. The time required for this process depends upon the length of the antenna, and hence upon the frequency (see fig. 7-10).

If the dipole is resonant to the frequency generated by the transmitter, the returning wave strikes the fresh oncoming wave and the current and voltage in the two waves reinforce each other. This condition is constant as long as the antenna is energized, and the effect is the same as though there were standing waves along the length of the wire, as is really the case. Only in the presence of standing waves is an antenna radiating at maximum.



76.14

Figure 7-11.—Standing waves along full-wave antenna.

PHYSICAL AND ELECTRICAL ANTENNA LENGTH

Although radiated r-f energy travels at the speed of light through free space, there is a difference in velocity between a radio wave traveling in space and a radio wave moving across an antenna. The difference is caused by the circumference of the wire (resistance to flow), the presence of insulators, and perhaps the proximity of nearby objects. An antenna never is completely isolated from its surroundings. The phenomenon of retardation is referred to as end effect, because the ends of the antenna, in effect, are made farther apart electrically than they are physically. Consequently, the physical length of a dipole should be about 5 percent shorter than the corresponding wavelength in free space.

Assume that a station is to transmit on a frequency of 3 mc. Applying the formula for finding wavelength, we find that:

$$\frac{300}{3} = 100 \text{ meters or, if you prefer,}$$

$$\frac{984}{3} = 328 \text{ feet.}$$

In the ideal situation, the physical length of an antenna for a transmitting frequency of 3 mc is therefore 164 feet (one-half wavelength). Because the ideal situation does not exist, the physical length is adjusted by 5 percent. The correct antenna length for a 3-mc transmission then becomes 156 feet.

HALF-WAVE DIPOLE

The half-wave dipole (sometimes called a Hertz antenna) has a length approximately equal to one-half a wavelength at the frequency being transmitted. It must be remembered that a transmitter is merely a high voltage generator of alternating current. If a feeder line from a transmitter is connected to the center of a dipole, the antenna will act as though an a-c generator were set between two quarter-wave antennas, as in figure 7-11. During one-half of the generator's alternation, electrons in the antenna will flow from right to left (fig. 7-12A). On the next half alternation, electrons flow in the opposite direction.

The dipole is the basis for many complex antennas. When employed for transmitting

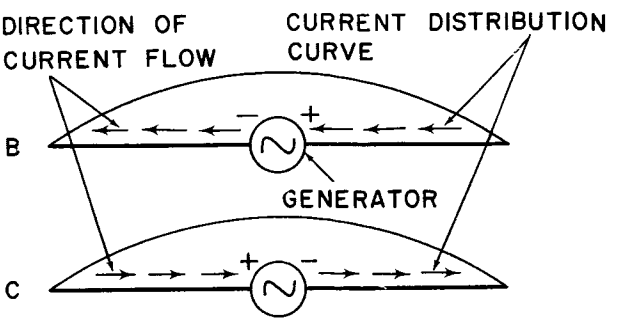


Figure 7-12.—Instananeous direction and distribution of current in a dipole.

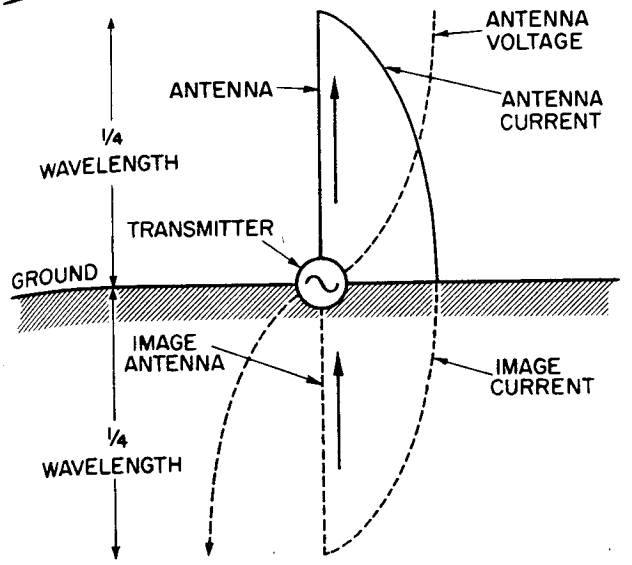
medium and high frequencies, usually it is constructed of wire. At very high and ultrahigh frequencies, the shorter wavelength permits construction utilizing metal rods or tubing. Depending upon the wave polarization desired, the dipole may be mounted either horizontally or vertically. Because it is an ungrounded antenna, the dipole may be installed far above the ground or absorbing structures.

A dipole suspended in space, away from the influence of the earth, is surrounded by an electromagnetic field resembling the shape of a doughnut. Very little radiation takes place at the ends of the dipole. When the antenna is vertical, radiation emanates predominantly on a horizontal plane. Conversely, if the dipole is horizontal, radiation emanates in a vertical pattern, as of a doughnut standing on edge. Maximum radiation, then, takes place in a plane perpendicular to the axis of the antenna.

At low and medium frequencies, half-wave antennas are physically too long for practical use aboard ship and at many shore stations. Dipoles for 500-kc transmissions, for example, require a length of about 936 feet. At these lower frequencies, the quarter-wave antenna affords a solution to the problem of undue antenna length.

QUARTER-WAVE ANTENNA

The principle of the quarter-wave antenna (also known as the Marconi or grounded antenna) is illustrated in figure 7-13. The transmitter is connected electrically to the earth. Although the antenna is only a quarter-wavelength, the earth itself acts as another quarter-wave antenna. By the aid of this



13.35

Figure 7-13.—Vertically mounted quarter-wave antenna.

image wave in the earth, half-wave operation is obtained from an antenna half the size of a dipole.

The relationship of current and voltage in a quarter-wave antenna is similar to that in a dipole. Voltage is maximum at the top of the antenna and minimum at the bottom. Current is greatest at the bottom and least at the top.

The quarter-wave antenna is used extensively with portable transmitters. On the airplane, a quarter-wave mast or a trailing wire is the antenna, and the fuselage produces the image. Similar installations are made on ships. A quarter-wave mast or horizontal wire is the antenna, and the superstructure and hull provide the image.

TYPICAL SHIPBOARD ANTENNAS

Problems not usually present in land installations arise when antennas are installed on board ship. Most of the masts, stacks, and other structures above decks are grounded to the ship's hull and, through the hull, to the water. To obtain adequate coverage from the antenna, it must be installed so that minimum distortion of the radiation pattern results from grounded structures.

Wire Antenna

A wire antenna, installed on board ship for medium- and high-frequency coverage, consists of a wire rope strung either vertically or horizontally from the yardarm or the mast to outriggers, another mast, or to the superstructure. Usually the wire is made of phosphor-bronze, a material that resists corrosion and is nonmagnetic.

Wire receiving antennas normally are installed forward, rising nearly vertically from the pilothouse top to brackets on the mast or yardarm. They are located as far as possible from the transmitting antennas so that a minimum of energy is picked up from the local transmitters. The transmission line (lead-in) for each receiving antenna terminates in antenna transfer panels in the radio spaces.

The transmitting antenna transmission lines may be coaxial cable or metal tubing supported on standoff insulators and enclosed in rectangular metal ducts called antenna trunks. Each transmission line connects with an individual transmitter or with an antenna multicoupler which permits the use of an antenna with more than one transmitter.

The metal rings, outside antenna transfer switches, antenna hardware, and accessories associated with transmitting antennas are painted red. Hardware and accessories used with receiving antennas are painted blue. This color scheme is a safety precaution that indicates, at a glance, whether an antenna is used for receiving or transmitting.

Whip Antenna

Whip-type antennas are essentially self-supporting and may be installed in many locations aboard ship. They may be deck-mounted or mounted on brackets on the stacks or superstructure.

Whip antennas commonly used aboard ship are 25, 28, or 35 feet in length and are made up of several sections.

On aircraft carriers, whip antennas located along the edges of the flight deck can be tilted. The tilting whip is pivoted on a trunnion and is equipped with a handle for raising and lowering the antenna. A counterweight at the base, of the antenna is heavy enough to nearly balance the antenna in any position.

Several special types of tilting mounts for whip antennas are used aboard submarines.

They are called erecting mechanisms, and in many cases may be operated from within the submarine. In most installations, as the submarine dives, the force of the water causes the whip to be folded back from a vertical to a horizontal position. A catch holds the antenna in this position. When the submarine surfaces, the catch is released and a spring mechanism causes the antenna to snap back to its vertical position. In the newer submarines, the whip antennas are mounted on retractable masts so that the antenna may be raised or lowered from within the submarine in much the same manner as the periscope.

VHF-UHF Antennas

The relatively short wavelengths at very high and ultrahigh frequencies enable the use of relatively small antennas. Vertically polarized, usually either dipole or quarter-wave, antennas are employed for all shipbaord external VHF-UHF communications. The antennas are installed as high and as much in the clear as possible to exclude as much as possible unwanted directivity in the radiation pattern caused by nearby masts, rigging, and cables.

Antenna Tuning

Previously we discussed the physical versus the electrical length of an antenna and postulated formulas to compute the required physical length of the antenna for a given frequency. Shipboard antennas usually are not of the proper length to give optimum performance at each desired operating frequency. There are several reasons for this condition. Many antennas are of a standard size and shape; available space may determine the type of antenna installed; antennas are designed to be operated at a number of frequencies.

It is physically and operationally impossible to lengthen or shorten an antenna each time the transmitter is changed to a new frequency. All transmitters, however, must be able to operate at any frequency within its tuning range. It is therefore necessary to employ some means for adjusting the antenna for reasonable efficiency at any frequency, regardless of the physical size or arrangement of the antenna.

Because each transmitter usually is associated with only one antenna of fixed length, adjustment of the effective length may be made electrically. This process, called antenna tuning, is accomplished by electronically adding either inductance or capacitance to the antenna at the point where it is fed from the transmitter or transmission line. Added inductance has the effect of increasing the electrical length of the antenna; capacitance decreases the length. In this manner the antenna is made to respond as though it has a number of quarter waves along its length. By tuning the antenna properly, the standing waves are increased and the radiated energy is increased.

Emergency Antennas

Loss or damage to an antenna, and consequent disruption of communications, may result from heavy seas, violent winds, or enemy action. It is not unusual for sections of a whip antenna to be carried away or insulators to be damaged. Emergency antennas, cut to proper lengths and with necessary insulators and other hardware installed, should be available and readily accessible in the ship's radio spaces.

The design of emergency antennas may be influenced by the type of ship, the location of transmitting receiving equipments, availability of space, and the suitability of structures for rigging the antenna quickly.

The simplest emergency antenna consists of the proper length of wire rope to one end of which is attached a high-voltage insulator and to the other end of which is soldered a heavy alligator clip or lug. To rig the antenna, the insulator end of the rope is hoisted to the nearest mast, the yardarm, or other high structure and secured. The opposite end of the rope is attached to the equipment transmission line by means of the clip or lug. To radiate effectively, the antenna must be sufficiently clear of all grounded objects.

TYPICAL SHORE STATION ANTENNAS

Unless physical dimensions are the fundamental consideration, a given type of antenna may be utilized practically anywhere. The rhombic, sleeve, and conical antennas described herein are considered mainly as shore station antennas. With technological advances, however, the sleeve and conical antennas have been modified for shipboard use and are employed both ashore and afloat. The three antennas discussed are only a sampling of many.

Rhombic

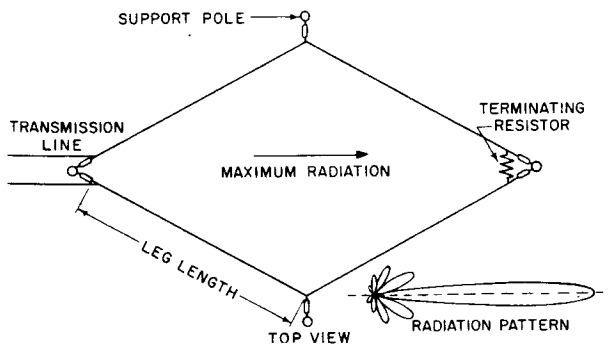
The rhombic antenna is extremely useful for long-range, point-to-point communications. As shown in figure 7-14, the characteristic radiation pattern is such that most of the r-f energy is released at the point of the antenna farthest from, and in a direction away from, the transmission line from the transmitter. The pattern is highly directive. Although permanently installed, the rhombic may be "pointed" toward the intended receiving station.

The basic rhombic has four straight wires joined to form the diamond, and it is suspended horizontally from four poles. Each leg of the antenna is at least 1 or 2 wavelengths at the operating frequency. The length may be as many as 12 or more wavelengths, so that rhombics, even for high-frequency operations, have leg lengths of several hundred feet.

The performance of the rhombic antenna is improved when more than a single wire is used to form the legs. The most common multiwire rhombic is the three-wire type, which provides an improved match to the transmission line and, when used for receiving, greatly reduces the noise caused by precipitation static. The three-wire rhombic antenna is the only rhombic installed at both transmitting and receiving station.

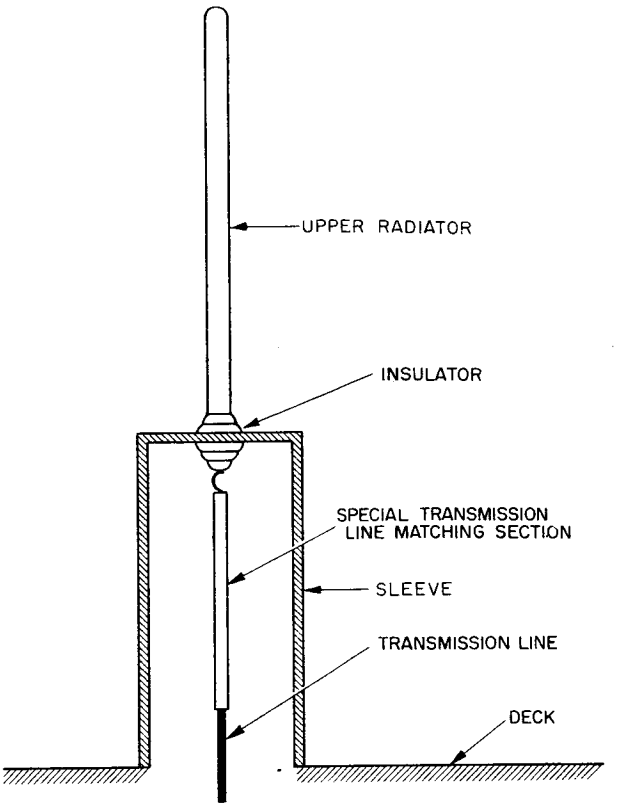
Sleeve

The sleeve antenna (figure 7-15 shows the shipboard version) is especially helpful in reducing the number of conventional narrow-band antennas that otherwise would be needed to meet the requirements of shore stations. Through the use of multicouplers, one sleeve antenna can serve several transmitters operating over a wide range of frequencies. This reduces the number of antennas without sacrificing required communication channels. The broad-band feature makes the sleeve desirable for use in small antenna sites.



13.37

Figure 7-14.—Typical rhombic antenna.



25.217

Figure 7-15.—Shipboard sleeve antenna.

Conical

The conical, or conical monopole, antenna is a broad-band antenna used extensively both ashore and aboard ship. It utilizes two methods of radiation.

When operating at frequencies near the lower limit of the HF band, the conical radiates in much the same manner as a regular vertical antenna. At higher frequencies only the lower cone section radiates, and the top section has the effect of exerting pressure on the lower section, pushing the signal out at a low angle. The low angle of radiation causes the skywave to return to earth at great distances from the

antenna. The conical monopole antenna, therefore, is well suited for long-distance communication in the high-frequency range.

FACSIMILE

The general uses of FAX were discussed in chapter 4. In this section we cover briefly the principles of operation of facsimile equipment.

The most useful application of facsimile has proved to be the transmitting of fully plotted weather charts, which has eliminated the need for skilled weather analysts and duplicate plotting aboard each ship and station where weather information is required. Significant economics, as well as a more uniform, accurate, and rapid weather service have been effected.

The Navy has a number of facsimile equipments in use. All operate in much the same way. The picture to be sent is wrapped around a cylinder on the transmitting machine. It is necessary that the picture lie perfectly flat, for variations in the surface planes cause faulty transmission of the intelligence. The cylinder rotates at a constant speed and at the same time moves longitudinally along a shaft. The picture is illuminated by a beam of light focused through a condensing lens. As the beam passes over each portion of the picture, it is reflected into a photoelectric tube, and the variation in intensity of reflected light due to the character of the picture creates voltage variations in the tube output circuit. These voltage variations constitute the picture signal and may be sent directly over a landline or used to modulate the radiofrequency carrier of a transmitter.

The photoelectric tube has been called the electric eye, but it does not have the capacity of the eye or camera lens to view many images simultaneously. It can only measure the light value of any single area toward which it is directed. It is not possible with present equipment to show the picture to the tube for an instant and expect it to analyze the intelligence for transmission. Rather, it is necessary to divide the picture into small areas containing monotone values of detail, which the photoelectric tube is capable of analyzing correctly. Thus, facsimile uses a scanning principle, and allows the photoelectric tube to view a spiraling area one one-hundredths inch wide. As the drum rotates and moves longitudinally, consecutive areas are viewed by the tube until the entire picture has been analyzed for transmission.

At the receiver the signal is demodulated and the voltage variations are used to operate a recorder in synchronization with the transmitter. If the transmission is to be recorded on photographic film or paper, the signal reaching the receiver is amplified until it is strong enough to operate a neon recorder lamp. The lamp scans sensitized paper or film on the drum, reception taking place in a darkroom. The paper or film is exposed in varying degrees corresponding to the image viewed by the photoelectric tube in the transmitter. In the case of film, photographic development yields a negative which may be used for making prints.

Where it is desirable to operate without a darkroom or chemicals, the nonphotographic process is preferable. One type of FAX receiver employs a device called a bar, hammer, or helix, which produces a picture by pressing down on carbon paper with pressures varying according to the transmitted picture. A second and more common type records on a specially prepared paper by what is literally a burning process. A stylus is connected to the output of the recorder amplifier in such a way that a high voltage is developed at the stylus point as signals are received. The electrified stylus burns a white surface coating on the paper which has a conductive black undercoating. One type of this paper may be used for making copies by the gelatin-ink transfer (hectograph) process.

One of the greatest problems in the development of facsimile, and still a difficulty of operation and maintenance, is synchronizing the transmitting and receiving drums. As the scanning begins, both drums must be revolving at exactly the same speed. This is accomplished by a sealed, temperature-compensated, tuned fork which vibrates at 1800 cycles per second. A frequency variation of as little as one-tenth cycle will, in 20 minutes, cause an inch of skew in the received copy.

A difficulty encountered in any transmission circuit, especially over long distances, is interference. In CW, voice, or RATT, bursts of noise obliterate a portion of the signal and repeats may be required. In facsimile, bursts of interference cause a one one-hundredth inch line through a portion of the picture, but leave it readable. A number of systems for minimizing fading and interference are in use. At present the Navy is concentrating on frequency-shift keying for facsimile transmissions.

TELETYPEWRITERS

Shore station RATT procedures are discussed in chapter 4. Large ships having the equipment and capability may be designated as tributaries in the Navy Teletypewriter and Tape Relay Network. Such ships include specially equipped communication ships and mobile fleet and task force command ships.

Most other ships, although not a part of the NTX, are equipped with radioteletypewriters for ship-ship and ship-shore communications. Generally, units not included in the NTX but having these equipments utilize what is referred to as manual teletypewriter procedure. In practice, manual teletype and NTX procedures are identical in many respects.

In most cases, for example, an operator may transmit either manually or by means of a tape. The former is useful for communicating between relatively nearby ships in the same force. A tape might be more practicable for lengthy messages that must be relayed or when the flagship has NTX relay capabilities.

When two teletypewriters are not joined by wire, the gap between the machines must be bridged by radio. To bridge the gap, a radio transmitter and receiver are needed. Two modes of operation are used: tone modulated and frequency shift keying (FSK). Tone modulating RATT generally is employed for close-range operations. A transmitter produces the r-f carrier wave to convey the intelligence. A device known as a keyer changes direct-current electrical pulses from the teletypewriter into mark and space modulation. A tone terminal changes the signals to audio tones. The transmitter impresses the audio tones on the carrier wave.

At the receiving station, a radio receiver and a converter change the r-f signals back to d-c pulses. The modulated carrier wave enters the receiver, which extracts the signal intelligence and sends the audio tones to the tone converter. The converter changes the audio tones into d-c mark and space signals for the page printer.

Frequency shift keying is a mode of operation usually employed in long-range communications. The r-f signal is shifted a small amount (425 cycles) above the carrier and the same amount below the carrier to produce mark and space signals, respectively, to correspond to the mark-space teletypewriter code.

All teletypewriter signals pass through the shipboard teletypewriter panel, which provides every possible RATT interconnection available on board. This operational flexibility provides maximum efficiency with the fewest number of circuits and the least amount of equipment.

Due to the volume of classified information that is transmitted in message form, and the inherent need for expeditious traffic handling, the use of on-line communications is increasing in importance.

By means of the on-line process, all information, regardless of classification, is simultaneously encrypted, transmitted, received, and decrypted in one operation. This procedure is especially beneficial for fleet broadcasts and point-to-point communications. Automatic crypto devices and associated teletypewriter equipments always are employed. When two stations cannot be linked by cable or landline, transmitting and receiving equipments also must be utilized.

On-line operations eliminate manual encryption/decryption procedures, speed up traffic handling, and provide positive security against traffic analysis. On the other hand, the system is sophisticated and complex, requiring skilled repairmen and trained operating personnel.

In the off-line method, messages are encrypted manually, relayed by any means, and decrypted manually in separate steps. Off-line operations are being phased out gradually.

CHAPTER 8

RADIOTELEPHONE PROCEDURES

Radiotelephone (voice radio) is one of the most useful military communication methods. Because of its directness, convenience, and ease of operation, R/T is used by ships and aircraft almost exclusively for short-range tactical communications. Its direct transmission of voice makes it possible for a conning officer to have in his hands a means of personal communication with the OTC and with other ships. There is little delay while a message is prepared for transmission, and acknowledgements can be returned instantly.

Although there is a current trend toward the use of R/T on the lower frequencies because of the need for longer-range tactical communications in dispersed formations, radiotelephone equipment usually is operated on frequencies that are high enough to have line-of-sight characteristics—that is, the waves do not follow the curvature of the earth. Because of the employment of high frequencies, the range of radiotelephone communications is normally limited to 20 to 25 miles.

All personnel must be cautioned that transmissions by radiotelephone are subject to enemy interception and therefore have no security. In the interest of security, because most radiotelephone messages are in plain language, all transmissions must be kept as short and concise as possible, consistent with clearness. Wave propagation characteristics of radiotelephone frequencies sometimes are freakish, and transmissions may be heard from great distances.

The most important element leading to efficient communications over the voice circuits is enforcement of strict circuit discipline. This can be accomplished only through indoctrination and insistence upon rigid compliance with the basic procedure prescribed in ACP 125.

MICROPHONE TECHNIQUES

The three basic rules for utilizing the radiotelephone are: speak slowly, speak loudly enough to be heard, and speak clearly. Transmissions should be distinct, with natural emphasis on each word.

From the viewpoint of procedure, R/T has become the most widely misused piece of communication apparatus in the Navy today. Some of the common faults are:

1. Breaking in on a net already in use;
2. Talking too rapidly;
3. Shouting into the microphone;
4. Blowing into the microphone to see if the transmitter is operating;
5. Keying the microphone continually throughout the transmissions;
6. Poor diction; and
7. Poor enunciation.

It is the responsibility of the supervising officer to exercise a firm and positive control over R/T circuits, to see that mistakes are called to the attention of those at fault, and to take steps to correct deficiencies and to prevent them from recurring.

Listed here are some useful do's and don'ts for oral transmissions:

DO—

1. Listen before transmitting. Unauthorized break-in is both discourteous and causes confusion. Often, neither transmission gets through.
2. Speak clearly and distinctly. Both slurred syllables and clipped speech are hard to understand. A widespread error among untrained operators is failure to emphasize vowels sufficiently.
5. Speak slowly. Unless the action officer is listening, he must rely on the copy being typed or written at the other end. Give the recorder a chance to get it all the first time.
4. Avoid extremes of pitch. A high voice cuts best through interference, but is shrill and unpleasant if too high. A lower pitch is easier on the ear, but if too low is hard to understand through background noises.
5. Maintain a normal speaking rhythm. Group words in a natural manner. Send messages phrase by phrase instead of word by word.
6. Use standard pronunciation. Speech with sectional pecularities may be difficult for persons from other parts of the country to

understand. Talkers using the almost standard pronunciation of a broadcast network announcer are easiest to understand.

7. Use a moderately strong voice to override unavoidable background noises.

8. Maintain correct distance between lips and microphone. If the distance is too great, speech is inaudible and background noises creep in; if too small, blaring and blasting result. If a handset is held naturally, the distance is approximately correct.

9. Shield the microphone from noise-generating sources while transmitting.

10. Give an accurate evaluation in response to a request for a radio check. A transmission with feedback and/or a high level of background noise is not loud and clear even though the message can be understood.

11. Release the microphone button and pause momentarily, when practicable, after each natural phrase. This allows any other station with higher precedence traffic to break in.

12. Transact your business and get off the air. Preliminary calls only waste time when communication is good and the message is short. It is unnecessary to blow into a microphone to test it, or to repeat portions of messages when no repetition has been requested.

DON'T—

1. Transmit while surrounded by other persons discussing the next maneuver or event. This practice confuses receiving stations, and a serious security violation can result.

2. Hold the microphone button in the push-to-talk position until ready to transmit. Doing so blocks communications on the net.

3. Hold a handset in such a position while speaking that there is a possibility of having feedback from the earphone added to other extraneous noises.

4. Hold a handset loosely. A firm pressure on the microphone button prevents unintentional release and consequent signal dropout.

5. Send test signals for longer than 10 seconds.

PHONETIC ALPHABET AND NUMERALS

The standard procedure for pronunciation and transmission of letters and numerals on both sound-powered telephone and radiotelephone circuits within the U. S. naval service is as follows.

When necessary to identify any letter of the alphabet, the accompanying standard phonetic alphabet is used.

Letter	Phonetic equivalent	Pronounced as
A	ALFA	AL fah
B	BRAVO	BRAH voh
C	CHARLIE	CHAR lee
D	DELTA	DELL tah
E	ECHO	ECK oh
F	FOXTROT	FOKS trot
G	GOLF	GOLF
H	HOTEL	hoh TELL
I	INDIA	IN dee ah
J	JULIETT	JEW lee ett
K	KILO	KEY loh
L	LIMA	LEE mah
M	MIKE	MIKE
N	NOVEMBER	no VEM ber
O	OSCAR	OSS cah
P	PAPA	pah PAH
Q	QUEBEC	keh BECK
R	ROMEO	ROW me oh
S	SIERRA	see AIR rah
T	TANGO	TANG go
U	UNIFORM	YOU nee form
V	VICTOR	VIK tah
W	WHISKEY	WISS key
X	XRAY	ECKS ray
Y	YANKEE	YANG key
Z	ZULU	ZOO loo

When signals from naval signal books are transmitted by voice, names of the flags (ALFA, BRAVO, etc.) that appear in the signal books are used. Difficult words within the text of plain text messages may be spelled, using the phonetic alphabet preceded by "I SPELL." When the operator can pronounce the word to be spelled, he does so before and after the spelling to identify the word.

When numerals are transmitted, the following pronunciation is used:

Numeral	Spoken as
Ø	Zero
1	Wun
2	Too
3	Thuh-ree
4	Fo-wer
5	Fi-yiv
6	Six
7	Seven
8	Ate
9	Niner

The numeral Ø is spoken as ZERO, never as OH. To distinguish numerals in the text from words pronounced similarly, the proword "FIGURES" may be used preceding the numbers.

In general, numerals are transmitted digit by digit except that exact multiples of hundreds and thousands may be spoken as such. Examples:

Number	Spoken as
44	Fo-wer fo-wer
90	Niner zero
136	Wun thuh-ree six
500	Fi-yiv hun-dred
1478	Wun fo-wer seven ate
7000	Seven thow-zand
16000	Wun six thow-zand
16400	Wun six fo-wer hun-dred
812681	Ate wun two six ate wun

The decimal point is spoken as DAY-SEE-MAL.

PROWORDS

Prowords (procedure words) are words and phrases for speeding the handling of radiotelephone messages. They perform the same functions and are used in the same manner as the prosigns discussed in chapter 2. Many prosigns and prowords are exactly equivalent in meaning.

Because single letters in oral communications are pronounced according to the phonetic alphabet, the letter prosigns usually employed in other forms of communicating have oral substitutes. Table 8-1 is a complete list of authorized prowords, together with an explanation of each, and the corresponding prosign (if any).

R/T MESSAGE FORMAT

Radiotelephone employs a 16-line message format closely comparable to the formats used in radiotelegraph and in teletypewriter communications. It uses the same three military message forms: plaindress, abbreviated plaindress, and codress. By far the most common message form in radiotelephone traffic is the abbreviated plaindress. In fact, sometimes it is so abbreviated that its resemblance to the basic message format is barely detectable. But the three major message parts, heading, text, and ending, are there. Each of these, as in teletypewriter message format, is reduced to parts, components, and elements.

A comparison of the R/T message format in table 8-2 with the basic message format in table 2-4 shows that the two are basically the same. This is already pointed out in chapter 2. The main difference is the substitution of prowords for prosigns.

The heading of an R/T message may include any or all of the first ten procedural lines shown in table 8-2. More often than not it includes only the call. The reason for such general use of the abbreviated form is that radiotelephone communication nearly always is conducted with station originating and station addressed to direct communication.

Every R/T message ends with the proword OVER or OUT. Omission of the ending proword often leads to confusion, particularly during rapidly developing tactical situations involving aircraft.

Nicknames and flag signals (those which could be sent by flaghoist) may be transmitted as plain language words, but encoded or enciphered groups are spelled phonetically. For example, the nickname LIBRA would be sent in the clear, as EXECUTE PLAN LIBRA. An encrypted group such as BAXTO, however, is spelled out phonetically and written in full as BRAVO ALFA XRAY TANGO OSCAR. When the proword I SPELL precedes a part of the message, each phonetic letter is recorded as a single letter—the sender is simply spelling out a word. For example, I SPELL—KILO ECHO GOLF—etc., is written as KEG. Without the proword I SPELL, the international alphabet flags are intended, and the message is recorded as sent: KILO ECHO GOLF. The meaning of the latter then is obtained from the appropriate signal book.

In addition to the prowords in table 8-1, GQ R/T operators should be familiar with the contents of ACP 165, Operational Brevity Codes. Words from ACP 165 are used whenever possible to make contact and raid reports.

Operational brevity code words and phrases are employed for the purpose of standardization and abbreviation. Like prowords, they are designed for speed and conciseness of transmission. Unlike prowords, in most instances they substitute for part of the textual component of a message. Although operational brevity codes may be used in the clear, discretion must be exercised because the meanings of a number of them are such as to reveal details of equipment, tactics, and intentions that could be of use to an opposing force.

Table 8-1.—Authorized Prowords

Proword	Explanation	Prosign equivalent
ALL AFTER	The portion of the message to which I have reference is all that which follows_____.	AA
ALL BEFORE	The portion of the message to which I have reference is all that which precedes_____.	AB
BREAK	I hereby indicate the separation of the text from other portions of the message. (Use is optional; usually included to avoid ambiguity.)	$\overline{BT}$
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 a corrected version in answer to your request for verification.	C
DISREGARD THIS TRANSMISSION	This transmission is in error; disregard it. (This proword is not used to cancel any message that has been completely transmitted and for which receipt or acknowledgement has been received.)	EEEEEEEE $\overline{AR}$
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 must 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.)	$\overline{IX}$ (5-sec. dash)
EXECUTE TO FOLLOW	Action on the message or signal that follows is to be carried out upon receipt of the proword EXECUTE. (To be used only with the executive method.)	$\overline{IX}$
EXEMPT	The addressee designations 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 designation 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
IMMEDIATE	Precedence Immediate.	O
INFO	The addressee designations immediately following are addressed for information.	INFO
I READ BACK	The following is my response to your instructions to read back.	—
I SAY AGAIN	I am repeating transmission or portion indicated.	$\overline{IMI}$
I SPELL	I shall spell the next word phonetically.	—

Table 8-1.—Authorized Prowords—Continued

Proword	Explanation	Prosign equivalent
I VERIFY	That which follows has been verified at your request and is repeated.	—
MESSAGE FOLLOWS	A message that requires recording is about to follow. (Transmitted immediately after the call.)	—
NUMBER	Station serial number	NR
OUT	This is the end of my transmission to you and no answer is required or expected.	$\overline{AR}$
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
RELAY (TO)	Transmit this message to all addressees or to the address designations 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)."	$\overline{IMI}$
SERVICE	The message that follows is a service message.	SVC
SIGNALS FOLLOW	The groups that follow are taken from a signal book. (This proword need not be used on nets primarily employed for conveying signals. It is intended for use when tactical signals are passed on nontactical nets.)	—
SILENCE	Cease transmissions immediately. Silence will be maintained until instructed to resume. (When an authentication system is in force, transmissions imposing silence are to be authenticated.)	$\overline{HM}$ $\overline{HM}$ $\overline{HM}$
SILENCE LIFTED	Resume normal transmissions. (Silence can be lifted only by the station imposing it or by higher authority. When an authentication system is in force, transmissions lifting silence are to be authenticated.)	—
SPEAK SLOWER	Your transmission is at too fast a speed. Reduce speed of transmission.	—
THAT IS CORRECT	You are correct, or what you have transmitted is correct.	C
THIS IS	This transmission is from the station whose designation immediately follows.	DE
TIME	That which immediately follows is the time or date-time group of the message.	—
TO	The addressees whose designations immediately follow are to take action on this message.	TO
UNKNOWN STATION	The identity of the station with which I am attempting to establish communication is unknown.	$\overline{AA}$

Table 8-1.—Authorized Prowords—Continued

Proword	Explanation	Prosign equivalent
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 whom the questioned message was directed.)	J
WAIT	I must pause for a few seconds.	$\overline{AS}$
WAIT OUT	I must pause longer than a few seconds.	$\overline{AS}$ $\overline{AR}$
WILCO	I have received your message, understand it, and will comply. (To be used only by the addressee. Because 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 is difficult. Transmit (or transmitting) 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_____.	—

OPERATING PROCEDURES

In almost every example of confusion arising from R/T communications the difficulty can be traced to the use of nonstandard operating procedures. It should be obvious that modern high-speed naval operations make the elimination of confused radiotelephone communications an absolute necessity. A hunter/killer force searching for an enemy submarine, for example, is not permitted the luxury of a 5- or 10-minute delay in executing a screening signal. This defeats the very purpose (speed) of the OTC in utilizing an R/T instead of a flaghoist signal. A 1-minute delay by a friendly aircraft pilot in executing a vectoring signal because he didn't understand the message could easily result in the pilot's death.

Whenever possible, the use of standard phraseology, authorized prowords, and brevity code words greatly speeds communications and simultaneously enhances reliability and clarity. Moreover, variations from standard procedure offer an ideal situation for introducing enemy deception on the circuit.

In the discussion that follows, assume for purposes of illustration that all transmissions pass over the voice radio net shown in figure 8-1. Each station (ship) on the net is assigned a prescribed R/T voice call sign. Call signs, which are tactical in nature, usually consist of spoken words that can be transmitted and understood more rapidly and more effectively than the actual names of ships or afloat commands. Occasionally, special or abbreviated calls are utilized. They are composed of letters, or letters and numbers, transmitted according to the phonetic alphabet and numeral pronunciation as follows:

Call sign	Transmission
AB	ALFA BRAVO
P3	PAPA THUH-REE

CALLING AND ANSWERING

The call in R/T procedure may be a full, collective, or abbreviated call.

Table 8-2. —Radiotelephone Message Format

Parts	Components	Elements	Format line	Contents
H	Procedure . . .	a. Call	1	Not used.
			2 and 3	Station(s) called (proword EXEMPT, exempted calls). Proword THIS IS and station calling.
		b. Message follows		Proword MESSAGE FOLLOWS.
		c. Transmission identification.		Proword NUMBER and station serial number.
E		d. Transmission instructions.	4	Prowords RELAY TO; READ BACK; DO NOT ANSWER. Operating signals; call signs; address groups; address indicating groups; plain language.
A	Preamble . . .	a. Precedence; date-time group; message instructions.	5	Precedence designation. Proword TIME; date and time expressed in digits and zone suffix; operating signals.
D	Address	a. Originator's sign; originator.	6	Proword FROM. Originator's designation as address group(s), call sign(s), or plain language.
		b. Action addressee sign; action addressee(s).	7	Proword TO. Action addressee designation as address group(s), call sign(s), or plain language.
I		c. Information addressee sign; information addressee(s).	8	Proword INFO. Information addressee designation(s) as address group(s), call sign(s), or plain language.
N		d. Exempted addressee sign; exempted addressee(s).	9	Proword EXEMPT. Exempted addressee designation(s) as address group(s), call sign(s), or plain language.
G	Prefix	a. Accounting information; group count; service information.	10	Accounting symbol; group count; proword SERVICE
SEPARATION			11	Proword BREAK.
TEXT	Text	a. Subject matter	12	Internal instructions; thought or idea as expressed by the originator.
SEPARATION			13	Proword BREAK.
ENDING	Procedure . . .	a. Time group	14	Proword TIME. Hours and minutes expressed in digits and zone suffix, when appropriate.
		b. Final instructions	15	Prowords WAIT; CORRECTION. Station designation.
		c. Ending sign	16	Prowords OVER; OUT.

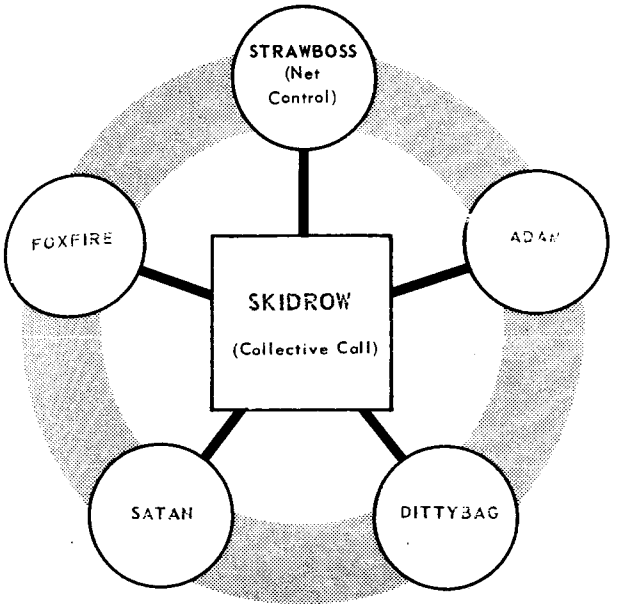
41.30

In the full call, a particular station is called and the sending station identifies itself. Example:

FOXFIRE—THIS IS STRAWBOSS—OVER

or FOXFIRE—THIS IS STRAWBOSS—
MESSAGE FOR YOU—OVER

This transmission indicates that Strawboss has a message for Foxfire and is attempting to establish communication. When the calling



41.31

Figure 8-1.—Radiotelephone net.

station calls more than one ship in the same message, the ships are addressed in alphabetical call sign order. Example:

ADAM—FOXFIRE—SATAN—THIS IS STRAWBOSS—OVER

The reply to Strawboss' initial call is made in the same form:

STRAWBOSS—THIS IS FOXFIRE—OVER
or STRAWBOSS—THIS IS FOXFIRE—SEND YOUR MESSAGE—OVER

This reply tells Strawboss that Foxfire is ready to receive. If more than one station has been addressed, stations reply in alphabetical call sign order.

The collective call is employed to address all stations on the net. Example:

SKIDROW—THIS IS STRAWBOSS—OVER

When necessary to exclude certain units from the collective call, the proword EXEMPT is inserted in the heading:

SKIDROW—EXEMPT ADAM—THIS IS..etc.

The practice of exemption is particularly useful when a large number of stations are on the net and all but a few are addressed in the same message. The alternative is literally to call the roll of ships on the net.

An abbreviated call omits the call sign of the station addressed. This practice is normal procedure when communications are not difficult and when the call would be part of an exchange of transmissions. Consider this exchange of messages:

A—THIS IS B—OVER
B—THIS IS A—OVER
A—THIS IS B—PROCEED TO RENDEZVOUS—OVER
B—THIS IS A—ROGER—OUT

Assuming good communications, the first two transmissions, being only preliminary calls, could be eliminated with no resulting ambiguity.

CLEARING TRAFFIC

With communications established, Strawboss commences clearing traffic. Compare this message in table 8-3 with the basic message format in table 8-2. The short dashes in the center column indicate natural breaks between words and phrases.

On hearing the proword OVER, receiving stations, after checking the message to be sure that it has been received fully and correctly, receipt in alphabetical order by the proword ROGER:

THIS IS FOXFIRE—ROGER—OUT
THIS IS SATAN—ROGER—OUT

No message is considered delivered until a receipt is obtained.

When speed of handling is an important consideration, the transmitting station may direct one station to receipt for a message even though a number of stations are called. Under normal conditions, it can be assumed that if one station on the net receives a message satisfactorily, all stations received it. For greater security, net control may direct one station on the net to receipt for all transmissions.

In the following example, the OTC sends a message using the collective call and directs that only Adam receipt by inserting Adam's call sign in the message:

SKIDROW—THIS IS STRAWBOSS—SEND BOAT FOR MAIL—ADAM—OVER

Adam receipts for the message in the usual manner.

Table 8-3.—R/T Transmission

	Transmission	Meaning
H	FOXFIRE—	Call signs of receiving stations.
	SATAN—	
	THIS IS	From.
e	STRAWBOSS—	Call sign of sending station.
	MESSAGE	
a	FOLLOWS—	A message that requires recording is about to follow.
	ROUTINE—.	Precedence.
	TIME—	Time of origin is_____.
d	ONE TWO ONE SIX	
	FIVE NINE	
	ZULU—	DTG.
i	FROM—	Originator of this message is _____.
	STRAWBOSS—	Call sign of originator.
	TO—	Action addressee is_____.
n	SATAN—	Call sign of action addressee.
	INFO—	Information addressee is_____.
	FOXFIRE—	Call sign of information addressee.
g	GROUPS SEVEN—	Group count.
Separation	BREAK—	Long break.
Text	GO ALONGSIDE	
	FOXFIRE AND	
	EFFECT PERSONNEL	
	TRANSFER—	Thought or idea conveyed by message.
Separation	BREAK—	Long break.
Ending	OVER—	Go ahead; transmit.

REPETITIONS

When parts of a transmitted message are missed or are thought to be incorrect, the receiving station, before receipting, requests a repetition of the parts in question by use of the proword SAY AGAIN. In complying with a request for repetition, the sender identifies the portion being repeated.

In the message from Strawboss, assume that Foxfire missed the words after EFFECT and that Satan missed the word FOXFIRE. Foxfire transmits:

THIS IS FOXFIRE—SAY AGAIN—ALL AFTER EFFECT—OVER

Satan transmits:

THIS IS SATAN—SAY AGAIN—WORD AFTER ALONGSIDE—OVER

Strawboss, upon receiving a response from all stations concerned, transmits—

THIS IS STRAWBOSS—I SAY AGAIN—ALL AFTER EFFECT—PERSONNEL TRANSFER—WORD AFTER ALONGSIDE—FOXFIRE—OVER

When the doubtful portions of the text are clarified, the stations addressed then receipt for the message.

CORRECTIONS

When a sending operator makes an error, he corrects himself by transmitting the proword CORRECTION. He follows this by repeating the last word, group, proword, or phrase correctly sent, correcting his error, and then proceeding with the remainder of the message. Example:

ADAM—THIS IS STRAWBOSS—TIME ONE ZERO ONE TWO ZULU—CONVOY ROMEO THREE—CORRECTION—CONVOY SIERRA ROMEO THREE—SHOULD ARRIVE—ONE SIX THREE ZERO ZULU—OVER

If the operator does not discover the error until he is some distance beyond it, he may make the correction at the end of the message as follows:

ADAM—THIS IS STRAWBOSS—TIME ZERO SIX THREE ZERO ZULU—RIG FOR HEAVY WEATHER—CORRECTION—TIME ZERO SIX FOUR ZERO ZULU—OVER

CANCELLATION DURING TRANSMISSION

During the transmission of a message and before the transmission of the ending proword, a message may be canceled by use of the prowords DISREGARD THIS TRANSMISSION and OUT. A message that has been completely transmitted may be canceled only by another message.

"DO NOT ANSWER" TRANSMISSIONS

When it is imperative that called stations do not answer a transmission, the proword DO NOT ANSWER is transmitted immediately following the call. The call and the complete transmission are sent twice. Example:

SKIDROW—THIS IS STRAWBOSS—DO NOT ANSWER—TIME ONE SIX THREE ZERO ZULU—BREAK—NOVEMBER YANKEE DELTA PAPA—I SAY AGAIN—SKIDROW—THIS IS STRAWBOSS—DO NOT ANSWER—TIME ONE SIX THREE ZERO ZULU—BREAK—NOVEMBER YANKEE DELTA PAPA—OUT

VERIFICATION

A station may request verification of a message any time after receipt by identifying the message and requesting clarification of any doubtful part. For example:

STRAWBOSS—THIS IS ADAM—VERIFY MESSAGE—TIME ONE ZERO ZERO EIGHT ZERO ONE ZULU—ALL BEFORE TEXT—OVER

The drafter verifies the message as prepared and sent, a member of the cryptoboard may check the cryptography (if any), and a verification or correction is transmitted as follows:

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—DITTYBAG—GROUPS ONE SEVEN—BREAK—OVER

Or, if a request for verification results in a correction, the following transmission is sent:

ADAM—THIS IS STRAWBOSS—CORRECTION—MESSAGE—TIME ZERO EIGHT FOUR FIVE ZULU—WORD AFTER PROCEED—HONG KONG—OVER

In either instance, Adam then transmits:

THIS IS ADAM—ROGER—OUT

READ BACK

The direction READ BACK is a form of reverse verification—the sending station directs the receiving station to repeat all or part of the message to ensure transmission accuracy. The proword and identifying data are inserted in the message immediately after the call. Thus:

ADAM—THIS IS STRAWBOSS—READ BACK TEXT—TIME—etc.

Adam replies:

THIS IS ADAM—I READ BACK TEXT—CONVOY....etc.

If the readback is correct, the sender transmits:

THIS IS STRAWBOSS—THAT IS CORRECT —OUT

When READ BACK is sent, the proword ROGER is not needed to indicate receipt of the message.

If a message is repeated back incorrectly, it is corrected by use of the proword WRONG followed by the proper version. In the foregoing example, assume that Adam read back as follows:

THIS IS ADAM—I READ BACK TEXT— CONVOY DELAYED TWO ONE HOURS—OVER

Strawboss corrects Adam by transmitting:

THIS IS STRAWBOSS—WRONG—CONVOY DELAYED ONE TWO HOURS—OVER

Adam then reads back the correct version and Strawboss ends the exchange of transmissions with:

THIS IS STRAWBOSS—THAT IS CORRECT —OUT

EXECUTIVE SIGNALS

The OTC uses the executive method of signaling to execute tactical signals in which two or more units are to take action simultaneously. The abbreviated plaindress form is employed almost exclusively for these messages.

Executive messages contain the proword EXECUTE TO FOLLOW or IMMEDIATE EXECUTE, as applicable, immediately following the call. The signal to carry out the purport of the message is the proword EXECUTE. It may be sent shortly after transmission of the message (normal executive method), later (delayed executive method), or, in case of urgency, as a part of the final instructions of the message itself (immediate executive method). In any event, a warning STANDBY precedes the proword EXECUTE. In our first example the OTC sends a message to the task group by the normal executive method.

SKIDROW—THIS IS STRAWBOSS—EXECUTE TO FOLLOW—BREAK—CORPEN THREE FIVE SEVEN—OVER

In alphabetical order, all ships reply ROGER—OUT. When Strawboss is ready to execute and desires a receipt from a single station, he sends the executive signal and indicates that he wishes to answer:

SKIDROW—THIS IS STRAWBOSS—STAND BY —EXECUTE—BREAK—ADAM—OVER

Adam replies:

THIS IS ADAM—ROGER—OUT

A delayed executive message is handled in exactly the same way as a normal executive message except that the text of the message is repeated just before STANDBY—EXECUTE is given. Assume that the foregoing message is sent by the delayed executive method. The message is transmitted and all stations receipt for it as before. The OTC is not ready to execute until several minutes have elapsed. When ready, he sends:

SKIDROW—THIS IS STRAWBOSS—CORPEN THREE FIVE SEVEN—STAND BY— EXECUTE—BREAK—ADAM—OVER

Adam again receipts for all stations on the net.

In the immediate executive method the text of the message is transmitted twice, the two texts separated by I SAY AGAIN. The warning proword IMMEDIATE EXECUTE is used in the message instructions instead of EXECUTE TO FOLLOW. The executive signal itself is contained in the final instructions of the message:

SKIDROW—THIS IS STRAWBOSS—IMMEDIATE EXECUTE—BREAK—TURN NINE—I SAY AGAIN—TURN NINE—STAND BY—EXECUTE—BREAK—SATAN—OVER

The immediate executive message utilizes only one transmission, and it does not allow stations to obtain verifications, repetitions, acknowledgments, and cancellations before the message is executed. Its use is confined to cases of urgency.

ACKNOWLEDGMENTS

It is the prerogative of an originator to request an acknowledgment to a message from any or all addressees of that message. Acknowledgments are originated only by the

stations to which the request for acknowledgement is made.

An acknowledgement is a reply from an addressee indicating that he received a certain message, understands it, and can comply with it. Only the commanding officer or his authorized representative may authorize an acknowledgement.

The request for an acknowledgement is the word ACKNOWLEDGE (which is not a proword) as the final word of the text. The reply is the proword WILCO. If the commanding officer can acknowledge at once, the operator receipts for the message with WILCO. If the acknowledgement cannot be returned at the moment, the operator receipts for the message with ROGER, and WILCO is sent later. The return transmission to a request for an acknowledgement is either ROGER or WILCO. The meaning of ROGER is contained in WILCO, and the two prowords are never used in the same transmission.

In the following example the OTC sends a tactical signal. He desires acknowledgement from two ships:

SKIDROW—THIS IS STRAWBOSS—EXECUTE TO FOLLOW—BREAK—TANGO BRAVO—TACK—ONE FIVE—TACK—ZERO ZERO ZERO—TACK—ONE TWO—FOXFIRE—DITTYBAG—ACKNOWLEDGE—OVER

The commanding officer of Foxfire wishes to consider the message before acknowledging. His operator transmits:

THIS IS FOXFIRE—ROGER—OUT

The commanding officer of Dittybag heard the message, understands it, and is able to comply. He directs his operator to acknowledge:

THIS IS DITTYBAG—WILCO—OUT

When the commanding officer of Foxfire is ready to acknowledge, he sends:

STRAWBOSS—THIS IS FOXFIRE—WILCO YOUR LAST TRANSMISSION—OUT

RELAY TO

The proword RELAY TO, followed by an addressee, directs the station called 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. Example:

DITTYBAG—SATAN—THIS IS STRAWBOSS—SATAN RELAY TO FOXFIRE—MESSAGE FOLLOWS—ROUTINE—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 ONE TWO TWO ZULU—FROM—STRAWBOSS—TO—FOXFIRE—INFO—DITTYBAG—SATAN—BREAK—PROCEED ON MISSION ASSIGNED—OVER

The proword RELAY used alone indicates that the station called is to relay the message to all addees.

Occasionally it is necessary to relay by some other means of communication a message received on an R/T circuit. When this happens, it is the responsibility of the relaying station to place the message in the proper form for the means of communication to be utilized.

AUTHENTICATION

Authentication is a security measure designed to protect a communication system against fraudulent transmissions.

Whenever an authentication system is promulgated, accompanying instructions specify the method of use and transmission procedures, which vary slightly with the form of authentication and the means of communication employed.

Briefly, authentication involves the insertion by the originator at a specified point in a message of an identifying letter, numeral, or group of letters and numerals to attest to the authenticity of the message. In R/T procedure, there may be both net and station authenticators.

RADIO CHECK

The words RADIO CHECK comprise a query by a sending station regarding its signal strength and readability. If the called station is receiving with no difficulty (loud and clear), it simply transmits the proword ROGER. This procedure

is a normal preoperational radio check. Otherwise, strength of signals and readability are not exchanged unless one station cannot hear another station clearly. In other words, a station is understood to have good readability unless notified to the contrary.

Reports of reception are short and concise, and utilize a combination of only the following forms:

Signal strength	Meaning
LOUD*	Your signal is strong; interference will not bother my copying.
GOOD	Your signal is good.
WEAK	I can hear you only with difficulty.
VERY WEAK	I can hear you only with great difficulty.
Readability	
CLEAR*	Excellent quality.
READABLE	Quality good—no difficulty reading you.
DISTORTED	Have trouble reading you.
WITH INTERFERENCE	Have trouble reading you due to interference.

*When combined, reported as ROGER.

Strawboss desires a radio check with all stations on the net and transmits:

SKIDROW—THIS IS STRAWBOSS—RADIO CHECK—OVER

The replies of each station, in alphabetical order, might be as follows:

THIS IS ADAM—ROGER—OVER
THIS IS DITTYBAG—WEAK BUT READABLE—OVER
THIS IS FOXFIRE—ROGER—OVER
THIS IS SATAN—WEAK WITH INTERFERENCE—OVER

Strawboss, in turn, indicates his reception of each of the called stations, perhaps as follows:

THIS IS STRAWBOSS—ROGER (loud and clear from Adam and Dittybag)—FOXFIRE LOUD AND DISTORTED—SATAN NOTHING HEARD—OUT

OPENING THE NET

The procedures described here are for use either when opening a net for the first time or when reopening a net that has been secured temporarily. The distinction between types of nets is discussed in chapter 2.

Free Net

Strawboss opens a free net by transmitting the usual:

SKIDROW—THIS IS STRAWBOSS—OVER

After the transmission, all stations answer in alphabetical order. Strawboss then sends:

SKIDROW—THIS IS STRAWBOSS—OUT

Strawboss' message informs all stations that their transmissions were heard and that he has no traffic for them at the time.

If for some reason a station does not reply to the collective call within about 5 seconds, the next station answers in proper order. The delinquent station then answers last; if possible. If the station concerned is having some difficulty that prevents it from answering the call at all, it reports in to the net as soon as possible by sending:

STRAWBOSS—THIS IS SATAN—REPORTING IN TO NET—OVER

Directed Net

When all communications over the net are to be controlled by the net control station, Strawboss calls member stations and announces that the net is directed. In the same transmission, he requests information on the status of any messages outstanding. Example:

SKIDROW—THIS IS STRAWBOSS—THIS IS A DIRECTED NET—OF WHAT PRECEDENCE—AND FOR WHOM—ARE YOUR MESSAGES—OVER

Each subordinate station then answers in order, indicating traffic on hand:

STRAWBOSS—THIS IS ADAM—I HAVE ONE IMMEDIATE AND ONE ROUTINE FOR YOU—OVER
STRAWBOSS—THIS IS DITTYBAG—NO TRAFFIC—OVER

STRAWBOSS—THIS IS FOXFIRE—I HAVE ONE PRIORITY FOR DITTYBAG—OVER
STRAWBOSS—THIS IS SATAN—NO TRAFFIC—OVER

Strawboss ROGERs for the transmissions and commences to clear traffic in order of precedence:

SKIDROW—THIS IS STRAWBOSS—ROGER—ADAM—SEND YOUR IMMEDIATE—OVER

When Adam has sent and obtained a receipt for his transmission, net control gives Foxfire permission to send the next highest precedence (Priority) message.

After initial traffic is cleared, stations having messages to transmit first obtain permission from net control. Example:

STRAWBOSS—THIS IS SATAN—I HAVE ONE ROUTINE FOR ADAM—OVER

Strawboss replies:

THIS IS STRAWBOSS—SEND YOUR MESSAGE—OUT

If higher precedence traffic is awaiting transmission, Strawboss sends:

THIS IS STRAWBOSS—WAIT—OUT

Permission to transmit is delayed until traffic conditions permit.

After Strawboss transmits to Satan SEND YOUR MESSAGE, Adam, to eliminate the need for Satan making another preliminary call, may transmit (for Satan's benefit):

THIS IS ADAM—OVER

Adam's transmission indicates that he is ready to receive the message.

CHAPTER 9

VISUAL SIGNALING

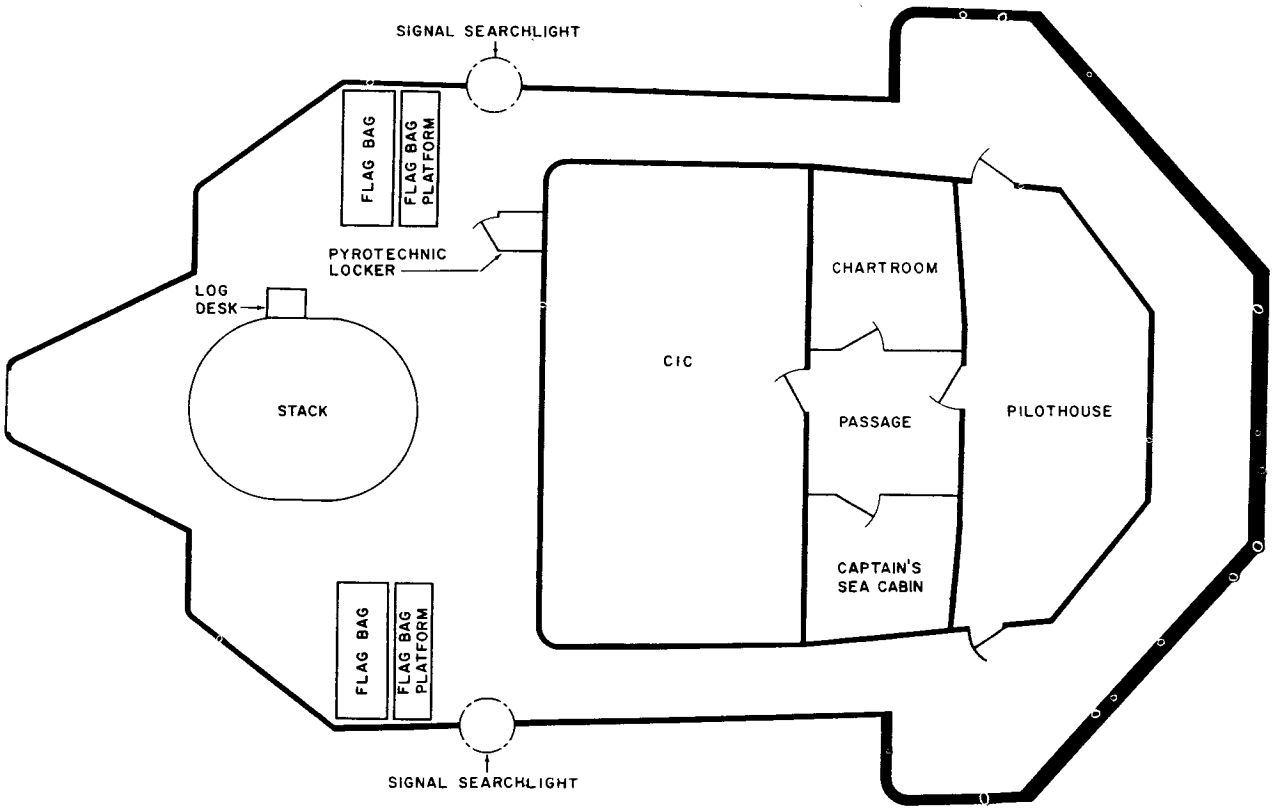
Basic communication doctrine stipulates that visual signaling, in preference to radio, is to be utilized for communications whenever practicable. This practice provides a greater degree of security against signal interception, distributes the communication workload within the ship, and obviates the need for parts of the r-f spectrum for short-range transmissions. Visual communications, therefore, constitute an integral part of the overall communication effort of the ship.

SIGNAL BRIDGE

The signal bridge, serving as an adjunct to the ship's main communication center, plays an important role in the effectiveness of communications as a function of command.

The signal bridge always is located high in the ship to provide all-around visibility. As an example, a DD 931 class destroyer has her signal bridge located on the 02 level abaft the navigation bridge, as in figure 9-1. The 02 level, or deck identifies the second horizontal division of the ship above the main deck. On other ships, the signal bridge may be on the flag bridge level or on the flying bridge.

Flag bags, which are stowage receptacles for flags when the latter are not in use, are installed on either side of the signal bridge. From the flag bags, halyards for flaghoist signaling lead up to the yardarm. In the vicinity are



105.9

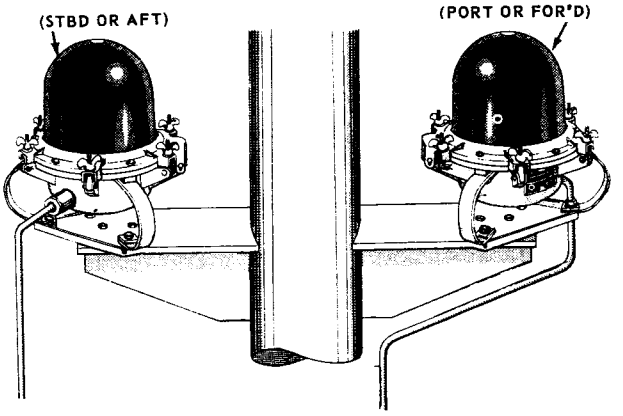
Figure 9-1. —The signal bridge is located abaft the ship's bridge.

appropriate means of communication with other stations within the ship, such as radio central and CIC. A 12-inch signal searchlight is mounted on either side of the bridge, and two additional 12-inch lights are located on the 03 level (anti-air warfare station) above the pilothouse. Searchlight operating controls are on the searchlights, but the on-off power switches are installed separately.

Normally, a signal shelter provides some sort of desk facility for writing up visual messages in inclement weather, as well as stowage space for the various required publications. Message-passing tubes run between the signal bridge and radio central.

Infrared transmitting and receiving equipments, usually employed only at night, are available to signal bridge personnel.

In our example, the infrared transmitters (fig. 9-2) are mounted on the foremast. Like ordinary yardarm blinker lights, two beacons are installed, one on the port side and one to starboard, to provide a coverage of 360°. The two transmitters are controlled by separate permanently mounted operating keys on the signal bridge. The transmitter control switch, however, is located in the pilothouse. The same control energizes both the infrared and blinker light communicating systems. The two systems are interlocked at the control switch, thus having a common keying system, but only one can operate at a time. This precaution eliminates the possibility of simultaneous keying of both infrared and yardarm blinkers under blackout conditions.



101.6

Figure 9-2.—Infrared beacons are mounted in pairs for all-around coverage.

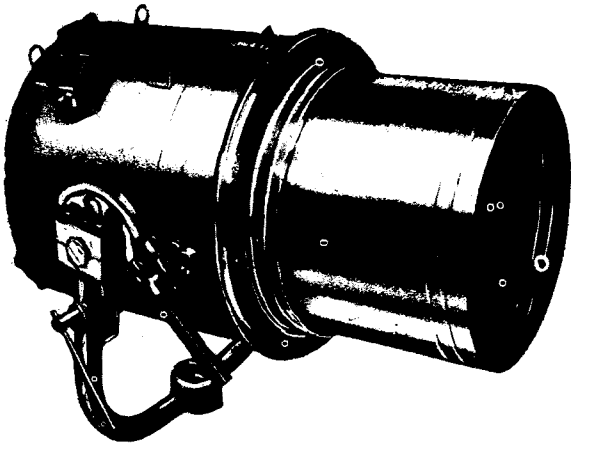
In addition to installed infrared omnidirectional transmitters, searchlights are provided with detachable infrared conversion hoods (fig. 9-3) to permit nighttime directional transmissions.

Infrared receivers are of two types: those which are electronic in design and require connections with the ship's power (fig. 9-4), and those which are completely independent in operation. The latter operate on the principle of phosphor conversion of infrared rays to visible wavelengths and are useful when long-range reception is not involved.

SIGNAL FORCE

The signal force must be continually on the alert, particularly while the ship is underway. Each signalman, in addition to performing his normal duties, is a qualified lookout. As such, he must be able to identify such details as the various types of both U. S. and foreign ships and aircraft, flags and ensigns of the principal maritime powers, and visual aids to navigation. He should be quick to note nearby ships (not part of own formation) and aircraft, objects in the water, and so on.

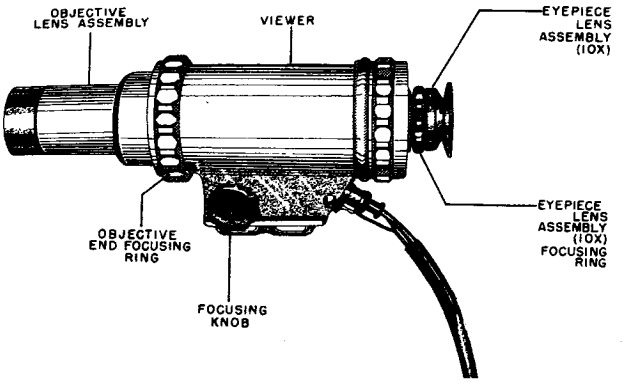
A good spotter is invaluable for spotting visual signals. When operating in company and performing tactical maneuvers by flaghoist, a spotter may be needed continuously. This is especially true when the flagship is some distance away.



77.58

Figure 9-3.—Infrared searchlight conversion hoods permit directional transmissions.

105.9



62.11

Figure 9-4. —Infrared viewer.

To magnify distant signals, the spotter may utilize any one of several optical instruments. These include, in ascending order of magnification, ordinary ship's binoculars, the OOD's 10-power long glass (spyglass), the quartermaster's 16-power glass, or the swivel-mounted, variable-power ship's telescope. The last is provided with several eyepieces that can be changed to obtain the desired magnification (up to 32).

A recorder writes up on a visual message blank each visual message (except tactical signals) exactly as it is called out by the spotter or the man on the signal light. Identifying portions of the message also are noted in the visual log.

When a tactical signal is received (invariably by flaghoist), the normal procedure is as follows:

The spotter calls out "Stand by your bags" as a warning to the men on the flag bags that a signal is being made. As the signal is received, the spotter calls it out and the bag men hoist the same signal flag for flag. After the spotter calls out the complete hoist for each halyard, he sings out "Going up." This indicates that no more flags are to be hoisted on the halyard being used. The bag men then hoist the signal at the dip (flaghoist terminology is explained in the next section). The signal officer or supervising petty officer refers to the signal book for the meaning of the signal. He reports to the OOD "Signal in the air," followed by the signal and its meaning. This same information is passed immediately to CIC, where the signal is decoded again, the CIC officer informing the OOD of the signal's meaning and action required. This practice serves as a check on the accuracy of the signal and also keeps CIC informed of the ship's possible movements.

If both reports to the OOD are in agreement, the OOD replies "Understood" to the signal force. This reply, in effect, is an order to receipt for the message, and the bag men then acknowledge the signal by hoisting it close up. Normally, the hoist is hauled down at the moment of the signal's execution.

Tactical signals are not processed through the ship's communication center. The recorder, therefore, enters the data on these signals only in the ship's visual log, as in figure 9-5. Each entry in the log should be self-explanatory. When the DTG is included, as in the first entry of the illustration, it refers to a message in the ship's files, and no amplification is needed. For tactical or other messages received with no DTG, the signal itself or the gist of the message is shown.

TYPES OF SIGNALS

Visual signaling is accomplished mainly by three methods: flaghoist, flashing light, and semaphore.

FLAGHOIST

Flaghoist signaling provides a rapid, accurate, and relatively secure system of passing tactical and administrative information during daylight hours. It is rapid because any ship, by hoisting flags to form a signal having a predetermined meaning, can communicate simultaneously with all ships in company. Accuracy is assured because all addressees of a message are required to repeat (unless impracticable to do so) the signal, flag for flag, allowing the originator to determine whether the addees have read the hoist correctly. Security is enhanced not only because the range of visibility is limited, but because the signals themselves are based on a code that is contained in a particular signal publication.

Terminology

The various parts of a flag and penant are shown in figure 9-6. The ring and snap hook are spliced to the ends of the halyard that leads through the tabling, which is reinforcing border. The tail line acts as a spacer between flags on the same hoist.

TOD or TOR	TOX	METHOD	FROM	TO	ORIG	ACTION ADEE	INFO ADEE	TEXT OR DTG
TIME ZONE:	+8 UNIFORM		WATCH: 1200-1600				DATE: 6 OCT. 1961	
1311		FL	Dp8p4p2		NABC	NDEF	NGHI	Ø621ØØZ
1415	1418	FH			pØp7	p7		TURN TWO
1430		SEM	Cp8p5		NAUP	NDEF		REQUEST BOAT FOR OPS OFF
1510		FL	EXCHANGED CALLS WITH THE SS UNITED STATES					
1530			12" S/L, PORT SIDE AFT, INOPERATIVE NOTIFIED ELEC. WORK SHOP					
1540			12" S/L BACK IN OPERATION.					
1545		WATCH	PROPERLY RELIEVED BY F.C. COLLINS, SM3					
						J.C. Rife SM2		

101. 10

Figure 9-5. —Visual log entries.

Following are some general terms associated with flaghoist signaling.

HALYARD: A light line, usually braided or plaited, used to hoist signal flags. Halyards are numbered from outboard to inboard. Thus, number 1 starboard halyard is the outboard halyard on the starboard yardarm.

HOIST: A signal consisting of the flags and pennants flown on a single halyard.

DISPLAY: A complete signal, whether on one hoist or on two or more adjacent hoists.

POINT OF HOIST: The highest point to which a signal can be raised; the yardarm block through which the halyard carrying the hoist is rove.

CLOSE UP: A hoist is close up when the top flag touches the point of hoist.

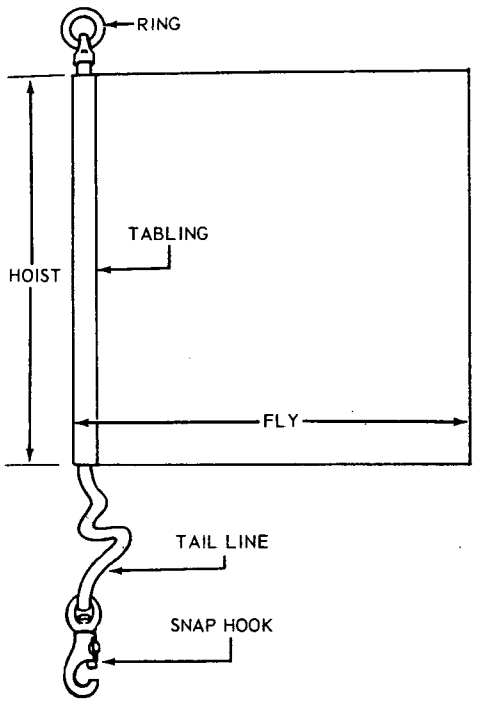
AT THE DIP: A hoist is at the dip when it is stopped about three-fourths of the way up toward the point of hoist.

HAULED DOWN: Said of a hoist when it has been lowered and cleared from sight on the halyard.

Reading

The flags of a single hoist are read from the top down. When a signal requires more flags than can be made into a single hoist, the signal is continued on another halyard. The hoists then are read from top down and from outboard to inboard, as in figure 9-7. To avoid ambiguity when a signal is broken into two or more hoists, the breaks are made where TACK normally would be inserted. (Tack and tackline are explained in chapter 5.) On occasion, flags may be hoisted at the triatic stay, which is a fore-and-aft line between masts or between a mast and a stack. A triatic display (fig. 9-8) is read from top to bottom and from forward aft.

When a display consists of more than one hoist, the separate hoists are run up one by one in the correct order. Usually, when a signal is too long to be shown completely on three halyards, two or more displays are employed. The heading flies on a separate halyard until the last hoist of the text is hauled down.



69. 121

Figure 9-6. —Flag and pennant nomenclature.

All flaghoist signals used for tactical communications are based on ATP 1(A), Volume II, the Allied Naval Signal Book. All the signals in that publication are based on the standard signal flags and pennants shown in figures 9-9 and 9-10, which also illustrate the phonetic and written version of each flag and pennant.

As can be seen in figure 9-9, each alphabet flag has the phonetic name of the letter that it represents, and each numeral flag takes the name of the numeral it represents. Numeral flags are written as numbers alone, but numeral pennants (fig. 9-10), which are used only in calls, are written as digits preceded by the small letter p (e. g., p1, p2). The special flags and pennants in figure 9-10 are used in tactical maneuvers to direct changes in speed, position, formation, and course; to indicate units; to identify units; and for other specialized purposes.

SUBSTITUTES. —Substitute pennants are utilized to prevent alphabet flags, numeral flags, and numeral pennants from appearing more than once in the same hoist. As the name implies, they are substitutes for other flags and pennants. They are used as follows:

FIRST SUB . . . . . Repeats the first flag or pennant in the hoist.

SECOND SUB. . . . . Repeats the second flag or pennant in the hoist.

THIRD SUB. . . . . Repeats the third flag or pennant in the hoist.

FOURTH SUB . . . . Repeats the fourth flag or pennant in the hoist.

Substitutes are written simply as 1st, 2nd, 3rd, and 4th. For example, the signal T 1415 is copied as T 1 4 2nd 5; 151Ø15 is hoisted as 1 5 1st Ø 3rd 2nd.

BASIC MANEUVERING SIGNALS. —Most flaghoist traffic at sea deals with tactics and maneuvering. As a matter of familiarization, this section discusses a few of the more common signals.

When three numeral flags are used in a tactical signal, they indicate a true course or bearing, depending upon the special pennant with which they are displayed. When fewer than three numeral flags are hoisted, the signal indicates a relative course or bearing in units of 10 ; e. g., the FIVE flag means 50° relative. The ANS pennant represents a fraction; in the text of a signal it means decimal point or one-half.

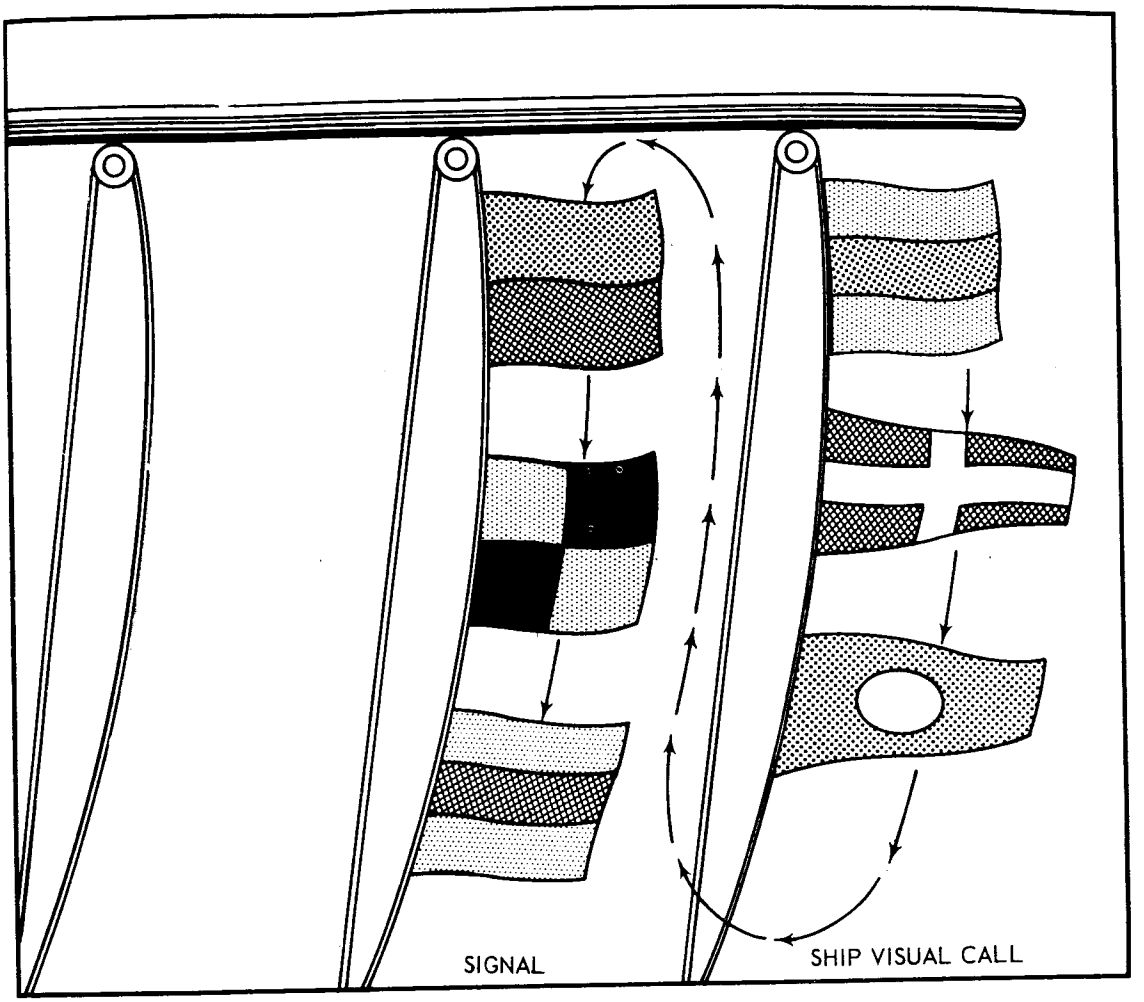
The course pennant is spoken, written, and transmitted as CORPEN. One of its most common uses is to maneuver ships, either by signaling a change of course in succession (column movement) or by indicating the base course of the formation. When CORPEN is hoisted above the numeral flags, the movement is to the right; when hoisted below, movement is to the left.

The foregoing may be summarized as follows:

CORPEN Ø9Ø. . . . . Alter course to 090° by wheeling to starboard.

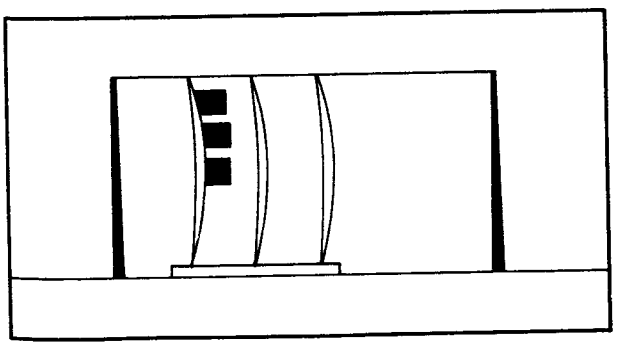
Ø9Ø CORPEN. . . . . Alter course to 090° T by wheeling to port.

CORPEN 9 . . . . . Alter course by wheeling 90° to starboard.



69.122

Figure 9-7.—Hoists are read from the top down, starting with the outboard halyard.



69.123

Figure 9-8.—The triatic stay.

4 ANS CORPEN . . . Alter course by wheeling 45° to port.

SPEED 16 ANS 8 . . Speed 16.8 knots.

The TURN pennant in a signal requires that all units addressed put over their rudders simultaneously upon the signal of execution. The interpretation of a turn signal is always a turn together to port or starboard. The rule for the direction of turn is similar to the CORPEN pennant. For example:

TURN 9 . . . . . Ships turn together 90° to starboard.

27Ø TURN. . . . . Ships turn together to port to course 270° T.

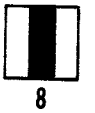
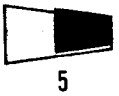
FLAG and NAME	Spoken	Written	FLAG and NAME	Spoken	Written	FLAG and NAME	Spoken	Written
 A	ALFA	A	 M	MIKE	M	 Y	YANKEE	Y
 B	BRAVO	B	 N	NOVEMBER	N	 Z	ZULU	Z
 C	CHARLIE	C	 O	OSCAR	O	 1	ONE	1
 D	DELTA	D	 P	PAPA	P	 2	TWO	2
 E	ECHO	E	 Q	QUEBEC	Q	 3	THREE	3
 F	FOXTROT	F	 R	ROMEO	R	 4	FOUR	4
 G	GOLF	G	 S	SIERRA	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 9-9. —Alphabetical and numeral flags. C17.67

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

PENNANT or FLAG	Spoken	Written	PENNANT or FLAG	Spoken	Written
 CODE or ANSWER	CODE or ANSWER	CODE or ANS	 NEGATIVE	NEGAT	NEGAT
 BLACK PENNANT	BLACK PENNANT	BLACK	 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.

C17.68

Figure 9-10. —Numeral pennants; special flags and pennants.

.67

TURN 1 ANS . . . . . Ships turn together 15° to starboard.

The FORM pennant is used in all signals to form an unformed group of ships. When ships already are in formation, the purpose of the FORM pennant is to change the formation to a new line of bearing from the guide, to order a fleet disposition, to order a special formation, and so on. Ships and lines of ships always form on the guide unless another ship is indicated by the OTC.

The most common use of a FORM signal is to order a group of ships to arrange or rearrange themselves on an indicated line of bearing from the guide. When the indicated direction is true, the usual three numeral flags are hoisted. When the indicated bearing is relative, the PORT or STARBOARD pennant is hoisted as part of the signal to indicate whether the new line of bearing is to the left or right of the guide. Example:

FORM Ø9Ø. . . . . Ships are to form on true bearing of 090° from their guide.

FORM PORT 9. . . . Ships are to form on a bearing of Ø9Ø° relative to the port side of the guide.

Relative bearings normally are thought of as running from ØØØ° to 36Ø° clockwise around the ship. For purposes of forming up, however, these bearings run only to 18Ø°—bow to stern—and may be on either side of the ship. A good reason for this is that there are a number of standard form signals consisting simply of FORM and a number. For instance, FORM 9, without the amplifying direction pennant, means "Form divisions in line abreast to starboard, division guides bearing astern," a signal entirely different from FORM PORT 9.

Although the execution of a form signal may require a change of course to carry out the maneuver, the original course always is the same as the final course. The only element that changes is the maneuvering ship's position relative to the guide.

STATION pennant signals are utilized mainly to assign a position or station to a ship or unit that is joining another ship or unit, or to move a ship or unit from one station to another. An accompanying distance or interval signal indicates the distance that the signaled ship or unit station is to be from the guide.

When used only with a ship's call sign, STATION directs that ship to take proper station.

Governing Pennants

To impart a different sense of a signal, three governing pennants—PREPARATIVE, INTERROGATIVE, and NEGATIVE—are available. Governing pennants immediately precede or follow the basic group. Their meanings follow.

Preceding the signal	Following the signal
PREP. . . .Prepare to ___.	My present intention is to _____.
INT . . . . .Questions or queries.	Request permission to_____.
NEGAT. . .Cease; do not _____; or gives a negative sense to an otherwise affirmative statement.	Action is not be-being carried out.

If the signal to launch aircraft were BZ, the governing pennants modify the basic message in this fashion:

PREP BZ . . . . . Prepare to launch aircraft.

BZ PREP . . . . . My present intention is to launch aircraft.

INT BZ . . . . . Are you launching aircraft?

BZ INT . . . . . Request permission to launch aircraft.

NEGAT BZ . . . . . Do not launch aircraft; or cease launching aircraft.

BZ NEGAT . . . . . I am not launching aircraft.

Answering

Flaghoist signals normally are answered, or receipted for, by addressees representing the

entire hoist at the dip when seen. If this is impossible, ANS alone or under the call sign of the originator may be used. A flag officer or unit commander, or his administrative flagship, may acknowledge a flaghoist signal addressed to him or to his administrative office from a ship or unit commander junior to him by hoisting ANS, either alone or under the junior's call sign.

When ANS is used to acknowledge a signal, and a further signal is hoisted after acknowledgment is given, ANS is to be dipped and rehoisted close up when the subsequent signal is acknowledged.

A hoist closed up constitutes an acknowledgment. When a tactical signal is closed up, it means that the unit(s) or ships concerned are ready to carry out the purport of that signal.

A senior officer may approve a request made by flaghoist signal from a junior ship by hoisting the call sign of the ship above ALFA. He may disapprove the request by hoisting NEGAT in the same manner. When signals are answered in this manner, the use of ANS by the senior is not required.

Emergency Signals

When an emergency exists, or when the tactical situation is such that speed is the main consideration in executing a maneuver, the originator hoists the EMERGENCY pennant as the first flag on the hoist.

Any received signal preceded by EMERG is to be acted upon as soon as understood. The originator sounds six short blasts on the whistle to call attention to his hoist and, if other than the OTC, passes the signal to the OTC by the most expeditious means authorized.

Emergency signals made by flaghoist are repeated by all ships. For an originator other than the OTC, the repeating ships hoist the call sign of the originator below FIRST SUB on an adjacent halyard.

When EMERG is used with several signal groups, it governs all groups when either separated from the group by TACK or hoisted in a superior position on an adjacent halyard. If EMERG is required to govern only one of several groups, it immediately precedes the group to be governed.

EMERG preceding a call executes all signals flying under a similar call sign as soon as understood. EMERG used without a call executes all signals flying without a call.

Signals of Execution

A flaghoist signal is executed when it is hauled down by the originator, except when execution is indicated otherwise, as follows:

1. Execution at a time designated in the signal;
2. Execution upon arrival at a position indicated in the signal; or
3. When execution is required as soon as understood in cases of emergency pennant and other signals prescribed in the Allied Naval Signal Book.

Nontactical signals that require no specific signal of execution, such as signals that transmit information, signals governed by PREP, NEGAT, and the like, are acted upon as soon as read, without waiting for the signal to be hauled down.

When a tactical signal is being made by the flagship, nontactical signals are not shown by other ships concerned with executing the tactical signal. Any nontactical signals then flying are canceled and hauled down at once.

When a signal is received by more than one method of signaling, the signal is executed on the first signal of execution received.

When the originator desires to have a signal executed at a specific time instead of when the signal is hauled down, he so indicates by means of the TANGO flag, which is the time indicator.

An exact hour transmitted in conjunction with the time indicator may be expressed in two digits, as 19 for 1900. The ANS pennant may be used in place of the last two figures of a time signal to express 30 minutes. Thus, 1630 is transmitted as 16 ANS.

When an indicated time is sent together with a signal group, TANGO is employed as follows:

	Meaning
T preceding numerals.	Action will commence at that time.
T following numerals.	Action will be completed by that time.
T between numeral groups.	Time by which action is to be completed and time at which action is to commence, respectively.

Examples of the foregoing are—

BZ TACK T 1845 . . . . Commence launching aircraft at 1845.

BZ TACK 1845 T . . . . Complete launching aircraft by 1845.

BZ TACK 19 T 1845 . . Commence launching aircraft at 1845; complete launching aircraft by 1900.

A time signal normally applies only to the group immediately preceding it. When the signal applies to two or more preceding groups, the flags AT are inserted before the first of the groups to which the time signal applies. Example:

FORM 3 TACK CORPEN 275 TACK SPEED 15 TACK T 13

The foregoing transmission means that FORM 3 and CORPEN 275 are to be executed when hauled down, but SPEED 15 will be carried out at 1300. On the other hand, the following transmission indicates that all signals between AT and T will be carried out at 1300.

AT TACK FORM 3 TACK CORPEN 275 TACK SPEED 15 TACK T 13

When AT is hoisted separately as the first hoist and remains flying during succeding hoists, all signals made are executed when AT is hauled down. With this method of execution, no time signal is required.

Visual Responsibility

When underway in formation, flaghoist is reserved mainly for collective address signals from the OTC. The only noncollective address transmissions that go by flaghoist are—

1. Signals pertaining directly to current operations.
2. Reports requested by the OTC.
3. Emergency signals.

The responsibility of an individual ship does not end when a collective address signal is repeated flag for flag. Although ships may be designated specifically as repeating stations, every vessel on the inner part of the formation is responsible for relay to ships outboard that have not yet replied. The general rule for determining visual responsibility in any situation is: Each addressee is responsible for delivery to addressees beyond himself in the general direction away from the originator. It is the duty of any ship to expedite the transmission by relay if it is evident that she is in a better position to do so than the vessel specifically responsible.

Relaying signals from the OTC is accomplished in the following manner:

1. Signals are relayed at the dip, then hoisted close up when the ships addressed have acknowledged.
2. The originator is not indicated.

Relay of signals from ships other than the OTC to ships other than the OTC is as follows:

1. The originating ship hoists the FIRST SUB, her call sign, the call sign of the addressee, and the text. If the identity of the originator is evident to all ships within visual communication range, FIRST SUB and originator's call sign need not be hoisted.
2. The relaying ship hoists the signal, flag for flag, at the dip.

When signals from individual units to the OTC are relayed, the call sign of the OTC is considered understood and therefore is omitted.

In multiple-line or circular formation, each task force (group) commander is responsible for his own subordinate commanders, and for other group commanders in the direction beyond and away from the originating ship. Each unit commander, in turn, is responsible for the division or line leaders of his own unit, and for other unit commanders in the direction beyond and away from the task group commander. The division or line leader is responsible for the ships of his division or line, and for ships of other divisions or lines in a direction beyond and away from the leader.

During maneuvers that alter the formation, visual responsibility for relay does not change until completion of the maneuver. A situation in which units change positions quickly relative to the OTC demands particular initiative and alertness by every ship if collective address messages are to be delivered rapidly and effectively.

The object of relaying is to reduce to a minimum the lag between the originator's original transmission and its accurate delivery to the last addressee. Ideal relaying is passing the message on, signal by signal or group by group, as it is being received. If the message is by flag, the next ship reads the message as the relay vessel repeats, flag for flag, the signal she is reading. If the message is by semaphore or light, fast relaying can be effected by having operators stationed on each side of the signal bridge, one receiving while the second is relaying.

A ship having visual communication duty for a nest of ships in port is considered the communication guard for the nest so far as visual communications are concerned.

Canceling or Correcting a Signal

In flag signaling, the special pennant NEGAT as a separate hoist cancels all other signals then hoisted on that yardarm. If more than one signal is flying and only one is to be canceled, that signal is repeated under NEGAT. Signals already executed cannot be canceled. In this instance, a new signal is required to meet the new situation.

FLASHING LIGHT

Directional flashing light transmissions are sent by a signal searchlight pointed and trained directly at the receiving station. The Morse code dots and dashes are formed manually by opening and closing a venetian blind type of shutter mounted inside the searchlight between the lens and the source of illumination. The shutter is held in the closed position by two springs, and is opened by a lever on either side of the drum. A multipurpose, portable, trigger-type signaling light also is available. Because of its limited range, however, its use is confined normally to small boats.

Directional flashing light is the longest range visual signaling method. In daylight, it is possible for a 24-inch carbon arc light to be read from a ship so far hull down that only the light itself can be seen. With the new 12-inch high-intensity signal searchlights, small ships also are able to achieve long-range flashing light communications. Flashing light communication is utilized chiefly in peacetime. Normal practice in the Navy, even during peacetime operations, is to use colored filters or infrared equipment for night signaling.

Nondirectional signals are transmitted by yardarm blinkers. On a destroyer-type vessel, these lights usually are actuated by a telegraph key mounted on the bridge wing. This type of light communication has a 360° arc of visibility, affording an effective way to communicate simultaneously with several addressees. Although it occasionally is used underway in company, and only at night, most frequent usage is in port, where administrative traffic addressed to all ships is sent via yardarm blinker.

Executive Method

The executive method of communicating was described previously, notably in chapters 5 and 9. You may recall that in the immediate executive method, the executive signal is made in the ending of the original message, and receiving stations, therefore, are unable to receipt before the purport of the signal is carried out. In the delayed method, stations receipt for the message when received, and the executive signal is made as a later transmission. In either method, the end of the 5-second dash that follows the prosign $\overline{\text{IX}}$ is the moment of execution.

No-Response Procedure

The prosign F, transmitted four times before a call and repeated as necessary, indicates that the station addressed is not to answer the call or receipt for the message. Transmission is then made twice. If the message is plaindress or codress, the prosign F is included in the transmission instructions also. For example, NBGE transmits a no-response, plaindress message to NBRF:

FFFF NBRF DE NBGE—F—R—122356Z—
GR7 $\overline{\text{BT}}$ TEXT $\overline{\text{BT}}$ $\overline{\text{IMI}}$ NBRF—DE—
NBGE—F—R—122356Z—GR7—$\overline{\text{BT}}$—
Text—$\overline{\text{BT}}$ $\overline{\text{AR}}$

Double-Flash Procedure

Double-flash procedure is for use at anchor when a recorder is unavailable. A called ship desiring to utilize this procedure transmits the appropriate operating signal (ZJJ). In this procedure, the first flash indicates receipt of a word or group; the second flash, that the word or group is recorded and that the receiving station is ready to receive the next word or group.

Steady Dim Light

If a station has difficulty keeping its light trained properly, the receiving ship or unit may be directed, by the signal OL, to show a steady dim light as a training mark. Flashes to indicate receipt must, of course, be brighter, or a second light must be used.

Infrared

One of the principal characteristics of infrared is its security advantage. This particular

equipment can be made highly directional, making it safe and difficult to jam. Infrared, like light, trends in straight lines, and its rays are only slightly bent by refraction as it passes through the atmosphere. This desirable characteristic, however, also imposes a range limitation to the horizon.

Infrared is absorbed by the atmosphere. Rain, snow, haze, and fog impose limitations as they do in the visible region of the spectrum. Infrared usually penetrates artificial smokescreens and some kinds of fog, however. Although restricted largely to night operations, infrared can be used also during daylight, provided the visible region of the spectrum is excluded.

Directional infrared communication uses the standard signal searchlights with filters or special purpose equipment. At a predetermined time, or when alerted by the designated code word via radiotelephone, ships having traffic turn on the point-of-train (POT) light, locate the ships for which responsible or with which they wish to communicate, and clear their messages via directional infrared searchlights. (The point-of-train light is a steady infrared light that assists the sender in locating the receiving station and in keeping his light trained properly. It is turned on only to indicate that a station is communicating, or is ready to communicate, with infrared equipment.)

Nondirectional uses of the infrared yardarm blinkers with nondirectional flashing light procedure. This procedure is principally for multiple-address messages.

Definite periods usually are established for transmitting and receiving communication traffic via infrared. At other times, units are alerted by a code word transmitted over voice radio. The officer in tactical command normally controls use of infrared communication, including guardship assignments. Visual responsibility is similar to that for other means of visual communication.

SEMAPHORE

Semaphore is the preferred method of transmitting message (as opposed to tactical) traffic during daylight. Although semaphore's usefulness is limited by its short range, it is extremely reliable and efficient. When ships are steaming in company, it is common for the OTC to send most of his administrative traffic by semaphore. Because of the possible speed of transmission, this method of communicating is better adapted to long messages than flaghoist or flashing light.

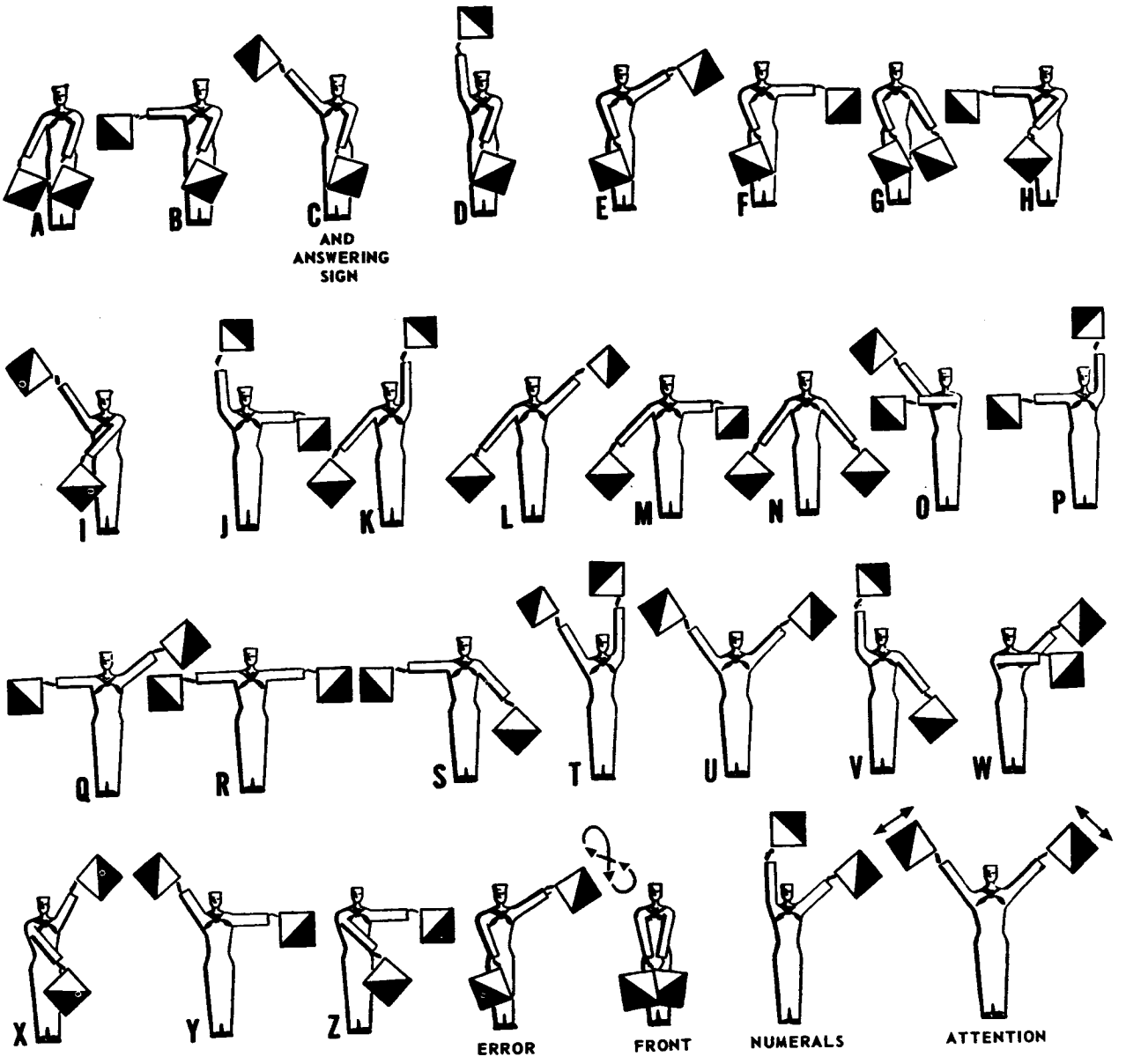
The only equipment needed for semaphore are two hand flags, 15 to 18 inches square, attached to staffs about 22 inches long. In general, the flags are similar to the OSCAR alphabet flag, although the PAPA design sometimes is substituted. Figure 9-11 shows how the semaphore alphabet and most of the special characters used in connection with it are formed.

A call by semaphore is made by transmitting the attention sign or, if this is impracticable, the call sign of the station being called. It may be answered by transmitting either the answering sign by semaphore or the prosign K by flashing light. The call for a semaphore message may be by flashing light, in which case it is answered by flashing light. When answered, the transmitting ship or unit then sends the abbreviation SEM to indicate that a semaphore transmission is to follow. Prosigns and operating signals are used in semaphore but are signaled as groups.

To call by flaghoist, a ship or unit hoists the call of the addressee(s) above the JULIETT flag, whose meaning when flown close up is "Have a semaphore message to transmit." To call all ships and stations within visual range, JULIETT is hoisted singly. Ships in company (or other units within visual range) hoist the call of the transmitting station above ANS at the dip when JULIETT is seen. This call then is closed up when the ship is ready to receive the message.

Several special characters, used in connection with semaphore, are the—

1. ANSWERING sign, as an answer to a call.
2. ATTENTION sign, a preliminary call, which also establishes communications.
3. DIRECTION sign, following the attention sign, indicates the direction of transmission.
4. FRONT sign, used before and after each prosign, operating signal, word, and code group.
5. NUMERAL sign, before and after each group of numerals or group of mixed letters and numerals in the text that are to be recorded and counted as a single group consisting of letters and digits. In the heading, numbers are always recorded as digits, and the numeral sign is not needed.



17. 18

Figure 9-11. —Semaphore alphabet and special characters.

6. SEPARATIVE sign, made by sending the character II as one group, separates letters or figures of adjacent groups.

7. EXECUTIVE signal, made by transmitting IX AR.

Table 9-1 shows how a semaphore message is transmitted and recorded as received.

A station having difficulty reading the semaphore signs may direct the sender to change his position by transmitting a move sign—MD, MU, MR, or ML (move down, up, to your (sender's) right, to your left). When other than fluorescent flags are used, a good background is essential for accurate reception.

The addressed ship, after obtaining any needed repetitions, receipts for a message either by sending the prosign R by semaphore or flashing light, or by hauling down the ANS pennant.

Table 9-1. —Semaphore Message

Special characters are indicated by the following abbreviations:

ATTENTION	ATT
FRONT	FR
SEPARATIVE	SEP
NUMERAL	NUM
DIRECTION	DIR

Message originated and transmitted in plain-dress form:

ATT FR DIR FR SEP FR
R (precedence) FR SEP FR ONE
FR SIX FR ONE FR TWO FR
ONE FR SIX FR Z FR SEP FR
FM FR NTSF FR SEP FR
TO FR NTSY FR SEP FR
INFO FR NCFX FR
GR FR FOUR FR
BT FR
HEAD FR FOR FR HATTERAS
FR NUM FR ZERO FR SIX
FR ZERO FR ZERO NUM FR
BT FR
K

Message as recorded:

R - 161216Z
FM NTSF
TO NTSY
INFO NCFX
GR 4
BT
HEAD FOR HATTERAS 0600
BT
K

IMPORTANT PUBLICATIONS

In addition to the effective editions of publications discussed earlier, there are a number of doctrinal publications with which communication personnel on the bridge should be familiar. A great part of the efficiency of the communicator and the signal force depends on their knowledge of where to look for needed information.

All publications mentioned in this section refer to the latest editions of those publications.

NWP 16, Basic Operational Communication Doctrine, primarily provides officers at all levels of command with the basic doctrine, policies, and principles governing fleet operational communications. Secondarily, it provides guidance to communication officers in conducting fleet communications within the limits imposed by command.

Perhaps the most widely used publication for tactical communications in the Navy is ATP 1(A), Volume II. A copy of this book is kept on the signal bridge as well as on the bridge, in CIC, and in main radio.

When flaghoist will not suffice, R/T transmissions of tactical maneuvering signals from ATP 1 may be employed, substituting the spoken version of the alphabetical and numerical flags and pennants.

ACP 129, Visual Signaling Procedure, prescribes the method to be followed in all military visual communications. When communicating with any but military units, international procedure described in H. O. 103 is employed.

ACP 118, Visual Call Sign Book, contains information on visual call signs and address groups.

ACP 121 Communication Instructions, General, and ACP 125, Radiotelephone Procedures, should be understood thoroughly by all communication personnel.

ACP 131, Operating Signals, and ACP 168, Pyrotechnic Signals, contain valuable information for visual communicators.

Volume I of H. O. 103, International Code of Signals, is, in effect, the visual signal book of the international merchant marine. It is the merchant marine service equivalent of ATP 1. Signals are set forth on a multilingual basis to facilitate communications along merchant ships.

When a Navy ship communicates with a merchant ship by flaghoist, she hoists the CODE pennant in a conspicuous position to let the merchant ship know that signals are based on those contained in H. O. 103, Volume I. When communicating by flashing light or semaphore, the signal PRB TACK as the first part of the transmission replaces the intent of the CODE pennant.

DNC 27, U. S. Naval Flags and Pennants, is a source of information on most matters pertaining to flags and pennants. It describes those used by the Navy, and includes a discussion of the customs and formalities to be observed in their use. Emphasis is placed on the ceremonial aspects of flag displays.

PUBLICATION CUSTODY LOG

Many of the publications needed on the signal bridge contain classified information. For this reason they generally are retained in the communication or signal officer's safe while the ship is not underway.

While the ship is at sea, the signal supervisor exercises firm control over all publications issued to the signal bridge. For this purpose, a publication custody log is maintained continuously on a watch-to-watch basis. All accountable publications and extracts are listed on the log sheet. Each oncoming supervisor, before relieving the watch, sight checks each listed document and signs the custody log for the appropriate watch.

CALL SIGNS, ADDRESS GROUPS, AND PROSIGNS

For transmitting groups from authorized signal books, visual call signs contained in ACP 118 are employed to—

1. Address ships, units, or commands (precede the signal).
2. Complete, amplify, or vary the meaning of a signal (used in conjunction with the signal).
3. Denote or indicate ships, units, or commands (follow the signal).

In addition to the call signs in ACP 118, the following call signs, employed mainly to provide a short call for delivering flaghoist messages, are authorized for use in visual communications:

1. Radio call signs (except radiotelephone);
2. International call signs;
3. Tactical call signs;
4. Collective call signs;
5. Indefinite call signs;
6. Task organization call signs.

TYPE INDICATOR LETTERS

Abbreviated call signs consist of single-letter type indicators (according to vessel type), plus numeral pennants to identify all or part of the assigned hull number. The following type indicators are used by the U. S. Navy for U. S. and Allied visual communications:

A — Auxiliary type;
B — Battleship type;
C — Cruiser type;
D — Destroyer type;
L — Amphibious type;
M — Mine warfare type;
P — Patrol type;
R — Aircraft carrier type;
S — Submarine type;
Y — Service craft type.

To illustrate, the USS Albany (CA 123) would have the visual (flaghoist) call sign CHARLIE p1p2p3.

In utilizing a type indicator plus the hull number of the vessel called, certain digits of the hull number may be omitted if the addressee is unmistakable. Thus, the screen commander addressing a flaghoist to a destroyer, hull number 765, may shorten the call sign to Dp6p5 provided no other destroyer in the screen has the same last two digits in her hull number. Similarly, Dp5 may be used if no confusion will result.

When using any visual communications besides flaghoist, call signs are transmitted by international Morse code or semaphore equivalents. Call signs (except radiotelephone call signs) in the text of signals are preceded by the prosign $\overline{PT}$, transmitted as a Morse symbol, meaning "Call sign follows." For example, the call sign of a cruiser with hull number 23 is transmitted as $\overline{PT}$ C23. When more than one such call is included in the text, each is preceded by $\overline{PT}$.

UNIT INDICATOR CALLS

Call signs for organized naval units are constructed as follows:

Unit indicator		Meaning
SUBDIV	. . .This	Subdivision
DIV		Division
SQUAD		Squadron
FLOT		Flotilla

To illustrate, the call for destroyer squadron 8 is D SQUAD p8. Later D is the type indicator, SQUAD the unit indicator, and p8 the numeral pennant and specific squadron number.

To call the individual units under a command, the unit indicator may be followed by pØ. For example, DIV pØ is a collective call from a commander to each unit under his command.

Occasionally, units within visual range of each other have the same abbreviated visual call sign. This can happen, for instance, in LST

division 11 and LSD division 11. Both have the visual call sign L DIV p1p1. Under this condition, appropriate division, squadron, or flotilla address groups are utilized.

To form the visual call sign of the commander of an organized flotilla, squadron, division, or subdivision of ships, the unit indicator is followed by the type indicator.

SQUAD D . . . . . Commander this destroyer squadron.
DIV D p2p2 . . . . . Commander Destroyer Division 22.

NUMERAL PENNANT CALL SIGNS

One- and two-numeral pennant call signs may be used alone or followed by the type indicator and/or unit indicator. To form commander visual call signs, collective visual call signs are preceded by pØ. The collective visual call sign of the command includes the commander thereof and all subordinate commanders. Following is a partial list of numeral pennant call signs from ACP 118.

Call sign	Meaning
pØpØ	Commanders under my command.
pØp1	Officer in tactical command.
p1	All ships under my tactical command.
p2	All ships.
p3	Main body.
p4	This line.
p5	Screen.
p6	This task force.
p7	This task group.
p8	This task unit.
p9	This task element.
p1p1	All task group commanders.
p1p2	All task unit commanders.

Following are some examples of numeral pennant call signs.

All destroyers under my tactical command p1D
Division commanders under my command . . . . . pØpØ DIV
Screen commander pØp5

Single-letter type indicators may be used following the numeral pennant call signs. Example:

p2D . . . . . All destroyers.

TASK ORGANIZATION CALL SIGNS

The visual call signs given in ACP 118 may be used in flaghoist communications as short call signs within a given task organization. These short call signs always begin with a numeral flag, followed by numeral pennant(s) indicating the number of the task organization. Type indicators may follow the call sign. The table of task organization visual call signs listed in ACP 118 follows.

Call sign (Numeral flag)	Meaning
Ø	Commander Task Force No._____
1	*Commander Task Group No._____
2	*Commander Task Unit No._____
3	*Commander Task Element No._____
4	
5	
6	Task Force No._____
7	*Task Group No._____
8	*Task Unit No._____
9	*Task Element No._____

*Within own task organization.

Examples:

6p4p5 . . . . . Task Force 45.
8p3 . . . . . Task Unit 3.
9p2D . . . . . Destroyers of Task Element 2.
3p6 . . . . . Commander Task Element 6.

TACTICAL CALL SIGNS

Tactical call signs are constructed from letter-numeral combinations to form a 4-letter-numeral group. All task organizations are assigned tactical call signs contained in ACP 112. Other tactical organizations are assigned call signs from the ACP 110 series. This type

of call sign may be a letter-number, number-letter, or any other 4-unit combination thereof. By way of illustration, TF 88 may be assigned a collective call J5NX, and the commander call might be C319.

ADDRESS GROUPS

You will remember from chapter 2 that an address group is a four-letter group assigned to represent a command, authority, activity, or unit.

To illustrate the use of address groups, assume that USS Turner Joy (DD 951), with COMDESRON 28 embarked, is participating in a training exercise. The communication annex to the operation order includes appendixes listing task organization call signs, ship call signs, and administrative call signs.

In the discussion on tactical call signs, we depicted the collective and commander call signs for the task organization setup, with CTF 88 as the OTC. From the appendix listing ships' call signs appears this information:

Ship . . . . . Turner Joy
Hull number . . . . . DD 951
Radiotelegraph. . . . . NENB
Radiotelephone. . . . . BALL ROOM

The appendix, entitled "Admin Call Signs," contains the following additional data:

ADMIN COMMAND . . . DESRON 28

	Radiotelegraph	Radiotelephone
Collective	ASAP	GUYS
Commander	SPUD	DOLL

In this example we demonstrated the ship's international call (described as signal letters when used visually), plus the collective address group for a naval commander, showing that he has both a commander and a collective address group call.

SPECIAL PROSIGNS FOR VISUAL PROCEDURE

In addition to the prosigns discussed in earlier chapters, certain special prosigns (following) are established for use only in visual communications.

D—Reduce brilliancy or use smaller light. This prosign is restricted to flashing light procedure when the situation requires that a transmitting operator be informed that his light is too bright or too large.

L—Relay or Relayed. Used only in flashing light and semaphore procedures.

NEGATIVE—Exempted addressee. The NEGATIVE pennant in flaghoist signaling is the equivalent of prosign XMT.

WHISKEY—(1) In flaghoist procedure, flag W means that addressee following this letter is information addressee. (2) In flashing light procedure, the prosign W means "Your light is unreadable."

CHAPTER 10

SECURITY

The security of the United States in general, and of naval operations in particular, depends greatly upon the success attained in safeguarding classified information. Every communicator must be security conscious to the point that he automatically exercises proper discretion in the discharge of his duties and does not think of security of information as something separate and apart from other matters. In this way, security of classified information becomes a natural element of every task and not an additionally imposed burden.

Most of the vast amount of intelligence handled by naval communications passes at some point through the hands of radiomen—data which, if available to an enemy, would enable him to learn the strength and intent of our forces, and to gather a wealth of technical information relating to the procedures and operations of the United States Navy.

Communication personnel use many official documents and publications that relate to such matters as frequencies, call signs, and procedures. Their contents also must be protected, because the more an enemy knows about our communications the better are his chances of deriving intelligence from them.

Rules and regulations on the subject of security do not guarantee results, and they do not attempt to meet every conceivable situation. The law of diminishing returns limits the control measures that can be employed profitably. In administering security it is important that a balanced and commonsense outlook be maintained. Each of us must learn to exercise proper discretion in carrying out our duties so that observing proper security precautions becomes an automatic and integral part of our work.

In official publications, the terms "classified information," "classified material," and "classified matter" have slightly different shades of meaning. Information, for example, may involve a document, or the term may denote an intangible, such as knowledge obtained by word of mouth. On the other hand, material or matter implies a physical element, such as an item of equipment, although either word might also refer to written intelligence. For our purposes, the three terms are synonymous.

CLASSIFICATION

Official information that requires protection in the interests of national defense is limited to three categories of classification that, in descending order of importance, carry the designation of Top Secret, Secret, or Confidential.

TOP SECRET

Top Secret material or information is that of which the defense aspect is paramount, and the unauthorized disclosure of which would result in exceptionally grave damage to the Nation. Such grave damage might consist of, but is not limited to—

1. Leading to a definite break in diplomatic relations affecting the defense of the United States, an armed attack against the United States or her allies, or a war.
2. The compromise of military or defense plans, or intelligence operations, or scientific or technological developments vital to the national defense.

SECRET

The classification Secret is limited to defense information or material, the unauthorized disclosure of which could result in serious damage to the Nation, such as jeopardizing the international relations of the United States, endangering the effectiveness of a program or policy of vital importance to national defense, compromising important military or defense plans or technological developments, or revealing important intelligence operations.

CONFIDENTIAL

The use of the classification Confidential is limited to defense information or material, the

unauthorized disclosure of which could be prejudicial to the defense interest of the Nation.

In addition to the usual types of information included within the Confidential category, such as operational reports, frequency and call sign allocations, and technical manuals, Confidential encompasses these personal elements:

1. Personnel security investigations and other investigations that require protection against unauthorized disclosure.
2. Matters and documents of a personal and disciplinary nature, the disclosure of which could be prejudicial to discipline and morale.
3. Documents used in connection with procurement, selection, and promotions of military personnel, the disclosure of which could violate the integrity of the competitive system.

The term Confidential—Modified Handling Authorized identifies certain Confidential matter pertaining to actual or simulated combat or combat-related operations. The term indicates that although the information concerned warrants security precautions, it requires less secure safeguards in stowage and transmission.

BASIS OF CLASSIFICATION

The Department of Defense security formula is based on the premise of circulation control. The higher the classification, the more limited is the distribution of the classified material. Security considerations in all cases take into account the ultimate required dissemination of the information involved.

Documents and information, including extracts therefrom, are classified strictly according to content—not according to their relationship to other classified material. For example, an outgoing message that refers to another classified message need not bear the classification of the referenced message, provided reference is made by means of the TDTG (explained in chapter 2) or other identifying symbols. The classification of the transmitted message depends entirely on the text.

Classified matter bears a single classification—that of its highest component—even though individual pages, paragraphs, or sections of the material are classified differently. Whenever practicable, those portions of a lesser classification than the overall classification are marked appropriately according to content.

NEED FOR PROPER CLASSIFICATION

The Department of the Navy Security Manual for Classified Information, issued by the Chief of Naval Operations, contains examples of the types of material that should be included in each classification category. Unnecessary classification or overclassification must be scrupulously avoided. Any information that requires safeguarding must be assigned the lowest classification consistent with content. A defense classification marking merely indicates that the material so marked requires certain minimum controls and restrictions regarding its accessibility.

Overclassification delays unnecessarily the action on important papers, overburdens security channels and facilities, and detracts from the importance of classification in the minds of all personnel. Furthermore, it can undermine our security system and jeopardize the protection required for important military secrets.

The Security Manual stresses the need for the greatest possible reduction in the number of highly classified documents. As one step in that direction, the manual designates the officials who have authority to assign an original classification. The commanding officer of a ship, for example, may not originate Top Secret material, unless specifically designated, except by derivative authority. Derivative classification authority may be exercised by any official whose duties necessitate classifying material created by him as a result of or in connection with material already classified. Thus, although a unit commander might not have specific authority to originate a Top Secret message, derivative authority permits him to classify as Top Secret a message of reply to a Top Secret communication.

It is important, of course, that an originator assign the security classification that he is convinced the information requires. If such classification is higher than the originator is authorized to assign, he recommends the classification by so marking the material, states his reason for doing so, and refers the material to higher authority.

RESTRICTED DATA

An occasional source of confusion regarding classification is the term Restricted Data. Oversimplifying, any item so marked is concerned with nuclear weapons or the use of

nuclear material, such as in the production of energy. Restricted Data means, in effect, that the information contained in the document is not to be exchanged with foreign nations unless the exchange is specifically authorized by the Chief of Naval Operations (Director of Naval Intelligence).

The confusion arises because documents containing Restricted Data are marked in the same manner as information that is classified. When the marking appears on a classified item, usually it is shown as a conjunctive classification, e.g., SECRET-RESTRICTED DATA. In addition, any item so marked carries the following identification:

RESTRICTED DATA

Atomic Energy Act of 1954.

DOWNGRADING AND DECLASSIFICATION

Any command may downgrade or declassify material that it originates. Available manpower, however, does not justify an administrative process whereby certain personnel periodically scan all the classified files in each command to determine what may be reclassified or declassified. The time element in analyzing the possible ramifications in each case would reach astronomical proportions. The national interest, however, demands that all classified information be made available to the general public when secrecy no longer is of importance or value.

To overcome the problem, the Secretary of Defense established a procedure, based on an Executive Order, for automatically downgrading, or downgrading and declassifying, certain defense information. Instructions were promulgated to the services by a joint Army-Navy-Air Force directive (for the Navy—OPNAV Instruction 5500.40 series) entitled Automatic, Time-Phased Downgrading and Declassification System. The key word is "automatic." Since the original directive was issued, the applicable instructions have been expanded to include defense information originated by or under the jurisdiction of the Federal Aviation Agency (FAA) and the National Aeronautics and Space Administration (NASA). By compliance with the provisions of the system, originators generally are relieved of future concern for the classified aspects of documents or material they produce. At the same time, recipients are advised upon receipt of the material of the downgrading or declassification status of each item of information they receive.

Depending on the contents of the material, all classified information originated or received within the DOD, FAA, or NASA is placed into one of four groups. The assigned category indicates whether an item therein may automatically be declassified at any time in the future, and if so, when. The grouping by category is as follows:

A document assigned to—	
Group 1:	Is completely excluded from automatic downgrading or declassification.
Group 2:	Is Top Secret or Secret material that normally would fall in group 3 or 4, but is individually and specifically exempted from automatic downgrading or declassification because of its sensitive nature.
Group 3:	Warrants some degree of classification indefinitely; it is downgraded at 12-year intervals, but it is not automatically declassified.
Group 4:	Is downgraded at 3-year intervals and is declassified after 12 years.

With few exceptions, classified material is conspicuously marked, on the front cover or on the first page if there is no cover, with an appropriate downgrading and declassification printed or stamped notation. For group 1 items, the notation need not be shown on material or equipment that bears the designation CRYPTO, or on certain communications intelligence material. The notations are as follows:

Group 1:	EXCLUDED FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION.
Group 2:	EXEMPTED FROM AUTOMATIC DOWNGRADING.
Group 3:	DOWNGRADED AT 12-YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED.

Group 4: DOWNGRADED AT 3-YEAR INTERVALS; DECLASSIFIED AFTER 12 YEARS.

The automatic downgrading and declassifying procedures apply to messages as well as other forms of recorded information. To eliminate transmission volume, the originator includes, at the end of the text, a group abbreviated notation marking (GP-1, GP-2, GP-3, or GP-4) in lieu of one of the notations described in the previous paragraph. The number may be spelled out to avoid transmission errors.

PHYSICAL SECURITY

Physical security has to do with safeguarding classified information by physical means. It includes the designation of security areas, stowage, custody, accountability, transmission, dissemination, and ultimate disposition or destruction. In other words, here we are concerned with methods of preventing unauthorized persons from obtaining physical custody of classified material.

SECURITY AREAS

Spaces that contain classified matter are known as security areas. These security (or sensitive) areas have varying degrees of security interest, depending upon their purpose and the nature of the work and information or materials concerned. Consequently, the restrictions, controls, and protective measures required vary according to the degree of security importance. To meet different levels of security sensitivity, three types of security areas have been established; all such areas are clearly marked by signs reading "SECURITY AREA—KEEP OUT."

Exclusion Area

Spaces requiring the strictest control of access are designated exclusion areas. They contain classified matter of such nature that admittance to the area permits, for all practical purposes, access to such matter.

An exclusion area is fully enclosed by a perimeter barrier of solid construction. All entrances and exits are guarded, and only those persons whose duties require access and who possess appropriate security clearances are authorized to enter.

Limited Area

A limited area is one containing classified information and in which the uncontrolled movement of personnel permits access to that information. Within the area, access may be prevented by escort and other internal controls.

The area is enclosed by a clearly defined perimeter barrier. Entrances and exits are guarded or controlled by attendants to check personal identification. The area may be protected by an automatic alarm system.

Operating and maintenance personnel who require freedom of movement within a limited area must have a proper security clearance. The commanding officer may authorized the admittance of persons who do not have clearances. In such instances escorts or attendants must be used and other security precautions must be taken to prevent access to the classified information located within the area.

Radio central, the message center, relay stations, transmitter rooms, and other communication spaces usually are designated limited areas. When any of these spaces contain on-line cryptographic equipment, however, they are designated exclusion areas.

Controlled Area

A controlled area usually does not contain classified information. It serves as a buffer zone to provide greater administrative control, safety, and protection for the limited or exclusion areas.

Controlled areas require personnel identification and control systems adequate to limit admittance to those having bona fide need for access to the area.

Passageways or spaces surrounding or adjacent to limited or exclusion areas may be designated controlled areas.

STOWAGE

Classified material not in actual use by appropriately cleared personnel or under their personal observation should be stowed to provide protection commensurate with the security interest of the material.

To provide a basis for establishing security protection for the various categories of classified material, a numerical evaluation for classified material in stowage enables any officer responsible for classified material to determine that an adequate level of protection is attained.

The system, covered in detail in the Security Manual for Classified Information, makes use of two tables:

1. A table of numerical equivalents (fig. 10-1), which establishes numerical values for various items that may be incorporated individually or collectively in the stowage protection system.

2. An evaluation graph (fig. 10-2), which establishes minimum levels of required protection based on the classification and the strategic and intrinsic importance of the material concerned.

The application of the numerical evaluation system to an existing stowage security program is as follows:

1. Select appropriate numerical equivalents for each applicable element in the security program, as set forth in figure 10-1, and total them. Assign only one value for each lettered subsection, interpolating as necessary to reflect the existing situation.

2. In figure 10-2 select from the left of the graph a subcategory that best describes the material to be stowed. Moving across the graph to the right to the point of intersection with the diagonal line shows the numerical value that must be equaled if the stowage is to be considered adequate.

CUSTODIAL PRECAUTIONS

All personnel are individually responsible for assuring that knowledge of classified information which they prepare or handle is made available only to persons who have appropriate security clearances and who have clearly established a legitimate need for the information. In view of this, it might be well to mention several custodial requirements that should be borne in mind constantly.

No one may remove classified material from the confines of the command without the approval of the commanding officer or his representative. When classified material is removed, the individual removing it signs a complete list (receipt) that remains on file until he returns the material.

When working with classified documents, take precautions to prevent either deliberate or casual access to the information by unauthorized persons. When the documents are removed from stowage for working purposes, keep them face down or covered when not in use. Visitors not authorized access to the classified information within a working space are received in an outside area. If the space must be vacated during working hours, stow all classified material as at the end of the working day.

During the preparation of a classified document, all preliminary drafts, sheets of carbon paper, stenographic notes, worksheets, and so on must either be destroyed (or placed in the burn bag) immediately after they have served purpose, or be treated and safeguarded in the same manner as the classified information produced from them.

At the close of working hours, a security inspection is made to ensure that users have stowed all classified material, that material to be passed from watch to watch is accounted for, and that burn bags and the contents of wastebaskets containing classified material are properly stowed or destroyed. Custodians include as part of the inspection a check on loose papers such as carbon sheets, written notes, rough drafts, and the like. As a matter of routine, however, these items should be placed in a burn bag immediately after use and not allowed to accumulate or remain adrift.

When securing a safe, file, or cabinet equipped with a combination lock, rotate the dial of the lock at least three complete turns in the same direction. When the dial is given only a quick twist, it may be possible to open the lock merely by turning the dial in the opposite direction. After the equipment is locked, test all drawers to be sure they are held in the locked position.

ACCOUNTABILITY

Except for publications containing a distribution list by copy number, all copies of each Top Secret document and each item of Top Secret equipment are numbered serially at the time of origination: Copy No._____of_____ copies. Each page of a Top Secret document not containing a list of effective pages is numbered:

"Page_____of_____pages."

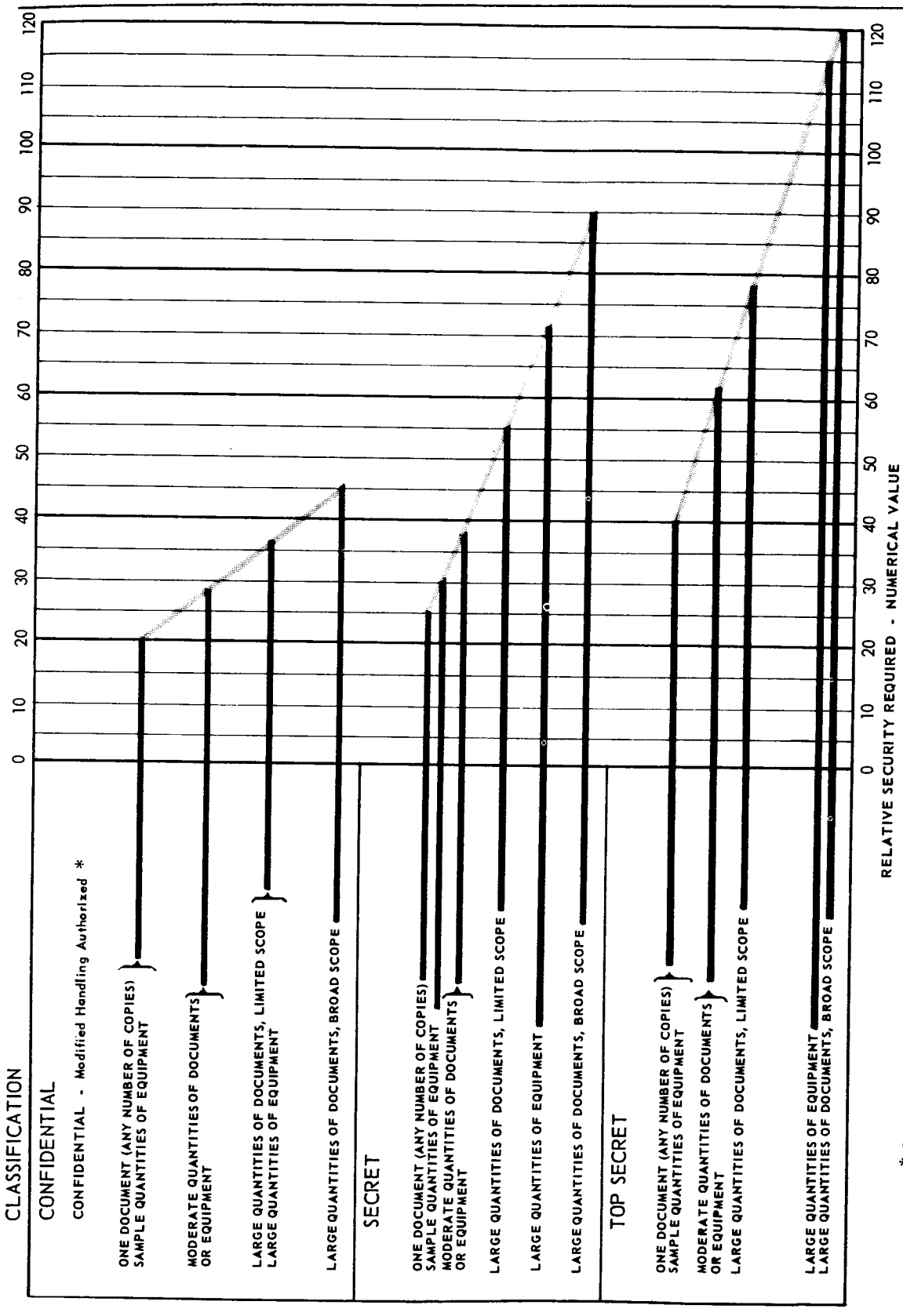
Top Secret documents may be reproduced in whole or in part only with the permission of the originator or higher authority. In the event higher authority grants permission, he should inform the originator immediately. All reproduced copies are numbered serially and recorded with the Top Secret control officer so as

ELEMENT OF SECURITY	VALUE
1. Stowage Areas	
a. Security Fences	
(1) Classified area surrounded by a security fence with all gates secured or controlled	5
b. Protective Lighting	
(1) Security areas lighted by protective lighting	5
c. Building or Ship	
(1) Conventional frame or good quality temporary structure	5
(a) Controlled area within	15
(b) Limited area within	25
(c) Exclusion areas within	35
(2) "In Service" or MSTS chartered Vessel	10
(a) Controlled areas within	20
(b) Limited areas within	30
(c) Exclusion areas within	40
(3) Masonry or steel structure with substantial partitions floors and ceilings (including magazines)	10
(a) Controlled area within	20
(b) Limited area within	25
(c) Exclusion area within	40
(4) Aboard a Commissioned Ship	25
(a) Controlled area	35
(b) Limited area	40
(c) Exclusion area	50
2. Stowage Containers	
a. Portable, any type	0
b. Wood, any type	0
c. Metal, keylock (built-in)	2
d. Metal, keylock (attached)	5
e. Metal, combination bar-lock (attached)	10
f. Metal, combination lock (built-in)	15
g. Light room vault	15
h. Heavy room vault	35
i. Class 3 security filing cabinet, GSA Federal Supply Schedule	50
j. Class 2 security filing cabinet, GSA Federal Supply Schedule	60
k. Class 4 security filing cabinet, GSA Federal Supply Schedule	60
l. Class 5 security filing cabinet, GSA Federal Supply Schedule	70

ELEMENT OF SECURITY	VALUE
3. Guarding	
a. Supporting Guard Force	
(1) Civilian Supporting Guard Force	10
(2) Military Supporting Guard Force	15
b. Guards	
(1) Civilian Guards	
(a) Civilian guard in general area	10
(b) Civilian guard check of container each hour	15
(c) Civilian guard check of container each 1/2 hour	20
(d) Civilian guard in attendance at container	30
(2) Military Guards	
(a) Military guard in general area	15
(b) Military guard check of container each hour	20
(c) Military guard check of container each 1/2 hour	25
(d) Military guard in attendance at container	60
c. Sentry dog accompanying military or civilian guard	10
4. Protective Alarm Systems	
a. Area Alarm System	
(1) Make or break (electromechanical) alarm to detect entry into immediate area	5
(2) Other alarm system to detect entry into immediate area	10
(3) Alarm system to detect entry or attempted entry into immediate area	15
(4) Alarm system to detect entry or attempted entry and approach to immediate area	25
b. Container Alarm Systems	
(1) Make or break (electromechanical) alarm to detect opening of container	10
(2) Other alarm system to detect opening of container	15
(3) Alarm system to detect opening or tampering with container	20
(4) Alarm system to detect opening or tampering with and approach to container	30

31.3

Figure 10-1.—Table of numerical equivalents.



31.2

Figure 10-2. —Evaluation graph.

31.2

to maintain complete accountability. The copy numbers of reproduced copies should maintain a relationship with the document received originally. For example, if a command holds copy No. 12 of a Top Secret document, and reproduces two additional copies, the latter might be identified as "Copy No. 12/1 of 2 copies" and "Copy No. 12/2 of 2 copies."

A continuous chain of receipts for Top Secret material must be maintained. In addition, a disclosure record form is attached to each document that circulates within a command or activity, and each person having knowledge of its contents signs the form.

Each command establishes administrative procedures for recording all Secret material originated and received, and maintains a receipting system for Secret matter distributed or routed within the command.

Each command also maintains a system that ensures accountability for all Confidential material originated or received.

TRANSMISSION

Classified material must be safeguarded during transmission from one place to another as well as when held within a command. Due to the very nature of the problem, compromise or loss is more probable during transmission than at any other time. For this reason, specific rules ensure maximum security consistent with the need for rapid communication of the information.

Top Secret material may not be sent through any postal system, United States or foreign. It may be transmitted only by one of the following means:

1. Direct personal contact of military personnel (E-7 or above) or appropriately cleared civilians of comparable grade.
2. Armed Forces Courier Service; or
3. Electric means in encrypted form.

Secret and Confidential material may be sent by any of the methods authorized for transmitting Top Secret material, or by U. S. registered mail. (For exceptions, see the next topic on ARFCOS.)

Confidential—Modified Handling Authorized material may be transmitted by ordinary U. S. mail or electrically in unencrypted form over U. S. Government-owned or leased landlines. When the originator is uncertain of the location of an addressee, as a unit afloat, U. S. registered mail must be utilized.

The foregoing rules apply only within the continental United States. When the national boarders must be crossed, the rules are modified slightly. Secret and Confidential matter can be transmitted by U. S. registered mail provided it stays within U. S. military postal channels. Within the continental U. S., Canada, and Alaska, Secret and Confidential may be sent by registered mail with registered mail receipt. Confidential—Modified Handling Authorized may be sent by regular first class mail, which is under the control of the U. S. or Canadian Governments.

Commanding officers are authorized to establish systems for transmitting classified material within the confines of their commands. Such systems must ensure that—

1. Top Secret material always is controlled by Top Secret control officers.
2. Personnel transmitting the classified material have security clearances for the highest category they are allowed to handle.
3. Personnel whose primary duties entail transmission of classified material are authorized in writing for such duties.
4. All personnel entrusted with transmitting classified material are instructed properly concerning their duties.

Armed Forces Courier Service

The Armed Forces Courier Service (ARFCOS) is a joint agency of the three military departments that provides for the secure and expeditious transmission of material, regardless of classification, requiring protected handling by an officer courier. The paramount objective of the ARFCOS is security.

A series of courier transfer stations are set up within the various Navy, Army, and Air Force commands in the United States and overseas. Each transfer station serves the various commands in its area by arranging for the transmission of authorized material originated by or addressed to them. During transit the material normally is placed in custody of a designated courier. The courier is designated by the officer in charge of the courier transfer station, and is called the courier transfer officer. If no qualified officer is available to be designated courier, the courier transfer officer may act in that capacity himself.

A courier ordinarily is designated from among the passengers traveling in a ship, aircraft, or vehicle. Any officer of the armed

Figure 10-2.—Evaluation graph.

services who has written evidence that he is cleared for Top Secret can be designated a courier regardless of the mode of travel. Such evidence of clearance is not required, however, for designation of an officer as a courier for transmission of ARFCOS material on a direct flight between two ARFCOS stations. A specifically designated Department of State courier also may be designated to convey ARFCOS material. Instructions covering the designation of couriers are included in the 2260 series of OpNav Instructions. Suffice it to say that designating as courier an officer who is traveling to the destination of the material ensures the security of the material throughout its transmission. Before departure, the courier inventories and signs for the material from one courier transfer officer and on arrival delivers it to another; or, if he is going to the same destination, he may be ordered to deliver the material directly to the addressee.

The following types of material are authorized for entry into the Armed Forces Courier Service:

1. Top Secret material.
2. Cryptographic material.
3. Cryptologic material (cryptomaterial obtained from an enemy and forwarded for analysis).
4. Registered publication system documents.
5. Communication material that cannot be transmitted electronically because of circuit casualties and is certified to require urgent delivery.
6. Other material approved by the Chief of Naval Operations.
7. Material that cannot be maintained in United States custody by any means except an officer courier.
8. State Department diplomatic pouches.
9. Material of the Central Intelligence Agency.
10. Material of the National Security Agency.
11. Certain NATO, SEATO, and CENTO material as defined in the foregoing items.

DISSEMINATION

"Disclosure," as it relates to classified information, is an officially authorized release or dissemination by competent authority whereby the information is furnished to a specific individual, group, or activity. "Need to know" is the term given to the requirement that the dissemination of classified information be limited strictly to those persons whose official military or other governmental duties require knowledge or possession of the material.

Classified material, to be useful, must be made available to those who need it. At the same time, security demands that classified information not be disclosed needlessly. No person is entitled to knowledge or possession of classified information solely by virtue of his rank, office, or position. Responsibility for determining whether a person's duties require that he possess or have access to any classified information, and whether he is authorized to receive it, rests upon each individual who has possession, knowledge, or command control of the information concerned, and not upon the prospective recipient.

A "need to know" is recognized when these four elements exist:

1. Release of the information is in the interest of national defense.
2. There appears to be a legitimate requirement that the applicant for the material must have the information to carry out his assigned duties.
3. The applicant has no other available source for the information.
4. The applicant is or can be appropriately cleared and is capable of providing adequate protection for the material.

DISPOSITION AND DESTRUCTION

Classified material that is not required should not be allowed to accumulate. It should be sent either to stowage at a naval records management center, or it should be destroyed. The effective revision to SecNav instruction 5212.5 relates the procedures for transferring records. For classified material so forwarded, proper safeguards must be taken to prevent loss or compromise. Extra copies and nonrecord material may be destroyed after they have served their usefulness.

An officer being relieved must deliver to his successor all classified material attached to the command and in his custody. Appropriate receipts cover, as a minimum, all Top Secret and Secret material.

Classified documents are destroyed by burning, pulping, pulverizing, or shredding. Burning is the method used most commonly in the fleet. When destruction is accomplished by

means other than burning, the residue must be inspected to ensure complete mutilation.

When classified papers are burned, the destruction must be witnessed by two commissioned officers. If sufficient officers are unavailable, warrant officers, enlisted men, or civilians may witness the burning, provided they are cleared at least for the highest category of material being destroyed. Witnesses must watch the burning until destruction is complete, after which the residue is obliterated completely by scattering or reduction to sludge. When appropriate, a certificate of destruction is prepared and signed.

In an emergency involving the danger of capture of classified material, it is highly important that such material be destroyed. The ship's emergency destruction bill (fig. 10-3) establishes procedures for the emergency destruction of all classified matter. Responsibility for destruction is assigned by watches, and alternates are provided to allow for casualties. The bill indicates the location of the classified material, the priority of destruction, and the methods of destruction to be employed. The emergency destruction bill is only one phase of a more encompassing emergency plan for security. See RPS 4 and, if available, KAG 1 for more information.

In connection with emergency destruction procedures, ensure that a sufficient supply of destruction materials, such as weighted bags, wirecutters, and sledges (the last two for destroying crypto equipment) are available in all communication spaces. The classified material must be readily accessible at all times for destruction by assigned personnel.

Destruction plans require the highest degree of individual initiative practicable under the operating conditions of the ship. Personnel must understand that, in emergency and when required, they are to initiate necessary destruction under the plan without waiting for specific orders.

TRANSMISSION SECURITY

Transmission security is that component of communication security resulting from all measures designed to protect transmission from interception, traffic analysis, and imitative deception. Every means of transmission is subject to interception. In radio transmission, we must assume that all transmissions are intercepted.

Within the requirements of precedence and security, the most appropriate means of transmission should be selected. The generally available means of transmission, in order of security, are these:

1. Messenger;
2. Registered mail;
3. Approved wire circuit;
4. Ordinary mail;
5. Nonapproved wire circuit;
6. Visual;
7. Sound systems; and
8. Radio.

SPEED VERSUS SECURITY

The three fundamental requirements of a military communication system are reliability, security, and speed. Reliability is always paramount. Security and speed are next in importance and, depending on the stage of an operation, are interchangeable. For instance, during the planning phase, security is obviously more important than speed. During the execution phase, speed surpasses security in importance. This is not to say that either can ever be ignored completely. Modern high-grade cryptosystems permit security with speed. In tactical operations, however, when speed is so important that time cannot be spared for encryption and the transmitted information cannot be acted upon by the enemy in time to influence current operations, messages of any classification except Top Secret may be transmitted in the clear over any wire or radio circuit. Each message must be approved and released separately, and any linkage to previously encrypted messages should be avoided. Such transmissions include the word CLEAR at the beginning of the text to indicate the message contains classified material. Upon receipt, the message is marked "Received in the clear" and is handled as Confidential. If the information must be further transmitted, an entirely new message is drafted.

WIRE SYSTEMS

With respect to transmission of classified information, there are two categories of wire systems: approved and nonapproved. These systems include telephone, telegraph, teletypewriter, and facsimile facilities.

The many requirements to be met before designating that a wire circuit is approved are not

USS JOSEPH K. TAUSSIG
DE-1030
EMERGENCY DESTRUCTION BILL

The following Emergency Destruction Procedures for Classified Material held by this command are effective this date: 10 October 19_

Space	Person Responsible	Alternate	Priority of Destruction
Registered publications safe	RPS custodian	Alternate custodian	1. Emergency keying data. 2. TOP SECRET cryptomaterial. 3. Superseded } Key lists, 4. Reserve } rotors, 5. Effective } and strips. 6. Reg. cipher equipment. 7. Maintenance documents. 8. Operating instructions. 9. Remaining cryptomaterial. 10. Registered publications. 11. Nonregistered classified publications.
Cryptocenter	General quarters cryptomember	Crypto-security officer	
Radio I	Supervisor	Circuit operator	1. Aircraft codes; authentication systems; call sign ciphers; recognition signals. 2. Registered publications. 3. Classified records; files. 4. Classified electronic equipment. 5. Classified nonregistered publications. 6. Unclassified publications and electronic equipment.
Radio II	Circuit operator	Radio I JX talker	
Signal bridge	Supervisor	Assistant navigator	
CIC	Supervisor	JOOD	

1. Method of destruction
   a. Deep water (over 100 fathoms)
      (1) Jettison publications in weighted perforated bags.
      (2) Smash crypto equipment beyond recognition if possible and jettison.
   b. Shallow water (less than 100 fathoms)
      (1) Burn publications completely, break up and scatter ashes.
      (2) Smash crypto equipment beyond recognition or reconstruction, taking care to remove all wiring, and scatter component parts over a wide area. Smash remaining electronic equipments so as to render them useless.
2. Record of destruction
   a. All personnel assisting in the execution of this bill will report in writing to the RPS custodian the degree of completion of such destruction. (Use the last watch-to-watch inventory.)
3. Execution of emergency destruction bill
   a. Emergency destruction will be ordered by the Commanding Officer, or, in his absence, by the next senior line officer present. In the event of an emergency, it may be necessary for the personnel designated above to carry out the provisions of this bill without further orders, if their estimate of the situation admits possibility of the loss of the ship.
4. Location of destruction equipment
   a. Sledges, wire cutters, screwdrivers, and weighted perforated bags are located in each communication space.

Approved:

Tolis Lewie, LCDR USN
Commanding Officer

Submitted:

H. T. Crowley, LTJG USN
Classified Material Control Officer

Figure 10-3.—Emergency destruction bill. 76.7

taken up in this text. An approved circuit may be designated as such only by a service Chief of Staff, the Chief of Naval Operations, the supreme commander of a theater of operations, or such officers as they may designate. The number of approved circuits is kept to a minimum consistent with operational requirements. Each approved circuit is rated according to the highest classification of information authorized to be transmitted over it in the clear. Under no circumstances, however, is information classified higher than Secret so transmitted. With the exception of those situations discussed previously, where speed is more important than security, no classified information may be transmitted in the clear over nonapproved circuits.

VISUAL TRANSMISSION SECURITY

The various means of visual transmission, in order of security, are these day and night groups:

Day:

1. Hand flags;
2. Directional flashing light;
3. Panels;
4. Flaghoists;
5. Pyrotechnics;
6. Nondirectional flashing light.

Night:

1. Infrared communication systems;
2. Directional flashing light;
3. Pyrotechnics;
4. Nondirectional flashing light.

Transmission of a classified message in plain language by visual means is authorized only after careful consideration is given to the possibility of interception by unauthorized persons. The aperture of directional flashing light equipment is kept as narrow as possible, and filters are used to reduce the detectable range at night. Under no circumstances are translations of encrypted messages transmitted by visual means. This method subjects the entire cryptosystem to possible compromise.

RADIO TRANSMISSION SECURITY

When a message is transmitted by radio, it sometimes is possible to know a few of the receivers, but all of them never become known. It must be assumed that the enemy receives every transmission. Properly prepared messages using modern cryptosystems may prevent the enemy from understanding the message, but he still can learn a lot. For instance, as the time of a planned operation approaches, the number of messages transmitted increases so markedly that, although the enemy may be unsure of its exact nature, he knows that something will occur soon and he can alert his forces accordingly. Strict radio silence is the main defense against radio intelligence.

The amount of radio traffic is not the only indicator used by the enemy. He can be expected to run statistical studies of message headings, receipts, acknowledgments, relays, routing instructions, and services. Communication experts can learn much about our operations, past and future, from such studies. By means of direction finders they determine from where the messages are transmitted—a valuable aid in their studies.

Although we cannot prevent traffic analysis by the enemy, it can be made more difficult and less reliable. Such measures as the following can be taken:

1. Maximum use of communication means other than radio.
2. Maintenance of strict circuit discipline.
3. Use of the broadcast method where possible.
4. Rotation of call signs and address groups.
5. Reduction of use of service messages.
6. Use of codress messages.
7. Encryption of all classified messages.
8. Reduction of test transmissions to minimum.
9. Avoidance of use of external routing instructions.

RADIOTELEPHONE SECURITY

Radiotelephone nets are operated so frequently that many operators tend to be careless. There are too many instances of interception of VHF/UHF transmissions at distances of many thousands of miles for this condition to continue. A large percentage of those using radiotelephone nets are officers, and the problems in formal training for educating the operators may be difficult. Certain rules apply, and all persons

having occasion to use a radiotelephone should be thoroughly familiar with them. They are:

1. Use each circuit for its intended purpose only. Keep the number of transmissions to a minimum.

2. Think out contents and wording before starting the transmission in order to reveal no information of military value, even by implication.

3. Write the message before transmission, if practicable.

4. Keep all transmissions brief, concise, and clear.

5. Transmit no classified information in plain language, including plain language references to classified titles, units, places, chart references, or persons that may reveal the nature of the headquarters, task force, or other unit concerned.

6. Avoid linkage between radiotelephone call signs and any other call signs.

7. Follow prescribed radiotelephone procedure outlined in chapter 9 of this text.

CIRCUIT DISCIPLINE AND OPERATOR TRAINING

Two basic elements in improving transmission security are circuit discipline and operator training. The communication officer is responsible for both elements.

Radio operators must adhere to prescribed circuit procedures. The importance of this is emphasized because radio is inherently the least secure means for transmitting messages. No variations, elaborations, or shortcuts in prescribed procedures are acceptable. Even individual operators are recognizable by skilled radiomen. Training should be such as to produce anonymity.

The following practices that endanger communication security are to be avoided:

1. Linkage or compromise of encrypted call signs and address groups by association with their unencrypted versions. Example: Use of unencrypted call signs in the callup, and encrypted call signs in the message heading.

2. Misuse and confusion of call signs, routing indicators, address indicating groups, and address groups by association with other call signs, routing indicators, address indicating groups, and address groups. This could result in the nondelivery of an important message, a compromise, or the linking of classified and unclassified call signs and address groups.

3. Violation of radio silence.

4. Unofficial conversation between operators.

5. Transmission in a directed net without permission.

6. Excessive repetition of prosigns or operating signals.

7. Individual mannerisms in transmitting.

8. Use of plain language in place of applicable prosigns or operating signals.

9. Use of unauthorized prosigns.

10. Unnecessary transmissions.

11. Identification of unit locations.

12. Identification of individuals belonging to an organization.

13. Excessively long calls. A unit may fail to answer, when called, owing to a condition of radio silence. Put the message on a fleet broadcast or transmit to any available station, using indefinite call signs, if necessary, instead of continuing to call. Blind transmissions are sometimes useful.

14. Failure to stand prescribed radio watches.

15. Transmitting at speeds faster than the receiving operator's ability to copy.

16. Use of excessive transmitting power.

17. Tuning transmitters with antennas cut in.

18. Excessive waste of time tuning, testing, shifting frequencies, or adjusting equipment. Drill radiomen to use their equipment properly.

19. Operating equipment off frequency. This practice can cause excessive repetition or even failure to establish communication, and increases the enemy's chances of interception and direction finding. Operate transmitters within allowed tolerances and check guard receivers on frequency at least once an hour.

CONTROL OFFICERS

In order that classified information may be controlled with maximum efficiency, the commanding officer or officer in charge of each command designates an officer to act as the classified material control officer. In commands that initiate, receive, or process Top Secret documents, he appoints a TOPSEC control officer. When an activity possesses cryptomaterial, he designates a cryptosecurity officer. Any of the designees may be the communication officer or one of his assistants.

CLASSIFIED MATERIAL CONTROL OFFICER

The classified material control officer performs the following duties:

1. Serves as the commanding officer's adviser and direct representative in cases pertaining to security of classified material.
2. Assures that all persons who are to handle classified information are properly cleared and instructed.
3. Formulates and coordinates security control measures within the command.
4. Maintains a program of declassification and downgrading of information.
5. Prepares classification guides to aid in the proper classification of material originated within the command. Preparation of such guides usually is limited to shore activities.
6. Exercises security control over visits to and from the command.
7. Reviews proposed press releases and indicates classified information that must be deleted therefrom.
8. Performs the duties of Top Secret control officer if another officer is not so designated.

TOP SECRET CONTROL OFFICER

The Top Secret control officer, subordinate to the classified material control officer, is responsible for the receipt, custody, accountability, and distribution of Top Secret information within the command and its transmission outside the command. In the performance of his duties, the TOPSEC control officer is governed by the following basic rules:

1. Avoid unnecessary dissemination of information.
2. Release to a subordinate echelon only the absolute minimum of Top Secret information necessary for proper planning or action.
3. Transmit Top Secret information within the command by direct personal contact.
4. Maintain a continuous chain of receipts for Top Secret material.

CRYPTOSECURITY OFFICER

The cryptosecurity officer is responsible for the accurate, secure, and efficient operation of the cryptocenter. Following are his more important duties:

1. Provide for and supervise the training of all crypto personnel. Recommend cryptographers for qualification by the commanding officer.
2. Ensure that all suspected compromises or violations of security are reported promptly. Great danger to the safety of the Nation can result from failure to report a compromise.
3. Ensure that a qualified cryptographer is available at all times to encrypt and decrypt messages.
4. Request message drafters to make changes as necessary to prevent errors of classification and precedence.
5. Supervise cryptographers in the performance of their duties.
6. In the event a cryptosystem is declared compromised, determine those messages originated and encrypted locally in that system, and report their contents to the commanding officer. The latter then reports to his immediate superior any compromise of significant importance.

CRYPTOGRAPHIC SECURITY

Cryptography is the science of cloaking information in codes and ciphers. A code is a system in which arbitrary groups of symbols represent units of plain text of varying length, usually syllables, words, phrases, and sentences. A cipher is a system in which individual letters of a message are replaced, letter for letter, by other letters instead of by complete words, phrases, or numbers. Cipher texts usually are transmitted in five-letter groups.

The enemy is constantly and painstakingly studying our codes and ciphers in an attempt to discover the keys to our cryptographic systems. The technique is known as cryptanalysis. The best defense against this type of enemy intelligence is cryptosecurity—the careful use of technically sound cryptosystems.

The cryptographers, under the direction of the communication officer, are responsible for the proper encryption and decryption of messages. Reliable enlisted personnel may be appointed to this board, along with officers. All cryptographers must be proficient in the use of all codes and ciphers held by the command.

Loss of a cryptographic publication or the transmission of faultily encrypted messages endangers the security of the cryptosystem. Such occurrences may require the immediate replacement of the key list, because subsequent transmissions with the same key list are considered little better than plain language. The inconvenience and expense of superseding a key list are insignificant compared to the consequences of a crypto compromise.

In all commands that hold cryptomaterial, the commanding officer, executive officer, communication officer, cryptosecurity officer, RPS custodian, and RPS custodian witnessing officers must hold Top Secret clearances. Other personnel must be cleared for access to the highest classification of cryptomaterial to which their duties require access.

Commanding officers are authorized, ex officio, access to all cryptomaterial they hold, and are responsible for authorizing access to cryptomaterial to properly cleared personnel in their commands. These personnel include on-line and off-line operators, maintenance and repair personnel, and individuals not primarily connected with operating crypto equipment but who may require access to cryptomaterials during the discharge of their duties. The commanding officer's authorization is always in writing, utilizing the letter format stipulated in NWP 16(A).

The cryptocenter is a classified communication space. For this reason, access to the space is strictly controlled. As pointed out in chapter 3, there is a single entrance with an authorized entry list posted nearby.

ON-LINE CRYPTOGRAPHIC INSTALLATIONS

In recent years the Navy has developed what is called on-line communications. This refers to communication processing systems that electronically encipher or decipher messages transmitted by teletypewriter. The older (but not obsolescent) process of enciphering or deciphering accomplished manually by members of the cryptoboard, is now referred to as off-line communications.

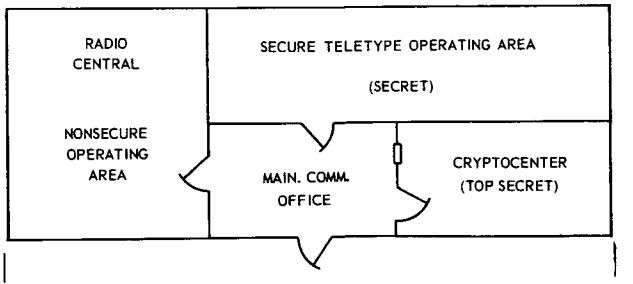
We are not concerned here with the types of on-line equipment or operating methods. The point to bear in mind is that, although on-line cryptographic procedures protect classified information during its transmission, a security problem is introduced into the communication spaces where the information is processed, because it is processed automatically into plain language. This means that anyone authorized entry into communication spaces containing on-line equipment must be cleared to handly the highest classification of material they may be received or transmitted by the equipment.

Communication spaces containing on-line equipment are divided physically into three separate areas of systems—nonsecure, secure Secret, and secure Top Secret—as in figure 10-4. Because of space limitations, the Top Secret area usually is combined with the already existing cryptocenter. On a small ship, the layout might dictate the inclusion of both the nonsecure and secure Secret areas within radio central, perhaps separated by curtains, cabinets, or merely distance. In any event, access to all the communication spaces is controlled by the CWO or, on small ships, by the operator on watch.

In the nonsecure area are the usual transmitters, receivers, and so on. Information processed in this area is vulnerable to intercept, hence classified information must be encrypted in the off-line cryptocenter. Operating personnel normally require a Confidential clearance except for those who operate off-line cryptosystems.

In the secure Secret area, information classified Secret and below normally is processed for transmission without prior off-line encryption. Personnel require a Secret clearance, with Top Secret required for those working in the cryptocenter.

On-line Top Secret circuits are limited to tactical or operational use where speed is of the utmost importance. Off-line encryption or decryption of Top Secret material, therefore, is affected only slightly by the new procedures.



105.10

Figure 10-4.—On-line communication operating spaces.

PERSONNEL SECURITY CLEARANCES

Personnel authorized access to classified information must be of—

1. Unquestionable loyalty, integrity, and trustworthiness; and
2. Excellent character and of such habits and associations as to cast no doubt upon their discretion or good judgment in handling classified information.

TYPES OF INVESTIGATIONS

The two types of personnel security investigations are the national agency check (NAC) and the background investigation (BI).

A national agency check consists of the investigation of records and files of the following agencies, as appropriate:

1. Federal Bureau of Investigation;
2. Office of Naval Intelligence;
3. Assistant Chief of Staff, Intelligence, Department of the Army;
4. Office of Special Investigations, Inspector General, U. S. Air Force;
5. Civil Service Commission;
6. Immigration and Naturalization Service;
7. Central Index Personnel and Facility Security File;
8. Bureau of Naval Personnel;
9. Headquarters, U. S. Marine Corps; and
10. Other agencies as determined by the Chief of Naval Operations (Director of Naval Intelligence).

The background investigation, much more extensive than a national agency check, develops information regarding whether access to classified information by the person being investigated is clearly consistent with the interest of national security. It inquires into the loyalty, integrity, and reputation of the individual. The BI consists of the following elements:

1. National agency check.
2. Verification of birth records.
3. Verification of last school or college attended, checking school records, and interviewing people who knew the individual while at school.
4. Examination of records of present and past employment to determine periods of service and efficiency records. Fellow employees are interviewed to determine character and reputation.
5. An interview of the majority of individual's references plus others who have knowledge of subject's background and activities.
6. Neighborhood investigation as deemed necessary to substantiate or disprove derogatory information.
7. Criminal records, including police and law enforcement agency records in areas where individual has resided for substantial periods.
8. Length of military service and type of discharge.
9. Connections individual has had with foreigners or foreign organizations both in the United States and abroad.
10. Citizenship status.

INTERIM AND FINAL CLEARANCE

A personnel security clearance is an administrative determination that an individual is eligible, from a security standpoint, for access to classified information of the same or lower category as the clearance being granted. It is emphasized that a certificate of clearance does not in itself constitute authority for access to classified information. It is merely a determination of eligibility for access. Classified information is made available to appropriately cleared persons only when a "need to know" is established clearly.

An individual may be granted either a final or an interim clearance as follows:

1. A final clearance is granted upon completion of all the various investigative requirements for the particular degree of clearance.
2. An interim clearance is a determination of temporary eligibility for access to classified information. It is granted as the result of a lesser investigative process. It is to be granted only when the delay in waiting for completion of the investigation required for final clearance would be harmful to the national interest. All requests for necessary investigations to enable a determination of final clearance should be initiated simultaneously with the procedures to issue an interim clearance.

GRANTING AND RECORDING CLEARANCES

Security is a function of command. The various investigations are carried out by the Office

of Naval Intelligence, but the final decision to grant a clearance is made by the individual's commanding officer or immediate superior The commanding officer ensures that necessary steps are taken to initiate the request for investigation in accordance with the specific instructions contained in the Security Manual for Classified Information. When the investigation is completed to his satisfaction, he issues a certificate of clearance.

Examine the personnel record of each individual, officer and enlisted, reporting on board for duty with the communication force. If no evidence of the appropriate security clearance exists (it generally is understood, for example, that all radiomen should have a clearance no less than Secret), ensure that a request for investigation is prepared. In this connection, it is the policy of the Navy Department that individual clearances be granted as the result of previous investigations, whenever feasible.

Each clearance is indicated by a properly executed Certificate of Clearance, OpNav Form 5521-429. The original and all copies are signed by the commanding officer or his delegated representative, and the ship or station seal is affixed. The original certificate of clearance is forwarded to the Chief of Naval Personnel for inclusion in the individual's personnel record. A copy is made a permanent part of the person's on-board service record, although the individual concerned does not receive a personal copy of the clearance.

Except in the case of a clearance granted as the result of a BI or NAC, it is unnecessary to issue a certificate of clearance to handle Confidential material.

INVESTIGATION REQUIREMENTS

Certain minimum investigation requirements must be met before issuance of a certificate of clearance to handle classified information. The requirements, as they apply to military personnel, are as follows:

1. Top Secret:
   a. Final clearance:
      (1) Background investigation, or
      (2) National agency check plus continuous honorable service in the Armed Forces, or a combination of active duty and civilian employment in the Government service for 15 consecutive years (with no break greater than 6 months) immediately preceding the date of the current clearance.
   b. Interim clearance: national agency check.
2. Secret:
   a. Final clearance: national agency check.
   b. Interim clearance:
      (1) Continuous honorable active duty as a member of the Armed Forces for a minimum of 2 consecutive years immediately preceding the date of the current clearance, plus
      (2) Check of ONI case history files, and the files of the Bureau of Naval Personnel or Headquarters, USMC, as appropriate.
3. Confidential:
   a. Final clearance: no formal investigation is required if the records available to the issuing command contain no derogatory information.
   b. Interim clearance: not authorized.

Security investigations remain valid and may serve as the basis for issuance of future clearances unless—

1. Derogatory information becomes available, indicating a need for further investigation; or

2. The individual is assigned to a particularly sensitive billet requiring a greater clearance criteria than indicated by the foregoing; or

3. Continuous active service in the Armed Forces and/or civilian employment in the Government service is broken by a period longer than 6 months.

CHAPTER 11

THE DIRECTIVE

All operations in the Navy start from a general plan of the commander concerned. The plan may be an elaborate, detailed schedule, or it may be no more than an idea in the mind of the senior. In essence, it has only one function: to enable the subordinate commanders and commanding officers to understand the thinking and desires of their superior.

The commander informs his subordinates of his plan by issuing a directive. A directive is any communication—oral or written—that initiates or governs action, conduct, or procedure. Commonly, it denotes the written instrument by which the plan of a commander is promulgated. It may be transmitted by any communication system. Regardless of the means of promulgation, the directive invariably follows a standard form mutually understood by the commander and the recipients.

The directive usually consists of a basic plan and detailed procedures in the form of enclosures, called annexes and appendixes. In many instances the plan could be written in a simple narrative form, but studying it would be difficult, and rapid reference during the execution phase of the operation would be practically impossible. As a result, the basic plan is concise, containing only those details necessary for a clear, overall picture of the operation. The annexes may be brief or protracted, and in many cases are accompanied by appendixes and tabs to elaborate on the many details to be considered in a large and complicated tactical problem.

TYPES OF DIRECTIVES

Common understandings among the individual services and, in combined operations, among Allied nations involved, are basic to successful combat. The form of the directive is designed to reduce to a minimum the areas of possible misunderstandings. Ideally, all subordinates, regardless of service or nationality, will interpret common instructions the same way.

Several different types of directives are in common use by the Navy. Each is designed for a specific purpose, and most are prepared in accordance with a standard approved format set forth in NWP 11, Naval Operational Planning.

WARNING ORDER

A warning order may be issued to alert subordinate commands to impending operations. It is a preliminary notice of an order or action that is to follow. Subordinates are expected to use the time thus gained to make preliminary plans and preparations.

LETTER OF INSTRUCTION

A letter of instruction (or letter directive), issued for planning purposes, usually is a directive to major commanders of participating forces, although other interested commands may receive copies for information.

Normally, the letter states the concept, mission, command relationships, areas of responsibilities and operations, and special instructions regarding communications, forces, and reports. The letter also may promulgate policy guidance of an operational nature.

CAMPAIGN PLAN

A senior commander promulgates a campaign plan to express his decision in terms of specific operations projected as far into the future as possible. The campaign plan is the next step after a long-range or strategic estimate of the situation wherein the commander decides on the line or lines of action to be followed. The purpose of this plan is to make known an orderly schedule of the strategic decisions made by the commander in order to allow sufficient time for subordinates to procure and provide the means for attaining the desired or assigned objectives.

OUTLINE PLAN

When a decision is made to carry out a specific operation, time limitations usually demand concurrent planning by the responsible senior commanders. In order to facilitate such planning by commanders who may be widely dispersed geographically, an outline plan is issued.

The outline plan is a preliminary general sketch of a plan portraying the salient features that will govern the complete plan. The term "outline" indicates only the degree of completeness of a plan; it may be an outline campaign plan, an outline operation plan, an outline logistic plan, or an outline base development plan. Usually it follows the format of the type of plan it summarizes.

Although the outline plan is more comprehensive than a simple listing of essential elements, it is less comprehensive than a completed plan. It is employed most frequently by commanders to test a concept in general form before detailed planning is initiated. The outline may be used by subordinate commanders to initiate concurrent planning for complex or extended operations.

CONTINGENCY PLAN

The contingency plan is an outline course of action to be adopted, stating tasks to be undertaken and listing the forces to be utilized, should an anticipated event take place. The purpose of this plan is to accelerate the actions a commander can take to meet a foreseen contingency.

OPERATION PLAN

An operation plan generally is designed for operations extending over a large geographical area and usually covering a considerable period of time. It may be based upon, and therefore restricted by, various appropriate assumptions. (Assumptions are included when data essential to the preparation of the plan are missing.) The OpPlan is prepared well in advance of the impending operation. Information telling when the plan will become effective may be included in the plan, or the latter may state merely that it will become effective on signal. The OpPlan is the instrument upon which subordinate commanders base directives to their commands covering the specific tasks assigned.

OPERATION ORDER

The operation order, prepared in a prescribed form similar in most respects to the operation plan, is issued by a commander to his subordinates to effect coordinated execution of a specific operation; that is, it directs the carrying out of the operation. No assumptions are included and, unless otherwise stated, the OpOrder is effective from the time and date signed. An operation order usually is not issued if an operation plan containing all the necessary details was promulgated.

This chapter is concerned mainly with the operation order. The reason for this is that, although there are variations in the contents of the various forms of directives, all types have basic similarities, and a detailed examination of the type encountered most frequently should suffice.

To bring closer the distinction between an operation plan and an operation order, let us assume that the Commander Fifth Fleet is assigned the mission of neutralizing the enemy-held island of Bolo. The Fleet Commander issues an OpPlan to all participating forces. He spells out in a general way the various tasks assigned, and in his various annexes defines his concept of the way the various groups are expected to operate in support of the landings. The directive, for example, to Commander Carrier Strike Force is general in nature, giving wide latitude to that commander regarding the detailed way in which he is to carry out his mission. The Fifth Fleet Commander's directive is an operation plan because it (1) includes operations covering a considerable area and period of time, and (2) is prepared well in advance of the operation.

Based upon the higher directive, Commander Strike Carrier Force issues an operation order to his command, as do each of the other subordinate task force commanders. Here are spelled out the details of how that particular force is to conduct its operations. The schedule of airstrikes is promulgated and maneuvering instructions are issued. Communication instructions peculiar to that force are delineated. Upon receipt of the OpOrder, the next subordinate echelon of commanders studies and (where necessary) issues supporting OpOrders to their commands. One such subordinate might be the screen commander who issues screening instructions, elaborates on the anti-submarine warfare instructions in the higher

directives, and (where feasible) assigns specific screen stations to ships.

The subordinate commander's directives are operation orders because they are issued for the purpose of effecting the coordinated execution of specific operations, each one being the mission assigned to the task force by the fleet commander.

The communication officer should be aware of all OpPlans and OpOrders that affect his unit, because he is responsible for ensuring that equipment, facilities, and the like are available if a directive is placed into effect. He also must have detailed knowledge of the organizations involved.

ARMED FORCES OPERATION ORDER

Essentially, an operation order (and, incidentally, an OpPlan) consists of three parts: the heading, the body, and the ending.

HEADING

Figure 11-1 shows a basic (abbreviated) OpOrder issued by a task group commander for a forthcoming exercise. The heading of the OpOrder consists of all items from the security classification down through the time zone to be employed in conducting the operation.

Directly beneath the centered classification appears a statement of the changes in verbal orders, if any. When there are changes in verbal orders, a statement such as "No change in verbal orders except in paragraph " might be used.

The third item of the heading, when used, is the copy number of the OpOrder, employed for the purpose of accountability. When only Navy forces are used in the operation and the order is classified no higher than Confidential, copy numbers are not required.

Items 4 through 9 consist of the issuing headquarters title (preceded, in this illustrative case, by "Fourth Fleet" to ensure proper identification); the name of the flagship or, if ashore, the headquarters; the geographic location of the issuing commander (if at sea, indicated by latitude and longitude); DTG of the signature (this is the date and time at which the order is effective unless stated to the contrary in the body of the order); and the message reference number. The last is the originator's serial number for identification. It contains no indication that it is associated with the order; this is so that recipients of the OpOrder may use the number to acknowledge receipt in the clear.

The remainder of the heading consists of the type of directive, the short administrative title of the originator, the serial number, appropriate references, and the time zone to be used in conducting the operation. When more than one service is involved, the type of directive is amplified by descriptive words, such as Joint Army/Navy Operation Order. The references in the heading should not duplicate those referred to in the body of the order.

BODY

The body of the directive contains the task organization, five numbered paragraphs, and acknowledgment instructions.

The task organization is a list of the subdivisions into which the commander has organized his force for conducting the operation covered by the OpOrder. Many factors may influence the assignment of elements to particular subdivisions. Special characteristics, speed and endurance limitations, state of readiness, and current employment are among the main considerations. Existing organizations, such as squadrons and divisions, are maintained intact when possible. A large operation may require a complex chain of command to ensure adequate control. In our illustration, the group commander provides the command structure simply by designating a subordinate to command each subdivision of the task organization. When an individual ship is assigned several different tasks to perform during various phases of an operation, the ship is listed under each appropriate subheading of the organization.

All paragraphs and subparagraphs are identified and given headings.

In paragraph 1, the commander sets forth only so much of the general situation as will enable his subordinates to understand the background for the planned operation. The information given is brief and to the point; such data as a history of preceding events or detailed items of common knowledge are not included. This paragraph contains three subparagraphs—a, b, and c. No subparagrpah may be omitted or left blank, although such entries as "See annex__," or "Nil" (no information to enter) are permissible. Subparagraph a reflects the best intelligence estimate of the forces the enemy

CLASSIFICATION
No changes from verbal orders

Fourth Fleet
TG 47.5 and ComDesRon 20
BARRY (DD 933), Flagship
Newport, Rhode Island
DTG 311200R, October 196_
Message Ref: 052/6_

Operation Order
ComDesRon 20 No. 52-6_

Reference: (a) NWP 11(A)

Time Zone: Use time zone plus 5 (ROMEO) for operations.

Task Organization:

a. 47.5.3	Heavy Unit ALLAGASH (AO 97)	CAPT E. C. ROMAN 1 AO
b. 47.5.4	Screen Unit DesRon 20 less FISKE (DDR 842)	CAPT R. M. PYLE 7 DD
c. 47.5.5	Air Defense, Coordination Unit HAILEY (DDR 836)	CDR W. C. MACE 1 DIR

1. SITUATION. ComCruDesLant Notice 03360 of 16 Sep 196_ scheduled an opposed ASW/AAW coordination sortie on 4 Nov with ComDesRon 20 as OCE and OTC. This OpOrder covers the conduct of the sortie.

a. Enemy Forces: None.

b. Friendly Forces: Land-based aircraft for ASW search and air strikes.

c. Attachments and Detachments: None.

2. MISSION. On 4 Nov 196_ conduct a combined opposed ASW/AAW coordinated sortie exercise from Narragansett Bay in order to train assigned units in ASW/AAW coordination.

3. EXECUTION. This force will conduct a combined opposed ASW/AAW coordination sortie exercise from Narragansett Bay on 4 Nov 196_.

a. Heavy Unit--Sortie in accordance with Annexes A and D.

b. Screen Unit--Sortie in accordance with Annexes A and D and protect heavy unit from submarine and air attack.

c. AAW Coordination Unit--Coordinate air defense of the sortie group in accordance with Annexes E and G.

CLASSIFICATION

50.3-.5

Figure 11-1.—A basic operation order.

CLASSIFICATION

x. Coordinating Instructions.

(1) This operation order is effective for planning on receipt and for operations commencing 4 Nov 196_.

(2) Search and rescue in accordance with CINCLANTFLT OpOrder 1-6_, NWP 37, NWIP 23-6, and Annex H. Submarine search and rescue plan in accordance with COMSUBLANT OpPlan 4-6_ (SUBMISS/SUBSUNK) and Annex H.

4. ADMINISTRATION and LOGISTICS. Submit reports in accordance with NWIP 10-1.

5. COMMAND and SIGNAL.

a. Communications in accordance with Annex C.

b. Commander Destroyer Squadron TWENTY in Barry (DD 933) is OCE and OTC.

c. Commander Destroyer Squadron TEN in SHERMAN second in command.

Acknowledgment Instructions:

Units listed in Task Organization acknowledge receipt of this directive by message using message reference number.

R. M. Pyle

R. M. PYLE
Captain, U. S. Navy
Commander Task Group 47.5 and
Commander Destroyer Squadron TWENTY

ANNEXES:

A--Time Schedule
C--Communications

Appendix I-- Frequency Plan
Appendix II-- Aircraft Communications
Appendix III--Call Signs
Appendix IV-- ASW Circuits

D--Antisubmarine Warfare Plan
E--Air Strike Plan
F--Friendly Air Schedule
G--Anti-Air Warfare Plan

Appendix I-- Picket, CAP, and Strike Control Assignments
Appendix II--AAW Coordination Plan

Z--Distribution

Authenticated:

H. P. ROLFE
LT, U. S. Navy
Staff Secretary

CLASSIFICATION

0.3-.5

50.3-.5

Figure 11-1. —A basic operation order—Continued.

has available; if none (as in peacetime), that is so stated. Subparagraph b, friendly forces, refers only to forces not listed in the task organization. Information on friendly forces should be brief and restricted to that required for proper coordination of operation. Subparagraph c lists any forces that will join or be detached from the force as the operation progresses.

Paragraph 2, the mission, may either have been assigned by higher authority or deduced from his instructions. In effect, paragraph 2 contains the most important information in the directive, and often is the first item to be read by a subordinate upon receipt of the document. The mission has two parts, the task to be accomplished and the purpose for accomplishing it, separated by the phrase "in order to." No other place in the operation order gives such a concise statement of the intent of the operation.

Paragraph 3, the execution paragraph, opens with the words "This force will." It then sets forth exactly what the overall organization is to accomplish. In succeeding subparagraphs, tasks assigned to the elements of the organization are prescribed in detail. In order to avoid repetition, paragraph 3 always contains a subparagraph x, titled "Coordinating Instructions," that embodies general instructions of an operational nature common to two or more task subdivisions. Here are listed common items of information, as well as instructions relating to security, cooperation, duration of events, and the like. If the directive is to become effective at another time or date than the DTG in the heading, it is so stated in paragraph 3.x. Wherever possible, the language of paragraph 3 allows subordinates some latitude in exercising individual initiative.

Paragraph 4, administration and logistics, contains the necessary administrative and logistical arrangements for accomplishing the mission. It explains what supplies, facilities, and services are available; who is responsible for providing them; and how, when, and where they will be furnished. As in the other paragraphs of the basic plan, it is permissible to refer to a logistics annex if one is appended or, as often happens in comparatively small local training operations, simply to existing instructions.

Paragraph 5 is the command and signal area. Signal, as used here, means communications. In this paragraph all special features of command are set forth, including designation of the officer second in command; locations of the commander and his second in command; division of responsibility among the various commanders; and the communication plan, or more usually, a reference to the communication annex. A complete communication annex and one or more appendixes are necessary—even for routine operations—down to the division level of destroyer operations, because the area of communications is so vital.

When necessary, acknowledgment instructions are included following paragraph 5. A commander interprets a received acknowledgment to mean that the directive was received and is understood.

ENDING

The ending of the directive consists of the signature of the originator, a list of annexes, the distribution, signature of the authenticating officer (if required), and the classification. (The security classification appears on the top and bottom of every page of the directive.)

The signature of the commander is required to make the directive effective. It appears below the acknowledgment instructions, to the right of center page, over his rank and command title. For OpOrders and OpPlans concerning only U. S. Navy units, the operational and administrative titles may be added as they appear in figure 11-1. The commander may sign the original copy of the directive, or he may sign the stencil or mat so that his signature is reproduced on all copies. In the former method, distributed copies are authenticated by the flag or staff secretary. When annexes, appendixes, and tabs are issued with the order, the signature on these supplementary parts is optional. When they are issued separately, signatures are required.

Immediately below and to the left of the signature are listed the appended annexes, designated by capital letters. Although not required, it is good practice to refer to each annex in the body of the directive. Appendixes and tabs to the various annexes also are included in the list. The content of annexes of most concern to the communication officer are discussed in following sections. It is general practice, though not stipulated by doctrine, to designate the communication annex as annex C and the distribution annex (of any) as annex Z.

Below the list of annexes appears the distribution list. Two practices are common: For

comparatively short distribution lists, each addressee is listed as part of the basic plan; for longer lists (this usually is true in all but the simplest directives), the distribution list may be a separate annex, as in figure 11-2. It is appropriate to include collective units in the list, but mailing time can be saved by listing individual administrative units separately. The number of copies each addressee is to receive should be indicated; and, if some are to receive all but certain portions, the deleted part should be so indicated. Administrative titles should be used vice tactical titles, which could serve to compromise the directive (by revealing the task organization) as well as cause mailing delays. Preparation of the distribution list is important and requires considerable thought and effort. If all commands that need to know do not receive copies, the entire operation can be reduced in effectiveness or be damaged irreparably.

ANNEXES, APPENDIXES, AND TABS

Any portion of a directive that is too extensive or detailed for inclusion in the basic order may be placed in an annex. Among the many subjects that may properly be discussed in annexes are battle plans, search and rescue procedures, communications, logistics, intelligence, anti-air warfare, and antisubmarine warfare, to name but a few. Amplifying information not appropriate for inclusion in an annex may be prepared as an appendix to that annex. Further, information amplifying an appendix may be prepared as a tab to that appendix. Each annex, appendix, and tab is given a title descriptive of its contents. Appendixes are listed at the end of the annex to which they pertain, and tabs are listed at the end of their governing appendixes.

Annexes are designated by capital letters, appendixes by Roman numerals, and tabs again by capital letters. Thus, a tab might be referred to as tab C to appendix II to annex W; and the first page number of the tab appears as W—II—C—1. Pages of the basic directive are numbered serially starting with 1, but these page numbers are not carried over to the amplifying instructions.

No prescribed format exists for the body of an annex. When issued separately, the heading and ending of each annex, appendix, and tab are identical to the basic directive. When issued with the basic order or plan, only the type directive, the short administrative title of the originator, and the serial number of the directive need be shown in the heading. In practice—although not required—the heading usually follows the form of the basic OpOrder.

COMMUNICATION ANNEX

In conjunction with paragraph 5 of the basic order, annex C (fig. 11-3) probably is the most important part of any operation plan or order as regards the shipboard communication officer. The communication annex, in addition to its main purpose of amplifying paragraph 5, may actually be the operation order for the communication unit of an individual command.

NWP 16(A) contains the basic communication doctrine for naval operations. The numbering of paragraphs in the communication annex follows the numbering of related matters in NWP 16(A). Each paragraph of annex C indicates how the correspondingly numbered paragraph of NWP 16(A) is to be amplified or modified.

In the communication annex for a combined operation, generally no reference is made to NWP 16(A), because not all Allied nations have access to the same publications and/or NWP 16(A).

The communication plan, or annex, must be sufficiently detailed to prevent misunderstanding, but duplication of material contained in the superior's directives are kept to a minimum. Unnecessary repetition burdens individual ships with instructions which are not needed for the operation and which tend to subordinate portions of the plan that may be important.

Radio checks are for the purpose of determining whether the available equipments are in all respects ready for the operation. If defects materialize, there is time to locate them and correct the trouble. When annex C includes instructions on conducting preoperational radio checks, preparations are to be made beforehand. Individual units should have the proper frequencies set and be ready for the checks well before the scheduled time. Ideally, all units should check out perfectly the first time around.

Appendixes to Annex C

Figure 11-4 is appendix I (in this instance the frequency plan to be employed) to the

CLASSIFICATION

Fourth Fleet
TG 47. 5 and ComDesRon 20
BARRY (DD 933), Flagship
Newport, Rhode Island
DTG 311200R, October 196—
Message Ref: 052/6—

Operation Order
ComDesRon 20 No. 52-6—

ANNEX Z

Distribution

	Number of copies
CNO	10
CINCLANTFLT	10
COMAIRLANT	2
COMSUBLANT	2
COMCRUDESLANT	2
PRES NAVWARCOL	2
COMONE	1
COMNAVBASE NPT	2
COMCRUDESFLOT TWO	2
COMDESRON 8	3 (less Appendix I to Annex ECHO)
COMDESDIV 202	1 (less Appendix I to Annex ECHO)
USS BARRY	3 (less Appendix I to Annex ECHO)
USS MILLER	3
USS HAILEY	3
USS ROOKS	3
USS McNAIR	3
USS DECATUR	3
USS FISKE	5 (less Appendix I to Annex ECHO)
USS DONALY	3
USS ALLAGASH	3
VU-2	5

R. M. PYLE
Captain, U. S. Navy
Commander Task Group 47. 5 and
Commander Destroyer Squadron TWENTY

Authenticated:

H. P. ROLFE
LT, U. S. Navy
Staff Secretary

CLASSIFICATION

Figure 11-2. —Distribution list as an annex.

CLASSIFICATION

Fourth Fleet
TG 47.5 and ComDesRon 20
BARRY (DD 933), Flagship
Newport, Rhode Island
DTG 311200R, October 196__
Message Ref: 052/6__

Operation Order
ComDesRon 20 No. 52-6__

ANNEX C

Communications

232. Effectiveness

1. Communications in accordance with the effective edition of NWP 16(A), and appropriate Joint, Allied and Navy Department Publications. NWP 16(A) is effective throughout as applicable to the existing situation unless modified or amplified by this Annex. The numbering of paragraphs herein follows the numbering of related matter in NWP 16. The interpretation as to the applicability of a specific article is a function of the command concerned.

411. Call Signs and Address Groups

1. The call signs for CTG 47.5 and TG 47.5 are effective for use commencing 040600R.

619. Radio Checks

1. Radio checks will be conducted at 020800R, 031500R, and 040700R on circuits 1, 2, 3, 4, 5, 6, and 9 in accordance with Appendix 1 to this Annex.

619. Frequency Plan

1. Radiofrequency plan is contained in Appendix I to this Annex.

2. Aircraft frequencies and AN/ARC-27 channelization are contained in Appendix II.

812. Distress

1. Distress guards are assigned in Appendix I to this Annex.

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Staff Secretary

CLASSIFICATION

Figure 11-3.—Communication annex.

CLASSIFICATION

Fourth Fleet
TG 47. 5 and ComDesRon 20
BARRY (DD 933), Flagship
Newport, Rhode Island
DTG 311200R, Octover 196_
Message Ref: 052/6_

Operation Order
ComDesRon 20 No. 52-6_

APPENDIX I TO ANNEX C

FREQUENCY PLAN

Circuit	Use	Desig.	Freq.	Emission	CTG	Screen	Main body	AAW	Picket	Remarks
1	TG M & WP (PRITAC)	C3. 5A	318. 6	V	N	X	X	X	X	Pickets may secure when in station.
2	ASW surface-air common	C3. 7B	324. 1	V	N	X	X	X	X	
3	TG CIC (P) (PRI CI)	C3. 5F	345. 8	V	N	X	X	X	X	
4	SAU A PRITAC	C3. 15D	283. 4	V		X				See Appendix IV.
5	SAU B PRITAC	C2. 20L	389. 8							
6	SAU C PRITAC	C3. 5D	315. 2							
7	TG Common	C3. 5C	442	CW	N	L	L	L	L	Alt Air Safety Net, if required.
8	SAU A CI	C3. 14A	148. 68	V		X				See Appendix IV.
9	SAU B CI	C3. 14D	134. 46							
10	SAU C CI	C3. 14J	158. 04							

X - Guard
N - Net Control
L - Listen

R. M. PYLE
Captain, U. S. Navy
Commander Task Group 47. 5 and
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Authenticated:

H. P. ROLFE
LT, U. S. Navy
Staff Secretary

CLASSIFICATION

Figure 11-4. —Frequency plan appendix.

communication annex of the operation order under discussion.

The various columns in figure 11-4 define the circuits, their uses, designations, frequencies, whether voice or CW emissions, and which subdivisions of the task organization are required to guard or listen on each. Detailed study of this appendix by the communication officer in conjunction with the operations officer, CIC officer, missile officer, ASW officer, and senior radiomen is necessary. After a decision is made on the logical employment of available equipment, a detailed plan is submitted to the commanding officer for approval. Only a limited amount of equipment in each frequency range is installed in each participating ship.

Appendixes II and III to annex C list the frequencies to be used for aircraft communications and both international and voice call signs, respectively. Appendix IV contains amplifying instructions pertaining to ASW communications. The communication officer ensures that the various stations (e.g., radio central, bridge, CIC) have appropriate excerpts posted conspicuously for ready reference.

MESSAGE OPORDER

When speed is important, an OpOrder may be prepared in message form and disseminated by rapid communications. The necessity for speed may be the result of unexpected wartime developments; or, in peacetime, to supplement the standing OpOrder of an organized force. For instance, a hunter/killer training force may be organized. The force commander undoubtedly will have a standing OpOrder covering the many ramifications of this type of operation, and merely issue an amplifying order in message form to effect a particular operation of limited duration and scope. This method of promulgation is desirable in that it allows all personnel to become familiar with the commander's general desires over a period of time, and reduces the administrative workload of the staff in preparing new orders. A standing OpOrder naturally is infeasible for carrying out such a specialized operation as the capture of a particular enemy stronghold.

As shown in figure 11-5, only essentials are included in a message operation order. The commander issuing the order depends upon the experience and knowledge of his subordinate commanders to ensure the effective execution of his plan.

FROM: CTF 21
TO: TF 21
INFO: COMPHIBLANT/COMSECFLT/CINCLANTFLT/CNO
SECURITY CLASSIFICATION
COMCARDIV TWO OPORD 12-6_
USE OPERATIONS TIME ZONE PLUS TWO
A. COMSECFLT LTR OF INST 0036-6_

1. SIT ALLIED SHIPPING SUFFERING HEAVY LOSSES FROM ENEMY SUBS AND AIRCRAFT OPERATING FROM XRAY AND ZULU ISLANDS. CINCLANTFLT HAS DIRECTED CAPTURE OF ZULU ISLAND. ENEMY FORCE CONSISTING OF CARRIERS, CRUISERS AND DESTROYERS, OBSERVED 1 MAY LAT 35 DEGREES NORTH LONG 20 DEGREES WEST. BEGINNING D-DAY JOINT AMPHIBIOUS TASK FORCE WILL CAPTURE ZULU ISLAND BY AMPHIBIOUS ASSAULT. LAND BASED AIR WILL CONDUCT LONG RANGE SEARCH OF AREA OF OPERATIONS.
2. MISSION BEGINNING D MINUS FIVE DAY NEUTRALIZE ENEMY NAVAL AND AIR FORCES BASED AT XRAY ISLAND IN ORDER ASSIST CAPTURE ZULU ISLAND.
3. EXECUTION THIS FORCE WILL BEGINNING D MINUS FIVE DAY DESTROY ENEMY NAVAL AND AIR BASE FACILITIES ON XRAY ISLAND AND FORCES BASED THEREON BY AIR AND SURFACE ACTION.
A. TG 21.1 ATTACK CARRIER STRIKING GROUP COMCARDIV TWO CARDIV 2 CARDIV 10 DESRON 4. DESTROY ENEMY AIR AND SURFACE FORCES, AIR BASE FACILITIES ON XRAY ISLAND. PROTECT BOMBARDMENT GROUP FROM ENEMY AIRCRAFT.
B. TG 21.2 BOMBARDMENT GROUP COMCRUDIV TWO CRUDIV 2 DESRON 6 DESRON 8. DESTROY NAVAL BASES AND COAST DEFENSES ON XRAY ISLAND. PROTECT CARRIER GROUPS FROM ENEMY SURFACE FORCES.
X. D-DAY IS DAY OF MAIN TROOP LANDING ZULU ISLAND TENTATIVELY TWENTY MAY. PROVIDE GUNFIRE AND AIR SUPPORT FOR JATF WHEN DIRECTED BY CTF 21.
4. ADMIN LOGISTICS REFUEL AND REPLENISH FROM UNDERWAY REPLENISHMENT FORCE AREA HEMLOCK.
5. COMMAND USE SECFLT COMPLAN SIX. COMMANDER BOMBARDMENT FTOUP IN BOSTON SECOND IN COMMAND. COMMANDER STRIKING FORCE OTC IN MIDWAY. END OPORD.
6. ANNEXES ALFA CONCEPT OF OPS ECHO CRUINS FORWARDED LATER TC ACTION ADDEES BY GUARD MAIL.

Note 1: The Task Organization is omitted from the beginning of the Message Plan; it is included in the task paragraph instead. It is only included, however, when the addressees of the message do not have the task organization information, or when there is a change in the organization. If the current organization has remained unchanged, the name of the commanders and their units may be omitted.

Figure 11-5. —OpOrder promulgated by message.

CHAPTER 12

THE DIVISION OFFICER

The bulk of this text presents in some detail the various facets of naval communications. This chapter and the two that follow (on training and maintenance) deal mainly with items of concern to all officers, but particularly those at the shipboard division officer level. The communication aspects of these last chapters are incidental to the topics being discussed.

A division officer is assigned by the commanding officer to head a division of men in the ship's organization. When so assigned, this officer is responsible not only for the organization, administration, and operation of his division but also for the conduct, appearance, efficiency, welfare, and training of all personnel in the division.

Although this text is not intended nor presented as a treatise on leadership, at least one comment is in order: Any distinction made between the duties of the communication officer as such and the communication officer as a division officer is, essentially, artificial. The two functions are mutually interdependent. It may safely be said that the degree of success in one field almost equals the degree of success in the other. The communication officer is in charge of all persons assigned to radio and visual communications. We stated previously that a necessary element in achieving efficient and reliable communications is officer interest and supervision. It follows, then, that if the communicator avoids or neglects the personal aspects of his division responsibilities, the ship's communication efficiency can only be degraded. When this happens, it reflects directly on the communication officer.

This chapter is devoted to the administrative side of the division officer's duties, including an introduction to the various personnel bills that are an integral part of the ship's organization and regulations manual (discussed in chapter 3).

Before he can organize his own division, it is essential that the division officer acquaint himself thoroughly with the organization of the ship as a whole as well as his department. Knowledge of the overall organization is basic to taking charge of any element within it.

BATTLE BILL

The guides for shipboard organization are NWP 50, Shipboard Procedures, and NWIP 50-1, Battle Control. The latter is concerned specifically with the organization for battle. The ship's battle bill lists the battle stations to be manned during various degrees of battle readiness. The complete list of the degrees of readiness follows.

First: Complete readiness for immediate action.

Second: Temporary relaxation from the first degree of readiness.

Third: A part of the armament ready for immediate action, the remainder on short notice.

Fourth: A part of the armament ready for immediate action, the remainder on prolonged notice.

Fifth: Peacetime cruising, no armament manned.

Sixth: No armament manned, ship in port under peacetime conditions.

Special: Continuing readiness for limited action.

A particular degree of readiness may have variations (antiship, antisubmarine, radiological, etc.) to meet pending threats with maximum effectiveness.

The basis for the organization of the ship is the manning requirement for battle. An individual's capability to perform the duties required in battle is the main consideration of his assignment within the ship. Whenever possible, however, a division of men is assigned as a unit in the battle organization.

Manning requirements of installed equipment, particularly weapons, fix the number of assigned shipboard personnel. The Office of the Chief of Naval Operations determines the total number of men and officers needed to accomplish the wartime objectives of the ship. Based on this determination, the Bureau of

Naval Personnel prepares both a wartime complement (i.e., the actual number of persons required to man all battle stations) and a peacetime allowance by officer grades and enlisted rates. The allowance, usually expressed as a percentage of the complement, is based on the number of persons needed to operate the ship in peacetime.

The complement and allowance are furnished to the type commander and the ship. The type commander then prepares a standard battle bill for ships of the type, just as he furnishes a standard ship's organization and regulations manual. In the same manner as the latter, the battle bill is modified by individual commanding officers only to the extent necessitated by manpower limitations, variations in installed equipments, and so on.

In the battle bill, each station and duty is assigned to an enlisted man by a billet number, as in figure 12-1. A billet number is composed of a series of numerals or a combination of numerals and letters indicating a man's division, and his seniority within the section. Billet number OC-101 shows a man to be in the communication division, in the first section, and senior man in the section. The reason for the need to show seniority, or precedence, is because the chain of command must be adhered to rigidly within the battle organization. Except in an emergency, each station normally reports only to the station of the immediate superior. Senior personnel in communication control, for example, report to operations control, which in turn reports to command control. The line of communications and the chain of command are the same.

CONDITION WATCHES

The objectives of the ship's watch organization are (1) security of the ship in all probable conditions, and (2) an optimum degree of efficiency in administration of the ship. The requirements for specified degrees of readiness and for condition watches are established to maintain the needed battle readiness and efficiency. Shipboard condition watches, as they are related to the degrees of readiness, are as shown on page 181.

ENLISTED ASSIGNMENTS TO BATTLE STATIONS

Station and duty	Complement				Allowance			
	Cond. I	Cond. III			Cond. I	Cond. III		
a. Ship control								
(1) Open bridge								
Talker (JA)	OC-204	-	-	-	OC-204	-	-	-
Talker (JL)	OC-106	-	-	-	OC-106	-	-	-
(2) Pilot house								
Ass't navigator	OC-101	-	-	-	OC-101	-	-	-
Quartermaster	OC-201	OC-104	OC-201	OC-303	OC-201	OC-104	OC-201	OC-303
Steersman	OC-303	1-108	1-209	OC-306	OC-303	1-108	1-209	OC-306
Lee steersman	OC-104	1-109	2-209	2-309	OC-104	1-109	2-209	2-309
Talker (1JV)	OC-105	OC-105	1-210	1-310	OC-105	OC-105	1-210	1-310
Messenger	OC-107	OC-107	2-210	2-307	OC-107	2-110	2-210	2-307
(3) Steering aft								
And so on								

24.12

Figure 12-1. —In the battle bill, enlisted men are assigned by billet numbers.

General degree of readiness	Condition watch
First	I
Second	IE
Special	II
Third or fourth	III
Fifth	IV
Sixth	V

During condition I, all ship's personnel are at individual battle stations. Condition IE permits temporary relaxation during the first degree of readiness for brief periods of rest and the distribution of food at battle stations. Condition II seldom is encountered; usually it is confined to cruisers during special situations such as shore bombardment. Condition watch III is the normal wartime cruising watch when combat is not imminent. Condition IV is the normal peacetime cruising watch, providing for the safe and efficient operation of the ship while permitting the best economy of personnel in assignment to watches. During condition V, it may be necessary to post additional watches for reasons of security or antisabotage, or to man weapons systems. Variations in a degree of readiness to meet a particular type of threat may be indicated as Condition I ASW (enemy submarine), Condition I AAW (enemy aircraft), and so on.

The main organizational unit of the ship for watch standing (as well as for liberty, messing, and berthing) is the section. Each division officer separates his division into three approximately equal sections, based on the number of available personnel and their relative seniority. All enlisted men attached to the ship then fall within one of the three sections. Each overall section of the ship must be adequate to maneuver and fight the ship within the limitations of the personnel in the section. Each section should be able to man all required stations in such emergencies as fire, getting underway unexpectedly, or in the event of surprise hostile activity.

In the ship's battle bill (fig. 12-1), the billet of quartermaster during general quarters is assigned billet number OC-201. Under other conditions of readiness, the duties of the quartermaster rotate among watch standers according to section. Although billet numbers are assigned mainly for battle station identification, they also are utilized invariable for watch standing purposes. The division officer is responsible for assigning personnel to watches and duties within the division, and for developing rotation programs for battle stations, watches, and general duties. Thus the division officer decides who in his division will be in which section and, within each section, who will occupy what billet. When possible, personnel should be assigned during condition III to the stations they man during condition I.

The three-section principle provides a common basis of reference that ensures a smooth transition from one condition to another. Furthermore, the principle has three distinct advantages:

1. If each section is trained properly, the ship routinely may be brought into port or taken to sea without special adjustments in watches and without the need for key personnel to remain on watch for abnormally long periods.
2. It permits flexibility in meeting the usual requirement that at least one-third of the ship's company must remain on board at all times.
3. It affords sufficient periods of rest between watches.

Underway watches normally are stood on a watch-in-three basis; that is, personnel rotate their duties in successive 4-hour periods. The division officer must pay particular attention to the administration of watches during conditions III, IV, and V. This is especially true when two or more divisions furnish personnel to a single watch or when two departments are jointly responsible for adequate manning. When condition watch V is permissible, watches and duties are assumed by each section in succession for 24 hours. In this event, the duty section may be divided into three watch units for rotation purposes.

SHIP'S BILLS

The ultimate objective of every ship is to serve as a superior weapon against the enemy in time of war. In time of peace, the main objective is to be ready for action at any time prescribed by national authorities. These goals require that active ships be maintained in the highest practicable state of operational readiness.

Operational readiness is mainly a matter of internal development and effective shipboard

administration. Effective administration requires planning, organizing, commanding, and controlling.

To coordinate the elements of administration, the type commander (or higher authority) establishes standard requirements to aid commanding officers and executive officers in administering their ships in the best possible manner. Standardization is required to offset the high turnover of personnel and to counter the tendency of individuals to make administrative changes to conform to their own preconceived ideas.

Organization is the machinery of administration. Although administration is concerned with overall policies, organization provides the channels through which the policies are made effective.

The ship's bills are the organization arms of the ship's overall administrative policies. They assign personnel to duties or stations for the purpose of executing specific evolutions or accomplishing certain functions. The type commander furnishes the ship with information necessary to permit the detailed assignment of personnel. In turn, supporting ship's bills guide the division officer in his assignment of personnel by name to the duties specified in the bills.

By a ship's bill is meant one that is included in the ship's organization and regulations manual. It should not be confused with the battle bill, the watch, quarter, and station bill (discussed later), or a ship's regulation. The last is a legal-type administrative directive promulgated by the commanding officer as an aid in the direction and control of his command.

A ship's bill is classified as an administrative, operational, or emergency bill.

ADMINISTRATIVE BILLS

Administrative bills facilitate the assignment of personnel, individually or by groups, to stations and duties that pertain to routine, overall ship administration. Included in this category are the personnel assignment, berthing and locker, and cleaning and maintenance bills.

Personnel Assignment

The personnel assignment bill consists mainly of the distribution of officers and men in such a way that enlisted personnel are divided, so far as possible, in equal proportions of rates among the three sections. Assignments are based on the ship's peacetime allowance. (Complement assignments are included in the battle bill.)

In accomplishing the initial assignments, the division officer--

1. Divides his men into three sections according to rates, numbers, and seniority, as in figure 12-2. This is the basic division organization, upon which are based watch, liberty, and duty assignments.
2. Lists all division responsibilities as contained in the battle bill and the ship's bills, noting and assigning the number of men he must furnish for each station or duty.
3. Fills out the watch, quarter, and station bill to inform his personnel of their stations and duties.
4. Assigns men to watches and special duties not contained in the ship's bills.

Berthing and Locker

The ship's berthing officer allocates berthing spaces to departments and divisions according to a standard method outlined in NWP 50, and he maintains a master numbering plan of all bunks and lockers. Division officers supervise all matters concerning berthing within their division spaces.

The main considerations in berthing assignments during peacetime are the efficient administration of the division and the moral of the men. During time of war, the emphasis necessarily shifts to the dispersal of key personnel and their proximity to battle stations.

No bedding is removed from berths for the purpose of sleeping on deck unless authorized by the executive officer. Topside sleeping on cots is never permitted while the ship is at sea.

All bunks are arranged for head-to-foot sleeping to reduce the danger of spreading respiratory diseases. Berths are made up and lockers stowed according to a standard arrangement, similar to that shown in figure 12-3.

Cleaning and Maintenance

The cleaning and maintenance bill sets forth policies and assigns responsibilities (by department and division) for maintenance, preservation, and cleanliness of shipboard spaces,

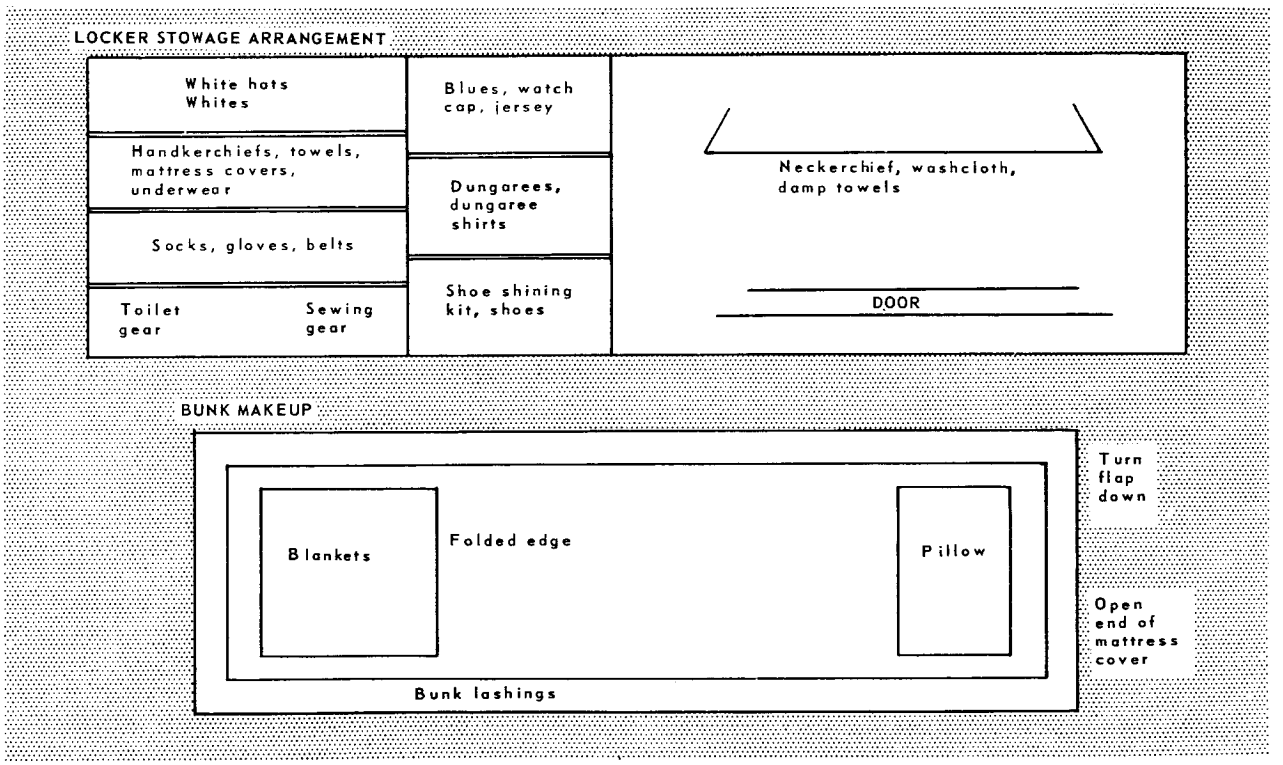
OPERATIONS DEPARTMENT
OC DIVISION

Allowance 21

First Section		Second Section		Third Section	
Billet	Allowance	Billet	Allowance	Billet	Allowance
OC-101	SMC	OC-201	QM1	OC-301	RMC
OC-102	SM2	OC-202	RM1	OC-302	YN1
OC-103	RM2	OC-203	SM2	OC-303	QM2
OC-104	QM3	OC-204	YN2	OC-304	RM2
OC-105	RM3	OC-205	SM3	OC-305	RM3
OC-106	YN3	OC-206	PN3	OC-306	QMSN
OC-107	RMSN	OC-207	RMSN	OC-307	SMSN

105.12

Figure 12-2.—The division officer divides his men into three approximately equal sections.



3.12

Figure 12-3.—Locker stowage and bunk makeup.

machinery, and equipment. The division officer ensures, by personal inspection, that painting and cleaning instructions, as outlined in the bill and in the type commander's instructions, are carried out by his men.

The first lieutenant has overall responsibility for the cleaning and maintenance of the ship's exterior. The division officer is immediately responsible for the upkeep of spaces assigned by the department head.

The following fixtures, openings, and equipment located within a space are cleaned and preserved by the division responsible for the space:

1. Doors, hatches, air ports, and battle ports that swing into the space, including dogs, knife edges, and coamings.
2. Ladders resting on the deck of the space.
3. Outside casing, cover, knife edges, and screens of ventilation systems opening within the space.
4. Escape or access trunks leading to the space.
5. Mechanical devices and equipment (including damage control equipment), blades and exterior casings of electric fans, darken ship switches, and the external surfaces of scuttlebutts.
6. Exteriors of first aid boxes and all other lockers except the personal lockers of men not assigned to the division having responsibility for the space.
7. Interior of all lockers in which the division gear is stowed.
8. All light traps.

OPERATIONAL BILLS

Operational bills facilitate the assignment of personnel for routine operations or ship evolutions. Operational bills are at least five in number.

1. Special sea detail;
2. Replenishment at sea;
3. Rescue and assistance;
4. Landing party; and
5. Visit and search, boarding, and prize crew.

Special Sea Detail

The special sea detail bill establishes policies for the assignment of personnel to stations and duties during periods when the ship is being maneuvered in restricted waters, and when preparations are being made for getting underway and returning to port. Men on the special sea detail either supplement or relieve the regular steaming watch.

Preparations for entering or leaving port start more than 1 hour beforehand on most ships. For example, the gyros used in navigating the ship are started at least 6 hours before getting underway. One hour before getting underway, radars are energized and the main deck steam lines are cut in; 15 minutes later, all hands shift into the uniform of the day, and the crew is mustered on station; 30 minutes prior to sailing, the special sea detail is stationed and the steering system, depth indicator, engine order telegraphs, communication systems, anchor windlass, and main engines are tested. Before entering port, tubes are blown, trash and garbage should be dumped overboard, anchors are prepared for letting go or mooring lines are laid out, the special sea detail is stationed, preparations may be made to receive tugs, and the like.

The OC division has relatively few stations to man in the special sea detail. (See fig. 12-4.) The quartermasters stationed in the pilothouse and on the navigation bridge are assigned by the navigator. On a small ship, the communication officer's station is either in radio central or on the signal bridge, depending on where he is most needed. In ships that have both a radio and a signal officer, each mans his appropriate station. All hands not on watch or assigned to the special sea detail fall in at quarters.

Each division officer must ensure that only qualified men are assigned to the stations he is required to man. Furthermore, he should attempt always to have another man in training for each special sea detail station in anticipation of the loss of any of his key personnel. These stations are not to be manned by inadequately trained persons.

Replenishment at Sea

The replenishment at sea bill sets up the procedures and assigns personnel to duties required for replenishing at sea and for transferring personnel and light freight.

The doctrinal source for these evolutions is NWP 38, Replenishment at Sea. In it are found the answers to most of the questions likely to arise concerning these common but often hazardous operations. Fueling and the transfer of light cargo and personnel frequently occur at the same time. Heavy cargo and ammunition transfer are more apt to be separate evolutions. Although the rigging and stations differ with the type of replenishment operation, the personnel and the communications used are practically the same.

The assignment of special personnel, if any, from the OC division during replenishment operations usually is confined to bridge talkers.

SPECIAL SEA DETAIL BILL
ENLISTED PERSONNEL STATIONS

OC Division

Station	Division	Rating	Duties
Bridge			
QMOW	OC	QM	Perform duties of quartermaster of the watch.
Navigator's assistant	OC	QM (senior)	Assist navigator as directed.
Steersman	OC	QM	Man the wheel.
Port alidade	OC	QM	Man the port alidade.
Starboard alidade	OC	QM	Man the starboard alidade.
Signal Bridge			
Signal supervisor	OC	SM (senior)	Supervise visual communications.
Signalman	OC	SM	Visual communications.
Anchor ball	OC	SM	Tend ball.
Colors			
Colors (gaff)	OC	SM	Tend ensign.

105.13

Figure 12-4.—Special sea detail bill for the OC division.

On a ship in which the communicator also is the signal officer, he may be stationed on the signal bridge to supervise visual communications.

Rescue and Assistance

The rescue and assistance bill provides a nucleus of men within each section qualified to render rapid assistance to persons or activities outside the ship who are the victims of a tragedy. Emergencies anticipated by the bill are survivors in the water, other ships in distress, and distress situations ashore, such as fire or catastrophes caused by nature.

In its broad aspects, the rescue and assistance bill is quite uniform within ships of the same type. The rescue and assistance group must be mobile and capable of fairly sustained operations away from the ship. The security of the ship itself, however, remains the principal consideration. Loss of a group of men for a period of time on a rescue or assistance mission must not detract from the operational capability of the vessel. When making assignments to this bill, the division officer should bear in mind that the rescue team might be called away during general quarters.

Normally, the OC division provides only one signalman or quartermaster for the rescue and assistance detail. Equipment furnished by the division includes semaphore flags, a portable signal searchlight, a Very pistol, megaphones, and perhaps a radio transceiver. The man assigned to the bill must be familiar with all his equipment.

Landing Party

The landing party bill organizes a nominal force of men to perform such functions as limited field operations, policing ashore during emergencies, and less dramatically but

certainly more regularly, participating in ceremonies and parades.

The basic type commander's bill requires only essential personnel; but they are not assigned by specific ratings as they are in other bills. The weapons officer, who maintains the shipboard bill, enlarges on the basic requirements to meet the needs of the vessel or the occasion. The OC division may provide a signalman or quartermaster, and usually furnishes a radioman.

A sample landing party bill is described in NWP 50, Shipboard Procedures. The Landing Party Manual, OPNAV P 34-03, provides detailed instructions for landing party operations.

Visit and Search, Boarding, and Prize Crew

The visit and search bill is combined with the boarding and prize crew bills because of the interrelationships of required actions. Although these bills are used infrequently, their advance preparation is essential because of the delicate nature of the situations in which they may be ordered.

Normally, investigating or taking possession of a ship is accomplished in three progressive phases. These are (1) visiting and searching; (2) boarding and, if necessary, salvaging; and (3) placing a prize crew aboard. In performing these duties, the officers and men assigned are governed by U. S. Navy Regulations and NWIP 10-2, Law of Naval Warfare. The communication officer assigns personnel from his division as illustrated in figure 12-5.

When visit and search are undertaken, several considerations govern. They are as follows:

1. The belligerent right of visit and search, subject to certain qualifying exemptions, must be exercised with tact and in strict conformity with existing treaty provisions. It may be effected outside of neutral jurisdiction after the beginning of hostilities. Under these circumstances, the purpose of visit and search is to ascertain the nationality of the ships, the character of the cargo, the nature of employment, and other facts that may have a relation to hostilities.

2. The examining officer wears a sidearm and normally is accompanied on board by unarmed men (arms are carried in the boat). The examining officer inspects the ship's papers to ascertain nationality, cargo, ports of departure and destination, and other pertinent data. He then makes recommendations to his commanding officer for one of the following courses of action:

a. That the ship be released (when papers or detailed search and inspection prove the innocent character of ship, cargo, and voyage); or

b. That the ship be captured and taken to port for adjudication (if papers, questioning of personnel, and searches do not result in satisfactory proof of the ship's innocence).

If the result of the inspection of the examining officer, or other circumstances, warrants further detention or seizure of the vessel, the boarding and salvage party is dispatched to go aboard and take command of the ship, restrain the crew, and conduct salvage operations as necessary. These actions on the part of the boarding and salvage party are likely to meet with hostility on the part of the crew of the vessel being seized, and the boarding and salvage crew must be alert to counteract attempts at sabotage.

The prize crew, of which the communication officer frequently is a member, operates the

VISIT AND SEARCH, BOARDING, AND PRIZE CREW BILL

Rating	Phase I Visit Search		Phase II Boarding and Salvage		Phase III Prize Crew	
	No.	Div.	No.	Div.	No.	Div.
SM	1	OC	1	OC	1	OC
QM	-	-	-	-	1	OC
RM	-	-	-	-	1	OC
RMSN	-	-	-	-	1	OC

105.14

Figure 12-5.—Visit and search, boarding, and prize crew bill.

seized ship, and makes every effort to bring her safely into port for delivery to the authorities for examination and adjudication.

EMERGENCY BILLS

The last type of ship's bills to be considered are the emergency bills—general emergency and man overboard. As prepared by the type commander, these bills serve as checkoff lists and guides in assigning men to stations and in training personnel to cope with emergencies.

General Emergency

The general emergency bill prescribes procedures for counteracting the effects of any major emergency that arises aboard ship, and for the orderly abandonment of ship when required. The bill includes provisions for collisions, grounding, explosions, extensive fire, battle damage, and probable or actual nuclear, biological, or chemical (NBC) contamination.

Although the ship's bill is based on the structure of the existing battle organization, provisions are made for requisite actions to be carried out in port with only a partial crew on board. Because of the unpredictable nature of many emergency situations, the bill must necessarily serve only as a guide for action by key personnel rather than furnish a detailed list of set procedures. For example, precise abandon-ship stations are not assigned to individuals because a number of the stations may become untenable, thus leading to more confusion than may already exist.

Under the general emergency bill, each division officer is responsible for—

1. Assigning personnel to duties and stations according to the provisions of the bill.
2. Ensuring that all personnel in the division are familiar with their assignments, and that they are trained properly in the necessary techniques, including survival.
3. Effecting the secure stowage of equipment, supplies, and tools so as to reduce the danger of missile hazards.
4. Constantly stressing the importance of watertight integrity, removal of fire hazards, and the operating efficiency of all firefighting equipment.

An important adjunct of the general emergency bill is the ship's emergency destruction plan, described in chapter 10. Under the coordination of the operations officer, the communication officer has direct responsibility for the destruction of classified material and equipment located in the communication spaces, if such destruction is considered necessary to avoid capture.

Man Overboard

The man overboard bill organizes the members of ship's company to accomplish the rescue of either a man overboard or the survivor(s) of an aircraft down in the vicinity of the ship. In the latter instance, procedures are similar to those contained in the rescue and assistance bill. The man overboard bill, however, is put into effect when only one person or a small number of persons need help. The rescue and assistance bill is established to aid a large number of survivors.

Whenever possible, standard procedure on destroyers is to accomplish recovery without putting a boat in the water. Often it is possible to maneuver the ship near the man and effect the rescue by using an embarkation ladder or net, assisted by an assigned swimmer. Shipboard recovery is not always possible, of course, for which reason the bill must provide for boat rescue operations.

As in the rescue and assistance bill, required personnel are assigned from each section to duties in the man overboard bill. Usually a signalman or quartermaster is on call for lifeboat communications, if needed. The OC division strikers may be utilized in the bill as lookouts to keep the man in the water in sight.

When necessary to verify that the man overboard is from own ship, a muster is taken of all personnel not directly involved in rescue operations. The identity of the missing man is passed to the OOD as soon as possible.

On the bridge, signalmen and quartermasters are responsible for—

1. Throwing over a smoke pot or signal flare.
2. Keeping the man in sight.
3. Breaking the OSCAR flag, or operating the man overboard lights.
4. Manning signal searchlights.
5. Maintaining communications with the boat.

When the ship is assigned to the rescue destroyer station while plane guarding for a carrier, the proper guard circuit must be instantly available on the bridge for communication with the rescue helicopter.

WATCH, QUARTER, AND STATION BILL

Having assigned the personnel in his division to all the duties and stations specified in the battle bill and the ship's bills, the division officer notifies his men by posting a detailed summary of those assignments in the watch, quarter, and station (WQS) bill. Because the main purpose of this bill is to inform, it must be displayed prominently in division spaces. A second important purpose of the bill is to provide supervisory personnel with an authoritative and readily available source of information needed for making or revising assignments. Although preparation of the bill is the responsibility of the division officer, his senior petty officers help in maintaining it.

We already have described the usual steps in accomplishing personnel assignments. In so doing, the division officer should maintain a division notebook to assist him in transferring data from the battle bill and ship's bills to the WQS bill. The notebook should be divided into sections, one section being alloted to each condition of readiness and each ship's bill. In the appropriate section are entered the stations and duties for which the division is responsible, and the names of the men to whom the division officer assigns each function. Actually, then, this portion of the division notebook is a working copy of the watch, quarter, and station bill, modified to suit the needs of the division officer.

The standard WQS bill (fig. 12-6) is arranged in tabular form. Columns are provided for entering data from each of the other bills, as well as for providing other information that is both necessary and useful; the use of billet numbers is optional. Duty and station assignments are in the same general order as contained in the ship's organization and regulations manual. Each person's duties during conditions I, II, and III and under each bill are noted in the appropriate column.

Certain assignments to watches and duties do not lend themselves to posting in the watch, quarter, and station bill. One example is the normal peacetime cruising watch, condition IV; another is the in-port watch under condition V. Such assignments normally are published in separate watch lists.

ASSIGNMENTS BY PRIORITIES

Assigning personnel under the various bills cannot be a haphazard operation in which any person can be placed at any station. The division officer must give some thought to the duties, and he must have at least a working knowledge of the strong and weak points of his men.

As an obvious example, if the man who normally would be a bridge talker has a speech defect, clearly his division officer must make a substitution. The situation is further complicated by personnel turnover. It is not a unique incident for the gain or loss of one man to result in the shakeup of an entire section.

It is important, therefore, that the division officer make every effort to place the right man in the right spot at the beginning. As a practical matter, this is nearly impossible unless the responsible officer interviews each man before assigning that man to his duties and stations under the battle bill and the ship's bills. Normally, looking through the man's service record is no help in this matter.

Within each bill to be considered, some duties have priority on the available talent because they require a degree of personal knowledge or experience not demanded by certain other duties. The division officer must ensure that only his most capable personnel are assigned to the top priority billets. Only when those are filled satisfactorily should he complete the remaining assignments.

The theory of assignment by seniority is a tried and tested method of command and control in all the services. In the rare situation where the division officer is fortunate enough to have exactly three (or a multiple of three) petty officers in each available pay grade, the chore of sectional assignments is no problem. He simply places a chief petty officer in the top priority billet, a first class in the second billet in importance, and so on.

When initially preparing a WQS bill, the division officer should first verify his assigned billet numbers, the allowance figures, and the actual on-board personnel situation. Figure 12-6 shows how the OC division officer assigned his men in the first section, based on his sectional assignments contained in figure 12-2. Personnel should be entered on the watch, quarter, and station bill by order of seniority, regardless of their assigned duties and stations. Then, there is no doubt in anyone's mind regarding who is senior in the section, or who becomes senior in the event of the loss of a top man.

WATCH, QUARTER, & STATION BILL

COMPLEMENT
ALLOWANCE
ON BOARD
DATE

SECTION 1 DIVISION OC

NAME	BUNK NO.	LKR. NO.	RATE COMP.	RATE ALL.	RATE ACT'L.	CLEAN. STATION	BATTLE STATIONS COND. I (GQ & GEN. EMERG.)	BATTLE STATIONS CONDITION II	BATTLE STATIONS CONDITION III	SPECIAL SEA DETAIL	UND'WAY REPL.	RESCUE & ASSIST. PARTY	RESCUE & ASSIST. PROVIDE	LANDING PARTY	VISIT AND SEARCH PHASE I	VISIT AND SEARCH PHASE II	VISIT AND SEARCH PHASE III	MAN OVERBD.	FIRE STATION	FIRE PROVIDE	EMERG. GETTING UND'WAY	WATCH DETAIL AT SEA	WATCH DETAIL IN PORT	SPECIAL DETAIL
OC-101 COLLINS	4	4	SMCS	MC	IN	SIG BR	100		S/G BR		S/G BR	—						S/G BR	S/G BR	—	S/G BR		7 OOD	
102 HALEY	11	11	SM2	SM2	SIG BR	IN CHG PART S/L	SCPUR		S/G BR		DISTRESS SIG. ASTERN	EQ	PARTABLE	S/G	S/G	S/G	COMM	S/G BR	S/G BR	—	S/G BR	S/G	BR	
103 POPE	14	14	RM2	RM2	RADI	RADI	RAD I		RAD I	PORT ALIDADE				MD. OPR	COMM	COMM	COMM	QTRS LIFE BOAT			RAD I	RAD II		
104 BRINKLEY	12	12	QMS	QM3	PILOT HOUSE	LEE STEERS-MAN	AMOW 1JV														STEERS-MAN	NAV	BR	MAIL PO
105 JOHNSON	17	17	RM3	RM3	RAD II	1JV TALKER	TALKER											QTRS			RAD I	RAD II	RAD I	
106 BUCKNER	20	20	QMS	QM3	COMPT	STBD S/L	ST BD S/L											S/G S/L	SCENE	CO2	PORT ALIDADE	NAV	BR	
107 SMALL	22	22	PMSN	SN	COMPT	MSGR	MSGR											QTRS	SCENE	50' HOSE	RAD II	RAD I		

76.6

Figure 12-6.—The watch, quarter, and station bill summarizes the division officer's assignments of personnel as required by the battle bill and ship's bills.

ADMINISTRATION

In addition to his responsibilities in connection with assignments of personnel under the various bills, the division officer has many administrative demands certain to be encountered on any ship.

TRAINING

The subject of training is discussed thoroughly in the next chapter. We touch on it here only as it applies to the duties performed and the stations manned during the several conditions of battle readiness and under the ship's bills.

The Navy is an instrument of national security. Because we must always be ready to carry out our assigned functions either in time of peace or war, our active components must be maintained in a condition of maximum operational readiness. It should be obvious that, without training in depth, maximum readiness will never be attained.

Each man in the division should be trained, and eventually qualified, to handle not only the requirements of his billet but also the billet of the man above him. As soon as an individual demonstrates the required skill level in all the duties for which he is responsible, he should be trained to discharge greater responsibilities. A desirable and practical goal is that each man be trained for the next two higher billets. As personnel changes occur and leading men are transferred, the division officer may compensate for the loss by moving men up to the positions for which they have been trained. Supervisory petty officers should be capable of taking over any of the positions on the stations for which they are responsible. It often happens that a ship is deprived of many men in a particular rating, with no immediate relief available. The presence of a striker who can take over immediately will lessen considerably the difficulties inherent in such a situation.

From a point of view of the detail necessary to keep the watch, quarter, and station bill current, such a replacement system will lessen the division officer's work. At first, considerable time may have to be spent in getting it started properly. Once established, however, it is relatively simple to maintain.

Many ships operate below allowance. Being understrength, billets of lesser importance may have to remain vacant; or, if this is impossible, they may have to be combined with others. When a new man reports aboard, he should be moved into the highest appropriate vacant billet. If the man is experienced and qualified, he should be assigned to a billet currently filled by a less-experienced individual. When personnel are transferred, the senior qualified man holding a lower billet is moved up, and the WQS bill is adjusted accordingly. If in-depth training has been worthwhile, these changes occur with little or no reduction in efficiency.

PERFORMANCE EVALUATION

Periodically, a commanding officer must evaluate the performance of duty of every person in his command. For officers, he completes fitness reports, which become the primary means for determining their promotions, eligibility for special programs, and perhaps for future assignments.

Reports on enlisted personnel utilize two forms. A routine report of enlisted performance evaluation (fig. 12-7) is prepared at least semiannually and at other times for significant reasons, such as a man's reduction in grade or transfer between normal reporting dates. The second form, enlisted evaluation report (fig. 12-8), is completed and submitted for a senior petty officer to provide factual information, perhaps in connection with his request for assignment to a special program or for appointment to a commission. The evaluation report is of importance to the division officer in that he might initiate the comment shown in block 18. It is with the continuing performance of his men, however, that the division officer is mainly concerned. Hence he has a direct and personal interest in the periodic performance evaluation.

Except in very small commands, it is a physical impossibility for the commanding officer to have sufficient knowledge of all his men to personally assign the enlisted performance marks. The process of evaluation usually is delegated to the officers and senior petty officers of the command. Each man's immediate and responsible supervisor should mark the appropriate block for each trait observed (fig. 12-7). Seniors in the chain of command adjust the assigned observations as they believe necessary. An initiating petty officer refers his recommendations to his division officer, who forwards them to the department head, and so

REPORT OF ENLISTED PERFORMANCE EVALUATION
NAVPERS 792 (Rev. 6-59)

PERIOD OF REPORT: 16 MAY 196_ To 15 NOV 196_

NAME (Last, First, Middle)	SERVICE NO.	RATE ABB.	PRESENT SHIP OR STATION
DOE, John James	000 00 00	SA	USS Rowe DD 564

INSTRUCTIONS

1. For each trait, evaluate the man on his actual observed performance. If performance was not observed, check the "Not Observed" box.
2. Compare him with others of the same rate.
3. If the major portion of his work has been outside his rate or pay grade during this reporting period, evaluate him on what he did. Describe what he did in the "Comments" section.
4. Pick the phrase which best fits the man in each trait and check left or right box under it. (Left box is more favorable.)

	NOT OBSERVED									
1. PROFESSIONAL PERFORMANCE: His skill and efficiency in performing assigned duties (except SUPERVISORY)	☐	Extremely effective and reliable. Works well on his own.		Highly effective and reliable. Needs only limited supervision.		Effective and reliable. Needs occasional supervision.	✓	Adequate, but needs routine supervision.		Inadequate. Needs constant supervision.
		*								* *
2. MILITARY BEHAVIOR: How well he accepts authority and conforms to standards of military behavior.	☐	Always acts in the highest traditions of the Navy.		Willingly follows commands and regulations.	✓	Conforms to Navy standards.		Usually obeys commands and regulations. Occasionally lax.		Dislikes and flouts authority. Unseamanlike.
		*								* *
3. LEADERSHIP AND SUPERVISORY ABILITY: His ability to plan and assign work to others and effectively direct their activities.	✓	Gets the most out of his men.		Handles men very effectively.		Gets good results from his men.		Usually gets adequate results.		Poor supervisor.
		*								* *
4. MILITARY APPEARANCE: His military appearance and neatness in person and dress.	☐	Impressive. Wears Naval uniform with great pride.		Smart. Neat and correct in appearance.	✓	Conforms to Navy standards of appearance.		Passable. Sometimes careless in appearance.		No credit to the Naval Service.
		*								* *
5. ADAPTABILITY: How well he gets along and works with others.	☐	Gets along exceptionally well. Promotes good morale.		Gets along very well with others. Contributes to good morale.	✓	A good shipmate. Helps morale.		Gets along adequately with others.		A misfit.
		*		✓						* *

6. DESCRIPTION OF ASSIGNED TASKS

Performed duties as a Messman for three months.

7. EVALUATION OF PERFORMANCE

* 8. THESE ITEMS MUST BE JUSTIFIED BY COMMENTS IN ADDITION TO THOSE IN ITEM 7 ABOVE

9. REASON FOR REPORTING	10. DATE	11. SIGNATURE OF REPORTING SUPERIOR
☒ SEMIANNUAL ☐ TRANSFER ☐ OTHER _____	11/20/6	C. C. Cabel RMC

21.45

Figure 12-7.—Report of enlisted performance evaluation.

ENLISTED EVALUATION REPORT
NAVPERS 1339 (Rev 3-56)

TO: Chief of Naval Personnel

DATE: 6 September 196-

INDIVIDUAL DATA

1. NAME (Last, first, middle)	2. SERVICE NO.	3. RATE AND PRIMARY NJC	4. BRANCH AND CLASS OF SERVICE	5. DATE OF BIRTH
GLASS, George Gerald	279 63 42	BT1	USN	9 NOV 32

6. Completed 14 years active naval service. 7. Active obligated service expires on 17 August 1963

REQUEST OR RECOMMENDATION

8. Request or recommendation for appointment to:
☐ WARRANT OFFICER ☐ LIMITED DUTY OFFICER ☐ OTHER (specify)

9. Request or recommendation for:
☐ INSTRUCTOR DUTY ☐ RECRUITING DUTY ☐ INDEPENDENT DUTY ☒ OTHER (specify) Nuclear Power Surface Ship Program

INDIVIDUAL'S COMMENTS

10. I ☒ DO ☐ DO NOT desire to be recommended for appointment or assignment as indicated above. (Enter pertinent comments, if any, in this section)

Upon receipt of orders to the Nuclear Power Training Program, I will agree to extend or reenlist, as necessary, in order to have the required obligated service prior to actual transfer to this program.

George Gerald Glass
(Signature of individual)

PERFORMANCE DATA

INSTRUCTIONS

(1) Enter SIX Performance Periods in this section; the first five should be the most recent periodic marks obtained from page 9; the sixth shall be special marks assigned upon submission of this report.
(2) Compute the average of the marks in each trait column and enter in item 14.
(3) Compute the average of the values recorded in item 14 and enter in item 15.

11. DATE	12. TRAITS: PROFESSIONAL PERFORMANCE	MILITARY BEHAVIOR	LEADERSHIP AND SUPERVISORY ABILITY	MILITARY APPEARANCE	ADAPTABILITY	13. NATURE OF DUTIES PERFORMED (When required)
8 JUL 6-	N.O.	3.4	3.0	3.2	3.4	
16 NOV 6-	3.2	3.8	3.2	3.6	3.8	
16 MAY 6-	3.6	3.6	3.6	3.8	3.6	
16 NOV 6-	N.O.	3.2	3.0	3.4	3.4	
16 MAY 6-	3.6	3.6	3.6	3.6	3.6	
~~5 AUG 6-~~	~~3.6~~	~~3.8~~	~~3.6~~	~~3.8~~	~~3.8~~	15. OVERALL TRAIT AVERAGE
14. INDIVIDUAL TRAIT MARKS AVERAGES	3.50	3.57	3.33	3.57	3.60	3.51

COMMANDING OFFICER'S COMMENTS AND RECOMMENDATIONS

16. THE ABOVE-NAMED INDIVIDUAL ☒ IS ☐ IS NOT RECOMMENDED FOR ASSIGNMENT TO DUTY AS INDICATED ABOVE.

17. THE ABOVE-NAMED INDIVIDUAL ☐ IS ☐ IS NOT RECOMMENDED FOR APPOINTMENT TO THE TYPE OFFICER CATEGORY INDICATED.
Nuclear Power Program
HIS QUALIFICATIONS FOR OFFICER STATUS ARE: ☐ FAIR ☒ GOOD ☐ EXCELLENT ☐ OUTSTANDING

18. COMMENTS PERTINENT TO THE ABOVE REQUEST OR RECOMMENDATION. (Do not leave blank)

Glass displays a high degree of leadership ability. He handles his men effectively, supervises their training, exercises initiative, and equipment in his charge is continuously in good operating condition.

19. NAME OF REPORTING ACTIVITY	20. SIGNATURE, RANK, AND FILE NUMBER OF COMMANDING OFFICER
USS Forrestal CVA 59	J. J. JOHNSON, CAPT, USN, 24331

U. S. GOVERNMENT PRINTING OFFICE: 1956 O-F—405323 B-60846

24.19

Figure 12-8.—Enlisted evaluation report.

on. When the evaluations reach the commanding officer, either he or a designated authenticating officer may make final adjustments. Established equivalent numerical grades then are assigned and inserted in individual service records.

It is important that the division officer be completely objective in evaluating his men. The performance marks assigned to an individual can be as important to him as the grades assigned to an officer on the latter's fitness report. An enlisted man's marks have a direct bearing, for example, on his advancement in rating, his selection for a commission or a course of instruction, the character of his separation, and his acceptance for reenlistment; and, going in the other direction, reduction in rate or rating for incompetency or early separation by administrative discharge.

The basic principle of the Navy's grading system is that men in each pay grade are evaluated on the basis of their personal merit in comparison with the performance of other men in the same pay grade. An extreme violation of this rule is to compare the leadership ability of a third class petty officer with a chief petty officer. In most examples, this would be grossly unfair to the junior PO.

A second important tenet is the avoidance of "blanketing." By this we mean automatically grading one man high and another man low in all respects. The latter situation sometimes crops up because of a personality deficiency; yet a man may lack in adaptability but rate higher in his performance on the job than many other men in the division.

The point to be made, of course, is that most of us are average, being somewhat better in some aspects and somewhat deficient in others, in comparison with our contemporaries. Although division section leaders or other senior POs may initiate certain performance evaluations, the responsibility rests with the division officer for the fairness, objectivity, and accuracy of the marks assigned.

CHAPTER 13

TRAINING

Battle readiness is a primary justification for the existence of the Navy. Continuous training is a major element contributing to battle readiness. The objective of the training program is to increase the ability of personnel to administer and operate the ship effectively under all foreseeable conditions. Emphasis on training is essential in order to maintain at peak efficiency the vital communications by which command is exercised throughout the Naval Establishment.

The Navy has several service schools for rated communication personnel. The class B radioman schools provide, at an advanced level, the knowledge and skills required of radiomen in fulfilling their shipboard supervisory and operational responsibilities. As another example, teletype maintenance schools offer excellent courses of instruction in teletypewriter maintenance and repair. Requests should be initiated to have a student quota assigned to the ship whenever possible and necessary.

This chapter discusses training procedures that have become standard through custom and usage, as well as the training concepts stated in governing publications issued by the Chief of Naval Operations, principally NWP 50.

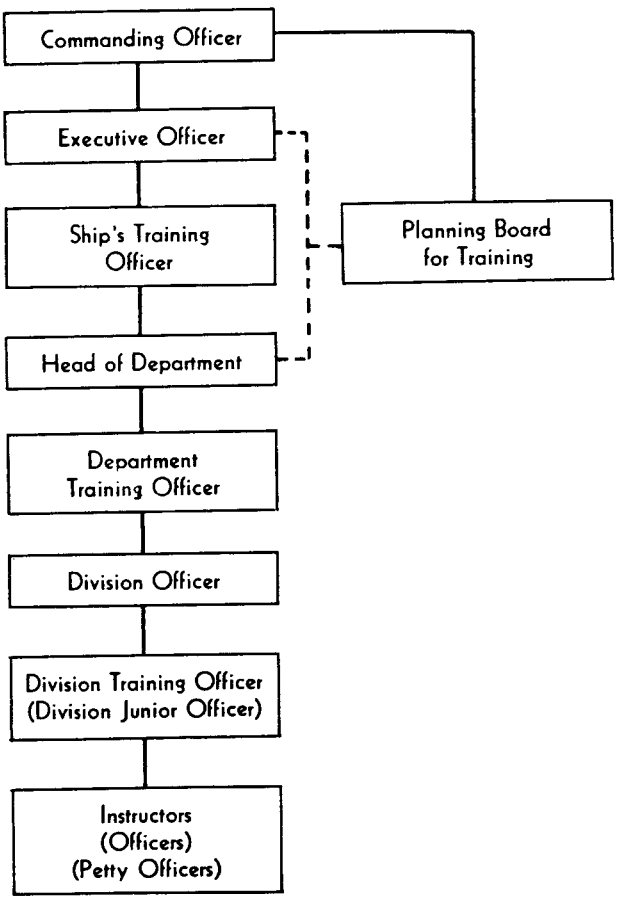
Training is directed by the Commanders in Chief of the U. S. Atlantic and Pacific Fleets, who exercise their training responsibilities through their administrative type commanders. The type commanders' written instructions relating to training, therefore, must be consulted to obtain a detailed knowledge of what is expected with respect to communication training and readiness.

ORGANIZATION FOR TRAINING

The normal administrative organization of the ship should include provisions for carrying out the training program. In most instances, the commanding officer, charged with overall responsibility for the efficiency of the ship, appoints a planning board to assist him in training matters.

PLANNING BOARD FOR TRAINING

The planning board for training, responsible directly to the commanding officer, consists of the executive officer, a delegated ship's training officer, and all department heads. The place of the planning board in the ship's training organization is shown in figure 13-1.



105.15

Figure 13-1. The planning board for training consists of the executive officer, ship's training officer, and department heads.

The planning board performs the following general functions:

1. Assists the commanding officer in the formulation of training policies.
2. Coordinates the training program for the ship and periodically evaluates progress of training and future requirements.
3. Establishes training syllabuses for both officers and enlisted men.

Executive Officer

The executive officer is charged with executing orders of the captain, and with coordinating and supervising the performance and administration of the command as a whole, including matters pertaining to training. The executive officer is chairman of the planning board for training, exercises overall supervision of shipboard training, and schedules training activities for the ship on a daily, monthly, quarterly, and yearly basis. He also may serve as training officer.

Training Officer

The ship' s training officer is an assistant to the executive officer in all matters pertaining to such essentials as—

1. Supervising the execution and administration of the overall shipboard training program.
2. Evaluating the effectiveness of the records, reports, graphs, and other control devices used in the training program.
3. Preparing and maintaining long- and short-range training schedules.
4. Promulgating weekly training schedules.
5. Coordinating and scheduling competitive exercises, trials, and inspections.
6. Coordinating departmental requests for school quotas.
7. Coordinating orientation and indoctrination courses for new personnel.

The foregoing list is not, of course, all-inclusive.

As a member of the planning board, the training officer assists the board in formulating plans for coordinating and evaluating training in order to facilitate the education and professional advancement of all personnel.

Head of Department

The department head formulates and carries out the department training program and supervises the training and professional development of junior officers assigned to him. The head of the operations department approves syllabuses and lesson plans for communication training.

Division Officer

The division officer is a vital key in the success of the training program. As an assistant to the operations officer, the communication division officer (on a small ship also the communication officer) normally has the following duties to perform in connection with training matters:

1. Assists the operations officer in developing a communication training program in support of the training objectives of the operations department.
2. Implements approved training plans and policies within the department.
3. Coordinates and assists in administration of the division training program, including supervision of the preparation of training materials; reviews schedules and lesson plans; selects and trains instructors; observes instruction at drills, on watch, and in the classroom; and procures training aids and other material for use in the training program.
4. Maintains division training records and reports.
5. Prepares and submits division training schedules to the operations officer.
6. Disseminates information concerning availability of fleet and service schools to communication personnel.
7. Assists the operations officer in planning and coordinating training of junior officers and leading petty officers in accordance with shipboard training policy.
8. Keeps the operations officer fully advised with respect to the training program for communication personnel.

In his division notebook, the division officer should place his program data, a personal data card on each man, and any supplementary information that might be useful for reference purposes and for the orientation of his relief.

Leading petty officers should plan lessons, observe immediate aspects of the program and offer suggestions for improvement, instruct individuals and groups as required, keep records

necessary to control the program, and consistently maintain a high degree of control over every aspect of communication training. Training-minded petty officers are essential to the effectiveness of the shipboard training program.

ORGANIZATIONAL CONSIDERATIONS

In organizing the training program, a few words should be said about at least three important elements that must be considered.

Management

Proper application of certain elements of management is essential to the establishment and execution of a successful training program. Five major functions of administration are applicable to the program. These may be defined as follows:

PLANNING: Establishment of objectives and a determination of the broad means by which these objectives will be accomplished.

ORGANIZING: Arrangement of the required factors in such a way that objectives will be accomplished effectively.

EXECUTING: Placing the training program in effect, utilizing the facilities with which the training will be accomplished, and motivating personnel to make the required effort.

CONTROLLING: Frequent evaluation of training results to ascertain whether the effort is accomplishing objectives.

COORDINATING: Maintaining balance in the training program in working toward established objectives.

Time

It is unfortunate that time for training is limited. It is recognized that the physical methods of teaching must vary between ships because of ship design or size, the personnel allowance, and so on. The most important contributing factor to the limitation of time for training is the maintenance problem. The upkeep and repair of material and equipment is a major contribution to battle readiness; none of the features of shipboard maintenance may be neglected. In all ships, one immutable principle of shipboard operations is that time must be balanced carefully between training and maintenance. Neither may be neglected in favor of the other. The proper apportionment of time must be made by officers who are familiar with the existing shipboard situation. This requisite, alone, points up the importance of the planning board. Once a balance is established, programs for both training and maintenance can be planned and executed.

Training is never completed. When a man becomes qualified in a particular duty, he should commence training immediately to master another. The most effective method for utilizing the time available for this continuing education is on-the-job training.

In the training program, the primary concern is to get the crew operating efficiently. During drills, routine evolutions, and watches, on-the-job instruction should be given until each individual in the watch section can perform the duties expected of him, and each member of a team or detail can do his part in the functioning of that unit.

Every effort must be made to obtain maximum training value from all watches, drills, and evolutions. The petty officer in charge of a watch section or special detail must know—and plan in advance—the phases of training he is going to cover during a particular watch or drill. Close and continuous supervision and coordination are essential to ensure that training actually is accomplished during watches and drills.

Training Effectiveness

Every ship must have two parallel, flexible, and closely integrated parts to its training program—one for teaching skills and operations, the other for imparting related knowledge through classroom instruction. The training program must be realistic and within the capabilities of ship' s personnel.

When one part of the training program is delayed, the other should be taken up. The need for this flexibility is occasioned by such incidents as inclement weather, changes in operating schedules, breakdowns, or even combat casualties. Rapid changes in training plans must be made in each instance.

An evaluation of the performance of individuals aboard ship, the transition of men from raw recruits into qualified watch standers within a reasonable length of time, the number of men fulfilling qualifications for advancement in rating, and other similar factors can be reliable indications of whether an adequate shipboard training program exists.

Instruction that is dynamic, progressive, and scheduled regularly results in effective training. The degree of preparation of the instructor, and his exhibited interest in the subject, also contribute to the success of training. Persons in authority must show real interest in the progress of individuals in matters of self-education and all other forms of training to the extent that they are conspicuously present when instruction of personnel in their departments is scheduled.

TRAINING PROGRAM

The general objectives of the overall ship's training program are to—

1. Increase the ability of personnel to administer and operate the ship effectively under all foreseeable conditions.
2. Schedule the training so that maximum benefit is derived during the time available.
3. Impart to all hands the technical knowledge and skill needed for the operation, maintenance, and repair of the ship and her equipment.
4. Increase the proficiency of each officer and enlisted man in his present duties, and prepare him for greater responsibilities.

Based on the planning board's interpretations of the ship's training objectives, the communication officer, in conjunction with the operations officer, establishes tasks for the communication division.

Training tasks for communication personnel necessarily consist of provisions for (1) general training of the individual aboard ship to include examination for advancement in rating, qualification for watches on duty stations, and the minimum training requirements for all hands; (2) ordering officers and enlisted personnel to schools; and (3) operational or team training both aboard ship and at fleet training centers ashore.

The communication training program should comprise the drills and exercises listed in figure 13-2.

PROGRAM DEVELOPMENT

The enlisted training syllabus is based on the objectives for training communication personnel plus the exercises and drills listed in Fleet Exercise Publication (FXP) 3. For each unit of instruction, shipboard instructors should develop a lesson plan, such as in figure 13-3 (the Guide for Curriculum Development, NavPers 92684, may be helpful). The advantage of a lesson plan is that it aids in standardizing the training. If the presentation of the subject matter is well planned to begin with, succeeding classes acquire very nearly the same knowledge and skill.

Simultaneous with development of lesson plans and syllabuses comes the assignment of instructors. Everyone in authority is responsible for training the personnel he commands in action. Each petty officer must instruct his subordinates. It frequently saves time to do a certain amount of basic instruction with men drawn from each watch section. In such instances the division officer should designate a qualified petty officer to instruct. Inasmuch as the major burden of teaching rests with the petty officers, each should become a well-qualified instructor.

A detailed explanation of instructional techniques is found in the Manual for Navy Instructors, NavPers 16103. Instructor Training, NavPers 92050 contains articles of lasting interest and usefulness on instructor training. Although slanted mainly toward personnel in schools ashore, this publication may prove helpful in the administration of shipboard training. For the training program to be successful, the instructors must know their subjects thoroughly, display the qualities of leadership while teaching, and perform their jobs with enthusiasm.

All other things being equal, it is axiomatic that the more every man knows about his assigned job, the better a fighting unit the ship will be.

The natural tendency is to keep a man in a job that he knows. This trend stems from a desire to achieve and maintain a smoothly working unit, division, or team. Such action limits the scope of knowledge of the man, and does not make provision for casualty replacement or for advancement to positions of greater responsibility. To offset this tendency, there should be a plan for rotating the men through jobs within the division. Such a plan does not mean that each man should have a new job each day. Rather, it should be approached with the idea that a man should be rotated after he reaches the standard of proficiency set for the division. Any individual should be thoroughly familiar with the duties of his present rate before he is assigned duties normally performed by a higher rate.

Rotation of personnel requires some planning and controlling to ensure complete coverage of

	Title	Lesson	Exercise
1.	Voice radio procedure	x	
2.	Tactical voice radio drill		x
3.	Administrative voice radio drill		x
4.	Radio circuit operation	x	
5.	Radio procedure	x	
6.	Use of frequency meter	x	
7.	Adjustment and calibration of radio transmitters and receivers.	x	
8.	Calibration and frequency shifting under normal conditions.		x
9.	Frequency shifting during conditions of radio silence		x
10.	Flashing light instruction	x	
11.	Flashing light—intership		x
12.	Instruction in use of infrared equipment	x	
13.	Infrared equipment drill		x
14.	Semaphore instruction	x	
15.	Semaphore—intership		x
16.	Visual signaling procedures	x	
17.	Flaghoist instruction	x	
18.	Flaghoist drill—intership		x
19.	Cryptography and security	x	
20.	Codes, ciphers, and crypto devices	x	
21.	Cryptoboard instruction	x	
22.	Cryptographic drill		x
23.	Cryptoboard drill		x
24.	Radio interference		x
25.	Radio jamming and heckling		x
26.	Radio equipment transfer panels	x	
27.	Coordination and dissemination of tactical signals between CIC, conn, and bridge.	x	
28.	Communication publications	x	
29.	Allied Naval Signal Book	x	
30.	International signal code	x	
31.	Security of classified publications	x	
32.	Encrypted traffic handling	x	
33.	Authentication systems	x	
34.	Radio call sign cipher	x	
35.	Transmission security	x	
36.	Distress traffic	x	
37.	Tactical radio communications	x	
38.	Casualties, failures, and use of emergency equipment	x	
39.	Logs and records	x	
40.	Maintenance	x	
41.	Radioteletype procedures	x	
42.	Teletype equipment safety precautions	x	
43.	Maintenance of teletype equipment	x	
44.	Emergency destruction procedures	x	
45.	Recognition procedures	x	
46.	Transfer of control of radio transmitters and receivers to remote position.		x
47.	Internal handling of tactical communications		x
48.	Allied Naval Signal Book drill		x
49.	Authentication drill		x
50.	Radio call sign cipher drill		x
51.	Equipment casualty drill		x
52.	Main radio destroyed in battle		x
53.	Rigging and use of emergency antenna		x
54.	Emergency destruction of classified matter		x
55.	Telephone talker instruction	x	
56.	Telephone talker drill		x

Figure 13-2. Communication drills and exercises. 105.16

LESSON NO.: C12.
LENGTH: 35 minutes.
SUBJECT: Flaghoist Instruction.
OBJECTIVE: To familiarize visual signal personnel with the composition and procedures of flaghoists, and the use of pertinent signal publications.

MATERIALS:
1. Training aids: Flaghoist equipment on board.
2. References (effective editions):
   a. ACP 129.
   b. ACP 118.
   c. ATP 1, Vol. II.
   d. ACP 131.
   e. DNC 5.

INTRODUCTION: The instructor should: inform the trainees of the purpose of the lesson, and the procedure to be followed in conducting it; discuss the importance of the lesson in developing skill and understanding of this phase of visual signaling; inform trainees what is expected of them during and after completion of the instruction.

PRESENTATION: Discuss the following points:
1. The use of flaghoists in visual signaling:
   a. Advantages.
   b. Disadvantages.
2. Composition of hoists:
   a. Applicable publications.
   b. Call and address.
   c. The signal.
3. Making up hoists:
   a. Bending on flags.
   b. Closing up smartly.
   c. Execution.
4. Answering hoists:
   a. Report to conn when sighted.
   b. Keep at dip until understood.
   c. Close up smartly when understood.
5. Accuracy and speed:
   a. Read signals carefully and report to conn correctly.
   b. Answer hoists promptly and accurately.

APPLICATION: Give demonstration on all phases covered in the presentation. Ask questions to stimulate discussion in an effort to bring out points that may not have been covered sufficiently.

SUMMARY: Review the material covered, reemphasizing key points, and ask questions to determine effectiveness of instruction.

105.17

Figure 13-3. A lesson plan may be developed for each unit of instruction.

jobs by the trainees. A progress chart is essential to record the jobs performed satisfactorily and point out those in which the trainee has yet to become experienced.

Schedule of Training

In determining the ship's schedule for training, the governing elements are the operating schedule and assigned navy yard overhaul periods promulgated by the type commander. A yard overhaul takes place approximately every 2 years; the exact intervals depend upon many conditions that affect fleet planning.

LONG-RANGE TRAINING SCHEDULE.--The ship's training cycle (fig. 13-4) is tied closely to the periods of time between the start of yard overhauls. The long-range training plan, prepared by the training board, is the basic instrument for planning and carrying out the ship's training requirements.

The long-range plan is confined to information of major importance needed to ensure that overall coordination and planning of the training effort are effective. It is not concerned with minor details of the ship's training schedule. In effect, the plan outlines the periods of time that are to be considered as all-hands evolutions and during which little personal training may be scheduled. These events include major inspection, trial, and maintenance periods; and competitive exercises, off-ship team training,

TYPICAL TRAINING CYCLE (DESTROYER TYPE)

Shipyard overhaul period	Months out of shipyard	
Preparation for refresher training; calibration and alignment of equipment; RFS; ISE; commence refresher training	1 (Jul)	Training year
Refresher training; ORI	2 (Aug)	
25-knot economy trial Commence competitive year	3 (Sep)	
	4 (Oct)	
	5 (Nov)	
	6 (Dec)	
	7 (Jan)	
	8 (Feb)	
Administrative inspection	9 (Mar)	
Full power trial	10 (Apr)	
	11 (May)	
Complete competive year	12 (Jun)	
Economy trial Commence competitive year	13	
Operational readiness inspection	14	
	15	
	16	
	17	
Economy trial	18	
	19	
Material inspection (INSURV)	20	
Administrative inspection	21	
	22	
Full power trial; prepare for shipyard overhaul	23	
Complete competitive year	24	
Shipyard overhaul		

105.18

Figure 13-4.--The ship's training cycle is adjusted to the periods of yard overhauls.

general quarters, general drills, and the like. When complete, the plan becomes the framework for the preparation of the more detailed quarterly forecast of all-hands evolutions and the weekly training schedules.

QUARTERLY FORECAST OF ALL-HANDS EVOLUTIONS.—Based on the long-range training schedule and general policy guidance from the commanding officer, the training officer prepares a quarterly forecast, or estimate, of the number of normal working hours required to carry out evolutions involving participation by all hands. On the basis of that estimate, he also forecasts the number of hours that are available to accomplish individual division activities.

When the ship's employment schedule is reasonably firm, the training officer prepares the quarterly forecast simultaneously with the long-range training schedule. At other times, he can forecast only as far ahead as reliable estimates can be made, perhaps monthly or biweekly.

The analysis is based on a normal workweek of 35 hours per man: 7 hours per day for 5 days. It is obvious that shipboard personnel work many more hours a week than 35. Watch standing, repairs to disabled equipment, dawn and dusk general quarters, off-duty studies,

and so on, take up much of the individual's time beyond the usual workweek. The quarterly forecast of all-hands evolutions, however, must be based on the realistic assumption that most training takes place during normal working hours.

In preparing the forecast, the training officer indicates the total number of crew-hours that are to be reserved for each all-hands evolution. Thus, during a week in which type training (TYT) is to be conducted, he may assume the utilization of 3 1/2 hours for Saturday inspection, 2 hours for general quarters, 2 hours for a competitive ASW exercise, and 2 1/2 hours for daily quarters and general drills. The reserved hours total 10. On the basis of his computation, the training officer informs all division officers of the results of his calculations, i.e., they may estimate that 25 hours during that week will be available for division activities.

DIVISION QUARTERLY FORECAST OF ACTIVITY. — The division officer may prepare a quarterly forecast of activity to indicate the manner in which time available for division activities during the quarter is to be divided between watch standing, lessons and drills, and routine maintenance and administration. The employment of this forecast is optional because small divisions, such as those on a destroyer-type ship, receive little benefit from its use. It is most helpful in the control of fairly large and homogeneous groups of men participating in diversified activities.

The forecast is simply a weekly breakdown of total hours available during the quarter as indicated by the quarterly forecast of all-hands evolutions. First, the hours needed for watch standing are subtracted from the total. The hours remaining are divided (as in the foregoing paragraph) according to the existing situation. Some routine maintenance, for instance, may have been curtailed recently because of operational commitments. If so, the first few weeks of the quarter should be devoted more to maintenance that to lessons and drills. Thereafter, the allocation of time may more nearly approach a 50-50 basis unless equipment becomes inoperable or an operational emergency arises.

QUARTERLY TRAINING SCHEDULE. — The preparation of a quarterly training schedule requires careful planning and imagination to ensure that needed individual and team training are accomplished.

In figure 13-5, the communication officer included in his quarterly training schedule a certain amount of information of interest mainly to himself. For example, he wishes to verify personally that "fully qualified" entries were made in the service records of all men scheduled to take the examinations for advancement. During August, he must supervise accomplishment of the predeployment procedures. In September, he has to work in three briefing periods for his senior petty officers, to instruct them on the communication aspects of current fleet exercises.

Most of the schedule, however, is devoted to the allotment of specific subjects that are to be taught during indicated weekly periods. A certain amount of instruction should take place during every watch, but a definite schedule ensures that each of the ship's communication drills and exercises is taught at least once every quarter, operational conditions permitting.

WEEKLY TRAINING SCHEDULE. — Toward the end of each week, division officers meet with the training officer to firm up a divisional training plan for the following week. Each division officer indicates the times and types of formal instruction periods he desires. The training officer coordinates the requests and submits a rough schedule to the executive officer for approval.

When approved and published, the weekly training schedule (fig. 13-6) serves as a guide to all hands for the ship's training effort during the period specified. The weekly schedule includes pertinent information on the long-range training schedule plus detailed plans for conducting operation drills and team training, division and interdivision instruction periods, and officer training periods. Because it also lists major maintenance activities, tests, and inspections, it can function as a plan of the week. If any scheduled event is not accomplished, the entry is marked and an explanatory note added nearby.

When space permits, the weekly schedule may include the names of instructors and such details as the locations and times of lectures and movies. Daily training schedules usually are incorporated in the plan of the day.

The weekly schedule makes provision for three categories of training: (1) all hands, (2) military, and (3) professional. All-hands training is best typified by the on-board "know-your-ship" requirements. These requirements apply to all newly reported personnel, regardless of

DIVSKED	July				August				September				
	1 UPK	8 TYT (ASW)	15-17 Enr Mayport	17 Special Ops Mayport	1-4 Miami	5 Special Ops Mayport	15-17 Enr NORVA	18 UPK and Prep Nelm	2 Enr and Nelm	4 Sea Spray	14 UPK	19 Strikeback	28 Noreur ports
	Exams E-3 Prepare for ASW and carrier ops Check equipment during upkeep Review mil and prof requirements for personnel sked to take exams for adv in rating in Aug				Carrier ops Fleet exams E-4—E-6 8 Aug Complete Nelm checkoff Tycom admin insp 23 Aug				Prep flt ops General comm exercise last wk month				
	Instruction												
Jul 1-5 8-12 15-19 22-26 29-2 Aug	Exams E-3 27, 39, 40, 43 ASW comm 6, 7, 29 1, 4, 5, 7, 10, 12 27, 28, 31 14, 16, 17, 29, 30				Aug 5-9 19, 20, 21 Exams E-4—E-6 12-16 38, 44, 45, 55 19-23 Nelm checkoff, admin insp 26-30 32, 33, 34, 35				Sep 2-6 Inst on flt exer Sea Spray 26, 41, 42 9-13 Inst on flt exer Strikeback 26, 41, 42 16-20 35, 36, 37, 55 23-27 Inst on conduct of Z-21-C 46, 47				
	Drills												
Jul 1-5 8-12 15-19 22-26 29-2 Aug	9, 15, 22, 24, 25 As sked by divcom during ASW TYT 2, 3, 8, 11, 13, 15, 18 2, 3, 8, 11, 13, 15, 18, 48				Aug 5-9 22, 23 12-16 51, 52, 53, 54, 56 19-23 Nelm checkoff admin insp 26-30 49, 50				Sep 2-6 as sked flt exer 9-13 as sked flt exer 16-20 as sked flt exer 23-27 Z-4-C, Z-8-C, Z-13-C, Z-15-C, Z-21-C				
Schools	Swabo, SN QM Scol Ftc Npt 1-27 Jul Ham, SA Radio code Ftc Npt 1 Jul - 30 Aug												

105.19

Figure 13-5.—Communication division quarterly training schedule. Numbers opposite the dates are keyed to the communication drills and exercises in figure 13-2.

WEEKLY TRAINING SCHEDULE
OPNAV FORM 3500-21

(1ST, 2ND, ETC.) 1st WEEK OF July 1958

ITEM	MON 30 June	TUE. 1 July	WED. 2 July	THU. 3 July	FRI. 4 July	SAT. 5 July
SHIP'S EMPLOYMENT	UPKEEP	UPKEEP	UPKEEP	UPKEEP	UPKEEP	UPKEEP
INSPECTIONS, EXAMINATIONS		Divers Inspect propellors				
TRIALS, TESTS					0900-Holi-day Routine	0900-Holiday Routine
MAJOR TOPSIDE MAINTENANCE		Paint ship's sides Tuesday and Wednesday				
MAJOR ENGINEER MAINTENANCE		Clean #1 and #3 boilers Tuesday and Wednesday				
OFF-SHIP TRAINING	Mount 51 crew to Dam Neck for the entire week					
COMPETITIVE EXERCISES						
GENERAL DRILLS GEN. QUARTERS	9-11 GQ			9-11 GQ 9-930 Fire drill		
OFFICER TRAINING	13-15 Tactical School		13-15 Leader-ship Discussion			

Tues. 5 men to 4 day fire fighting school

Cancelled due to heavy rain

OPERATIONAL DRILLS *(CIC, Gun, Flt., etc.)* AND TEAM TRAINING *(Watch and Battle Stations)*

NAME OF FUNCTION	MON.	TUE.	WED.	THU.	FRI	SAT
ASW	930-11 ASW-5					
Communi-cations	930-11 CW-2 VIS-4			On-the-job battle		
Gunnery	930-11 GUN-8			station instruction		
Engin-eering	930-11 ENG-1,4			period 930-11		
Damage Control	930-11 DC-6			No drills.		
Combat	930-11 CIC-4,5					

DIVISION AND INTERDIVISION INSTRUCTION PERIODS

OPERATIONS & NAVIGATOR	13-14 "O"-F-4			13-14 "O"-F-5		
GUNNERY & 1ST LT	13-14 I&2-E-2			13-14 B-2 (all crews)		
ENGINEERING & DAMAGE CONTROL	13-14 MM W-1			less engineers 13-14 BT-W-2		
AIR OR REPAIR						
MEDICAL & DENTAL						
SUPPLY	13-14 SK-P-4			13-14 SK-P-4		

KEY FOR BASIC TRAINING *(Division and *Inter-Division Instruction Periods)*

*A - SMALL ARMS	H - LANDING PARTY AND CLOSE-ORDER DRILLS	N - OFFICER NAVIGATION	*T - TELEPHONE TALKERS
*B - BOAT CREWS	*I - INDOCTRINATION & ORIENTATION	O - ORGANIZATION AND GENERAL REGULATIONS	*U - UCMJ AND DISCIPLINE
C - COMMUNICATIONS	J - MILITARY COURTESY	P - PROFESSIONAL PRACTICAL FACTORS	V - OFFICER TACTICAL SCHOOL
*D - DAMAGE CONTROL, FIREFIGHTING AND ABC WARFARE	K - SPECIAL MILITARY DUTIES	Q - SUPERVISED SELF-STUDY	W - WATCH STANDING & SENTRIES
E - CARE OF MATERIALS	*L - LEADERSHIP & CHARACTER GUIDANCE	*R - RECOGNITION & LOOKOUTS	*X - SWIMMING & LIFESAVING
*F - FIRST AID & HYGIENE	M - MILITARY PRACTICAL FACTORS	S - SEAMANSHIP	Y - CODING BOARD
G - GUNNERY			Z - TRAINING FILMS
			PF - PHYSICAL FITNESS

NOTE: Division or rating abbreviation and dash (1st-, E-, BM-, RM-) before key letter indicates divisions or ratings involved. Dash and number (-1, -5, etc.) after key letter shows lesson number. Times of starting and finishing all training activities should be shown in brief form: 9-11, 13-14, 830-10, etc.

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24.2

Figure 13-6.—Weekly training schedule.

rate or rating. Military training applies to the mandatory military requirements for all hands according to pay grade. Professional training is for men in a specific rating group, by pay grade.

Training Records

It is important to an effective training program that the responsible officers know at all times (1) how much training has been accomplished, and (2) how much remains to be done. To have this knowledge on a current basis, numerous records of individual training must be maintained.

To standardize recordkeeping, the Office of the Chief of Naval Operations has developed four forms, one of which should be suitable for any record or schedule needed in the training program. One such form is the weekly training schedule. All three of the remaining forms bear the title General Record; they are distinguished by the designations type I, type II, and type III. The main difference in the three types is a flexible columnar arrangement, which permits any one of the forms to be utilized for several records.

Type I is useful in preparing the long-range training schedule, quarterly forecast of all-hands evolutions, and the division quarterly forecast of activity. At the personal level, figure 13-7 illustrates several uses of the type I form.

Type II may be utilized to maintain both enlisted and officer records of training. Its format is such that a broad column on the left of the sheet permits relatively lengthy entries, such as duties, functions, or training requirements. The other columns are headed by individual names. Figure 13-8 employs type II as a group record of practical factors for enlisted personnel. Practical factors are specific physical functions that all men must demonstrate an ability to perform before they are recommended to participate in an examination for advancement in grade. It is important to each man that his Record of Practical Factors, NavPers 760, reflect all his performance qualifications. By use of a group record of practical factors, the division officer retains the needed information for all men on one readily available sheet. This system avoids the administrative difficulty of making day-to-day entries on a large number of individual records. Periodically, the information is carried forward to an individual NavPers 760 for inclusion in each man's service record.

In figure 13-9, the type II form summarizes data concerning assignments, shipboard qualifications, off-ship schooling, and self-study courses of individual officers. Each topic covered may be supplemented by a more detailed record, as in figure 13-10.

Usually the type III form is reserved for scheduling division and interdivision instruction periods. The obverse side (fig. 13-11) basically is a calendar with a space for each day of the year. Planned instruction periods are noted in pencil. Because of space limitations, the entries ordinarily are coded or abbreviated. When a planned period of training has taken place, the appropriate entry is inked in to indicate its accomplishment. On the reverse side of an interdivisional form, each division officer lists the drills and exercises that apply to his division.

APPLICATION OF TRAINING PROGRAM

The main training concern of the communication officer is to have each man function at maximum efficiency. To accomplish this, it is necessary to ascertain exactly what each is expected to do in a particular rate or rating or in a specific team effort situation. Each man must know exactly what is expected of him and what his responsibilities are. It is insufficient to tell a man: "Know your exercises." He must be told what exercises. Under "Learn safety precautions," specify which one. When you tell him to "Learn the jobs of nearby people," be specific so he won't be wondering exactly which people.

You cannot train, measure progress, or define achievement unless you define what you are trying to achieve.

Billet Analysis

An analysis of the communication billets aboard the ship may solve the problem of determining and describing accurately what tasks there are and who is to be trained to do them. An examination of the jobs assigned to the men listed on the watch, quarter, and station bill is helpful and important in making the analysis. Other sources of information are lists of all machines operated, logs and records kept, and all other duties performed by communication personnel.

GENERAL RECORD (Type I)
OPNAV FORM 1500-30 (10-60)

PERIOD COVERED: FROM date started TO continuous

TITLE
Record of Courses for Advancement in Rating.

COLUMN CAPTIONS NAME AND RATE	DATE LAST ADVANCED	NAME OF COURSE	DATE START	COMPLETED	FINAL MARK	ENTERED SERV.REC.
A.B. SEA, RM3	3-15-64	RM2	4 Aug	15 Sep	3.7	29

GENERAL RECORD (Type I)
OPNAV FORM 1500-30 (10-60)

PERIOD COVERED: FROM (start of cycle) TO (end of cycle)

TITLE
SCHEDULE OF OFF-SHIP SCHOOL TRAINING.

COLUMN CAPTIONS NAME AND LOCATION OF COURSE	NR.	QUOTA DIRECTIVE	LENGTH, CONVENES	DESIGNED FOR	QUOTAS WANTED	QUOTAS USED THIS CYCLE (TOTAL TO DATE)
Basic Damage Control FltTraCen NPT-NORVA	40	List the instruction	5 days each Mon.	enlisted w/o exper.	(KEEP IN PENCIL)	27
Prac. Damage Control Procedures, FTC, NPT	402	which controls your	5 days, 1st & 3rd Mon.	Repair Party	6	8
ABC Defense Monitoring & Decontam. FTC NPT-NORVA	426	quota requests.	5 days, 2nd & 4th Mon.	D.C. Repair Party	3	5

GENERAL RECORD (Type I)
OPNAV FORM 1500-30 (10-60)

PERIOD COVERED: FROM (date cycle started) TO (end of cycle)

TITLE
INDIVIDUAL RECORD OF OFF-SHIP SCHOOL TRAINING.

COLUMN CAPTIONS SCHOOL	NAME AND RANK OF CANDIDATE	ELIGIBILITY Qual.	ELIGIBILITY Sec. Clear.	SERIAL NO. & DATE Quota Request	& DATE Reply to Request	ATTENDANCE DATA Date Start	Date Grad	Mark & Stand.
Prac. D.C. Procedures #(402)	John J. Jones DC2	Yes	None needed	EDE791/55-64 of 30 Jun	CDL 168-64 of 18 July			

Figure 13-7.—Three possible uses of General Record, Type I. 24.1

GENERAL RECORD (Type II)
OPNAV FORM 1500-31

(date started)
PERIOD COVERED FROM 12 Aug 19— continuous

TITLE
Group Record of Practical Factors for Signalmen (SM)

COLUMN CAPTIONS

Page 1 of 3

Date assigned to division.
Date transferred.
Date last advanced in rating.
Date qual. next rate level.

PRACTICAL FACTORS	RATES
PROFESSIONAL REQUIREMENTS FOR SM	
100 PRACTICAL FACTORS	
101 OPERATIONAL	
1 Locate and operate during darkness all light switches for electrical and electronic visual signal equipment controlled from the signal bridge	3
2 Stand watches as signalman on bridge underway and in port	3
3 Construct visual call signs, and look up international call signs for individual ships	3
4 Make and recognize flag and light signals pertaining to breakdown, man overboard, international distress, and storm warnings	3
5 Recognize all visual signal flags and pennants, know the order of reading flaghoist and the significance of dipped, close up, and hauled down	3
6 Render passing honors to naval ships, gigs, and barges, answer dips from merchant vessels	3
7 Perform duties of signalman as a member of a boat crew	3
8 Identify visual aids to navigation, buoys, beacons, lights and ranges	3
9 Take visual bearings using azimuth and bearing circle and alidade	3
10 Take fathometer reading	3
11 Perform duties of lookout and identify a Types of U S ships and aircraft b Foreign types of ships and aircraft	3 2
12 Transmit and receive code groups by flashing light at an approximate speed of a Eight groups of 5-character code a minute b Nine groups of 5-character code a minute c Ten groups of 5-character code a minute	3 2 1
13 Transmit and receive plain language messages by flashing light at an approximate speed of a 40 characters a minute (8 wpm) b 50 characters a minute (10 wpm) c 60 characters a minute (12 wpm)	3 2 1
14 Transmit and receive plain language messages by semaphore at an approximate speed of a 75 characters a minute (15 wpm) b 100 characters a minute (20 wpm) c 125 characters a minute (25 wpm)	3 2 1
15 Prepare a visual message for transmission using proper form	3
16 Construct any commander or collective call sign using type and unit indicators and be familiar with the use and system of constructing all other visual call signs	2
17 Encode and decode any naval or international signal contained in effective visual communications publications, demonstrate rules of visual responsibility	2
18 Recognize aircraft emergency signals, including special flight gesture signals to ships	2
19 Identify foreign flags and ensigns of major maritime powers	2

This is a cut-out sheet from NavPers 760 pasted on the card.

Date & initial | Date & initial

Recommend that all entries in this form be written in ink. When a man is transferred simply cross out his column.

Number all pages of this record: Page 1 of 3
Page 2 of 3
Page 3 of 3

Don't Gundeck this record.

Figure 13-8.—Enlisted group record of practical factors.

GENERAL RECORD (Type II)
OPNAV FORM 1500-31

PERIOD COVERED FROM 1 July 19__ (date started) TO continuous

TITLE

Officer Assignment, Qualifications, and Courses

COLUMN CAPTIONS	Name and rank	Name and rank	Name and rank	Name and rank					
Date reported aboard									
Source of commission									
Anticipated length of tour									
Actual detachment date									
Months previous shipboard exp.									
Months prev. exper. in type									
Date of present rank (modify when promoted)									
CHRONOLOGICAL RECORD OF PRINCIPAL SHIPBOARD ASSIGNMENTS (shows progressive utilization in more responsible jobs)									
date and title of 1st principal assignment									
date and title of 2nd principal assignment									
date and title of 3rd principal assignment									
RECORD OF MAIN SHIPBOARD QUALIFICATIONS (enter previous qualifications in this record when officer reports aboard)									
Qualified as:									
Officer of the Deck									
CIC Watch Officer									
Coding Board Member									
Other (specify)									
RECORD OF OFF-SHIP SCHOOLS ATTENDED WHILE ATTACHED TO THE SHIP (do not list short courses lasting only one week or less)									
School									
Date enrolled									
Date graduated									
School									
Date enrolled									
Date graduated									
RECORD OF SELF-STUDY COURSES (NavPers and type commander courses)									
Course Title									
Date started									
Date completed									
Course title									
Date started									
Date completed									
Course Title									
Date started									
Date completed									

(Use reverse side for additional entries)

Figure 13-9.—Summary of officer assignments, qualifications, and courses. 24.3

GENERAL RECORD (Type II)
OPNAV FORM 1500-31 (10-60)

Date started continuous

PERIOD COVERED: FROM TO

TITLE

Officer of the Deck Training Record

COLUMN CAPTIONS	Name and rank	Name and rank	Name and rank		
OFFICER HAS ACQUIRED A KNOWLEDGE OF THE FOLLOWING:					
Voice radio procedure and voice calls (ACP 125)		Date & initials of certifying officer.			
Contents of the Allied Naval Signal Book (ATPI, Vol. II)					
Contents of the OOD Standing Order Book		Note: Tactical school periods should be scheduled as opportunity permits but main emphasis in officer training should rest upon each officer's demonstration of his professional qualifications and not upon means for helping him become qualified.			
Bridge Emergency Procedures					
Rules of the Road					
OFFICER HAS DEMONSTRATED HIS ABILITY TO:					
Solve 5 simple maneuvering board problems in 10 min.					
Send & receive flashing light at 6 wpm.					
Read on sight & decode 25 flag hoist signals					
etc. etc.					

24.3

Figure 13-10.—Supplemental officer training record.

The Manual of Navy Enlisted Classifications (NEC Manual), NavPers 15105 and the Manual of Qualifications for Advancement in Rating, NavPers 18068 are available sources of information for billet analyses. The former publication lists job titles and their applicable NEC code numbers. A complete rundown, by rate, on functions and tasks that enlisted men must be able to perform is provided by NavPers 18068; it thus serves as a basic reference for those concerned with the assignment and utilization of enlisted personnel.

4.3

After the billet analysis is complete, a determination should be made of—

1. The order in which training will be given.
2. How much each man already knows.

GENERAL RECORD (Type III)
OPNAV FORM 1500-32 (10-60)

PERIOD COVERED: FROM 1 Jan 196_ TO 31 Dec 196_

TITLE

Division Instruction Periods: OC Division

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1		Sat	Sat									
2		Sun	Sun									
3	C-1	C-16	C-27									
4	Sat											
5	Sun	C-17	C-39									
6	C-4											
7												
8	C-5	Sat	Sat									
9		Sun	Sun									
10												
11												
29												
30												
31												
WEEKLY OR BIWEEKLY 1ST												
WEEKLY OR BIWEEKLY 2ND												
WEEKLY OR BIWEEKLY 3RD												
WEEKLY OR BIWEEKLY 4TH												
WEEKLY OR BIWEEKLY 5TH												
MONTHLY												
QUARTERLY												
SEMI-ANNUAL												
ANNUAL												

Notes: Enter planned lessons in pencil: ink in the entry when actually accomplished Show Saturdays and Sundays

24.8

Figure 13-11.—The type III form usually is reserved for group instruction periods.

3. The time, place, and methods for providing the needed instruction.

PRIORITY OF TRAINING.—In establishing priorities for training, the principal consideration usually is the ship's operating schedule. The immediate training needs center around the most commonly used equipment.

An unexpected event may present a training opportunity that can be used to good advantage. For example, the division commander issues an order to stand by for tactical drills while steaming in company, the evolutions to be indicated by flaghoist. All signalmen and strikers should be ordered to the signal bridge to participate in the training.

Too frequent breakdown of equipment, abuse of tools and equipment, and uneconomical or inefficient operational performance are

manifestations of a need for training. Other symptoms are situations where petty officers are working while nonrated men run errands, stand by, or just loaf.

Low morale may be caused by a feeling of unimportance or incompetence, stemming from a lack of training. Such conditions may indicate lack of leadership and also reveal that some officer or petty officer is not taking advantage of training opportunities.

DETERMINE HOW MUCH EACH MAN KNOWS.—A determination of how much each man knows is important. Nothing is more detrimental to interest in training than to require personnel to attend instruction in a subject they already know. Individuals may be examined by written or practical tests, by observation of their daily performance of duties, or evaluation of past experience. When the extent of knowledge of duties is determined accurately, the communication officer has a more positive basis on which to apply the training program.

On-the-Job-Training

Primary emphasis should be given on-the-job training of personnel to perform the duties assigned them as individuals or in crews, parties, or teams. Instructions may take place during watches, drills, or other evolutions. All officers and petty officers are responsible for on-the-job training of personnel, and they should take advantage of every opportunity to conduct some phase of instruction in the men's duties.

On-the-job instruction is mainly for teaching skills. It is the best method for complex operations. This method teaches skills rapidly and—more important—completely. When instruction is finished, the trainee can perform. Because the method itself is simple, the practical man finds it relatively easy to teach by this method. There are limitations, of course: other methods are better for teaching principles and theory; the number of trainees who can be taught at one time is limited. The latter limitation, however, is more apparent than real. On board ship, the number of occasions at which more than 6 men (for example) are to be taught one skill at the same time is unusual. This is particularly true of destroyer types.

On-the-job training requires complete knowledge of the subject, ingenuity, and initiative on the part of the instructors. They should take advantage of every training opportunity that presents itself.

Classroom Instruction

Even though all skills and some of the related information may be taught on the job, certain basic information, which leads to a better understanding of the operations, may be taught best in a classroom situation. Such instruction should be scheduled regularly, but not allowed to substitute for on-the-job instruction.

Fleet schools, such as the fleet training centers, feature short operational or team training courses. BuPers-controlled schools, on the other hand, provide basic and advanced technical instruction applicable to specific ratings. Normally, the type commander controls the input to these schools from the forces afloat. The educational services officer has information concerning availability of quotas and the method of obtaining them.

The current Catalog of U. S. Naval Training Activities and Courses (NavPers 91769) is a valuable compilation of training available at BuPers and fleet schools.

Individual Study and Practice

Self-study is mandatory if the enlisted man is to complete the requirements for advancement in rating and gain further knowledge of subjects needed to improve the efficiency of the ship. Officers also must devote time to individual study in order to be considered for promotion and gain knowledge of special skills. Individual study by all hands should be encouraged.

To ensure a successful training program, self-study requirements should be established for all communication personnel. Such requirements can be in the form of Navy training courses and associated correspondence courses. Training Publications for Advancement in Rating (NavPers 10052) contains information concerning appropriate study material for communication personnel. Some form of control, such as a checkoff list, should be used to ensure that personnel complete the required study.

Navy training courses supply information the enlisted man needs to perform the duties of his rating. The value of the training course increases if its content is correlated closely with on-the-job instruction. Supervision of the use of the training course is the responsibility of the division officer, who must assure proper correlation. The educational services officer is in charge of procurement and issue of training course books. Most of them are supplied to

the ship automatically, but replacements must be ordered. Associated correspondence courses must be requested individually, by the men concerned, through the educational services officer.

As new training and correspondence courses become available, announcements concerning them are made in such publications as the Naval Training Bulletin, All Hands, and the Naval Reservist. In addition, NavPers 10052 is revised annually, and the List of Training Manuals and Correspondence Courses, NavPers 10061, is revised semiannually.

A thorough knowledge of the appropriate directives controlling the Navy system of advancement in rating is mandatory for all officers and key enlisted personnel in administering the shipboard training program. Following are the governing references pertaining to advancement in rating:

Bureau of Naval Personnel Manual.

Manual of Qualifications for Advancement in Rating (NavPers 18068), which includes instructions for the administration of servicewide examinations for enlisted personnel.

Training Publications for Advancement in Rating (NavPers 10052).

Orientation of New Personnel

Every new man reporting aboard should be given immediate instruction in topics that will speed his assimilation into the crew. This program, carried out on a shipwide basis, should be coordinated by the training officer. The program is directed chiefly toward personnel new to the Navy, but everyone reporting aboard should receive some orientation. This training phase takes the form of reading both the ship's and operations department's organization and regulations manuals, becoming acquainted with the watch bill, and the policy on leave, liberty, and so forth. Essentially, every new man should be instructed in ship's regulations, organization, history, and what is expected of him as a crewmember, and what he may expect in turn. This training should emphasize the necessity for complete knowledge of his job by the individual and the need for teamwork in making the ship an efficient fighting unit. A checkoff list should be established for uniformity of orientation of communication personnel.

As a part of the orientation of new personnel, and as a benefit to all hands on board, some ships develop "Know your ship" or "Minimum requirements for all hands" local training courses. This program helps to develop the smartness and efficiency that distinguish a capable and well-trained ship's company.

CONTROL DEVICES

Controlling, in its administrative sense, is evaluation of progress or results. It is concerned with ferreting out data relative to direction and amount of achievement so that future corrective action may be taken. Any device used to collect these facts is called a control device. Inspections are control devices used at the point of activity. The supervisor sees at firsthand what has been or is being accomplished. Because this practice is not always possible, other control devices are utilized. In the field of training, these devices usually are records.

Two principles must be borne in mind in establishing or using any system of control: (1) The system must be accurate, effective, and impartial; and (2) a practical system of control can exist only in relation to a standard. If the communication training program has no objective, no policy, no method, none of the control devices serve any useful purpose.

The specific purposes of having a control system on the training program are to find out if (1) the objectives of the program are being met according to plan; (2) prescribed methods are used; (3) each person responsible is doing his part; and (4) basic policy is observed.

Because the program is aimed at improving individuals, these additional questions must be answered:

- Which individuals are being trained?
- What training are they receiving?
- How well are they being trained?

Inspections

Inspections as a control device for a training program do not differ materially from other inspections. The inspector has to know what he is looking for, and must employ uniform standards in judging units inspected. If the inspector does not use standards, or does not obtain meaningful facts, irrelevant considerations enter into his judgment, and his opinion loses validity.

Progress Charts

The main purpose of progress charts is to display graphically the progress of the trainee. Such a chart should provide sufficient information so that the communication officer can ascertain quickly the degree to which each trainee has completed the units of instruction, and what remains to be done. Use of checkoff lists or progress charts, such as the equipment qualification chart shown in figure 13-12, is essential to the training program.

Training records must be maintained not only for progress with respect to advancement in rating of the individual but also for showing qualification in team aspects such as firefighting and damage control. Examples of many types of records that can be maintained are available, and determination of the exact format to be used is a matter of individual choice.

To summarize, the communication officer must maintain a training and educational record for each man in his division to show special qualifications set forth in the BuPers Manual, records of completion of training and educational courses, and progress of training for advancement in rating.

Evaluation of Instructions

The communication officer should check the on-the-job performance of instructor personnel of his division. Some of them may be graduates of a Navy instructor school and may actually have been assigned to instructor duties at some time. Others may not have had the benefit of such training or experience. But all Navymen must become qualified instructors, because training is a continuing process.

Basically, three factors can be employed in evaluating the instructor: (1) knowledge of subject matter, (2) knowledge and application of instructional techniques, and (3) instructor characteristics (i.e., voice, diction, delivery). The Manual for Navy Instructors, NavPers 16103-C, contains excellent advice on instructor evaluation.

Efficiency of Administration and Operational Readiness

Control devices may be applied also to the following aspects of communication administration and operations to reflect the effectiveness of a training program:

1. Performance during maneuvers and exercises, including display of self-sufficiency and grades attained in exercises and inspections.
2. Military character and qualities of leadership displayed by communication personnel.
3. State of morale of communication personnel.
4. Material condition of the communication spaces and equipment, including ability of personnel to take corrective action promptly when material casualties occur.
5. Proportion of men engaged in bettering themselves by educational pursuits and percentage passing fleet exams for advancement in rating.
6. Speed, orderliness, and efficiency with which drills and daily evolutions are carried out.
7. Smart appearance of communication spaces and personnel at all hours.
8. Knowledge demonstrated by personnel in such matters as insurance, savings programs, ship's regulations, and operating schedule.

TRAINING DURING SHIPYARD OVERHAUL

During shipyard overhaul, training must be subordinate to the primary objective—the best possible overhaul. Most yard overhauls are trying periods. Work items listed under "ship's force accomplish" (SFA) often take all available personnel for the seemingly endless jobs to be completed in accordance with an exacting time schedule. In addition, there are personnel requirements for messenger watches, fire watches, shore patrol, mail clerk, and so on.

Before entering the shipyard, personnel should be briefed on the need for detailed work requests and thorough inspections to be carried out before, during, and after the yard work. As a related training item, it is important that key personnel understand the importance of making a careful inspection of yard work before recommending acceptance. The ship bears the ultimate responsibility for all work performed by the yard.

Planning for administration of personnel during the shipyard overhaul should include instruction regarding their employment in special tasks, duty assignments, and watch, training, and leave schedules.

Leave for personnel must be planned during shipyard overhaul periods. Equable distribution of leave is necessary to ensure that sufficient

Name and Rate \ Equipment	AN/SRT-15	AN/URC-32	TED-9	AN/GRC-27A	AN/SRR-11	R-390/URR	AN/URA-8B	AN/SGC-1A	TT-23/SG
SHAFFER, E. J., RM1		3		6		1 / 2	2	1 / 1	
CROWLEY, H. T., RM2	6	5 / 10		6 / 15	1	5	3	2	
SKELLY, W. W., RM2		3	2	3		1 / 2	1		
PRESTIL, J. V., RM3	2	10 / 3	2	3			1	2	
SCRUGGS, W. A., RM3	2		2	3		2	1	2	
SELLERS, W. E., RM3		10		1	2		1		
HAMILTON, M. L., RMSN	2	3			2	2	2	3	
RICE, L. K., RMSA	6 / 25 / 1	3 / 6	4 / 5	2	5	2 / 1	2	1 / 2	

LEGEND

Circuit theory and unit function.	Space filled in indicates fully qualified.
Operation of the equipment only.	Number in space indicates number of hours of instruction.
Calibration, adjustment, checks, and measurement.	
Signal tracing, trouble isolation, parts replacement.	

24.3.2

Figure 13-12.—Equipment qualification chart.

qualified personnel are always on board so that ship routine and work continue uninterrupted.

The regular watch bill must be adjusted during the yard period because of vacant billets resulting from personnel away on leave or at school. In planning for the yard period, it is essential to list the requisite watch stations and the communication personnel who will man them. Obtain a copy of shipyard regulations in advance of preparation of this list to assure that required watches are planned for. Normally, the shipyard will forward a copy of instructions

and regulations to the ship ahead of beginning the overhaul.

PLANNING FOR TRAINING

The training objectives to be accomplished during the yard overhaul are based largely on the personnel situation. Local training facilities (shipyard training facilities and nearby fleet schools) may be utilized. Deciding how much training is to take place away from the ship is difficult, because of the heavy demands on personnel while the overhaul is in progress.

The navy yard (or other shore-based repair facility) in which the ship will receive her overhaul always is known in advance. If the overhaul is in a shipyard near a fleet training center, the excellent training facilities available at this type of activity can be used to good advantage. Figure 13-13 is fairly representative of the overhaul training plan.

Training to be accomplished must be worked out carefully in advance of the overhaul. It should encompass both officer and enlisted training; it should include requirements for individuals in the operation of specific equipment, and team training in such important functions as firefighting. Upon arrival at the yard, a visit to the training aids center, section, or facility may be rewarding. Training aids such as scale models, mock-ups, and charts may considerably reduce instructional time. Training plans should be worked out with key enlisted personnel, then submitted to the operations officer for approval. He, in turn, submits the overall operations department shipyard training schedule to the executive officer for final approval and inclusion in the ship's integrated training schedule for the yard period.

A navy yard overhaul experience can be an education in itself. Actually, there are many opportunities for on-the-job training while completing ship's force work. Personnel can learn a great deal by observing installation of new equipment and facilities. Where mutually agreeable, ship's personnel often can learn by working with yard personnel in the installation or overhaul of equipment.

REFRESHER TRAINING

A major phase of the training cycle is post-overhaul refresher training. In anticipation of this event, planning relative to completion of the overhaul must be detailed carefully for the final weeks within the shipyard. Emphasis is shifted at that time from the overhaul to operational routines.

READY-FOR-SEA PERIOD

A ready-for-sea (RFS) period is assigned by the type commander to afford the commanding officer time to prepare his ship for sea upon completion of the actual overhaul. Prior to the RFS period all yard work items must be reviewed for completeness, and a final report of their status made to the operations officer. On completion of the RFS period, the captain is expected to report to the type commander and other interested commands that the ship is in all respects ready for sea. The communication officer ensures that all matters affecting communications have been taken care of, that equipment is in good operating condition, and that the watch bill is up to date. All hands should be kept fully informed of what is expected of them during these final weeks in the yard.

For training purposes, plans for the final weeks of overhaul should provide for—

1. Completion of the schedule of forthcoming training and operational tests of equipment.
2. Completion of the fleet training command's arrival inspection checkoff list.
3. The return of personnel from leave and schools.
4. Inauguration of the new watch, quarter, and station bill.

Because refresher training is the ship's next major assignment, the type commander's requirements for items to be completed before beginning that training should be studied and plans made to assure compliance. The communication officer should review the training command's standard training requirements, which include the communication exercises required during refresher training.

INDIVIDUAL SHIP EXERCISES

The individual ship exercise (ISE) period is assigned to provide time for orientation of ship's company to operational functions, and to make adjustments to organizational matters and material before commencing refresher training. Basic training is conducted in communication drills and exercises, including walkthrough of exercises listed in the training command requirements.

TRAINING PLAN FOR SHIPYARD OVERHAUL PERIOD

COURSE	LENGTH	LOCATION	CONVENING DATE	PERSON ATTENDING
OFFICERS				
CIC watch officer	4 wks.	Dam Neck, Va.	1 Feb 3 Mar	ENS MOOR ENS GROVE
ASD deck watch officer	3 wks.	Key West	12 Jan	ENS KLINE
Electronics repair	16 wks.	Treasure Island	7 Mar 3 Feb	LTJ DOE LTJ FITZGERALD
Loran navigation	1 wk.	Local	1 Mar	ENS BROWN
Emergency ship handling	2 days	Local	Each Monday and Wednesday	1 officer each week for 8 weeks
ENLISTED MEN				
CIC team	2 wks.	Local	3 Mar	CIC team
Fire fighting	2 days	Local	Every Monday and Wednesday	10 men each course
Telephone talker	3 days	Local	Every Monday	5 telephone talkers each course

SHIPBOARD TRAINING, WEEKLY SCHEDULE

COURSE	MON	TUES	WED	THURS	FRI
			0830–1000		
Visual communications	A		A		A
Radio communications	B		B		B
Engineering		C			
Landing party		D		D	
			1000–1130		
Seamanship			E		E
Navigation		F		F	
Gunnery				G	
			1400–1600		
Swimming qualifications			H		H
Athletics			I		

DESIGNATOR	PERSONNEL ATTENDING	IN CHARGE	LOCATION
A	Quartermasters	Op. Off	Rm 6 Bldg 72, yard
B	Radiomen	Op. Off	Rm 4
C	Eng. strikers	Eng. Off	Rm 3
*D	Landing party	Wep Off	Rifle range
E	Deck strikers	Wep Off	Rm 6
F	Quartermasters	Nav	Rm 4
G	Gunnery strikers	Gun Off	Rm 3
H	All hands not qualified swimmers	Athletics Off	Swimming pool
I	Personnel not in duty section	Athletics Off	Rec. area

*1st of each month

LESSON PLANS AND INSTRUCTOR: FIRST WEEK

DESIGNATOR	1st PERIOD	2nd PERIOD	3rd PERIOD
A	QMC Signaling procedures	QMC Signal book	QMC Call signs
B	RMC Radio procedures	RMC Radio procedures	Radio officer Security
C	MMC Maintenance		
D	Landing party officer Firing the range	Landing party officer Close order drill	
E	BMC Qualifications for rating	BMC Splicing	
F	Asst. navigator Log writing	QMC Maintenance of equipment	

Figure 13-13.—Typical training plan during the overhaul period. 105.20

Before departure from the yard, it is desirable to brief communication personnel on the forthcoming operating schedule and the general schedules to be followed while undergoing refresher training. It is suggested that this review include a brief talk by the communication officer on what he expects of the division, emphasizing overall ship requirements for communications from the commanding officer's point of view. The ship's organization and regulations manual should be checked carefully to be sure all communication requirements are met, and that personnel are briefed on what to do.

The instructions and drills to be conducted should be planned in advance for each day of the ISE period and integrated carefully with the overall ship training. The communication officer should hold a short meeting each day with key enlisted personnel to discuss the next day's training schedule and instruction assignments. These personnel then pass the word to the communication gang. Each man must know in advance what training will be conducted. The communication officer must plan far enough ahead so that his proposed schedule can be approved by the operations officer and submitted to the executive officer for inclusion in the daily and weekly training plans for the ship.

FLEET TRAINING COMMAND

Refresher training of all fleet units is under the cognizance of the training command, which is a type command of the fleet organization. It is concerned essentially with training groups of men into teams and crews. Commander, Fleet Training Group (COMFLETRAGRU) is the local representative of the training command. He supervises fleet schools and directs the afloat training conducted by the underway training unit (UTU). The UTU is composed of officer and enlisted shipriders (as they are known in the training command) who oversee shipboard training of the crew for periods varying from 3 to 11 weeks, depending, among other considerations, on the type of ship. During this period the ship undergoes a progressive series of exercises, culminating in a comprehensive battle problem to evaluate her battle readiness.

Refresher and team training conducted with the assistance of the training command is in addition to those drills, schools, and exercises held aboard the ship as part of the regular training program carried on continuously under the direction of the ship type commander.

Arrival Inspection

On reporting for refresher training, the ship is accorded a welcome in the form of an arrival inspection. The purpose of this combined administrative and material inspection is to determine if the ship is ready to commence training. This inspection is based on the arrival inspection checkoff list. Emphasis is placed on items that tend to handicap training, if they are not in good order. If effective effort was made to meet requirements of the arrival inspection checkoff list, and all communication equipment is in good operating condition, the communication division is declared ready to commence training.

For the officer dealing with the training command for the first time, the refresher training period may prove a trying experience. For a period of about 6 weeks, 5 days a week, he should expect reveille about 0500, to be underway at 0600, and to return to port anywhere from 1700 to 1900.

Team Training

During the refresher training period, emphasis is on team training—the techniques, methods, and procedures of operating machinery and equipment on battle and watch stations in a team situation. The CIC team and damage control repair parties are, perhaps, the best examples of operational team performance. Effective communications also demands team performance, and many of the training exercises required of destroyer types reflect this need.

Lesson Plans and Syllabuses

Training commands in both the Atlantic and Pacific Fleets have prepared extensive lesson plans and syllabuses to assist ships in planning and conducting training. These references are readily available, and may be used to ensure inclusion in the ship's daily training plan of all important elements of team training.

These ready-made training media in no way prevent the ship from developing her own lesson plans or syllabuses, if considered desirable. In this connection, the Manual for Navy Instructors and Instructor Training may be helpful.

REFRESHER TRAINING UNDERWAY

Once the refresher training period is underway, the ship is expected to perform her own training. The fleet training group schedules exercises that require services and assigns shipriders to assist in on-the-job training. Shipriders are personnel especially qualified in the various phases of shipboard operations, such as damage control, CIC, ASW, and communications. They assist by inspecting or instructing during exercises. These same shipriders grade the ship on battle problems.

During the refresher training period, the ship schedules and conducts the various communication, damage control, gunnery, and other exercises required by the training command and applicable NWP and FXP publications for training for her type of vessel. With shipriders observing, assisting, and coaching, the ship goes through the scheduled exercises—those including the assistance of servicing ships and aircraft—and the internal drills in damage and engineering casualty control, first aid, NBC attacks, and the like.

BATTLE PROBLEMS

Exercises during the early part of the training period are paced at a deliberate rate. Gradually, the number and complexity are increased, together with the emphasis on realism that is a primary factor in training.

Midterm Battle Problem

Midway in the training period, the ship may receive a midterm battle problem. This event is designed to simulate, as nearly as possible, conditions that might prevail during actual combat, and affords the ship an evaluation of her progress in training. The fleet training group normally provides a full inspection team for this problem, and conducts a critique afterward to apprise the ship of any weaknesses in operation. From this point on, emphasis in training is directed to correct these shortcomings.

Operational Readiness Inspection

The final battle problem, or operational readiness inspection (ORI), is the official evaluation of the ship's combat readiness on completion of refresher training.

COMMUNICATIONS DURING REFRESHER TRAINING

The basic requirements for training plans are (1) those contained in FXP 3 and (2) the training command's standard requirements for the ship type. Other elements that may bear on the plans are the arrival inspection report of deficiencies, weaknesses already known to the communication officer, and the daily shiprider reports that list deficiencies noted during the daily underway training.

Training in communications has to be integrated with the overall ship training schedule for any given day. Drills in shifting frequencies, for example, obviously cannot be conducted when the ship is engaged in an exercise in which maintenance of communications is important. The ship"s daily and weekly training plans are built around the weekly operation schedule, promulgated by the fleet training group, which lists exercises to be conducted by the ship requiring services. When the ship is scheduled for refueling from a tanker, the communication officer should arrange visual communication drills while joining up. Similarly, he must plan to conduct infrared drills with a carrier during night plane-guarding operations.

It is vital that the communication officer impress key personnel with the importance of maintaining lines of communication within the division so that all hands are briefed each day on training planned for the following day. He should plan daily and weekly training schedules with leading petty officers, and review the next day's training each evening for any last-minute changes.

The training-minded communication officer should bear in mind that the training schedule he prepares for the refresher training period must be flexible and subject to change, depending upon conditions that may vary from day to day.

TYPE TRAINING

Type training includes training in the various tasks assigned to naval vessels of a particular type. In type training, the self-sufficiency and smartness displayed by the ship indicate to a marked degree her state of training. This training encompasses tactics, screening, emergency ship handling, underway replenishment, rescue operations, competitive exercises, and participation in various operations. (These

operations include distant deployment designed to provide training in antisubmarine warfare, air defense, or escort of convoy.) Other features of type training provide annual qualification in shore bombardment, gunfire support, and the like. Communications, of course, is vital to the success of type training operations.

The chief concern of the communication officer in type training, as in all other operations, is to ensure that the media of intership exchange of information is as near perfect as possible.

COMPETITIVE YEAR

Closely allied with type training is the requirement for completion of certain competitive exercises by vessels of the same type. The competive year parallels the fiscal (or training) year, running from 1 July to 30 June. The battle efficiency competition between ships of the same type is designed not only for training but also serves as a measuring device for evaluating combat readiness. Controlled exercises designated for this evaluation are taken from FXP 3, the basic training exercises publication, and are agreed upon mutually by the appropriate type commanders in both the Atlantic and Pacific Fleets.

In the destroyer force, orders and standards for controlled battle readiness (competitive) exercises are incorporated in either Orders and Standards for Battle Readiness Exercises (DESBATREAD) or the Destroyer Competition Manual (DESCOMP).

The foregoing discussion should not be interpreted to men that only exercises listed in DESBATREAD are conducted during the training year; they represent the type commander's minimum requirements for valid evaluation of the ship. These selected exercises conducted for the battle efficiency competition comprise only a small fraction of the entire type training program.

The communication officer incorporates in the training schedule as many as possible of the communication exercises listed in FXP 3. Particular attention is required to ensure that the prerequisite communication exercises listed in DESBATREAD are completed preceding the conduct, semiannually, of the overall communication exercise for competitive purposes.

In addition to the specific criteria provided by FXP 3, the following considerations govern evaluation of exercises:

1. Proficiency of teamwork.
2. Efficiency in handling daily communications.
3. Alertness in handling traffic.
4. Ability to handle casualties.
5. Proficiency during fleet problems and tactical exercises.
6. Adequacy of shipboard training program.
7. Condition of registered publications and RPS files and accounts.
8. Proper transmission security.
9. Proper security measures taken in the handling, marking, and destruction of classified information.

The foregoing items purposely duplicate information contained in other publications, but they provide the communication officer with an indication of the bases on which his ship will be evaluated so that training can be planned to stress necessary qualities.

RESPONSIBILITY FOR TRAINING

The U. S. Navy Regulations and NWP 50 amply state the training responsibilities of all officers. Suffice it to say here that the communication officer has full responsibility for the training of his personnel in the many and varied phases of communications, and must prepare himself accordingly.

The communication officer aids and advises the operations officer in directing training within the division, and coordinates the program with the departmental and overall training program of the ship.

A review of the duties normally associated with administering training within the communication division includes the following:

1. Plan, develop, and coordinate the division training program in accordance with the departmental and ship's training objectives.
2. Plan, develop, and ensure the preparation of division training schedules, and obtain space and materials required to support these schedules.
3. Select and train instructors within the division.
4. Supervise preparation of training materials, and review syllabuses and lesson plans prepared within the division.
5. Obtain, maintain custody, and issue required training aids and devices.
6. Supervise the preparation, administration, and correction of tests in practical

factors within the division, and arrange for examinations for advancement in rating.

7. Observe instruction given at drills, on watch, and on stations, and make recommendations as appropriate.

8. Maintain training records and prepare required reports.

9. Keep personnel informed of training progress, using charts and other records.

10. Submit requests to the operations officer to schedule drills and exercises.

11. Keep communication division personnel informed of available training courses, correspondence courses, fleet and service schools, and encourage their use.

12. Consult with the operations officer in all training matters affecting the division.

Ideally, an officer should have at least a working knowledge of the tasks and responsibilities assigned to all those serving under him. This quality is the real foundation of command capacity, and nothing else serves so well to give an officer an absolutely firm position with all his subordinates.

The greater part of modern naval operations, however, is noted for its diversity and complexity. For this reason, it is virtually impossible for a general line officer to know more about radio repair than his technicians, or more about the workings of the ECM gear than a specialist in electronics repair.

It readily can be understood that there must be a different approach to the question of what kind of knowledge an officer is expected to possess, otherwise the requirement would be unreasonable and unworkable. The distinction lies in the difference between the ability to perform a task well and to judge when it is done well.

Training without leadership (or vice versa) is impossible. Whatever his rank, the naval officer stands before his men as a leader. Whether he is training them for action, or merely performing some routine duty, he represents naval leadership to those under him. Matters of correct attitude, personal conduct, and awareness of moral obligations and of obligations to the Navy and the men he commands do not lend themselves to control by a set of rules. They must be lived by the individual. The naval officer must set a high standard and inspire confidence in those under him. In the final analysis, the success of any officer's efforts depends upon his setting the very best example in everything he does, and practicing what he preaches.

CHAPTER 14

MAINTENANCE

Reliable communications depend greatly upon the equipment operating at optimum efficiency. Maintenance of material is a major factor contributing to battle readiness; because it is essential that none of the features of shipboard maintenance be overlooked or neglected, a continuing maintenance program is needed to avoid equipment failures at crucial moments. The program itself must provide command and all subordinate supervisory levels with the tools for effectively planning, directing, and controlling all preventive maintenance requirements within the ship.

Maintenance may be broken down into three broad categories.

1. Corrective maintenance: the sum of those actions required to restore equipment to an operational condition within predetermined tolerances or limitations.

2. Preventive maintenance: the sum of those actions performed on operational equipment that contribute to uninterrupted use of the equipment within design characteristics.

3. Checks: standard procedures to determine if the current operational status of an equipment is within the tolerances and limitations of the designed performance standards. When carried out at prescribed intervals, checks are a part of preventive maintenance.

For a maintenance program to be effective, at least the following conditions are necessary:

1. The program must be realistic and within the capabilities of the ship's force to accomplish.

2. Operating personnel should conduct all of the preventive maintenance on the equipment they operate.

3. All personnel should understand the necessity for and importance of maintenance.

4. Persons conducting preventive maintenance should be familiar with sources of information on maintenance procedures.

5. An on-the-job training program must be pursued to attain and retain individual maintenance proficiency.

Communication personnel should have the direct responsibility of both maintaining and operating the ship's communication equipment. The alternative to this procedure is that, when equipment malfunctions, repairs are scheduled along with needed repairs to other shipboard electronic equipment. The main disadvantage of such a system is that if several different types of equipment are in need of repair simultaneously, a shortage of ETs may necessitate a delay in the correction of one type or another. If communication equipment, which in need of repair is given a low priority as compared to—say—radar gear, the communication force might have to improvise in assigning equipment, which could prove a severe handicap.

It should be immediately obvious that the better trained the operators are in the maintenance and repair of their equipment, the more assurance the ship has that effective communications will not be disrupted because of a routine casualty or outage.

MAINTENANCE POINTERS

To be effective, a preventive maintenance program must be systematic, and it must be laid out in an orderly fashion to accomplish prescribed items of work at regular intervals.

To actually prevent a breakdown, there isn't much we can do. A tube that tests satisfactorily today, for example, may go out tomorrow. The only work that is preventive is of a mechanical nature: lubrication, checking tube clamps and electrical connections for tightness, repairing frayed leads, and the like. But this does not mean that the preventive maintenance program should stop there. About half the secret of a successful program lies in detecting small troubles as they occur, and having them corrected before they get beyond control.

The big problem in any preventive maintenance program is training people to know what to look for, to ensure that they look for those signs of trouble, and finally to make certain that they are reported as soon as they appear. Attaining such a goal and overcoming the obstacles placed in its way require constant

attention by all hands, as well as some kind of continuing training program.

To ensure that his assigned equipments are in fact being maintained properly, the communication officer himself must make frequent inspections. Routine material inspections by the commanding officer or the department head are no substitute for thorough examinations by the person directly responsible for upkeep and repair. Periodic maintenance checks by specifically named persons are extremely important. Whenever possible, these checks should be verified personally by the communication officer. Because a check is ticked off as accomplished is no automatic guarantee that the job actually was done.

This section is confined to a general discussion of matters to be considered in connection with maintenance of radio equipment.

TRANSMITTERS AND RECEIVERS

Transmitters and receivers are comparatively sensitive and delicate machines. As such, they are subject to the abuses of every man-used instrument. The conditions of shock, temperature control, and climatic variations to which they are subjected aboard naval ships are severe.

Salt particles and dust are the worst enemies of receiving and transmitting equipment. An accumulation of dust prevents proper cooling, which, in turn, causes the rapid deterioration of circuit components. Salt corrodes contacts and can damage the equipment severely. Every transmitter and receiver should be cleaned periodically with a vacuum cleaner.

The equipments should be turned on daily to (1) ensure that they are working properly, and (2) prevent damage due to the accumulation of moisture. An operator should check the controls each day to troubleshoot for binding, excessive play, or loose knobs. He should ensure that spare fuses of the correct type and rating (usually secured on clips inside access doors) are ready for instant use.

Loose cable couplings and bonding straps, burned-out pilot lights, and broken meter glasses should be repaired or replaced immediately. All sliding mechanical contacts should be lubricated lightly with nonfluid mineral oil or petrolatum. Because lint and dust accumulate easily on these contacts, they should be cleaned frequently.

ELECTRON TUBES

The most common cause of communication equipment casualties is electron tube failure. A tube also may be operating considerably below standard, and in some instances this substandard performance may not be apparent even in a tube test. The average tube tester applies a 60-cycle sine wave to a tube, whereas in actual performance the tube is expected to handle extremely wide frequency ranges.

A few critical circuits are tuned to the characteristics of the particular tube installed. Replacement with another tube of the same design may, in fact, detune the circuit, resulting in poor equipment performance.

Some tubes perform satisfactorily in an equipment but do not check "good" in the tester. Conversely, some tubes that test "satisfactory" may not perform well in actual use. This explanation is not intended to imply that the shipboard tube tester should not be used, but one should treat its indications with reservations.

Many tubes in common use aboard ship cannot be tested in an ordinary tube tester. Notably, the list includes high-powered transmitter and modulator tubes, klystron oscillators, and magnetrons. The following tube-testing policy is suggested.

1. Tubes should not be tested merely as a matter of routine. The results obtained do not justify the work and time involved. Test tubes only when the equipment shows signs of improper operation, and do not rely too heavily on the results unless the tube is shown to be completely bad.

2. When testing tubes, each tube must be replaced in its original socket to avoid detuning critical circuits. It is quite easy to put a tube of one type into a socket designated for another type, because so many different tubes use the standard octal socket.

MOTORS AND GENERATORS

Motors and generators are capable of extended operation without mishap and with very little care. They often are neglected, however, and casualties, which easily could have been prevented, occur.

The units should be protected from moisture, dirt, and friction. Carbon dust, which collects near the commutator as the result of the wearing of the carbon brushes, should be removed periodically with a vacuum cleaner. Use of a

blower may force foreign matter into the windings and bearings, and for this reason the practice should be prohibited. To ensure proper ventilation, loose gear must not be stowed near any motor or generator; overheating is a major cause of casualties.

Bearings

The greatest single source of motor and generator failures is bearing casualties. Lack of proper lubrication and excessive lubrication contribute to these breakdowns. The manufacturer's instruction books specify the proper grade of lubricant and method of application.

Two types of ball bearings are in general use: the grease-lubricated bearing and the permanently lubricated sealed bearing. Grease-lubricated bearings require periodic lubrication. Sealed bearings are permanently lubricated by the manufacturer, are sealed, and need no additional lubrication throughout their service life.

Sealed bearings installed in an equipment should be replaced, when necessary, only with bearings of the same type. If not already provided, nameplates reading "do not lubricate" should be attached to the bearing housing.

Some Navy equipment is oil-lubricated, and have approved lubrication charts furnished. The latter should be obeyed exactly; great harm can be caused by excessive lubrication.

Brushes and Holders

Brushes, which are sticks of carbon, should move freely in their holders. Sufficient spring tension should exist to ensure firm contact with the commutator. The area of the commutator where the brushes bear should be a chocolate-brown color. Carbon dust tends to prevent free movement of the brushes in their holders, and the dust must be removed at frequent intervals. If the commutator is scored, it may be repaired by a tender or, for small generators, by ship's force personnel using a commutator stone. Small copper particles adhering to the brushes are the usual cause of scoring of the commutator.

When insulation resistance readings are being made of the windings, the results should be recorded on the appropriate history card for the machine.

ANTENNAS

Maximum communication efficiency depends on properly maintained antenna systems. Because of their location high in the ship, they are subject to the corrosion of salt spray and stack gases. Vibration and wind may cause such damage as broken strands and broken couplings and brackets, which are not located easily by visual inspection. Improper painting also contributes to antenna troubles. Paint, salt, and soot can reduce antenna efficiency considerably by shorting the signals around the insulators. This is a major factor in poor UHF communications.

When one considers the many enemies of antenna systems, their reliability and effectiveness are remarkable. A reasonable amount of preventive maintenance is sufficient to ensure satisfactory and consistent performance.

Antennas should be lowered and inspected whenever the opportunity presents itself. Deterioration at clamps and lead-ins is a common fault. Nicks and kinks should be avoided because they tend to weaken the wire. Soot and salt spray should be removed; insulators should be wiped clean, and all paint removed. Do not use a wire brush on insulators; cleaning without resorting to wire brushes is always preferable.

Whip antennas, which may collect moisture in their hollow centers, should be inspected and cleaned when opportunity permits.

AIR FILTERS

Many modern electronic equipments are cooled by forced air, which involves the movement of a large volume of air within the units. The air is filtered to keep out dust and other foreign particles. If the filters are efficient, they remove most of this foreign material from the air that passes through them.

An analysis of the failures of parts in electronic equipment indicates that many failures can be traced to excessive heat caused by dirty air filters. The cleaning of air filters is exceedingly important for the proper operation of electronic equipment. For some reason (perhaps their importance is not fully recognized) it appears that air filters often are neglected or disregarded until excessive heating causes a breakdown of the equipment.

SAFETY PRECAUTIONS

If a 60-cycle alternating current is passed through a man from hand to hand or from hand

to foot, the effects when current gradually is increased from zero are as follows:

1. At about 1 milliampere (0.001 ampere) the shock can be felt.

2. At about 10 ma (0.010 amp) the shock is severe enough to paralyze muscles so that the man is unable to let go the conductor.

3. At about 100 ma (0.100 amp) the shock is fatal if it lasts for 1 second or more.

It is important to remember that current, instead of the quantitative value of the voltage, is the shock factor. About 50 percent of shipboard electrocutions are caused by circuits of 115 volts or less.

Two conditions must be met for current to flow through a man: He must form part of a closed circuit through which current can flow, and somewhere in the closed circuit there must be a voltage to cause current to flow. If the difference of potential (voltage) is small between the two conductors touched by the man, or if his body resistance is high, or if both these conditions are met, the current through his body may be small enough that he will not be fatally shocked, and may, indeed, be so small that he does not feel any shock at all.

If the two points of contact with the conductors at different potentials are on the same arm or the same leg, or are otherwise located so that the current path between them does not go through any vital organs of the man, he perhaps may not be fatally shocked even if the current is great enough to kill him if it followed a different path.

If, on the other hand, the potential difference between the points of contact is high enough (and 115 volts is more than high enough) and the body resistance is low enough, and if the current path goes through some of the man's vital organs, he will be fatally shocked.

The application to safety is obvious. A man should see to it that his body never forms part of a closed circuit through which current can flow. Unfortunately, as a man's ability with equipment increases, an increasing disregard often develops for the dangers inherent in high voltages. Electronic equipment enforces a stern safety code, thus violators are likely to be executed on the spot. High-voltage warning signs are posted prominently on and near electronic equipment, and they must be obeyed.

Deenergizing Circuits

Before any maintenance operations are started, circuits must be deenergized to enable work to be done safely. The best method of deenergizing, of course, is to turn off the main power source. Some equipments, however, have heater circuits and synchro voltages that are on another line than the main power source, and these also must be turned off. After securing main power supply and cutout switches in each circuit from which power can be fed, each switch is tagged with a red tag-out card. The card is a warning to others that work is in progress and that only the man who opened the switch is allowed to close it and remove the tag. When more than one group of personnel is working on a circuit, each group places a tag on the switch; each group removes only its own tag when the work is completed.

Dangerous voltages may exist at capacitor terminals even after equipment is deenergized. Each space containing electronic equipment should be equipped with shorting bars to dissipate the residual charge and remove the dangerous voltages. The same procedure applies for tubes having caps with connecting wires.

When repair work of an emergency nature, or servicing considered essential by the commanding officer, is undertaken on an energized circuit, the procedures described in chapters 60 and 67 (when revised on rewritten, chapters 9600 and 9670) of the Bureau of Ships Technical Manual are mandatory. No one is permitted to work on a live circuit unless a man is stationed to deenergize the circuit immediately in case of emergency. Further, a man qualified to render first aid for electric shock stands by during the entire period repairs are being made.

Handling Cathode Ray Tubes

Certain hazards pertain to handling the relatively small cathode ray tubes in teletypewriter converters and test equipments.

The tubes should be handled only with heavy gloves. Safety goggles must be worn to protect eyes from flying glass in the event of envelope fracture, which might cause implosion owing to high vacuum within the tube. Recommended goggles provide side and front protection and have clear lenses that withstand a fairly rigid impact test. No part of the worker's body is to be directly exposed to possible glass splinters caused by implosion of the tube. The inside fluorescent

coating on some tubes is poisonous if absorbed into the bloodstream.

The tube is removed from its packing box with caution, care being taken to avoid striking or scratching the envelope. The tube is inserted into the equipment socket cautiously, using only moderate pressure. (This precaution also applies when removing tube from equipment socket.) The neck of the tube is made of thin glass. If the tube should break, particles from the neck may scatter with enough force to cause severe injury.

Cleaning Equipment

Cleaning electronic equipment may seem to be a routine housekeeping chore, but during the cleaning operation certain precautions are necessary to protect the equipment as well as the worker.

Power switches must be turned off, and the capacitors grounded with the shorting bar before the operation begins.

A vacuum cleaner with a nonmetallic hose is safe and useful but does not reach all the areas where dust accumulates. The preferred method of cleaning inside electronic equipment is with a brush such as a typewriter cleaning brush, together with the vacuum cleaner to remove the dirt as it is loosened by the brush.

Compressed air may be used to blow dirt from the equipment. A hand bellows is safest. Compressed air lines are available aboard ship but are not recommended for cleaning radio equipment because the air pressure is high enough to cause physical damage to delicate electronic parts. Besides, such air usually has a high moisture content. Attempts to blow dirt from radio equipment with compressed air may do more harm than good. The air may blow the dirt from the surface into inaccessible spaces, making the cleaning job more difficult.

Steel wool or emery paper are never utilized inside an equipment. Tiny particles of these conducting materials may cause dangerous short circuits.

Solvents are not used for cleaning unless absolutely necessary. Some solvents are flammable, others are toxic, and still others are both flammable and toxic. Besides these hazards, all solvents are somewhat harmful to electronic equipment. They dissolve waxes and compounds used to protect the equipment from fungus growth. They soften most types of insulation and cause it to become saturated with the very dirt the user is trying to remove. The commonly available chlorinated solvents combine chemically with wax and oil to produce enough hydrochloric acid to etch metal surfaces, causing such troubles as erratic operation of switch contacts. A flammable solvent, such as alcohol, must never be used on energized equipments or near any energized equipment from which a spark may be received.

If a solvent must be resorted to, the user must observe the usual precautions regarding adequate ventilation, prolonged inhalation of the vapor, and repeated or prolonged contact of the solvent with the skin.

Working Aloft

No one is allowed aloft to work on antennas without first obtaining permission from the CWO and the OOD. Upon completion of the work, both officers are notified again.

When a man is going aloft, he should use only properly grounded ladders. All antennas in the vicinity should be isolated from the transmitters and grounded. A small spark, which of itself may be insufficient to cause harm, may result in death by causing a man to relax his grip involuntarily and plunge to the deck below. Ensure that every man working aloft wears a tested safety belt.

Before a man goes aloft, the various transmitters should be deenergized and their power switches tagged open. Failure to tag switches properly may result in injury if another man throws the switch.

While in port, the potential danger to personnel working aloft must be considered, because of transmissions from antennas of ships alongside. A mutually acceptable period is agreed upon before work is performed.

Radiation Hazards

Biological hazards resulting from high-energy radiation fields are discussed in chapter 7.

MOBILE UNIT

At various U. S. naval bases throughout the world, small groups of civilian electronics engineers and Navy enlisted technicians are maintained to assist in training shipboard repair personnel. These groups, called mobile

technical units, are designated by number (e.g., MOTU 6, MOTU 3).

Training is one of the primary missions of the MOTU. On many occasions a ship experiences casualties which the assigned technicians are unable to repair. In some instances, this inability is due more to inexperience of the men than to the complexity of the derangement. Upon request of the ship, the MOTU assigns a civilian engineer to assist the ship's force in training and repair.

The engineers do not do the work or attempt to effect repairs in the absence of shipboard personnel. Rather, they help the ship's force to analyze the difficulty and direct the repair force in the light of their greater experience. When the casualty is eliminated, the ship's personnel will have learned the proper technique of troubleshooting and should be able to handle the situation without assistance in the event of another similar difficulty.

MAINTENANCE RECORDS AND PUBLICATIONS

Important elements of the preventive maintenance program are the ship's material histories and the Current Ship's Maintenance Project (CSMP). Efficient administration requires, among other things, an exact knowledge of the current operating status of all electronic equipment and systems. In maintaining equipment material histories and the CSMP, the electronics material officer utilizes the following forms:

NavShips 529, Repair Record;
NavShips 530, Alteration Record;
NavShips 531, Resistance Test Record;
NavShips 536, Electronic Equipment History Card;
NavShips 537, Record of Field Changes.

MATERIAL HISTORY

The material history is a record of all repairs, alterations, inspections, derangements, measurements taken, parts renewed, nameplate data, length of time units were used, and other pertinent information on each item of equipment. An item's material history consists of the electronic equipment history card and the resistance test record.

The equipment history card, because it furnishes a complete picture of the past history of an equipment, is an aid in troubleshooting, correcting repetitive failures, and indicating the general reliability of the unit. A history card is prepared for each equipment, filled out initially by the electronics material officer, kept up to date, and remains with the equipment throughout its normal service life. Additional cards are made out for each major unit of the equipment to which the basic card pertains; these are filed alphabetically behind the basic card in a looseleaf material history binder.

A resistance test record, NavShips 531 (commonly called a megger card), is for the purpose of recording the insulation resistance of units and circuits such as radio antennas and power distribution circuits. Any significant drop in resistance indicates that repairs are needed. The megger card normally is inserted in the material history binder adjacent to the applicable equipment history card.

THE CSMP

The three remaining forms, Navships 529 (blue), 530 (pink), and 537 (white), constitute the Current Ship's Maintenance Project. The CSMP is, in effect, a record of repairs, alterations, and field changes remaining to be accomplished. As a repair is required, an alteration approved, or a field change authorized, the applicable card is filled out and filed in the material history binder behind the appropriate history card. Being of distinctive colors, the cards readily indicate the type of work outstanding. When preparing the cards, an important consideration is the adequate description of work to be accomplished.

The repair records for work that is beyond the capacity of the ship's force, for example, should contain the information that will be needed later for the repair requests for shipyard or tender work. Entering complete data at the time the need for repair becomes evident will do much to guarantee successful shipyard and tender availabilities.

The record of field changes, which remains with the equipment throughout its service life, is extremely important. Without needed modifications, an equipment may become operationally obsolescent or subject to numerous failures. Lacking a record of field changes, it is difficult to determine what modifications, if any, were made. The information recorded on the record of field changes is essential for

routine maintenance, troubleshooting, and ordering parts for the improved equipment.

MAINTENANCE PUBLICATIONS

A number of other publications are also important to the maintenance program. These include the equipment technical manuals furnished by manufacturers, the BuShips Technical Manual, BuShips Journal, Electronics Installation and Maintenance Book (EIMB), and the Electronics Information Bulletin (EIB).

BuShips Technical Manual

The BuShips Technical Manual contains 90-odd chapters of instructions and data for the maintenance and repair of equipment and machinery that come under the cognizance of the Bureau of Ships. These instructions indicate what the Bureau considers the best engineering practice for the operation, maintenance, testing, and safety of the equipment and for the safety of personnel concerned with the equipment.

BuShips Journal

The Bureau of Ships Journal, published monthly, contains articles on new developments in ship operation, construction, and engineering. It has sections on ship maintenance, electronics, and shop notes.

The EIMB

The EIMB consists of a series of authoritative publications that provide data to field activities on the installation and maintenance of electronic equipment. Information in the EIMB is supplementary to equipment technical manuals and related publications, and is intended to reduce time-consuming research.

The informational content in the EIMB is divided into three categories: (1) general procedures that apply to all classes of equipment; (2) articles on particular classes of equipment, i. e., communication, radar, sonar, and related fields; and (3) information that relates to specific equipments.

The EIB

The EIB is a biweekly publication containing advance announcements on changes to be made in the field, installation techniques, maintenance notes, beneficial suggestions, and technical manual distribution. Articles of lasting interest later are transcribed into the EIMB, except for field changes and corrections to other publications, which subsequently are reproduced and stocked at the Naval Supply Depot, Philadelphia.

Issues of the EIB are made available to all civilian and military personnel concerned with installation, operation, maintenance, and repair of electronic equipment. It is especially important that they be read by all electronics technicians, sonarmen, and operators.

PERIODIC REPORTS

An efficient reporting system, sensitive to failure or replacement trends of parts and equipments, is required to provide feedback information needed to measure and improve equipment reliability and maintainableness.

By means of BuShips instructions and the biweekly EIBs, the Bureau of Ships specifies certain electronic equipment for which periodic reports must be submitted.

Electronic Performance and Operational Report

To evaluate the characteristics and usefulness of selected newly installed or modified equipments, BuShips requires the monthly submission of an electronic performance and operational report. (See fig. 14-1.)

For most of the chosen equipments, reporting begins with the first operating month after installation or medication, continuing monthly for 1 year. A special report is submitted when an equipment failure is noted in a casualty report, when a hazard is believed to exist, or when it is considered that additional facts would be of interest to BuShips.

These reports contain firsthand data obtained under actual operating conditions. They are of great value to BuShips in determining whether the equipment meets design capabilities and operational requirements, evaluating installation adequacy, checking maintenance procedures and safety devices, verifying preliminary manufacturer's standards, and enforcing contractual warranties.

In the general remarks section of the reverse side of the report are indicated any pertinent facts not given elsewhere on the form.

Included are detailed information on any unusual difficulty encountered in operation; exceptional maintenance required; and suggestions for improvements in design, tests, and new applications. A list of possible problem areas is shown on the form for convenience, but comments need not be limited to these areas.

Electronic Failure Reporting System

The electronic failure reporting system is established to collect failure data for the purpose of improving the performance, reliability, and ease of maintenance of electronic parts, assemblies, and equipments; and to facilitate improved support capabilities for items indicating abnormal failure rates.

The failure reporting system utilizes two reporting forms: (1) an electronic equipment failure/replacement report, and (2) an electronic equipment operational time log. These reports serve several excellent purposes:

1. They provide BuShips with a comprehensive presentation of the overall performance of selected material.
2. They point out the weakest circuit components of a particular equipment.
3. They are useful for calculating load lists and repair parts requirements.
4. Because new models (or modifications of existing models) usually are in some stage of development, prompt receipt of failure reports enables the Bureau to initiate corrective action to eliminate similar or related deficiencies in subsequent production.

The success of the reporting program, of course, depends on the basic data being presented accurately and rapidly by the personnel operating and maintaining the equipment.

FAILURE/REPLACEMENT REPORT. —The failure/replacement report (fig. 14-2) is designed so that, in most instances, all information relating to one equipment mishap can be entered on the same form.

Reported failures are tabulated in BuShips, and regular summaries are made to show the number and types of failures of any part of any equipment. The summaries are forwarded to the cognizant design and maintenance engineers in the Bureau of Ships and to the equipment contractor for evaluation and corrective measures. From the reported data a determination may be made of the field changes required to make the equipment perform reliably. The information also shows the point of diminishing return at which it is more economical to replace an equipment than to keep the old one in operation.

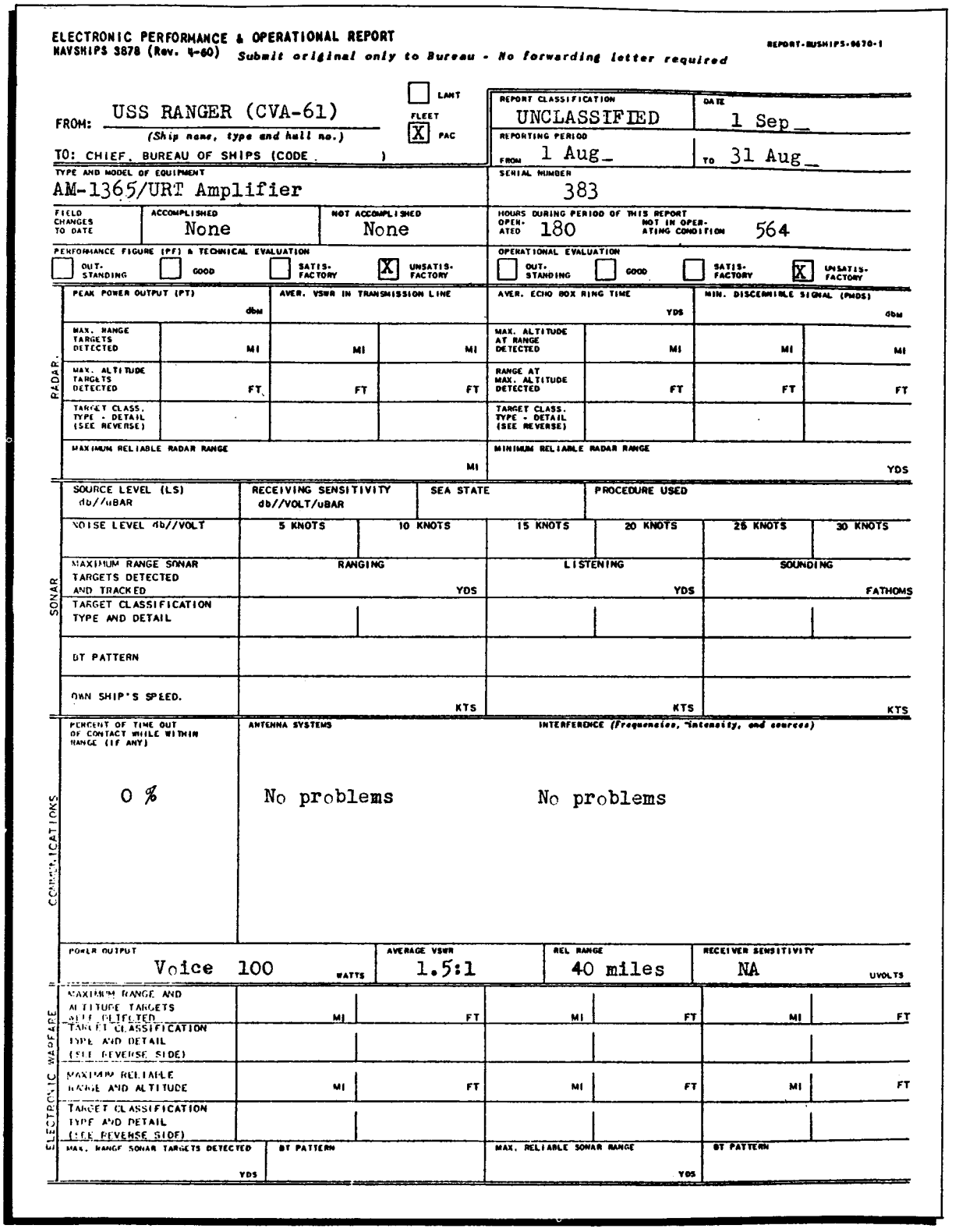
Responsible officers must realize the importance of reporting electronic failures and their causes, particularly the circumstances existing when failures occur under actual operating conditions. The reports must be filled in completely and in conformity with the instructions accompanying the forms. Reports received by the Bureau of Ships are valueless if they do not provide the essential information required by the form or if the information given is incomplete.

OPERATIONAL TIME LOG. —The electronic equipment operational time log serves two purposes. First, it accumulates information for BuShips concerning the reliability of a selected part or system, its maintenance problems, and failure/replacement rate calculations. Second, it keeps the Bureau informed concerning the number of selected equipments that are operationally in use. At the operating level, it can be helpful in the preparation of both the failure/replacement report and the performance and operational report. Each sheet of the log covers one calendar month, as indicated in figure 14-3. Instructions for completing the log accompany the forms.

PLANNED MAINTENANCE PROGRAMS

The U. S. Navy makes every effort to provide properly designed electronic material and to support this material with adequately trained personnel. Because of broad limitations, however, this is not always possible. It is mandatory, therefore, that each organizational element plan on using efficiently its existing material with a minimum of outside assistance. Ships must be as self-sufficient as possible. Reliance on expected new equipment or receipt of special experts to improve a unit's readiness is unsound. Lack of a specific electronic equipment or of a specially trained officer or enlisted man is no valid reason for not using available equipment efficiently.

The Bureau of Ships has cognizance over all electronic equipment used in the fields of detection and tracking, recognition and identification, communications, and electronic warfare, including all testing and measuring devices. In furtherance of what was said in the



ELECTRONIC PERFORMANCE & OPERATIONAL REPORT
NAVSHIPS 3878 (Rev. 4-60) *Submit original only to Bureau - No forwarding letter required*

REPORT-NUSHIPS-0670-1

FROM: USS RANGER (CVA-61) *(Ship name, type and hull no.)* ☐ LANT ☒ PAC FLEET

TO: CHIEF, BUREAU OF SHIPS (CODE)

REPORT CLASSIFICATION: UNCLASSIFIED | DATE: 1 Sep

REPORTING PERIOD: FROM 1 Aug TO 31 Aug

TYPE AND MODEL OF EQUIPMENT: AM-1365/URT Amplifier | SERIAL NUMBER: 383

FIELD CHANGES TO DATE: None | NOT ACCOMPLISHED: None

HOURS DURING PERIOD OF THIS REPORT: OPERATED 180 | NOT IN OPERATING CONDITION 564

PERFORMANCE FIGURE (PF) & TECHNICAL EVALUATION: ☐ OUTSTANDING ☐ GOOD ☐ SATISFACTORY ☒ UNSATISFACTORY

OPERATIONAL EVALUATION: ☐ OUTSTANDING ☐ GOOD ☐ SATISFACTORY ☒ UNSATISFACTORY

RADAR

PEAK POWER OUTPUT (PT) dbm		AVER. VSWR IN TRANSMISSION LINE		AVER. ECHO BOX RING TIME YDS		MIN. DISCERNIBLE SIGNAL (MDS) dbm	
MAX. RANGE TARGETS DETECTED	MI	MI	MI	MAX. ALTITUDE AT RANGE DETECTED	MI	MI	MI
MAX. ALTITUDE TARGETS DETECTED	FT	FT	FT	RANGE AT MAX. ALTITUDE DETECTED	FT	FT	FT
TARGET CLASS. TYPE - DETAIL (SEE REVERSE)				TARGET CLASS. TYPE - DETAIL (SEE REVERSE)			

MAXIMUM RELIABLE RADAR RANGE: MI | MINIMUM RELIABLE RADAR RANGE: YDS

SONAR

SOURCE LEVEL (LS) db//uBAR	RECEIVING SENSITIVITY db//VOLT/uBAR		SEA STATE	PROCEDURE USED		
NOISE LEVEL db//VOLT	5 KNOTS	10 KNOTS	15 KNOTS	20 KNOTS	25 KNOTS	30 KNOTS
MAXIMUM RANGE SONAR TARGETS DETECTED AND TRACKED	RANGING YDS		LISTENING YDS		SOUNDING FATHOMS	
TARGET CLASSIFICATION TYPE AND DETAIL						
BT PATTERN						
OWN SHIP'S SPEED.	KTS		KTS		KTS	

COMMUNICATIONS

PERCENT OF TIME OUT OF CONTACT WHILE WITHIN RANGE (IF ANY)	ANTENNA SYSTEMS	INTERFERENCE (Frequencies, intensity, and sources)
0 %	No problems	No problems

ELECTRONIC WARFARE

	POWER OUTPUT	AVERAGE VSWR	REL RANGE	RECEIVER SENSITIVITY
	Voice 100 WATTS	1.5:1	40 miles	NA UVOLTS
MAXIMUM RANGE AND ALTITUDE TARGETS ARE DETECTED	MI / FT	MI / FT	MI / FT	MI / FT
TARGET CLASSIFICATION TYPE AND DETAIL (SEE REVERSE SIDE)				
MAXIMUM RELIABLE RANGE AND ALTITUDE	MI / FT	MI / FT	MI / FT	MI / FT
TARGET CLASSIFICATION TYPE AND DETAIL (SEE REVERSE SIDE)				

MAX. RANGE SONAR TARGETS DETECTED YDS | BT PATTERN | MAX. RELIABLE SONAR RANGE YDS | BT PATTERN

35.83.1

Figure 14-1. —Electronic performance and operational report.

TARGET CLASSIFICATION

TYPE	DETAIL
1. Large Plane (Bomber)	a. Own Ship's controlled aircraft
2. Small Plane (Jet Fighter)	b. An alerted aircraft approach or contact (An aircraft whose existence and location is known prior to being picked up on own radar)
3. Group of Planes	c. An unalerted aircraft approach or contact (An aircraft whose existence was not previously known)
4. Merchant Ship	d. An opening aircraft contact
5. Warship	e. An anticipated surface contact
6. Formation of Ships	f. An unanticipated surface contact
7. Submarine	g. Snorkling
8. Buoy	h. Submerged
9. Weather Front	i. Other (Explain)
10. Land	j. Unknown
11. Other (Explain)	
12. Unknown	

OUTAGE REMARKS: (Account for time equipment was NOT in operating condition. Show casualty, corrective action, outage time and comments. Include time inoperative for preventive maintenance and POMSEE. Reference Casualty Report, if one submitted on this equipment during this reporting period)

Equipment was in use for about 180 hours when C8, P.A. plate feed through capacitor, shorted, causing overload relay to kick out. Repair part not available on board, was ordered and not yet received. Three failures of this type have occurred among the eight units installed.

GENERAL REMARKS: (Comment on any problems or inadequacies encountered in the equipment. Comment is also desired on any item above or any item not covered by this report. When detailed tracking data is available and the equipment can be evaluated operationally, comment on such items as reliability, target discrimination and clarity. If overheating occurs report ambient and equipment temperature in degree. If equipment is considered to be operating satisfactorily, so state.) (Problem areas listed below are for convenience.)

Antenna
Cabling (including wave guides)
Design
Electrical
Interference
Lubrication
Maintenance
Mechanical
Overheating
Power input
Physical operation
Safety devices
Spare parts
Test equipment
Test points
Transducer
Tube failures
Vibration
Logistic support (Manuals, repair activities, overhaul, etc)

While equipment was operating properly, 40 mile range was consistent.

The failure of C8 is considered a design problem.

Experience to date has indicated that the AM-1365/URT is saving the 4X150A output tubes in the TED-8 transmitter. Longer tube life is gained through reduced drive required from the TED-8. Ten watts output is sufficient, compared with the attempt to drive the transmitter at 30 watts before the AM-1365/URT amplifier was installed.

SIGNATURE C. O. Holt

C. O. HOLT, CDR USN By direction

CLASSIFICATION (Of this report) UNCLASSIFIED

0-43867

35.83.2

Figure 14-1. —Electronic performance and operational report—Continued.

ELECTRONIC EQUIPMENT FAILURE/REPLACEMENT REPORT DD-787 (PROPOSED) REPORT BUSHIPS 10550-1

1. DESIGNATION OF SHIP OR STATION: CVA(N)-65

2. REPAIRED OR REPORTED BY: NAME: R.E. LEE; RATE: RMC; AFFILIATION: 1 [X] U.S. NAVY 2 [ ] CONTRACTOR 3 [ ] CIVIL SERVICE

3. TYPE OF REPORT (CHECK ONE): 1 [X] OPERATIONAL FAILURE; 2 [ ] PREVENTIVE MAINTENANCE (POMSEE); 3 [ ] PREVENTIVE MAINTENANCE (NOT POMSEE); 4 [ ] STOCK DEFECTIVE; 5 [ ] REPAIR OF REPLACEABLE UNIT OR PLUG-IN ASSEMBLY; 6 [ ] OTHER

4. TIME FAIL OCCURRED OR MAINT. BEGAN: MONTH 3; DAY 3; YEAR 6_; TIME 1200

5. TIME FAIL CLEARED OR MAINT. COMPL.: MONTH 3; DAY 3; YEAR 6_; TIME 1225

EQUIPMENT

6. MODEL TYPE DESIGNATION: AN/URC-32

7. EQUIP. SERIAL NO.: 23

8. CONTRACTOR (NAVY CODE OR COMPLETE NAME): COL

9. FIRST INDICATION OF TROUBLE (CHECK ONE): 1 [X] INOPERATIVE; 2 [ ] OUT OF TOLERANCE, LOW; 3 [ ] OUT OF TOLERANCE, HIGH; 4 [ ] INTERMITTENT OPERATION; 5 [ ] UNSTABLE OPERATION; 6 [ ] NOISE OR VIBRATION; 7 [ ] OVERHEATING; 8 [ ] VISUAL DEFECT; 9 [ ] OTHER, EXPLAIN

10. OPERATIONAL CONDITION (CHECK ONE): 1 [X] OUT OF SERVICE; 2 [ ] OPERATING AT REDUCED CAPABILITY; 3 [ ] UNAFFECTED

11. TIME METER READING: A. HIGH VOLTAGE: NONE; B. FILAMENT /ELAPSED: NONE

12. REPAIR TIME: MAN-HOURS; TENTHS: 4

REPLACEMENT DATA

13. LOWEST DESIGNATED UNIT (U) or SUB-ASSEMBLY (SA)	14. LOWEST DES. U/SA SERIAL NO.	15. REFERENCE DESIGNATION (V-101, C-14, R11, ETC.)	16. FEDERAL STOCK NUMBER	17. MFR. OF REMOVED ITEM	18. TYPE OF FAILURE	19. PRIMARY OR SECONDARY FAIL ?	20. CAUSE OF FAILURE	21. DISPOSITION OF REMOVED ITEM	22. REPL. AVAILABLE LOCALLY ?
SA1	17	N/A	F5820-672-6313	COL	255	P[X] S[ ]	8	T	Y[X] N[ ]
						P[ ] S[ ]			Y[ ] N[ ]
						P[ ] S[ ]			Y[ ] N[ ]
						P[ ] S[ ]			Y[ ] N[ ]
						P[ ] S[ ]			Y[ ] N[ ]

23. REPAIR TIME FACTORS

CODE	DAYS	HOURS	TENTHS	CODE	DAYS	HOURS	TENTHS

24. REMARKS (CONTINUE ON REVERSE SIDE IF NECESSARY)

15.2

Figure 14-2.—Electronic equipment failure/replacement report.

first paragraph of this chapter ("...because it is essential that none of the features of shipboard maintenance be overlooked or neglected, a continuing maintenance program is needed..."), BuShips currently has two official maintenance programs in effect.

Performance, Operation, and Maintenance Standards for Electronic Equipment (POMSEE) is the basis for a recommended preventive maintenance program for electronic equipment under the technical control of the Bureau.

The shipboard Planned Maintenance System (PMS) is a mandatory management tool designed to plan, schedule, and control the performance of routine preventive maintenance on all equipment.

POMSEE PROGRAM

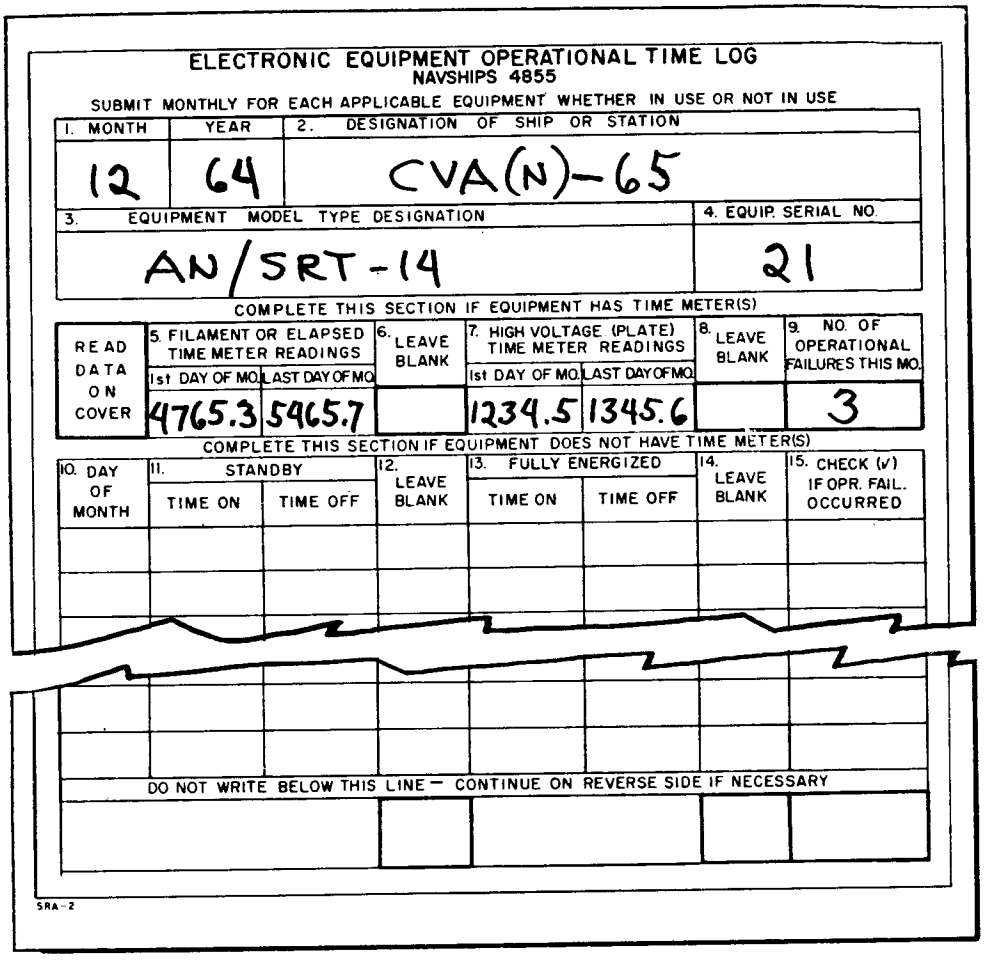
3.2

Under the POMSEE program, performance standards sheets provide the operational performance data and basic technical measurements indicative of the minimum acceptable level of performance for the electronic equipments.

The performance standards sheets provide a single standard for each equipment type, furnishing both a technical and nontechnical description of the expected equipment performance. This standard must be met by all ship installations of a particular model.

Procedures for obtaining the maintenance standards test indications are given in a series of charts. Each chart or group of charts covers a functional section of the entire system. An accompanying illustration page shows the equipment setup pertaining to each of the procedural steps on the chart. The illustration page bears encircled numbers corresponding to the steps of procedure of the chart to which it applies.

Using an illustration page along with its associated chart makes a relatively simple task of determining the reading or performing the required check. The comparison of a current reading with readings previously recorded re-



ELECTRONIC EQUIPMENT OPERATIONAL TIME LOG
NAVSHIPS 4855

SUBMIT MONTHLY FOR EACH APPLICABLE EQUIPMENT WHETHER IN USE OR NOT IN USE

1. MONTH	YEAR	2. DESIGNATION OF SHIP OR STATION
12	64	CVA(N)-65

3. EQUIPMENT MODEL TYPE DESIGNATION	4. EQUIP. SERIAL NO.
AN/SRT-14	21

COMPLETE THIS SECTION IF EQUIPMENT HAS TIME METER(S)

READ DATA ON COVER	5. FILAMENT OR ELAPSED TIME METER READINGS		6. LEAVE BLANK	7. HIGH VOLTAGE (PLATE) TIME METER READINGS		8. LEAVE BLANK	9. NO. OF OPERATIONAL FAILURES THIS MO.
	1st DAY OF MO.	LAST DAY OF MO.		1st DAY OF MO.	LAST DAY OF MO.		
	4765.3	5465.7		1234.5	1345.6		3

COMPLETE THIS SECTION IF EQUIPMENT DOES NOT HAVE TIME METER(S)

10. DAY OF MONTH	11. STANDBY		12. LEAVE BLANK	13. FULLY ENERGIZED		14. LEAVE BLANK	15. CHECK (✓) IF OPR. FAIL. OCCURRED
	TIME ON	TIME OFF		TIME ON	TIME OFF		

DO NOT WRITE BELOW THIS LINE — CONTINUE ON REVERSE SIDE IF NECESSARY

SRA-2

15. 3

Figure 14-3. —Electronic equipment operational time log.

veals any significant change. Slight changes, which occur frequently, are no cause for alarm. When a particular step of procedure results in a reading that varies progressively in the same direction, however, it is an indication of improper operation or of reduced performance.

Although the POMSEE program may be phased out when a ship changes over to the PMS program, the charts, illustrations, and performance standards sheets may be of value for reference purposes so long as the applicable equipment does not become obsolete.

PLANNED MAINTENANCE SYSTEM

A Navy planned maintenance system (PMS) is being installed throughout the operating fleet as the result of an OpNav instruction (4700.16) issued in 1963. Within the next few years, the PMS will be standard in all departments on all active ships.

For several reasons, previous maintenance programs and efforts fell short of desired goals. To eliminate the problem areas, the PMS defines and schedules the preventive maintenance required for all shipboard equipment, even down to the methods and tools to be used and the time and rate required to accomplish each task.

The objective of the PMS is to prescribe a standard, uncomplicated system of planning and control to provide for the uniform accomplishment of preventive maintenance aboard ships. This in turn will enable achievement of the highest possible state of material readiness with the resources available.

Organization

Personnel are organized into maintenance groups, patterned after the standard shipboard organization, which are assigned responsibility for maintaining specific equipment. Each maintenance group is under a maintenance group supervisor, who is the petty officer in charge of that group.

It is desirable, wherever possible, that personnel who operate equipment perform the required preventive maintenance. Where personnel from one department operate equipment under the cognizance of another, coordination between the two departments is necessary to ensure that all tasks are accomplished.

Tools of the System

In the PMS, emphasis is placed on advance planning instead of on the recording of mere historical maintenance facts. Planning is initiated by the type commander when he issues an overhaul cycle maintenance schedule. Based on this schedule, department heads prepare quarterly schedules. To carry the plan further, responsible petty officers/division officers break down the quarterly schedules into weekly maintenance actions.

Proper use of the scheduling devices ensures accomplishment of all preventive maintenance tasks, takes into consideration the ship's employment schedule and daily routine, provides interdepartmental coordination, and affords flexibility to allow schedule adjustments when the situation dictates. It is important that the schedule of maintenance tasks be planned at least one quarter in advance; this plan then may be adjusted on a monthly basis as contingencies demand.

The basic tools of the system consist of the following:

1. Overhaul cycle schedule (referred to simply as the cycle schedule).
2. Quarterly schedule.
3. Weekly schedule.
4. Departmental PMS manual.
5. Maintenance requirements cards (MRCs).

CYCLE SCHEDULE.—A cycle schedule is prepared for each maintenance group on the ship. This practice permits equalization of the group's workload throughout the overhaul cycle. The time frame of the schedule is the entire period between and through overhauls for the class of ship concerned. It commences during the calendar quarter in which the ship completes overhaul (or in which the PMS is installed).

The schedule lists the components (e.g., receivers, transmitters) for which each maintenance group is responsible, and it shows, on a quarterly basis, all the preventive maintenance actions (except weekly and daily) required during the period between overhauls. All the maintenance items in the schedule are within the capability of the ship's force and equipment.

The department head uses the cycle schedule to prepare current and subsequent quarterly schedules. It is then posted on the department's maintenance control board, with the quarterly schedules, as part of the long-range maintenance schedule. Because the schedules are displayed visually, they are readily accessible to departmental division officers and maintenance group supervisors.

QUARTERLY SCHEDULES.—Taking into consideration the ship's quarterly operating schedule, the department head prepares the current and subsequent quarterly maintenance schedules, based on the requirements contained in the cycle schedule. He does this in conjunction with his division officers and maintenance group supervisors.

The information is transcribed from the cycle schedule to a specific week (in the quarterly schedule) during which the work is expected to be done. The quarterly schedule is arranged in weekly columns to permit flexibility in rescheduling to accommodate changes that may occur in the ship's operating schedule.

A quarterly schedule displays the entire maintenance workload for the quarter, and is a directive for maintenance group supervisors in scheduling their weekly maintenance. At the end of each week, the group supervisors cross out (with an X) all maintenance requirements that have been accomplished, and encircle those not accomplished; the latter must be rescheduled. At the end of each quarter, the current quarter schedule is removed from the display board to become the ship's record of preventive maintenance actions performed or not performed. The subsequent quarter schedule then becomes the current schedule, and a new subsequent quarter schedule is posted.

WEEKLY SCHEDULE.—Each maintenance group supervisor prepares weekly schedules from the information appearing on the quarterly schedule. Preprinted on the weekly schedules

are recurring daily and weekly maintenance actions that do not appear elsewhere.

The weekly schedule lists the components involved in the maintenance group area. It is used by the working area supervisor to assign work and record its completion.

The group supervisor assigns personnel, by name, to perform each required action on a specified day during the week. The schedule is posted in each maintenance group's working area.

The man assigned to work on a component is responsible for completing the required action on the day scheduled. After maintenance is completed, he marks the scheduled item with an X. If, for any reason, work cannot be accomplished during the week concerned, he circles the appropriate entry. At the end of the week, the group supervisor utilizes the X and O entries on the weekly schedule to bring the quarterly schedule up to date. He then cleans off the old weekly schedule (the form is made of plastic) and prepares a new one for the following week.

PMS MANUAL.—Each department of the ship (engineering, operations, weapons, and so on) utilizes its own planned maintenance system manual. It contains the minimum preventive maintenance requirements for every component or system installed for the department. The PMS manual normally is retained in the department office, and it is used mainly by the department head to plan and schedule maintenance.

Each page in the manual (fig. 14-4) covers a single component or equipment. (The pages are referred to as manual index pages.) On the page are given a short description of all maintenance requirements pertinent to the component, the frequency with which the maintenance actions occur (e.g., M—monthly, A—annually), the enlisted rates required to do the work (in other words, the minimum skills required), and the length of time normally needed to perform the operation. The letters and numerals in the left-hand columns are for BuShips control and identification purposes. The column headed "M.R. No." identifies the number of the maintenance to be accomplished.

MAINTENANCE REQUIREMENTS CARDS.—The maintenance requirements cards are the key to the success of the entire planned maintenance system aboard ship. The development process for the MRCs, which was a vital and critical phase in setting up the PMS, demanded the best professional efforts of all the agencies concerned with the program.

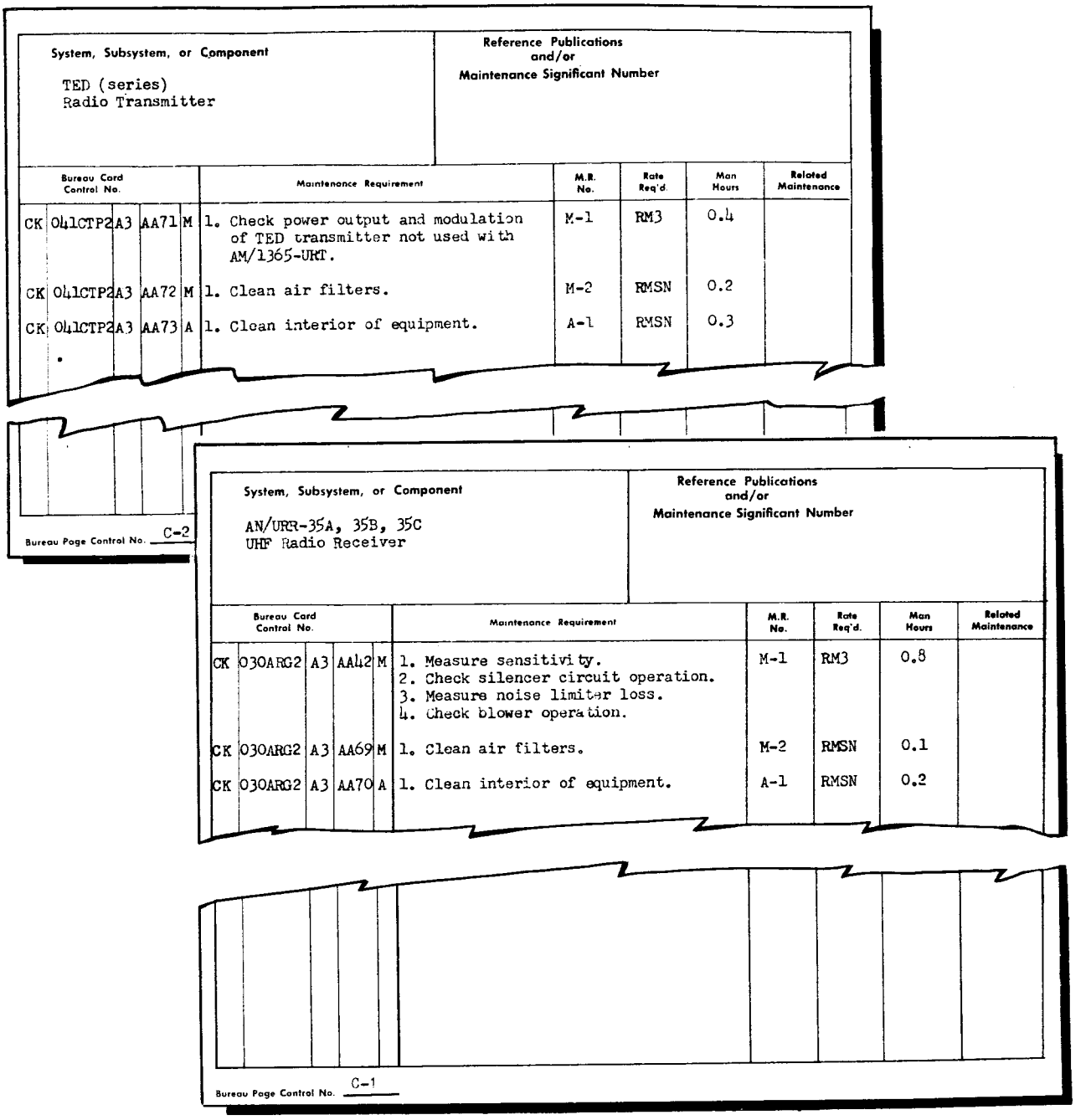
For example, all sources of requirements for maintenance, such as bureau manuals, manufacturer's instruction books, fleet and type commanders' instructions, POMSEE manuals, and the like, had to be reviewed to sort out; tabulate, and evaluate the requirements. It was then necessary to examine these requirements critically to eliminate extraneous material but to ensure that no required action was overlooked.

To be of value, the MRCs on any ship must agree completely with the contents of the PMS manual as well as the equipments and systems actually on board. At the very least, this requirement necessitates a complete inventory of all equipment before the cards can be prepared. Once these cards are received on board, they supersede the requirements set forth in any technical publications (including the BuShips Technical Manual), so far as preventive maintenance is concerned.

As shown in figure 14-4, there is a separate MRC for each preventive maintenance action that must be taken on every system, subsystem, or component. The index page number, the card number, and a description of the required maintenance are entered on both the index page and the associated card. In figure 14-5, for example, the complete maintenance requirement numbers are C-1 A-1 and C-2 M-2. The designations C-1 and C-2 refer to the index page numbers of the PMS manual; A-1 and M-2 are the card numbers. Further, the letter C identifies each equipment as a "communications and control" component; the letters A and M indicate the periodicity of the maintenance action required.

The MRC provides detailed guidance for the individual performing a preventive maintenance task on a specific equipment. The complete operation is defined in sufficient detail to enable assigned personnel to perform the job without difficulty. In addition to the instructions regarding the maintenance task, the card lists information needed by supervisory and scheduling personnel (frequency of accomplishment, minimum skill level required, time to accomplish, and so on).

A complete working set of applicable MRCs, with a container, is installed in each maintenance group working area where they are available to those performing the maintenance tasks.



System, Subsystem, or Component: TED (series) Radio Transmitter

Reference Publications and/or Maintenance Significant Number:

Bureau Card Control No.	Maintenance Requirement	M.R. No.	Rate Req'd.	Man Hours	Related Maintenance
CK 041CTP2A3 AA71 M	1. Check power output and modulation of TED transmitter not used with AM/1365-URT.	M-1	RM3	0.4	
CK 041CTP2A3 AA72 M	1. Clean air filters.	M-2	RMSN	0.2	
CK 041CTP2A3 AA73 A	1. Clean interior of equipment.	A-1	RMSN	0.3	

Bureau Page Control No. C-2

System, Subsystem, or Component: AN/URR-35A, 35B, 35C UHF Radio Receiver

Reference Publications and/or Maintenance Significant Number:

Bureau Card Control No.	Maintenance Requirement	M.R. No.	Rate Req'd.	Man Hours	Related Maintenance
CK 030ARG2 A3 AA42 M	1. Measure sensitivity. 2. Check silencer circuit operation. 3. Measure noise limiter loss. 4. Check blower operation.	M-1	RM3	0.8	
CK 030ARG2 A3 AA69 M	1. Clean air filters.	M-2	RMSN	0.1	
CK 030ARG2 A3 AA70 A	1. Clean interior of equipment.	A-1	RMSN	0.2	

Bureau Page Control No. C-1

105.21

Figure 14-4.—PMS manual index pages.

A master deck of all cards for each department is retained in the department office with the PMS manual. If a card is lost, soiled, or torn, it is replaced by typing a duplicate card from the master deck.

DATA COLLECTION SYSTEM

For the planned maintenance system to be successful, there must be an adequate method that will enable commanders and the technical bureaus to carry out their management functions in support of the program. Accordingly, a maintenance data collection (MDC) system for gathering, processing, analyzing, and distributing feedback information was implemented in parallel with the PMS. Currently, the MDC system is being tested and evaluated through the efforts of the Maintenance and Material Management Project Center (MMMPC). The Center is under the direct control of the Chief of Naval Operations.

The shipboard test plan (aircraft squadrons are included in the total project effort) utilizes the destroyer ship class. The test involves designated destroyer squadrons and tender repair departments reporting on equipment maintenance. Data generated in individual ships are key-punched, edited, and forwarded to an electronic data processing facility in the tender, where they are machine-processed to produce the required management reports. The MMMPC provides mobile training teams to the selected ships to train personnel in the mechanics of implementing the system.

Commencing about mid-1964, it is planned to introduce the data collection system to the fleet on a progressive basis. It is expected to include all surface force activities by January 1966.

ACCOMPLISHMENT OF REPAIRS

An availability is the period of time assigned a ship for the uninterrupted accomplishment of work at a repair activity. Repair availabilities may be classified as restricted, technical, interim overhaul, regular overhaul, voyage repair, and upkeep period.

A restricted availability accomplishes specific items of work, normally with the ship present. This availability is assigned to many of the ships that go alongside a repair ship or tender.

A technical availability accomplishes specific items of work, normally with the ship not present. This type of availability may be assigned when a unit of auxiliary equipment needs repair; the unit may be left at the repair activity while the ship continues on its mission. Arrangements must be made for the ship to deliver the defective units and either call for them on completion of repairs or provide shipping instructions.

An interim overhaul availability accomplishes general repairs and alterations at a shipyard or other shore-based repair activity. Many ships are assigned interim availabilities about midway between the regular overhauls. The length of an interim availability may not exceed more than one-half the duration of a regular overhaul.

Ships are assigned regular overhaul availabilities at naval shipyards or other shore-based repair activities in accordance with an established time cycle. In general, a major overhaul is scheduled for a 3-month period about every 2 years. The period assigned may vary somewhat, depending on the type of ship and whether extensive alterations are planned. Ships are notified of the assigned period by means of the type commander's annual employment schedule, which is promulgated to all ships under his command.

A voyage repair is an availability for emergency work necessary to enable a ship to continue on its mission. Voyage repairs can be accomplished without requiring a change in the ship's operating schedule.

An upkeep period is assigned to a ship for the accomplishment of work by the ship's force or other forces afloat. Whether the ship is moored alongside a tender or repair ship depends on whether the work to be done is within or beyond the capacity of the ship's force. Regularly scheduled upkeep periods are a normal part of the ship's maintenance cycle. Their purpose is to keep the ship in condition during intervals between regular overhauls.

REGULAR OVERHAUL

Of the types of availability listed, the regular overhaul is by far the one of greatest importance. It also requires the most preparation in advance. Although the procedures covered in this section may apply in some degree to

SYSTEM	COMPONENT	M. R. NUMBER
Communications and Control	AN/URR 35A,35B, & 35C UHF Radio Receiver	C-1 A-1
		CARD OF
SUB-SYSTEM	RELATED M.R.	RATES M/H
Radio Communication Systems		RMSN 0.2
MAINTENANCE REQUIREMENT DESCRIPTION		TOTAL M/H 0.2
1. Clean interior of equipment.		ELAPSED TIME 0.2

TOOLS, PARTS, MATERIALS, TEST EQUIPMENT

1. Vacuum cleaner
2. Soft bristle brush
3. Clean rags
4. Shorting bar

PROCEDURE

1. Clean interior of equipment:
   a. Secure all power to the equipment.
   b. Loosen fastening devices on the front panel and pull the receiver out on its slides to the stops.
   c. Discharge all capacitors with a shorting bar.
   d. Remove dirt from the "hard to get to" areas with a soft bristle brush.
   e. Wipe out the inside of the cabinet with a clean rag.
   f. Remove remaining dirt from the chassis with a vacuum cleaner.
   g. Replace and secure the chassis in the cabinet.
   h. Return equipment to normal operation.

C-30470 MAINTENANCE REQUIREMENTS CARD OPNAV FORM 4700-1 (REV. 1-64)

SYSTEM	COMPONENT	M. R. NUMBER
Communication and Control	TED (Series) Radio Transmitter	C-2 M-2
		CARD OF
SUB-SYSTEM	RELATED M.R.	RATES M/H
Radio Communication Systems		RMSN 0.2
MAINTENANCE REQUIREMENT DESCRIPTION		TOTAL M/H 0.2
1. Clean air filters.		ELAPSED TIME 0.2

TOOLS, PARTS, MATERIALS, TEST EQUIPMENT

1. Vacuum cleaner
2. Shorting bar

PROCEDURE

NOTE: Air filter is located on rear of RF chassis.

1. Clear air filters:
   a. Secure all power to the equipment.
   b. Loosen the captive wing nuts on the front panel.
   c. Withdraw the unit from the cabinet to its normal stops.
   d. Discharge all capacitors with the shorting bar.
   e. Release the fasteners on the air filter frame and remove air filter.
   f. Vacuum the filter causing the air to reverse flow through the filter.
   g. Reinstall the filter in the equipment if cleaning by this method is satisfactory; if not, proceed with the following steps.
   h. Wash the filter in warm water and detergent and rinse in warm water.
   i. Blow excess moisture from the filter with low pressure air or shake out, whichever is desirable.
   j. Allow filter to dry thoroughly, then reinstall.
   k. Replace and secure chassis in cabinet.
   l. Return equipment to normal operation.

C-30470 MAINTENANCE REQUIREMENTS CARD OPNAV FORM 4700-1 (REV. 1-64)

Figure 14-5. —The MRC provides detailed guidance for the individual performing a preventive maintenance task on a specific equipment.

92.100

other (or all) availabilities, the discussion is aimed mainly at the regular overhaul.

Work Requests and Job Orders

Preceding the assigned availability, all field changes that can be made by ship's personnel should have been made or plans made for their accomplishment during the overhaul. Equipment histories associated with the communication equipment should be evaluated, and all operational and maintenance logs and checklists reviewed for accuracy and completeness.

If the ship's CSMP and required reports are maintained properly, the work requests necessary to have repairs effected should be relatively simple to prepare. The repair items that can be accomplished only during overhaul are transcribed from the CSMP card onto a formal work request. Procedures for submitting the work requests are laid down in general in Navy Regulations, and in detail in fleet and type commander instructions.

Items of work are entered in the relative order of priority for each work list of the group (e.g., hull, engineering, ordnance) listed. After the work lists are complete, a ship's priority index is prepared. Usually the priority index is made up in a conference of all heads of departments and the executive officer. The various items are selected from the individual repair lists and are assigned in an overall order of priority for the ship.

In defining the work to be accomplished, specific descriptions must be included in the requests. Needed parts should be identified by stock numbers, blueprint numbers, nameplate data, and so on, to provide yard planners with sufficient information and time to order the parts and have them on hand before the ship's arrival.

Each work request lists the names of the ship's inspectors; normally, the cognizant officers and petty officers are designated. The ship's inspectors are qualified to discuss the details of the specific job with yard workmen and pass on the completeness of the repairs.

All work within the capacity of the ship's force must be done by ship's company. A schedule of communication work items should be prepared to include (1) names of persons responsible for accomplishment; (2) estimate date of completion; (3) estimated number of man-hours required; and (4) assistance required from the yard in the form of materials or tools.

The communication officer is responsible for submitting a timely list of communication work items to the operations officer for approval and further routing to the repair officer (usually the engineer officer). The repair officer incorporates the list in the overall schedule of ship's force work to be submitted to the yard. A copy of the communication work list should be posted in a conspicuous place and the items checked off as each is completed.

SUPPLEMENTARY WORK REQUESTS.—In the period between submitting the original work lists and the ship's arrival at the shipyard, an unforeseen difficulty might necessitate shipyard repairs. In such a circumstance, an additional repair list, called the first supplement, is prepared and submitted before the ship's arrival at the yard.

The naval shipyard holds numerous tests and inspections of equipment in accordance with an established procedure and as requested by the ship. These tests and inspections may disclose additional needed repair items. When these initial tests and inspections are completed, a supplementary repair list is made out to cover defects that are found. This repair list is called the first or second supplement, as applicable.

Ordinarily, apart from the two instances mentioned, there should be no further need for submitting supplementary repair items. In other words, all items requiring shipyard repairs should be written up and submitted before a ship arrives in the yard—not after it has been in the yard for some period of time. In most instances, other last-minute jobs indicate that the ship's maintenance program is inadequate, that the CSMP recordkeeping is incomplete or not up to date, or that there is a lack of experience or knowledge in submitting a complete list of repair items for shipyard overhaul.

Arrival Conference

When the ship arrives in the shipyard for overhaul, an arrival conference is held. This conference is supervised by the shipyard planning officer, and is attended by representatives from the ship, type commander, shipyard, and other interested persons. The ship's work request list and individual item costs estimated

by the shipyard planning department are reviewed.

The limitation of the funds available (a limitation set by the type commander) determines the number of job orders or specifications issued for the accomplishment of repairs during the overhaul period.

Overhaul Progress Analysis

During a shipyard overhaul period, the ship may be required to submit weekly shipyard progress reports in compliance with the type commander's instructions. For these reports, ship's supervisory personnel must maintain an accurate check on the progress of work at all times. The progress analysis should include ship's force work and shipyard work. Any number of progress charts can be used, but usually one chart is kept for the shipyard work and another for ship's force work.

Inspection of work being done by a repair activity for a ship is the responsibility of both the repair activity and the ship. The repair activity makes those inspections that will ensure the proper execution of the work and adherence to prescribed specifications and methods. The ship makes any inspections that are necessary to determine if the work is satisfactory both during its progress and upon completion.

The communication officer should arrange his schedule in such a way that he is free of all times to inspect and check the progress of shipyard work going on in his spaces or being performed on equipment for which he has responsibility. A check should be made to see that any required tests are made by the shipyard before the job is considered fully completed.

Shipyards are required to hold frequent (usually weekly) conference. These are attended by the commanding officer and repair (engineer) officer of the ship and interested shipyard personnel such as the production officer, other shipyard department heads, the ship's superintendent, and master mechanics. The topics discussed at the conference customarily include jobs encountering delays or other difficulties, additional work required, the quality of work being done, and the availability of critical materials.

In checking on the progress of a job, responsible persons must have detailed information of what repair work is to be accomplished. This information can be obtained from the job orders issued by the planning department of the yard. The ship receives three or more copies of these job orders; a copy of orders applicable to the communication division ordinarily is held by the communication officer.

STOCK REPLENISHMENT OF SPARE PARTS

The quantities and types of nonconsumable material (such as repair parts) that a ship may carry at any one time are limited by the ship's allowance list. The list is used as authority for procuring, replacing, and making alterations to allowed equipment. Ships normally are required to carry a full allowance but are not permitted to exceed the allowance except with the approval of the type commander or cognizant bureau.

The necessity for a ship to maintain sufficient stocks to meet its requirements is obvious. Also important, but less obvious, is the necessity to avoid overstocking. Overstocking increases the dollar value of a ship's inventory, requires additional stowage space, and cuts into the critical weight allowance aboard ship. Furthermore, overstocking in one ship may cause another ship to be immobilized.

Excess stocks often are built up to ensure that sufficient material is available at all times without immediate recourse to the supply system. Certain parts may require replacement so often that there may be a tendency to consider them as a part of shop stores. Either way, an increase in the quality of manufacture, an improvement in design, or obsolesence may leave the shop store with a 6-year supply of a certain item instead of a 90-day supply.

COORDINATED SHIPBOARD ALLOWANCE LIST

The coordinated shipboard allowance list (COSAL) consolidates the repair parts needed to support all the equipment aboard a given ship. Tailored to meet the needs of individual ships, it is distributed by the Bureau of Ships on a progressive basis according to regular overhaul schedules.

Aboard ship, the COSAL is divided into segments in conformity with equipment category, such as electronic and ordnance segments. A complete copy of the COSAL is retained by the supply department. Other departments receive only the segment for which they have primary

responsibility. For example, the operations officer, the CIC officer, or the electronics material officer might have custody of the electronic segment, regardless of where in the ship a particular electronic equipment is installed.

Each COSAL segment contains an introduction (of interest to all users) and three parts.

Part I (fig. 14-6) is an alphabetical equipment index. For the user's convenience, the index is divided into two sections: section A lists items alphabetically by equipment name; section B lists them alphabetically by function.

Part II of each COSAL segment contains the allowance parts/equipage lists (APLs). As shown in figure 14-7, each APL describes a component shown in part I and lists repair parts, manufacturers' numbers, nomenclature, and stock numbers. For ordering purposes, the last item is the most important. The APLs, then, constitute standardized parts lists for particular equipments. This section of the COSAL is the one used most frequently. For ships not yet using the COSAL, stock numbers required for ordering parts are obtained from the ship's stock number identification table (SNIT) for each equipment.

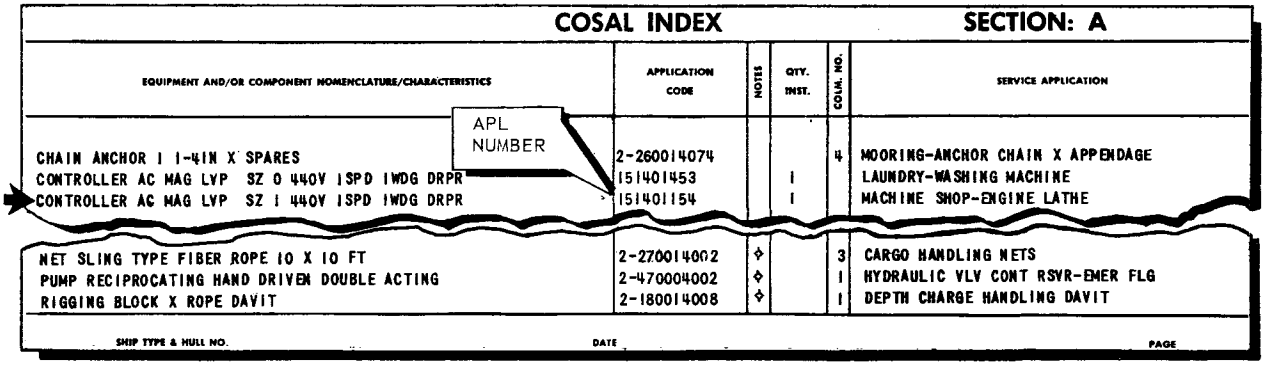
Part III is a stock number sequence list (SNSL) of all items allowed for support of equipment shown in part I. It also indicates the unit of allowance and storeroom quantity for each repair part in the COSAL. Consolidation of all the SNSLs received on board provides a single source for effecting stock and inventory control.

Ordering Parts

Aboard ships having central storerooms, material for general use of all departments is maintained in storerooms and other spaces under the custody and control of the supply department. Supply personnel keep stock record cards for all items stored, recording receipts and issues of material in order to estimate future requirements of the ship.

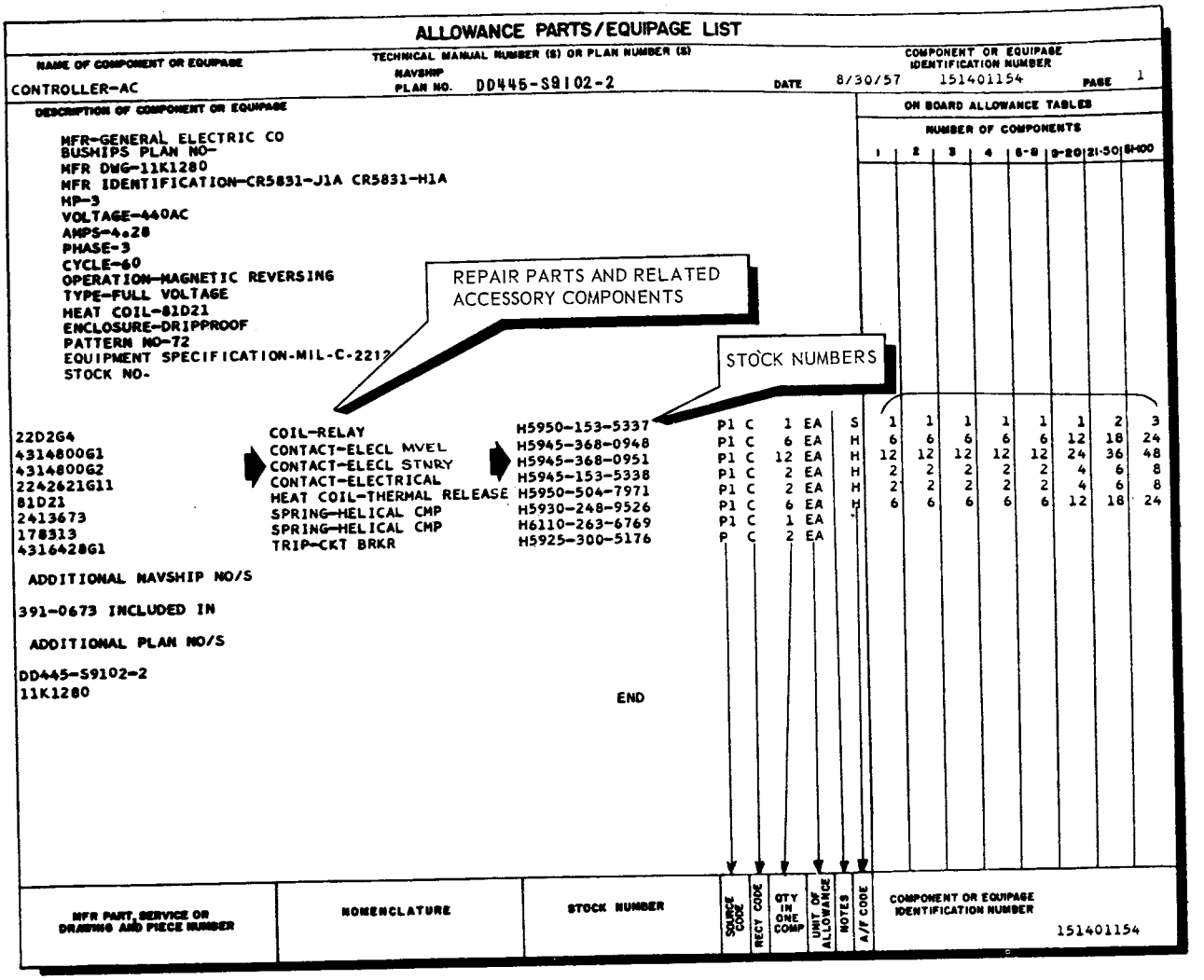
On board ships without central storerooms (in general, ships smaller than destroyers), received supplies are turned over directly to department heads. To the extent that space permits, each department maintains its own storeroom. Department heads then are responsible for the accuracy of departmental inventories and for the timely submission of requests for additional repair parts and supplies.

To order parts, a requisition signed by an officer is submitted to the supply officer. Currently, the same form may be used for issues from the ship's storeroom and as a request to procure materials from sources outside the ship. Each requisition bears the part stock number, if available, and a brief description of the requested item. If the stock number is unavailable, a complete written description accompanies the requisition on an additional form provided by the supply department.



17.61

Figure 14-6. —Part I of the COSAL is an alphabetical equipment index.



17.63

Figure 14-7. —Part II of the COSAL contains the allowance parts lists.

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