# AIRCRAFT
# EMERGENCY PROCEDURES
# OVER WATER

**UNITED STATES COAST GUARD**
**CG 306**

**DEPARTMENT OF THE NAVY**
**OPNAV INSTRUCTION NO. 3730.4**

**DEPARTMENT OF THE AIR FORCE**
**AFM 64-6**

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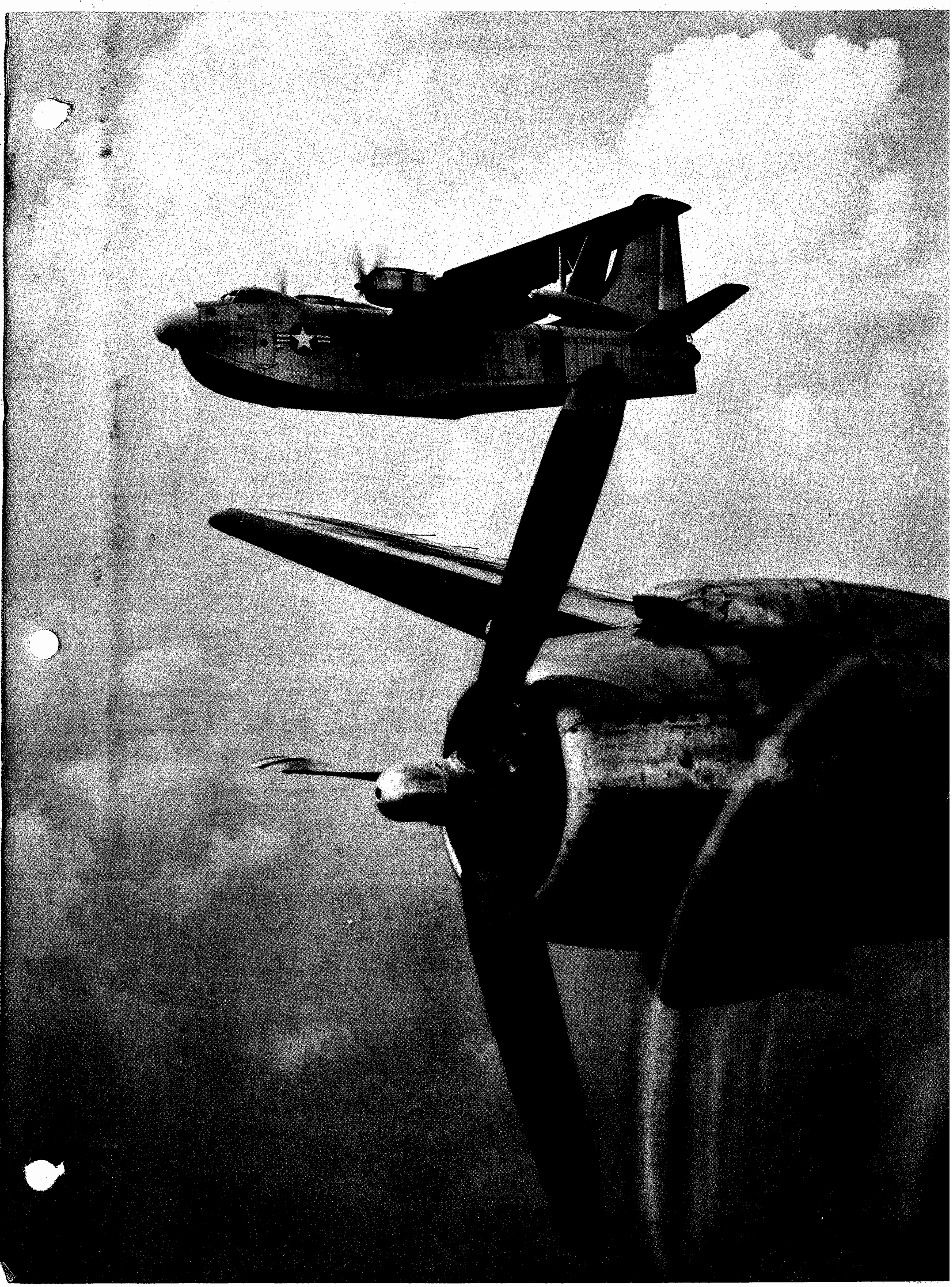

November 1955

# FOREWORD

Aircraft Emergency Procedures Over Water, CG-306, has been compiled by the Coast Guard for use by the Coast Guard. It has been adopted for use by the Department of the Navy as OPNAV Instruction 3730.4 and by the Department of the Air Force as AFM 64-6. The doctrines, techniques, and procedures which it describes are the result of experience, performance studies, extensive experimentation, Coast Guard ship-aircraft drills and exercises. The publication is presented as a guiding directive. Because of the many variables in aircraft emergencies and SAR operations, it is impracticable to cover every possible contingency which may arise. Likewise, it is undesirable to set forth procedures and techniques which are so detailed and rigid that on-scene flexibility is sacrificed. Hence, many of the procedures and techniques contained herein should be tempered with judgment and due regard for unusual conditions existing at the time of any particular emergency which may require deviation and resourcefulness.

Personnel concerned shall familiarize themselves with the contents of this publication.

The Coast Guard gratefully acknowledges the advice and assistance of the Navy and the Civil Aeronautics Administration in the preparation of certain material and of the Air Force, Navy, Civil Aeronautics Administration and Civil Aeronautics Board in the review of the document.

Aircraft Emergency Procedures Over Water is available to military and civil agencies of the Government, and to commercial and private organizations and individuals by purchase from the Government Printing Office, Washington, D. C.

Recommendations for changes and additions to these procedures are invited and should be transmitted to Commandant (O), U.S. Coast Guard, Washington 25, D.C. Changes will be issued when required in a separate series of consecutively numbered amendments available from the original source of supply.

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Vice Admiral, United States Coast Guard
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# Chapter I
# EMERGENCY COMMUNICATIONS

## IMPORTANCE

Of all emergency procedures with which the over-ocean pilot must be familiar, none is so important as Communications. It is the means by which the Search and Rescue (SAR) organization is alerted and put into action. It enables the numerous and varied facilities to function as a team.

## RESPONSIBILITY OF PILOTS

The pilot of the distressed aircraft is a vital member of the SAR team. From the inception of distress, the pilot can guide and assist the SAR organization in its efforts to help him. If he cannot, or does not, announce his predicament at the earliest possible moment, his chance of survival may be greatly reduced. It is imperative that the pilot of the aircraft in distress start the distress procedure when doubt exists as to the safety of his aircraft. The pilot, as commander of the aircraft, has the responsibility of deciding when an emergency exists or when a forced landing or bailout may be necessary. It is a grave responsibility. Some pilots are reluctant to declare an emergency even when the situation requires it. Wise pilots do not hesitate to call for assistance when confronted with the remotest possibility of a forced landing at sea. It is far better to start the distress procedure, and then not to need assistance, than to delay until it is too late. The SAR organization is always ready to respond immediately and render timely assistance which may well prevent the development of a full emergency.

When a decision is made that an emergency situation exists, the pilot should AT ONCE START THE APPROPRIATE EMERGENCY PROCEDURE as shown in the following diagrams.

## ALERTING PROCEDURE

ACTION REQUIRED BY PILOT OF LOST AIRCRAFT

**HE WILL**

Transmit XXX on CW and/or "PAN" on voice (three times) followed by aircraft identification.

Transmit on normal air-ground frequency. If this channel fails, use any of the following frequencies: 121.5 mc., 243 mc., 500 kc., 2182 kc., or 8364 kc., depending on distance and time of day.

When communications contact is established, request a D/F fix or bearing. Give the following information:

1. Course, speed, and altitude and best estimate of position.
2. Flying time remaining
3. Intention
4. Type aircraft

At end of message, give two 10 second dashes, followed by aircraft identification once.

If within range of radar stations, climb to altitude and execute prescribed lost aircraft radar pattern. If doubt exists as to possibility of reaching a safe landing field, initiate urgent or distress phase.

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## URGENCY PROCEDURE

ACTION REQUIRED OF PILOT IN POSSIBLE DISTRESS

**WHEN**

Pilot has first intimation that he is in trouble and may not reach a safe landing field.

**HE WILL**

Turn on EMERGENCY IFF

If within range, climb to altitude to enable radar stations to take a fix

Transmit XXX on CW and/or "PAN" on voice (three times) followed by aircraft identification.

Transmit on normal air-ground frequency. If this channel fails, use any of the following frequencies: 121.5 mc., 243 mc., 500 kc., 2182 kc., or 8364 kc., depending on distance and time of day.

Send urgent message including such elements of the following as time permits:

1. Position or estimated position
2. Course, speed, and altitude
3. Situation and intention
4. Type aircraft

At end of message, give two 10 second dashes, followed by aircraft identification.

Decide most feasible location for bailing out or ditching, such as near a surface vessel or other source of help, and advise intentions.

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## DISTRESS PROCEDURE

ACTION REQUIRED OF PILOT IN ACTUAL DISTRESS

### HE WILL

Turn on EMERGENCY IFF

Transmit three times "SOS" on MCW if available or CW and/or "MAYDAY" on voice followed by aircraft identification repeated three times.

Transmit on normal air-ground frequency. If this channel fails, use any of the following frequencies: 121.5 mc., 243 mc., 500 kc., 2182 kc., or 8364 kc., depending upon distance and time of day.

Send distress message including as much of the following as time permits:

1. Position or estimated position
2. Course, speed and altitude
3. Nature of distress
4. Intention of pilot as to bailout or ditch
5. Kind of assistance required (escort, ditch heading, etc.)

At end of message, give two 10 second dashes followed by identification of aircraft.

Immediately prior to bailing out or ditching set radio for continuous emission.

Bail out using standard doctrine

or

Ditch using standard doctrine

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## DISTRESS PROCEDURE

ACTION REQUIRED OF A PILOT OBSERVING A DISTRESS INCIDENT

**HE WILL**

Switch on EMERGENCY IFF

Immediately mark position with dye marker, float light, etc.

Simultaneously

Transmit the distress message:

a. When aircraft in distress not able to transmit the message; or
b. Pilot in command of observing aircraft believes that additional help is necessary

IF

NO SURFACE CRAFT ARE IN VISUAL RANGE

Drop survival equipment as able

Climb to an altitude that will enable radar stations to take a fix. Execute radar emergency pattern.

SURFACE CRAFT ARE IN VISUAL RANGE

Guide vessels to scene by circling them and gunning engine as aircraft crosses vessel's bow, then flying in the direction of the distress, rocking the wings

Send urgent message including following elements:

1. Position, or estimated position
2. Situation and intention
3. Type aircraft
4. Action taken

Transmit on normal air-ground frequency. If this channel fails, use any of the following frequencies: 121.5 mc., 243 mc., 500 kc., 2182 kc., or 8364 kc., depending upon distance and time of day.

Direct surface craft to scene

Remain on scene as long as possible

Advise controlling station if further aid is needed

## EXAMPLES OF DISTRESS COMMUNICATIONS

### DISTRESS:

VOICE: Mayday, Mayday, Mayday, this is Coast Guard 1234, this is Coast Guard 1234, this is Coast Guard 1234.

(Follow with amplifying information on situation)

10 second tone — 10 second tone

This is Coast Guard 1234. Over

(MCW or CW) SOS SOS SOS DE Q1234 Q1234 Q1234

(Following with amplifying information on situation)

10 second dash — 10 second dash

DE Q1234 K
The distress message may be repeated at intervals until an answer is received.

### CANCELLING THE DISTRESS MESSAGE:

VOICE: Mayday. All stations, all stations, all stations, this is Coast Guard 1234. Cancel distress. Cancel distress. (Any explanatory or amplifying data.) This is Coast Guard 1234. Over

(MCW or CW) SOS CQ CQ CQ DE Q1234 (date-time of distress message)

Q1234 QUM K

References: ITU Convention 1947
Flight Information Manual

## THE IMPORTANCE OF INDOCTRINATION

While the foregoing diagrams provide an outline of action to alert and assist the SAR team, a basic understanding of the communications problem is essential in order to cope with the many situations that may arise. The average pilot is not familiar with much of the information concerning emergency communication procedures. Some of it is in publications carried on each flight, but that is not sufficient--it must be immediately and continuously available, that is--in the pilot's mind. This problem of emergency communications is common to all pilots and crews flying over water. The time to consider the problem is now--not when faced with a complicated situation requiring your entire attention. How can a surface vessel best be contacted...Should present air-ground communications be maintained...Where is the nearest source of assistance...How can it be alerted...What can be done to help him...Will an intercept by SAR aircraft help...What is the sea condition...How can the aircraft best be ditched? The answer to these and many other questions must be fixed in the pilot's mind.

## CAPABILITIES OF AIRCRAFT COMMUNICATIONS EQUIPMENT

The modern multi-engine aircraft is a highly flexible mobile radio station; the pilot and radioman have a number of transmitters and receivers with which they can work many frequencies. The pilot or radioman has a primary air-ground frequency assigned; if contact is lost on this frequency, the air-ground station can usually be worked on an alternate frequency. If the air-ground station cannot be worked on either the primary or an alternate frequency, traffic should be relayed through another surface or aircraft station. The occasions are infrequent when a well-qualified operator cannot get his traffic through in one manner or another by CW transmission, but in the case of voice transmission, difficulty may well be encountered, particularly on the enroute frequency channels.

## INITIAL DISTRESS CONTACT

THE MOST IMPORTANT SINGLE THING THAT A DISTRESSED PILOT CAN ACCOMPLISH IS TO LET ANOTHER STATION KNOW THAT HE IS IN DISTRESS. The first transmission should be on the air-ground frequency in use. A distress call to any aeronautical ground station will result in an immediate response by the SAR organization. Once contact is established with the ground station, do not break contact to shift to another frequency without a compelling reason. The SAR units will make contact on the air-ground frequency or VHF/UHF channels 121.5/243 mcs., the latter if U. S. military aircraft. Many single engine aircraft have only VHF and/or UHF. If the normal air-ground VHF or UHF frequency is overloaded with traffic, the emergency transmission should be made on the emergency channels (121.5 or 243 mcs.). Along the coastal regions of the United States, an aircraft is usually in range of some station guarding 121.5 or 243; these stations are equipped to alert the SAR net.

At times, the aircraft may not be able to receive traffic, although its transmissions are heard by other stations. If no acknowledgment is received, make "blind" broadcasts, giving all pertinent information.

If contact is not possible with a ground station on route frequencies, traffic can sometimes be relayed through other aircraft. They may be contacted on route frequencies, or on the emergency VHF or UHF frequency. On overseas flights, pilots should guard 121.5 mc/s and/or 243 mc/s; they may be able to act as a relay. Any pilot over the ocean on hearing of a distress case in his area, should closely guard 121.5 and/or 243 mc/s, and, if possible, the distressed unit's air-ground frequency. Pilots should not hesitate to offer relay services; the distressed unit may not have contact with anyone else.

The distressed unit is in control of communications until the distress is terminated, or until the distressed unit delegates control to another unit. It is strongly recommended that the distressed unit delegate control of communications to a rescue unit once it is in positive contact with the rescue aircraft. The rescue unit is familiar with distress communications and will be able to relieve the distressed craft of some communications. All other units not having essential distress traffic should maintain radio silence on the distress frequency being used.

Ships at sea provide a valuable means of ready assistance. Other than the Ocean Station Vessels, and certain Navy and Coast Guard vessels, ships do not guard aeronautical frequencies. Most trans-ocean pilots have communicated with the Ocean Station Vessels. These ships maintain a communication guard especially for aircraft on frequencies listed in flight information publications. Establishing communications with merchant vessels presents an entirely different problem; pilots and radio operations should be familiar with the factors involved. 500 kc/s has long been an international distress and calling frequency. It is used by ships and CW equipped aircraft to request assistance. Another frequency, 2182 kc/s, was established by the International Telecommunications Union, Atlantic City, 1947, as the international distress and calling voice frequency for the maritime mobile service. Since there is a trend toward the use of voice for aeronautical communications, this frequency offers promise as a useful ship/air distress and calling frequency.

## LOST AIRCRAFT RADAR PATTERN

If unable to establish radio contact and the severity of the distress warrants, attempt to alert the Air Defense Command radar system by flying one of the emergency patterns described below. . . .repeat each twenty minutes until instructions are received or interception is accomplished.

With operating receiver only, tune to 121.5 or 243.0 megacycles. Fly a triangular pattern to the right of two minute legs with half-standard-rate turns (1-1/2 degrees per second) of 120 degrees. Complete a minimum of two patterns before resuming course. If radar contact is established, instructions will be given on the emergency frequency.

With no receiver, fly a triangular pattern to the left in the manner described above. If radar contact is established, a rescue aircraft will be dispatched for intercept. Resumption of course will not compromise this system as the aircraft will continue to be tracked as "distressed" from point of initial contact.

## DISTRESS FREQUENCIES

500 kc/s: The International Distress Frequency--500 kc/s--is the oldest distress frequency in use. Most larger ships of the Maritime Service maintain a watch on 500 kc/s continuously either by radio operator on watch or by means of an "auto-alarm". High-powered shore stations also guard it. In addition to being the international distress frequency, it is also an international calling frequency. By reason of its dual purpose, it fulfills a most important requisite of a distress frequency, i.e., it is guarded by many units.

Even a weak distress signal on 500 kc/s may serve to alert some unit which can assist or summon assistance. Because it is a calling frequency, as well as a distress frequency, international law requires that all ships and stations operating in this frequency band maintain a three-minute silent period twice every hour, beginning at 15 and 45 minutes after the hour. During these periods, a weak SOS stands its best chance of being heard.

Shipboard auto-alarm system. Most merchant vessels do not maintain a "live" 24-hour radio watch. To provide a means of alerting these ships on 500 kc/s in event of emergency, an auto-alarm system is installed. Any ship that can be reached with sufficient power can be alerted. The auto-alarm is triggered by a signal consisting of twelve four-second dashes separated by intervals of one second. Any four of the dashes will actuate the alarm. The alarm bell is sounded to alert the operator; he must report to the radio room in order to turn it off. One of the first cases in which the auto-alarm system was used during an aircraft distress occurred on January 21, 1939, when the British flying boat Cavalier ditched at sea. A coastal radio station intercepted the distress message and transmitted an auto-alarm alert. This alerted the radio operator on the SS ESSO BAYTOWN, the nearest vessel to the distress. The ESSO BAYTOWN proceeded immediately to the scene and rescued ten survivors. It is of interest to note that the auto-alarm transmission was received by 62 merchant ships, actuated 52 auto-alarm systems aboard American ships, and served as the first indication of distress to those ships.

A distress message is handled as follows: The initial distress signal is received by some ship or shore station, which will then transmit a high-power auto-alarm signal--followed shortly by a broadcast of the distress message. Word of the emergency may quickly reach a vast area of the ocean. On being alerted, ships in the vicinity will immediately initiate action to render assistance. A prompt response may be expected. Should the pilot choose to ditch with the assistance of a nearby ship, he can request that signals be transmitted on 500 kc/s for aircraft homing. The band between 405 and 490 kc/s includes the normal radio direction finding frequencies in the maritime services, but 500 kc/s may be used for distress homing. An aircraft suitably equipped should be able to communicate on 500 kc/s at a distance of at least 75 miles and much greater distances under some conditions. Since 500 kc/s is used almost exclusively by the maritime services, the importance of its use should not be overlooked by aviation personnel. Plan to use the facilities which are available. If the equipment can transmit on 500 kc/s, the means are available for contacting many ships on the surface below which guard that frequency--and guard it well. International telecommunications conferences have ruled that aircraft desiring to communicate with ships may do so on 500 kc/s. This frequency is an important international distress frequency available to all. Know its capabilities.

2182 kc/s: Many aircraft do not carry CW radio operators. Such aircraft have only voice frequencies with which to contact surface vessels. 2182 kc/s (voice) is the International Maritime Mobile Radio Telephone Distress and Calling Frequency. With the decrease in the use of CW communications, if aviation is to have any voice frequency on which it will have a reasonable chance to contact merchant vessels, this frequency must be one within the aircraft equipment capabilities, and one that is also guarded by maritime units. Both of these conditions can be met by 2182 kc/s. The most important limitation on the usefulness of 2182 kc/s is its limited use by ships. The maritime service is continuing to use CW as its primary mode of communications. For a complete understanding of the situation a review of some of the provisions relating to maritime service communications requirements is necessary.

All seagoing passenger ships, and some cargo vessels, are required to carry radiotelegraph equipment capable of operation on 500 kc/s and adjacent frequencies. High frequency and radiotelephone equipment is optional. Relatively few of these ships carry radiotelephone. Generally, small cargo vessels, unless fitted with radiotelegraph, are required to carry radiotelephone equipment to operate in the band 1605 to 2850 kc/s. Radio equipment for small craft, such as fishing boats and yachts is not a mandatory requirement; however, many carry radiotelephone. It is apparent that 2182 kc/s now falls short of being an ideal air/surface calling and distress frequency; however, all transocean aircraft should be equipped to work this frequency. In an emergency requiring contact with a surface unit, if 500 kc/s (CW) cannot be used, a determined effort should be made to contact nearby merchant, naval or Coast Guard vessels on 2182 kc/s. All major Coast Guard vessels and shore radio stations, many naval vessels, and most coastal radio stations guard this frequency.

8364 Kilocycles: For long range CW high frequency distress communication, the frequency 8364 kc/s may be used by aircraft. It has been designated as the International High Frequency for Survival Craft Equipment (Gibson Girl et al) and for this purpose replaces 8280 kc/s. 8364 kc/s is also the center band frequency of the 8 mc/s CW calling band and, as such, is reserved for the use of aircraft desiring to communicate with stations of the maritime mobile service. It is guarded by the Coast Guard, Navy, Air Force, Civil Aeronautics Administration, coastal radio stations, and some ships. In order to establish two-way communications on 8364 kc/s, the message must be of an emergency nature and the calling unit must request reply on the same frequency. Otherwise, the station called will reply on its assigned working frequency.

Summary: The pilot and radio operator must know how to communicate effectively and directly with surface vessels, shore stations, and other aircraft. They must know the capabilities and limitations of their equipment and the distress frequencies. They should, if possible, work ships until the procedure is entirely familiar. Not until then can the ships at sea offer the maximum security and protection. If ships' calls are not known, transmission of the general call "CQ" by CW, or "All Stations" by voice, followed by a request that ships in the vicinity answer for radio check will establish communications.

The primary frequencies available in distress operations are as follows:

a. Air/ground route or control frequency
b. 500 kc/s--International calling and distress, radiotelegraphy
c. 2182 kc/s--International calling and distress, radiotelephony
d. 8364 kc/s--International survival craft communications and aeronautical calling
e. 121.5 mc/s--International aeronautical emergency frequency for VHF band
f. 243 mc/s--Military emergency frequency for UHF band

## THE SAR CYCLE

What is the normal sequence of events when a pilot declares an emergency? Examine a typical case in the New York Ocean Control Area. The distressed pilot will usually transmit his distress message to the air-ground station on the assigned air-ground route frequency. The air-ground station flashes the information to the Oceanic Air Traffic Control (OATC) Center. The OATC then takes the following steps:

a. Passes distress information to RCC New York by rapid means. (This Rescue Coordination Center (RCC) is under control of Commander Eastern Area, U.S. Coast Guard.)
b. Alerts other aircraft in the vicinity of distress who may be able to assist.
c. Controls traffic to avoid any conflict with distress traffic.

On receipt of distress information, RCC takes the following action:

a. Dispatches Coast Guard escort aircraft and surface units.
b. Requests additional units from Air Force, Navy, or other sources if required.
c. Initiates alert to vessels at sea on "all ship broadcasts".
d. Alerts direction finder nets.
e. Alerts radar facilities if needed.
f. Coordinates rescue operation.

## RCC CAPABILITIES

The RCC is a complex communications center able to contact and alert SAR facilities quickly. The RCC maintains a plot of vessels at sea or has ready access to this information through the appropriate Navy command. The controller, by examining the ship plot, can divert a specific vessel which is in a position to be of assistance to a distressed unit. The RCC coordinates with OATC the diversion of enroute aircraft to assist the aircraft in distress. The RCC normally is able to supply sea condition and surface weather forecasts for SAR operations during certain hours. Some RCCs maintain current sea conditions data and are able to furnish a suggested ditching heading if so requested. When air or surface rescue units are alerted by RCC, they will be proceeding within minutes.

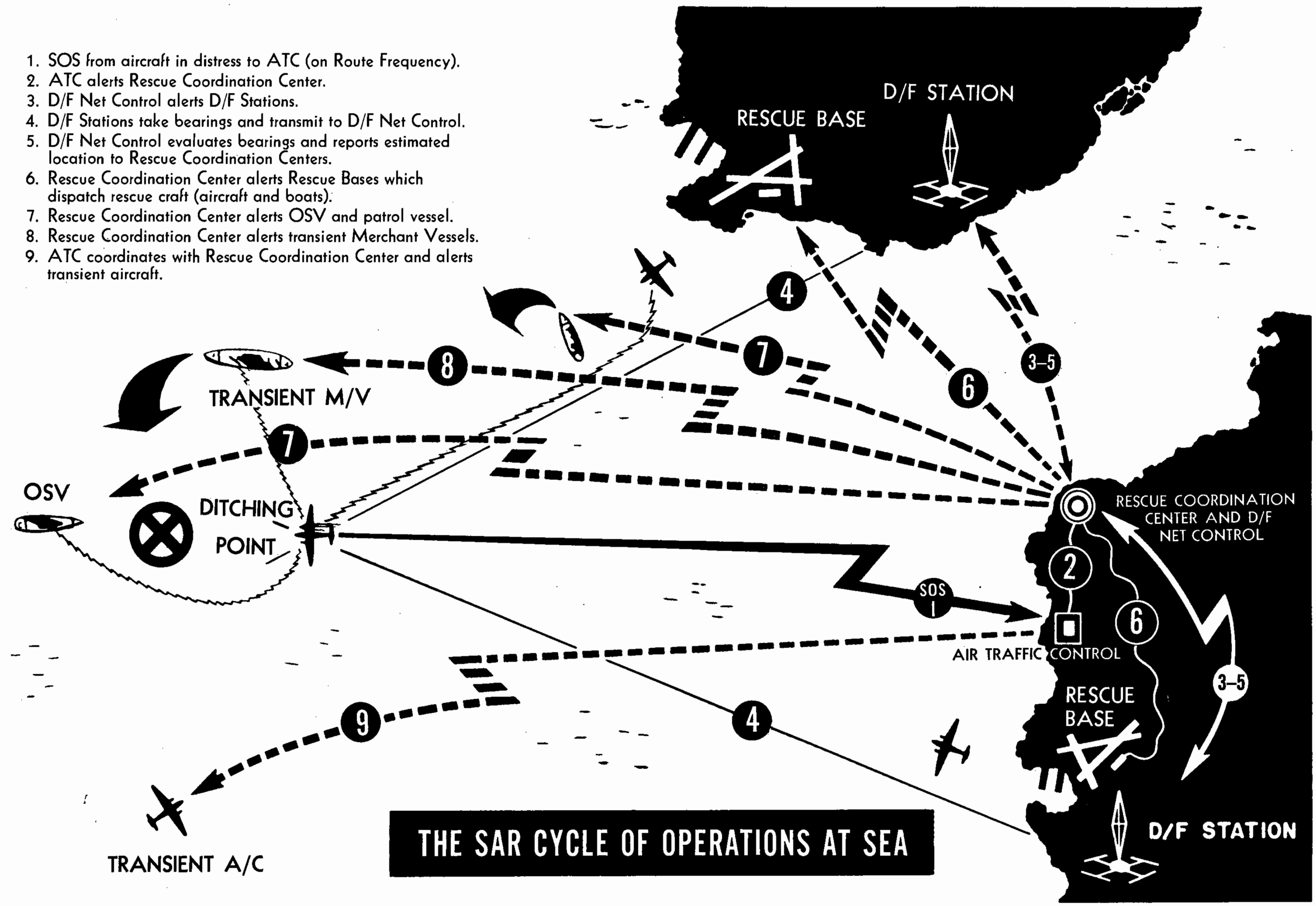


FIGURE 1-1--THE SAR CYCLE OF OPERATIONS AT SEA

# Chapter 2
# ELECTRONIC LOCATION AIDS

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## Chapter 2
# ELECTRONIC LOCATION AIDS

## INTRODUCTION

Most pilots have at some time been disorientated, or lost. Some of them have been reluctant to declare the uncertainty of their position. This reluctance has led to more serious situations. An extensive network of electronic systems and aids is available to quickly locate aircraft lost or uncertain of their position. A thorough knowledge of the use of these systems and aids is mandatory, if rapid location of aircraft, or rescue of survivors is to be effected. A brief discussion of various systems and equipment follows. Operating personnel should become thoroughly familiar with these by study of technical manuals.

## DIRECTION FINDING SYSTEMS

HF/DF Nets: Two primary HF/DF (High Frequency Direction Finder) nets are available in the Western Atlantic and Eastern Pacific for SAR use. One of these, operated by the Federal Communications Commission (FCC), is primarily a regulatory and enforcement net; the other is the military HF/DF net. Request for HF/DF service can be made direct to the air/ground station. These nets are alerted through RCC by rapid service landline--usually, bearings will be available within approximately 10 minutes. DF stations can take bearings on frequencies between 1500 and 30,000 kc/s; these bearings will usually be taken on the air/ground frequency the distressed unit is working. The pilot is asked to give a tone on the frequency, usually by counting, for a specific length of time, during which the various stations take bearings. Each station then classifies its bearing as to accuracy and relays it to the net control station for plot. Accurate and rapid fixes are possible, depending on distance and radio propagation conditions. It is possible to take bearings on the pilot's transmissions while he converses with his air/ground station without requiring additional communications. At times, due to heavy ionospheric or traffic interference, the distressed unit may be asked to transmit on a different frequency; however, rescue units are reluctant to change frequencies for fear of losing contact.

MF/DF: The majority of merchant, naval and Coast Guard vessels, some Coast Guard Radio (Primary) Stations, several FCC monitoring stations, and all large aircraft have MF/DF (medium frequency direction finder) equipment, capable of taking bearings on a medium frequency such as 500 kc/s. In an emergency, the RCC may obtain bearings taken by ships, shore stations, and aircraft to determine a fix for relay to the distressed unit.

VHF/DF and UHF/DF: A third direction finder system consists of VHF and UHF direction finders. These are usually located at air facilities, and on some naval vessels; they are primarily used to give an aircraft a fix, or "steer" to the appropriate landing facility. VHF and UHF direction finders are usually connected by rapid communication systems, so that bearings can be taken by two or more stations to determine a fix. VHF and UHF reception is roughly line of sight; the effective range is dependent on altitude, with the maximum range being about 100 miles from an aircraft at 10,000 feet. The VHF/DF and UHF/DF coverage along the coastal areas of the United States is extensive. A pilot has an excellent chance of obtaining a "steer" or fix if he is at altitude. The system can best be alerted on the VHF or UHF emergency frequencies (121.5 or 243 mc.).

Classification of Bearings and Fixes: The DF net classifies all courses and fixes given to the distressed aircraft. When using the DF service, the following classifications should be known:

Bearings

Class A ± 2 degrees

Class B ± 5 degrees

Class C ± 10 degrees

Fixes
(two or more bearings)

Class A--Within 5 miles
Class B--Within 20 miles
Class C--Within 50 miles

FCC Classifications

Good--Within 20 miles
Fair--Within 40 miles
Poor--Within 60 miles

## RADAR FACILITIES

Radar Net: Radar nets along the coast of the United States, and radars on certain ships at sea are available for use in aircraft emergencies. Nets and certain ships at sea may be alerted through air traffic control, or on the VHF or UHF emergency frequencies, 121.5 or 243 mc. In case of communication failure, they may be alerted by flying a prescribed emergency pattern.

Radar Emergency Alerting Patterns: If unable to establish radio contact, and severity of distress warrants, attempt to alert the radar system by flying one of the emergency patterns previously described. Radar is restricted to roughly line of sight coverage, therefore, increase altitude if possible, before initiating this procedure. Repeat each twenty minutes until instructions are received or interception is accomplished.

## AIRBORNE LOCATION EQUIPMENT

Aircraft VHF/DF and UHF/DF: Rescue aircraft carry special VHF and UHF direction finding equipment to aid in locating distressed aircraft. At present, two types of direction finders are used, one for VHF and the other for UHF. The UHF/DF equipment is being modified to work on VHF as well; when this modification is completed, only the one dual purpose equipment will be used for both. To obtain a bearing on a distressed aircraft, the rescue pilot requests the distressed pilot to count slowly. The bearing is then shown on a needle type indicator (similar to an ADF needle) in the rescue aircraft. In transmitting for a bearing on VHF or UHF, the pilot should count or talk steadily. Some installations have a tone switch on the control box; it may be necessary to use this for best signals.

Aircraft MF/DF: Coast Guard aircraft have special medium frequency direction finders which can take bearings on frequencies between 2 and 3 mc. By the end of 1956, this equipment will be further modified to include the frequencies between 2 and 3.5 mc.

Airborne Radar: Airborne radar has been of tremendous value in search and rescue. Airborne radar is especially useful in escort work, location of survivors, and making intercepts under instrument conditions. Normally, with present equipment, aircraft will not be detected at a range in excess of 15 miles. Use of radar in escort work is discussed in Chapter 8.

IFF: This equipment, carried by military aircraft, is of great aid in locating distressed aircraft. Its use is highly recommended.

Medium Frequency Air-to-Air Homing: During aerial intercepts, the rescue aircraft may transmit on a medium frequency so that the distressed aircraft may use its ADF or loop to take bearings. Bearings obtained should then be passed to the rescue aircraft. This procedure is used to prevent overloading the distressed aircraft's communications. The rescue aircraft transmits on the air-to-air homing frequency (522 kc/s) or other specified frequency. The best procedure is for the rescue aircraft to initially transmit its identification continuously. When the distressed aircraft advises that it is reading the signal, the rescue aircraft commences 20 second dashes, broken by its identification.

## PORTABLE EMERGENCY RADIOS

The Gibson Girl: The Gibson Girl is a portable, hand-operated, emergency radio transmitter capable of transmitting on 500 kc and 8364 kc. Detailed operating instructions are incorporated on the equipment. This equipment has proved invaluable in the past.

A case history will illustrate the point. Several years ago, an amateur yachtsman demonstrated, very dramatically, the potentialities of 500 kc/s, using the Gibson Girl transmitter. Before leaving his home port of Minneapolis for a voyage down the Mississippi and across the Gulf of Mexico to the West Coast of Florida, the prudent mariner approached the local yacht club for advice concerning emergency equipment. It was suggested that he invest in an emergency radio and some flares. Both items were readily available through an outlet of war surplus articles. This equipment was purchased and placed aboard. The trip was uneventful until, a short distance off the West Coast of Florida, the engine failed. Following the advice given him at the yacht club, he broke out his Gibson Girl. Unlacing the cover, detailed operating instructions were found. Operation was very simple. Within a short time, stations throughout the United States and as far away as Alaska had been alerted. A Coast Guard Radio Station, at Richmond, Florida, intercepted his SOS on 500 kc/s, and transmitted an auto-alarm signal on the same frequency. Ships alerted were requested to take bearings on the SOS's and submit them to the Coast Guard. Before the flood of bearings could be stopped, 134 had been submitted for evaluation. Nine of the bearings came from aircraft in the area. His position was quickly fixed. When SAR aircraft flew over, he fired flares, and within a short time a Coast Guard Cutter had him in tow.

Whenever an aircraft is reported down at sea, it is the duty of all aircraft in flight to listen for emergency radio signals. If possible, a continuous guard should be set on 500 and 8364 kc/s; otherwise guard 500 kc/s on the ADF and listen from 5 minutes before to 5 minutes after each silent period. Aircraft should also guard 121.5 and/or 243 mc at all times.

If an aircraft does not have installed equipment capable of transmitting on 500 kc/s, the Gibson Girl may be used to transmit while the aircraft is still airborne. This may be done as follows: Attach the Gibson Girl to the trailing antenna--after the antenna is reeled out fully. If the aircraft has no trail antenna--trail the Gibson Girl antenna. For best results, the set should not be attached to the fixed antenna. The Gibson Girl ground wire should be attached firmly to the metal of the aircraft. With the switch in the automatic position (SOS), the set should be cranked for two minutes, followed by a steady tone with the switch in the "manual" position. In automatic position the SOS is alternately transmitted on 500 and 8364 kc/s. In manual position, the transmission is on 500 kc/s. The aircraft call sign should be sent at two-minute intervals for identification purposes. The SOS transmission will serve to clear the frequency of other traffic. Interference from traffic will be at a minimum if transmissions are made during the international silence periods.

The AN/URC-4 Emergency Radio: The radio set AN/URC-4 is a compact, light-weight, portable receiving and transmitting unit designed for emergency use. It may be worn in a special vest, carried by hand, or dropped in a special container by rescue aircraft. It transmits and receives on the VHF and UHF emergency frequencies--(121.5 and 243 mc). When operated on a schedule of 5 minutes transmitting, followed by 5 minutes receiving, the set can operate continuously for 24 hours. Under normal search conditions, with the search aircraft at low altitude, it is safe to assume that the URC-4 can be heard at least 15 to 20 miles. It should be remembered that the antenna of this equipment is directional, and it should be turned with each call if the direction of rescue units is unknown. By using the "Tone" transmission, rescue aircraft equipped with VHF/DF or UHF/DF are enabled to home on the signal. Two way communication is possible between survivors and an aircraft equipped with UHF or VHF. The URC-4 may possibly be used as a standby transceiver in an aircraft in case of complete communications equipment or electrical failure. The potentiality of this equipment is apparent, considering that an aircraft flying within 15-20 miles of survivors equipped with this set can be contacted. Its light weight and small size make it much easier to remove from a ditched aircraft than a Gibson Girl. Rescue aircraft locating survivors often drop the URC-4 by parachute to provide means of communication.

The AN/PRC-17 Emergency Radio: The U. S. Navy has adopted for use the AN/PRC-17 Emergency Radio. Its operational use is the same as the URC-4; it is somewhat more compact.

NOTE: When using the URC-4 or PRC-17, the tone feature should be used to allow the rescue aircraft's UHF/DF or VHF/DF to function at maximum efficiency. Do not use the tone feature until instructed by the rescue pilot.

# Chapter 3
# SELECTION OF DITCHING HEADING BY EVALUATION OF SEA AND WIND

## Chapter 3
# SELECTION OF DITCHING HEADING BY EVALUATION OF SEA AND WIND

### INTRODUCTION

In order to select a proper ditching course for an aircraft, a basic knowledge of sea evaluation and other factors involved is required. The great danger to an aircraft during ditching is that rapid deceleration, extensive damage, and injury to personnel may be experienced upon contact with the water. These dangers can be minimized by selecting the optimum ditching heading. Selection of the ditching heading may well determine the difference between survival and disaster.

### DEFINITIONS

Some basic definitions of oceanographic terminology are:

Sea. The condition of the surface that is the result of waves and swells, i.e., waves that are formed by local winds, and the swell systems that have formed because of distant winds.

Wave (or Chop). The condition of the surface caused by local winds. It is characterized by its irregularity, short distance between crests, whitecaps, and breaking motion.

Swell. The condition of the surface which has been caused by a distant disturbance. The individual swell appears to be regular and smooth, with considerable distance between the rounded crests.

Swell Face. The side of the swell toward the observer. The backside is the side away from the observer. These definitions apply regardless of the direction of swell movement.

Primary Swell. The swell system having the greatest height from trough to crest.

Secondary Swells. Those swell systems of less height than the primary swell.

Fetch. The distance the waves have been driven by a wind blowing in a constant direction, without obstruction.

Swell Period. The time interval between the passage of two successive crests at the same spot in the water, measured in seconds.

Swell Length. The horizontal distance between successive crests, measured in feet.

Swell Velocity. The velocity with which the swell advances with relation to a fixed reference point, measured in knots. There is little movement of water in the horizontal direction. Each water particle transmits energy to its neighbor, resulting primarily in a vertical motion, similar to the motion observed when shaking out a carpet.

Swell Direction. The direction from which a swell is moving. This direction is not necessarily the result of the wind present at the scene. The swell encountered may be moving into or across the local wind. Swells, once set in motion, tend to maintain their original direction for as long as they continue in deep water, regardless of changes in wind direction.

Swell Height. The height between crest and trough, measured in feet. There is no simple formula for determining swell height. It is proportional to the strength of the wind of origin, the length of time the wind has been blowing, the steadiness of direction, and the fetch. High swells are not generated instantaneously, nor are there high swells in the lee of an obstruction, no matter how long the wind has blown. The vast majority of ocean swells are lower than 12 to 15 feet, and waves over 25 feet are not common at any spot on the oceans. Due to interference, which is the overrunning of one swell system by another, successive swells differ considerably in height.

### PHENOMENA OF SWELLS

The phenomenon of swell interference can be illustrated by dropping two pebbles into a pond at different locations. It will be observed that the two circular waves pass through each other undisturbed. Since waves at sea originate in much the same manner, i.e., by imparting energy to the surface, an analogy can be made.

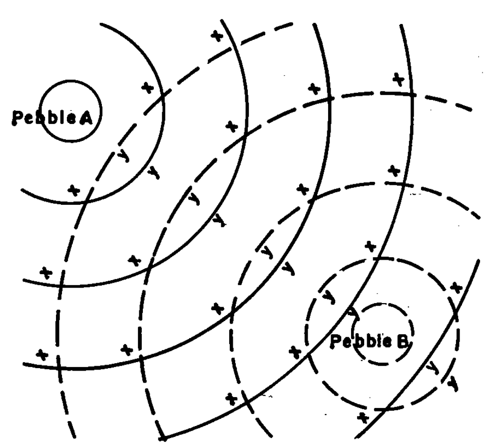



Figure 3-1-Waves emanating from two energy sources

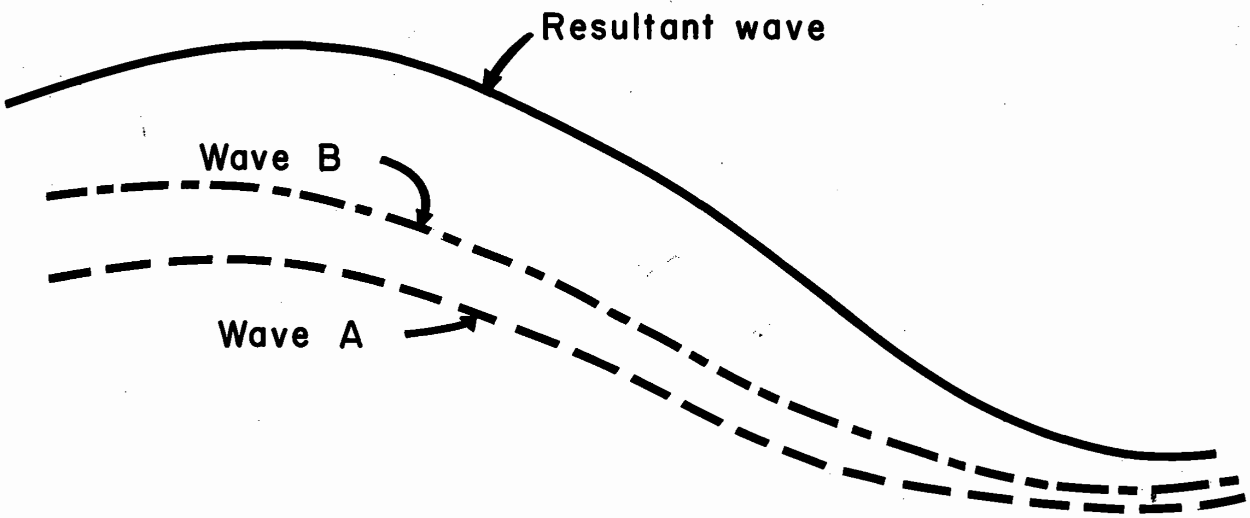



Figure 3-2-Two waves in phase

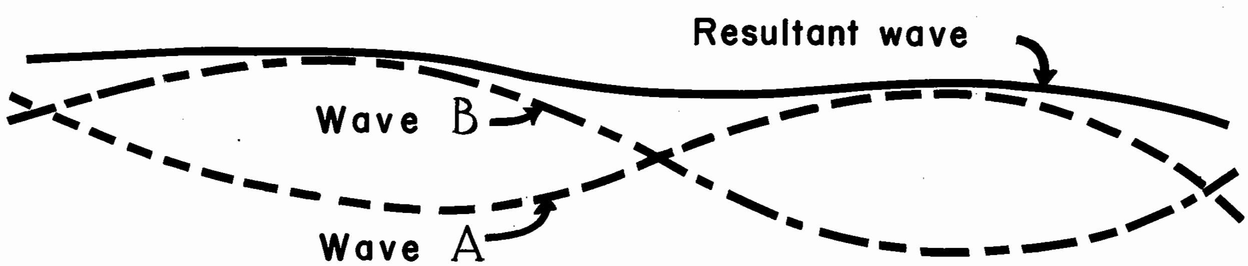



Fig.3-3 - Two waves in opposition

Instead of pebble A in Figure 3-1, assume a low pressure system in that position, and instead of pebble B, substitute a second low pressure system. Waves emanating from each low pressure system proceed outward from their respective centers and intersect at the places marked "X". At these points, the two wave systems are in phase, thereby adding in height to each other as in Figure 3-2.

At points "Y", the two wave systems are in opposition, and tend to cancel each other. (Figure 3-3).

Notice the resultant wave in Figure 3-3 when the two swell systems are in opposition, or "filling in the troughs". This provides a good touchdown spot. On the ditching approach, this relatively flat area will appear as a lesser concentration of whitecaps and shadows.

## SELECTION OF DITCHING HEADING

Effect of Swells: It is not sufficient to land into the wind without regard for sea conditions. This procedure has proved disastrous in the past. Many ditchings, plus hundreds of open sea seaplane landings, have proved that the swell system, or systems, must be taken into consideration.

There are two simple empirical formulae for determining the length and velocity of swells. The two formulae are:

a. Length (ft.) = 5 x (period in sec.)$^2$

b. Velocity (knots) = 3 x (period in sec.)

Assuming a 10-second swell period, by substitution in the formulae, the swell length is found to be 500 feet with a velocity of 30 knots.

Figure 3-4 illustrates an aircraft landing into the swell. As an example, assume the aircraft takes 450 feet and 7 seconds to come to rest. During the 7 seconds of runout, the swell moves toward the aircraft a distance of about 300 feet--thereby shortening the effective swell length to about 200 feet. Since the aircraft takes 450 feet to come to rest, it would meet an oncoming swell about halfway through its runout; it would probably be

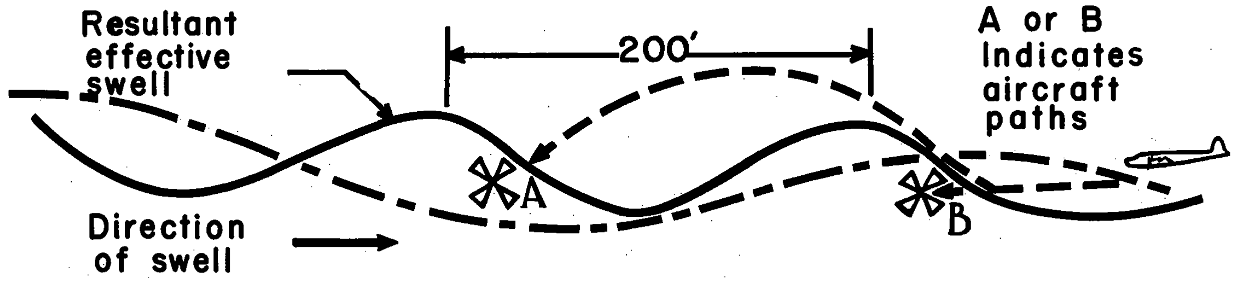



Figure 3-4- Landing into the swell

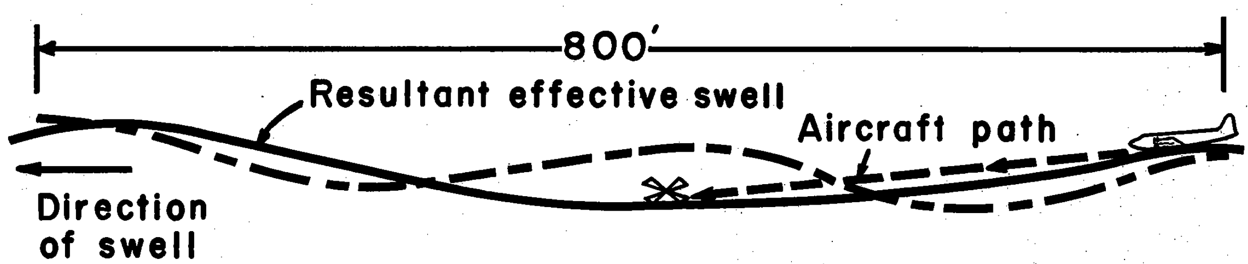



Figure 3-5-Landing down swell

swamped, or thrown into the air out of control. This ditching heading is to be avoided if at all possible.

Next consider the downswell heading shown in Figure 3-5.

The swell is moving with the aircraft during landing runout--thereby increasing the effective swell length by about 300 feet, resulting in an effective swell length of 800 feet. The aircraft, if touched down just beyond the crest, will come to rest short of the next crest. In the long swells of the Pacific, this can be an easy landing. However, in the Atlantic, shorter swell lengths ordinarily prevent this heading except when landing down a secondary swell system. (In some cases, selection of a ditching heading to parallel a primary swell system may require landing down swell on a secondary system.)

Figure 3-6 shows a landing parallel with the swell. This is the best ditching heading. In ditching parallel to the swell, it makes little difference whether touchdown is on top of the crest or in the trough. It is preferable, if possible to land on the top or back face of the swell.

If only one swell system exists, the problem is relatively simple--even with a high, fast system. Unfortunately, most cases involve two or more systems running in different directions. With many systems present, the sea presents a confused appearance. One of the most difficult situations occurs when two swell systems are at right angles. If the pilot parallels one, he must land into, or down, the second system. For example, if one system is 8 feet high, and the other 3 feet, a landing parallel to the primary system, and down swell on the secondary system is indicated. If both systems are of equal height, a compromise may be advisable--selecting an intermediate heading at 45 degrees down swell to both systems. When landing down a secondary swell, attempt to touch down on the back side, not on the face of the swell. This is shown in Figure 3-7. Remember one axiom--AVOID THE FACE OF A SWELL.

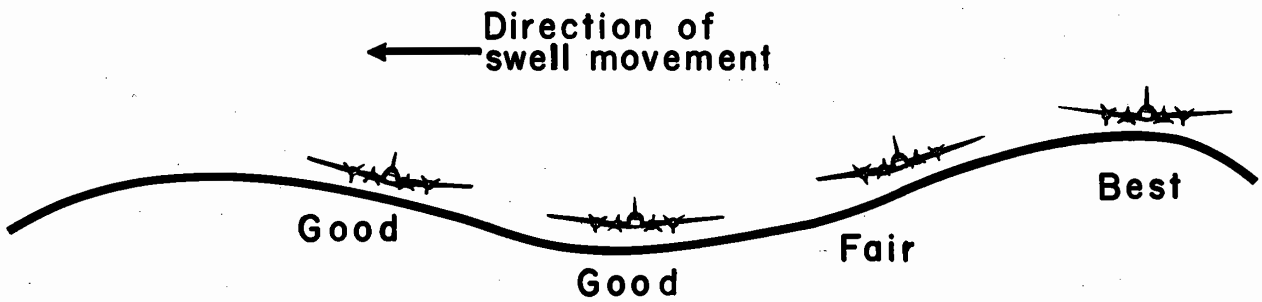



**Figure 3-6 - Landing parallel to the major swell**

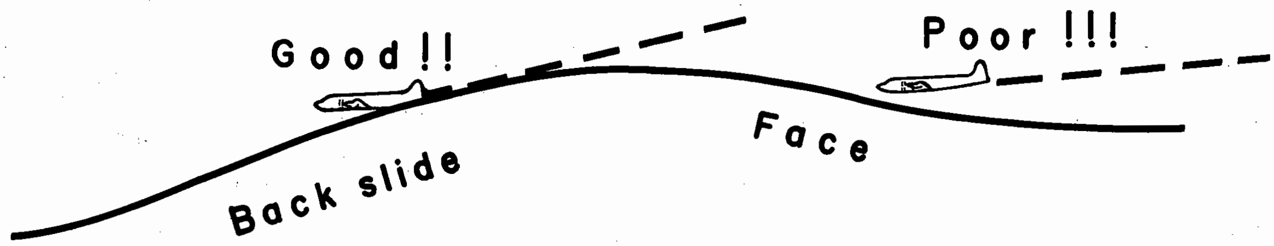



**Figure 3-7- Landing on the face and back**

Effect of Chop: Local winds create chop (waves) which act much the same as a swell system. When winds are 14 knots or above whitecaps will form on the wave crests. The chop rides on top of the resultant uneven surface, and if severe, may serve to hide the underlying swell systems. Moderate chop, alone, can be discounted as a danger to ditching.

Effect of Surface Wind: The best condition for an open sea landing is one which permits landing parallel to a single swell system and into the wind; this situation seldom exists. Some crosswind is usually present, and must be accepted in order to parallel the major swell. The following general rules apply to seaplane operations in the open sea.

a. Winds from 0 - 25 knots. Ignore the crosswind component, and land parallel to the major swell. Two headings parallel to the major swell will be possible. Select the heading which has greatest headwind component. However, if a pronounced secondary swell exists, it may be desirable to land down the secondary system and accept some tailwind component.

b. Winds over 35 knots. Generally, with winds of this force, the landing will be made into the wind regardless of the swell. The primary swell system will usually be from the same direction as the wind. Ground speed is materially reduced. A landing into the wind and swell may be best under these difficult conditions. However, if the swell is so formidable as to make a successful ditching into it doubtful, it may be advisable to land at an angle to, or parallel to, the swell--accepting crosswinds of great force.

c. Winds between 25 - 35 knots. It may be necessary to select an intermediate heading, neither parallel to the swell, (since the crosswind component may prove too much to handle), nor into the wind (because the ground speed reduction due to headwind will not compensate for the disadvantages of landing into the swell). A heading at an angle into the wind and swell is indicated. If the swell is very high, a greater crosswind component should be accepted in order to more closely parallel the swell.

There is ample reason, based on theoretical considerations, and on a limited number of actual ditchings in high winds, to believe that low wing landplanes can accept a much higher crosswind component than seaplanes. In a recent ditching in the Atlantic, alongside an Ocean Station Vessel, a C54 landed parallel to a 12 - 15 foot swell system with 42 knots crosswind; the ditching was relatively smooth. The above rules for seaplane operation may be interpreted with more latitude for landplane ditchings. If the swell system is formidable, it is considered advisable, in landplanes, to accept more crosswind in order to avoid landing directly into the swell.

The secondary swell system is often from the same direction as the wind. Here, the landing may be made parallel to the primary system, with the wind and secondary system at an angle. There is a choice of two headings paralleling the primary system. One heading is downwind and down the secondary swell; the other is into the wind and into the secondary swell. The choice of heading will depend on the velocity of the wind versus the velocity and height of the secondary swell.

The simplest method of estimating the wind direction and velocity is to examine the wind streaks on the water. These appear as long streaks up and down wind. Some persons may have difficulty determining wind direction after seeing the streaks on the water. Whitecaps fall forward with the wind but are overrun by the waves thus producing the illusion that the foam is sliding backward. Knowing this, and by observing the direction of the streaks, the wind direction is easily determined. Wind velocity can be accurately estimated by noting the appearance of the whitecaps, foam and wind streaks.

d. Beaufort scale: The following Beaufort scale will prove useful.

| Beaufort Number | Velocity Knots | Sea Indications | Height of Waves, Ft. |
|---|---|---|---|
| 0 | Calm | Like a mirror | 0 |
| 1 | 1-3 | Ripples with the appearance of scales; | 6 inches |
| 2 | 4-6 | Small wavelets; crests have glassy appearance and do not break. | 1 Foot |
| 3 | 7-10 | Large wavelets; crests begin to break. Foam of glassy appearance; few very scattered white-caps. | 2 |
| 4 | 11-16 | Small waves, becoming longer. Fairly frequent whitecaps. | 5 |
| 5 | 17-21 | Moderate waves, taking a pronounced long foam; many whitecaps. | 10 |
| 6 | 22-27 | Large waves begin to form; white foam crests are more extensive; some spray. | 15 |
| 7 | 28-33 | Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of waves. | 20 |
| 8 | 34-40 | Moderately high waves of greater length; edges of crests break into spindrift; foam blown in well marked streaks in the direction of the wind. | 25 |
| 9 | 41-47 | High waves. Dense streaks of foam; sea begins to roll; spray affects visibility. | 30 |
| 10 | 48-55 | Very high waves with overhanging crests; foam in great patches blown in dense white streaks. Whole surface of sea takes on a white appearance. Visibility is affected. | 35 |

NOTE: The heights given for the wind-driven sea are approximate. The height depends on the length of time and steadiness with which the wind has blown, and the fetch. It should also be remembered that it is possible to have a heavy swell running in an area where there is little or no surface wind. Also, a heavy swell system may be obscured or hidden beneath a local wind-driven system.

## SELECTION OF THE TOUCHDOWN POINT

On final approach, look ahead and observe the surface of the sea. There may be shadows and whitecaps--signs of large seas. Shadows and whitecaps close together indicate that the seas are short and rough. Touchdown in these areas is to be avoided. Select and touchdown in an area (only about 500 feet is needed) where the shadows and whitecaps are not so numerous.

## USE OF SURFACE VESSELS IN SEA EVALUATION

Many ships will be able to give an estimate of the sea conditions. Coast Guard Ocean Station Vessels maintain current information on wind direction and velocity, swell direction, height, length and velocity, and can give a suggested ditching heading if so requested.

## ROUTINE SEA EVALUATION

Whenever practicable, pilots flying over water should make a habit of evaluating the sea. This procedure ensures a tentative ditching heading at all times. It also provides practice in swell system identification.

## SEA EVALUATION TECHNIQUE

The pilot should begin analyzing the surface from as high an altitude as the surface can be seen, two thousand feet (2000) or more if possible. The primary or basic swell can readily be distinguished from high altitude and will be seen first. It may be hidden beneath another system plus a surface chop, but from altitude the largest, and most dangerous system will be the first one recognized. This will appear as a definite pattern or differences in light intensity on the surface--not necessarily a line of shadows, although this might be possible near sunrise or sunset, but a pattern will definitely stand out. By watching the pattern for a few seconds the direction of motion of the system can easily be determined. Once the basic system is found, look in different directions for other systems. Perhaps the second system may not be visible until the altitude is decreased so a continued scanning is required. Some minor systems may not be seen until an altitude of five to eight hundred (500 to 800) feet is reached. The wind driven sea, if any, will be easily recognized by the appearance of white caps. Ironically, once a low altitude is reached (1500' or so) the basic system may disappear from view, hidden by the secondary system and the local chop. It is essential, therefore, to plot the direction of the various systems as they are recognized.

Once primary and secondary systems are recognized the analysis may be easily checked by flying on various headings around the compass just above the water, the lower the better. When flying into any system the sea appears to be steep, fast, and rough. When flying down or parallel to the systems the surface appears much more calm. This is true because your relative speed over the uneven surface is materially reduced.

If the surface is not visible from altitude the speed and direction of the seas underlying the local chop may be approximated with a ceiling as low as seventy-five (75) to one hundred (100) feet.

If time permits, the following steps should be followed:

a. Drop a smoke float, dye marker, or other floating object.
b. Observe the swells as they pass under the float to determine direction of swell movement.
c. Obtain the period of the swell by timing the interval between passage of successive crests.
d. Compute the primary swell length and velocity by use of the formulae.
e. Compute length and velocity of secondary swell.
f. Estimate direction and velocity of the surface wind.
g. Select the best and alternate ditching headings.

## EMERGENCY EVALUATION TECHNIQUE

Whenever possible, the above procedure should be followed. In some cases, however, the pilot may be unable to carry out a full evaluation because of lack of time or maneuverability. In such cases, an abbreviated procedure should be used as follows:

a. Determine the direction of the primary swell.
b. If time permits, determine the direction of the secondary swell.
c. Estimate the direction and velocity of the wind.
d. Using these factors, select the ditching heading.

In some areas of the ocean there are prevailing swells from a fairly constant direction. This condition should be recognized by pilots regularly flying certain routes.

## SUMMARY

From the above discussion on sea evaluation and selection of ditching heading the following general rules are presented:

a. Never land into the face of a primary swell system (or within 30 to 45 degrees of it) unless the winds are extremely high.
b. The best ditching heading is usually parallel to the major swell system and

down the minor swell system.

c. The next best choice is parallel to the minor swell system and down the major swell system.

d. The choice between b and c above will be determined by the heading that gives the greatest component of wind on the nose of the aircraft.

e. In moderately strong winds it may be desirable to compromise the above rules by landing more into the wind and slightly across the swell system.

f. If able to fly low over the water on various headings around the compass, the heading which appears to be the smoothest, and which does not run into the face of a primary swell will usually be the best ditching heading.

# Chapter 4
# BASIC DITCHING PROCEDURES AND TECHNIQUES

## CONTROLLING FACTORS

<u>Sea Conditions and Wind</u>

<u>Type Aircraft</u>

<u>Deceleration Forces</u>

<u>Pilot Skill and Technique</u>

# Chapter 4
# BASIC DITCHING PROCEDURES AND TECHNIQUES

## CONTROLLING FACTORS

A successful aircraft ditching is dependent on three primary factors. In order of importance they are:

(1) Sea conditions and wind
(2) Type of aircraft
(3) Skill and technique of pilot.

Sea Conditions and Wind: The behavior of an aircraft on making contact with the water will vary within wide limits according to the state of the sea. If landed parallel to a single swell system, the behavior of the aircraft may approximate that to be expected on a smooth sea. If landed into the face of a major swell system, or into a confused sea, the deceleration forces may be extremely great--resulting in breaking up of the aircraft. Within certain limits, the pilot is able to minimize these forces by proper sea evaluation and selection of ditching heading.

Type Aircraft: The pilot has no choice of the type aircraft he is forced to ditch. By knowing the characteristics of the aircraft, however, and its expected behavior on the water, certain steps can be taken to insure best ditching performance. Data on ditching characteristics of most aircraft are available from controlled tests on models or from studies of actual ditchings. It is impossible to list each individual aircraft's characteristics here. For illustration, the performance of a "composite" aircraft made up from data on several transport aircraft of similar design will be discussed.

Other factors being equal, the larger the aircraft, the better are its ditching characteristics. Fighter aircraft, due to their higher landing speeds and smaller size, often react violently on ditching. However, due to their strong fuselage and cockpit, as well as the shoulder harness worn by the pilot, the survival rate is high.

Every effort should be made to keep the air intake clear of the water during the runout. If the air intake enters the water at high speed, adverse behavior will result.

Transport aircraft are generally better in ditching than combatant types. Transport aircraft bottoms, where most failures can be expected to occur, are stronger than those found in bomber aircraft. The bomber is greatly weakened by large bomb bay doors, and failure of these doors can result in violent behavior of the aircraft on runout. Chance of survival of personnel stationed aft of the bomb bay is reduced by the rush of water through it into the aft part of the fuselage. Most of the damage to the bottom of the fuselage of any aircraft may be expected to occur in the critical mid-section. The behavior of the aircraft on runout is dependent on the damage suffered, and is more violent if damage to the fuselage occurs on first impact. In most aircraft, bottom damage may be expected. Double deck aircraft will probably suffer rapid flooding of the lower deck, but the upper deck is a relatively safe location. Aircraft equipped with cabin pressurization have good inherent watertight integrity and, if the fuselage is intact, afford better protection against rapid flooding than non-pressurized types. In all cases, however, the aircraft must be depressurized before ditching. Glass in the nose section of aircraft with bow turret or bow lookout station may be shattered during ditching with a resultant inflow of water. Nose-wheel doors may also collapse.

On many aircraft with long after-bodies, the fuselage may break a few feet forward of the tail--especially when ditching in a full stalled attitude into the face of a swell system. In several recent military patrol-type aircraft ditchings, the after-end of the aircraft separated entirely from the remainder of the fuselage.

Low-wing aircraft, due to the flotation support derived from the wings, are safer for ditching than high-wing types. The high-wing aircraft tends to sink rapidly after impact until the wings settle in the water. As a result, most of the fuselage is under water immediately after the aircraft comes to rest.

External protuberances exert varying effects on the ditching characteristics. The landing gear must be retracted; failure to do so will result in extremely violent behavior and deceleration--often flipping the aircraft on its back. Low-wing aircraft with large engine nacelles, if landed wing low, may dig one nacelle first, causing a waterloop. This rotation around the vertical axis may also cause structural failure of the after fuselage. Flaps in most aircraft may be expected to carry away on initial impact. If the flaps are unusually strong and withstand the impact, some diving tendency may result. The paramount importance of flaps in slowing down the aircraft on the approach makes their use mandatory. Auxiliary fuel tanks located beneath the wing or fuselage will adversely affect the ditching characteristics. They should be jettisoned prior to touchdown. Wingtip tanks have no marked adverse effect, and if empty, provide additional flotation.

Deceleration Forces: An aircraft in flight contains kinetic energy that must be fully expended before the aircraft can come to rest. This energy is determined by the formula:

$$E = \frac{1}{2} MV^2$$

where
E = energy in foot pounds
M = the mass of the aircraft (in poundals)
V = velocity in feet per second

It becomes apparent that to reduce the energy to be expended and, thereby reduce damage to the aircraft and personnel involved, the aircraft must be made as light as possible by dumping fuel and cargo; and, landing speed must be as slow as possible consistent with good control. Here again the point that power should be available for ditching is emphasized since a power approach will appreciably lower the touchdown speed.

To illustrate the forces involved, and the performance to be expected, data was obtained from the scale model tests of five transport aircraft. The data are based on CALM water ditchings. A maximum attitude of 12 degrees noseup for four of the aircraft, and 9 degrees for the fifth, was used. Flap settings varied between 40 and 50 degrees. Average touchdown speed was 81 knots. The length of run after touchdown varied between 250 and 700 feet, with the average being 450 feet. Maximum linear decelerations varied between 1.5 and 4 "g", with the mean of these being 2.1 "g". The average linear deceleration varied between 0.5 and 1.5 "g", with the mean being 0.7 "g". These figures apply to a composite aircraft which ditched without sustaining damage. In case of substantial damage, the runout was generally about 35% shorter, with maximum deceleration about 100% greater.

When landing in rough water and into the face of a swell, much greater forces are to be expected. The length of runout will depend on whether or not the aircraft is swamped or thrown back into the air by contact with a swell. Landings made parallel to a major swell system will more nearly approximate those to be expected on calm water.

An interesting illustration of the forces involved in deceleration in smooth versus rough water can be obtained by a study of numerous sea plane landings. Coast Guard sea planes are equipped with reversing propellors, enabling them to be stopped with a very short runout. In a series of recent landings made in smooth water, the aircraft was stalled at 63 knots, and full reverse pitch immediately applied. The average runout distance after touchdown was approximately 350 feet--or about that to be expected on an undamaged transport in smooth water. No discomfort was felt by any of the crew. This, of course, was a smooth linear deceleration.

When landing in a moderate sea with the same aircraft, the deceleration forces can be expected to be uncomfortable but probably not of such severity as to injure personnel. The hull of a seaplane is conducive to fairly smooth linear deceleration, even in rough water. A landplane, due to its shape and probable damage incurred on impact, may be subjected to an irregular deceleration, with one or more severe jolts. Vertical forces also prove severe if the aircraft is stalled from too high an altitude, or drops heavily after being thrown back into the air with insufficient airspeed.

Pilot Skill and Technique: In a landplane ditching, probably the least important of the three controlling factors after touchdown (sea, type aircraft, and skill of pilot) is the skill of the pilot. The pilot's task is essentially to set the aircraft down on a proper heading in the right spot at the best combination of attitude and speed. The importance of a low touchdown speed must be appreciated. The energy of the aircraft, which must be dissipated during the runout, is proportional to the square of the speed. Touchdown should be at the lowest speed and rate of descent which permit safe handling and optimum nose up attitude on impact. Once first impact has been made, there is often little the pilot can do to control a landplane--especially if the control surfaces are carried away. In a seaplane, however, the skill of the pilot is a very important factor; he is normally able to control the aircraft through the runout.

Once pre-ditching preparations are completed, the pilot should turn to the ditching heading and commence letdown. The aircraft should be dragged low over the water, and slowed down until ten knots or so above stall. At this point, additional power should be used to overcome the increased drag caused by noseup attitude. When a smooth stretch of water appears ahead, cut power, and touchdown at the best recommended speed as fully stalled as possible. By cutting power when approaching a relatively smooth area, the pilot will prevent overshooting and will touch on with less chance of planing off into a second uncontrolled landing. Most experienced seaplane pilots, prefer to make contact with the water in a semi-stalled attitude, cutting power as the tail makes contact. This technique eliminates the chance of misjudging altitude with a resultant heavy drop in a fully stalled condition. Care must be taken not to drop the aircraft from too high an altitude, or to balloon due to excessive speed. The altitude above water depends on the aircraft. Over glassy smooth water, or at night without sufficient light, it is very easy for even the most experienced pilots to misjudge altitude as much as 50 feet or more. Under such conditions, carry enough power to maintain nine to twelve degrees noseup attitude, and seven to ten knots

FIGURE 4-1

A Navy P2V sinking after ditching on Ocean Station ECHO. This ditching occurred with high winds and seas. The ditching was made into the wind and swell due to the 40-knot winds. Note the breakage point of the fuselage aft of the wings, and part of the left wing flap which did not carry away. Personnel can be seen over the left wing in a life raft. Despite the fact the aircraft sank less than two minutes after ditching, all hands were evacuated and saved.

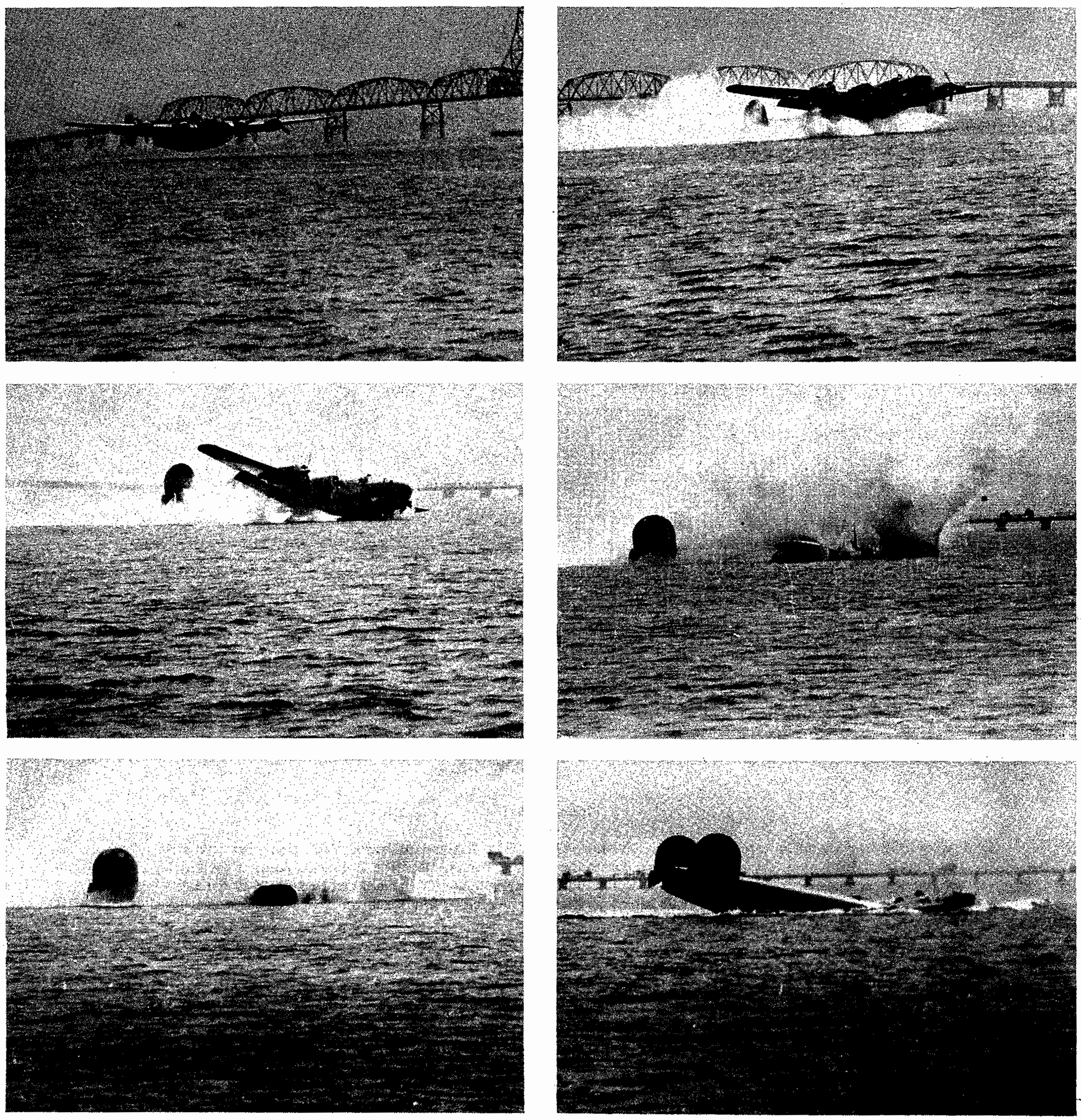


FIGURE 4-2

B-24 especially reenforced being ditched during tests in the James River. This aircraft had a reputation with pilots as a poor ditcher. Note the position of the fuselage after coming to rest. This is typical of high wing aircraft. (Official NACA photographs) over stalling speed until contact is made with the water. The proper use of power on the approach is of great importance. If power is available on one side only, a little power should be used to flatten the approach; however, the engine should not be used to such an extent that the aircraft cannot be turned against the good engines right down to the stall with a margin of rudder movement available. When near the stall, sudden application of excessive unbalanced power may result in loss of directional control. If power is available on one side only, a slightly higher than normal glide approach speed should be used. This will insure good control and some margin of speed after leveling off without excessive use of power. The use of power in ditching is so important that when it is certain that the coast can not be reached, the pilot should, if possible, ditch before fuel is exhausted. The use of power in a night or instrument ditching is far more essential than under daylight contact conditions. If no power is available, a greater than normal approach speed should be used down to the flare-out. This speed margin will allow the glide to be broken early and more gradually, thereby giving the pilot time and distance to feel for the surface--decreasing the possibility of stalling high or flying into the water. When landing parallel to a swell system, little difference is noted between landing on top of a crest or in the trough. If the wings of the aircraft are trimmed to the surface of the sea rather than the horizon, there is little need to worry about a wing hitting a swell crest. The actual slope of a swell is very gradual. If forced to land into a swell, touchdown should be made just after passage of the crest. If contact is made on the face of the swell, the aircraft may be swamped or thrown violently into the air, dropping heavily into the next swell. This may prove disastrous, particularly if the control surfaces are damaged or carried away on first impact. If control surfaces remain intact, the pilot should attempt to maintain the proper nose attitude by rapid and positive use of the yoke.

In most cases drift caused by crosswind can be ignored; the forces acting on the aircraft after touchdown are of such magnitude that drift will be only a secondary consideration. If the aircraft is under good control, the "crab" may be kicked out with rudder just prior to touchdown. This is more important with high wing aircraft, for they are laterally unstable on the water in a crosswind, and may roll to the side in ditching.

# Chapter 5
# DITCHING UNDER NIGHT AND INSTRUMENT CONDITIONS

# Chapter 5
# DITCHING UNDER NIGHT AND INSTRUMENT CONDITIONS

## INTRODUCTION

An emergency may arise at any time--forcing the aircraft to ditch under adverse circumstances. This chapter outlines procedures for night and instrument ditching under the following conditions:

a. Without escort
b. With escort
c. With very low visibility and ceiling

## AIRCRAFT PROCEDURES WITHOUT ESCORT

Sea Evaluation: The pilot must know the sea and wind conditions to select a suitable ditching heading. If an emergency occurs shortly after darkness, he may have an estimate of the best ditching heading from observations made during daylight. Often, the pilot will have no conception of the sea condition. The information must be obtained from other sources, or by flare illumination or moonlight. Many ships at sea, including Ocean Station Vessels, send frequent weather reports, including sea conditions. This information may sometimes be obtained through the air-ground station, which obtains it from the Rescue Coordination Center. As an example, in a recent case 300 miles off the California Coast, a cargo aircraft lost two engines. Realizing that a night ditching was imminent, the pilot requested a sea condition forecast. This was furnished from the best information available. Using this forecast, the pilot successfully ditched the DC-4 without benefit of illumination. It should be realized however, that a forecast based on scattered ship reports, and under changing weather conditions, is subject to error. It is better for a pilot to evaluate the sea himself.

Sea evaluation by parachute flare: Many aircraft carry only two parachute flares for use in emergency. A sea evaluation procedure suitable for wide use must therefore be based on this minimum number, and on the further assumption that the distressed aircraft's maneuverability may be restricted. If more flares are available, they should be used.

After extensive tests, the Coast Guard has adopted three basic parachute flare sea evaluation methods--the Modified Race Track, Circling, and Tail Lookout. These are executed as follows:

Modified race track sea evaluation:

a. Set parachute flare to ignite 300 feet below the aircraft
b. Drop the flare and a drift signal from 3000 feet.
c. After drop, maintain altitude and heading for 10 seconds.
d. Turn 90 degrees left, losing 300 feet in the turn.
e. Roll out of turn, and hold course and altitude for 30 seconds.
f. Turn 180 degrees to left, losing 300-600 feet in the turn. On completion of this turn, the flare will be 40 seconds ahead.
g. Roll out of turn, maintain altitude of 2100 feet, and pass close to the flare.

NOTE: All turns are standard rate 3 degrees per second.

After entering the 180 degree turn (step f), the sea is visible for about 80 seconds. This limited time will allow only the determination of primary swell direction, and the direction and estimated velocity of the wind. The drift signal will aid greatly in estimating direction of the wind and swell.

Descent during the turns allows a safe speed margin for a crippled aircraft, and provides a better view of the sea. Aircraft unable to climb should not descend below 2100 feet--the minimum altitude for the second flare drop.

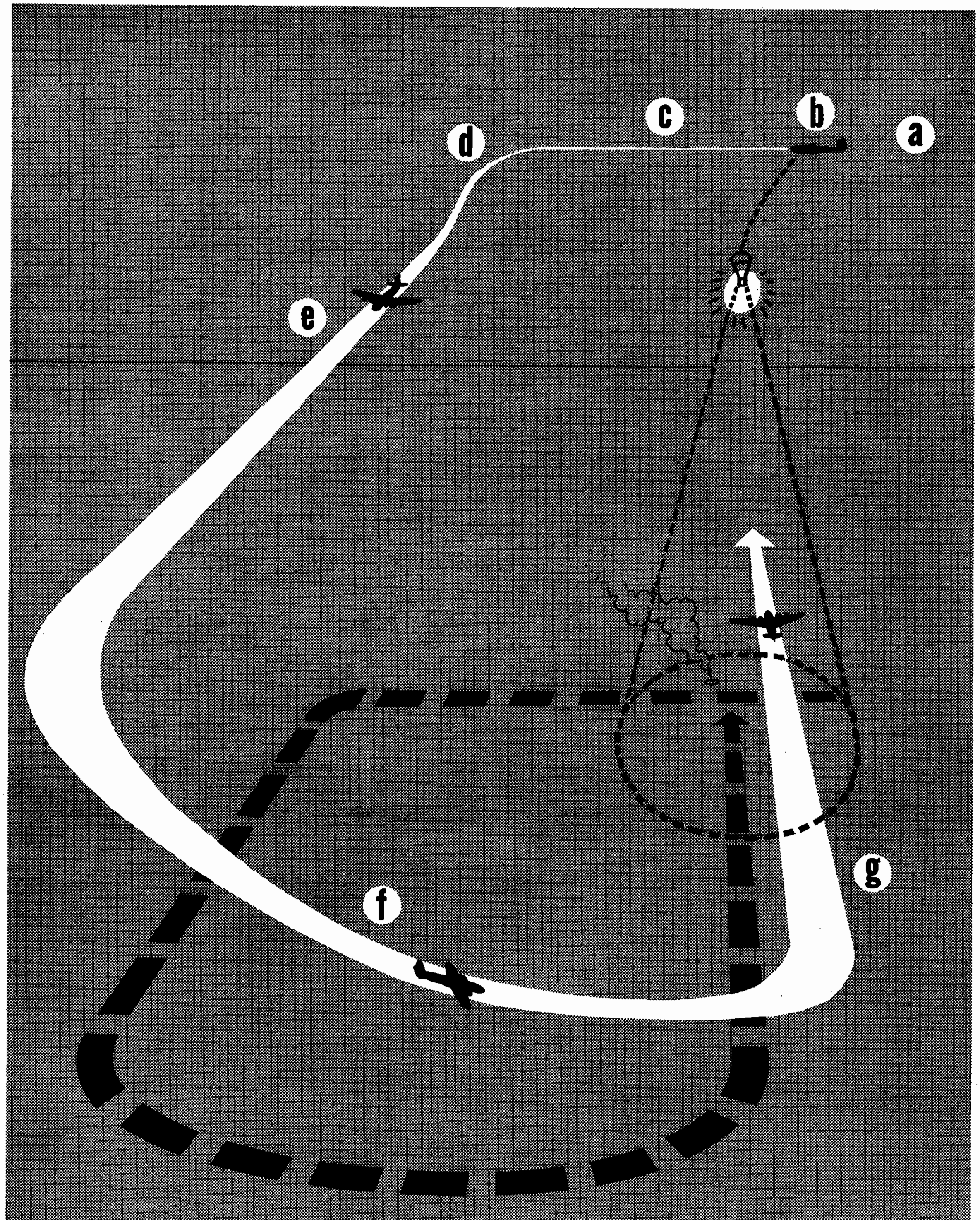
Circling sea evaluation:

a. Set parachute flare to ignite 300 feet below the aircraft.
b. Drop flare and a drift signal from 3000 feet.
c. After drop, turn 90 degrees left.
d. Roll out of turn, and hold course for 10 seconds.
e. Turn left until illuminated surface area is visible.
f. Decrease rate of turn and continue circling the flare in a wide turn. Turn should be adjusted to keep the lighted area in sight just aft of the beam (8 o'clock).

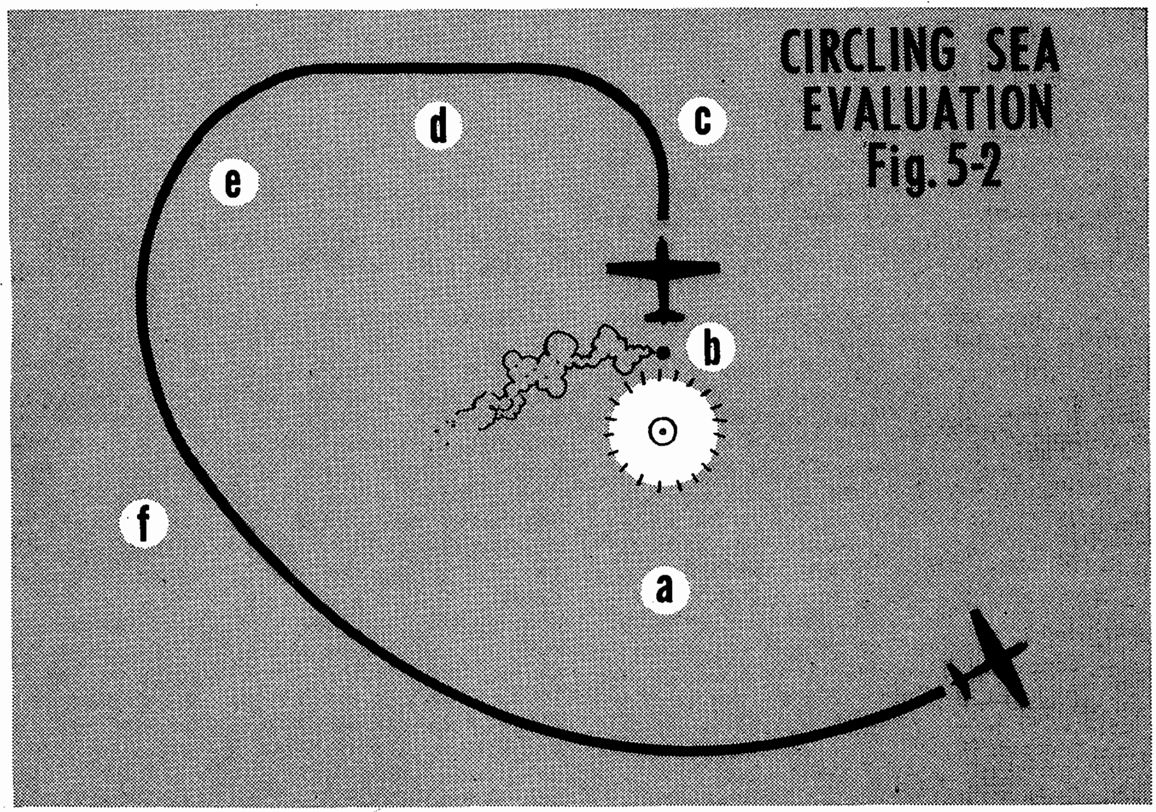
Using this method, the wings and engines in some low wing aircraft may obstruct vision. Some pilots also find it difficult to get a true perspective of the sea while in a continuing turn. A gradual descent during the turn will give a better view of the surface, but is not mandatory.

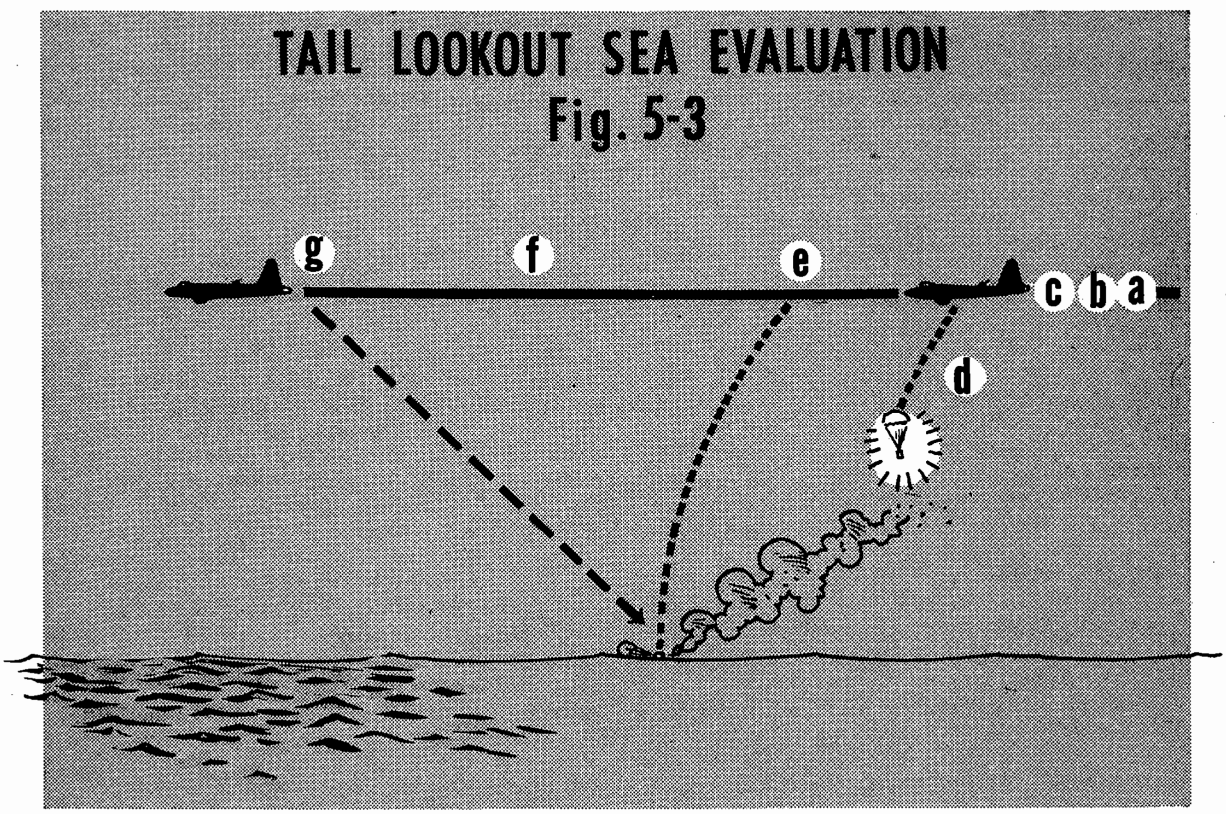
Tail lookout sea evaluation: This procedure is feasible only for those aircraft having a tail turret or lookout station.

a. Descend to 3000 feet, maintaining course and speed.
b. The aircraft commander, or other pilot qualified in sea evaluation, takes station in the tail lookout position.




MODIFIED RACETRACK SEA EVALUATION
Fig. 5-1


CIRCLING SEA EVALUATION
Fig. 5-2
a
b
c
d
e
f


TAIL LOOKOUT SEA EVALUATION
Fig. 5-3
g
f
e
c
b
a
d

c. Set the parachute flare to ignite 300 feet below the aircraft.
d. When ready, drop the flare.
e. 10 seconds after dropping flare, drop a drift signal.
f. Continue on steady course. The sea will be visible astern for three minutes.
g. The pilot in tail lookout station will make an evaluation of the sea and select a ditching heading.

This method allows more time for sea evaluation, and requires much less maneuvering. The aircraft can continue on course while the evaluation is being made.

Precautions in use of parachute flares. Several precautions should be observed when using parachute flares. Only qualified personnel should handle them; the safety rules should be carefully observed. When a flare ignites, it gives the illusion of burning just behind the cockpit; this effect is more pronounced in clouds. It is actually hundreds of feet astern. When an aircraft approaches a flare, it may appear to be at or near the same altitude. To relieve any apprehension, pass to the side of the flare (except on final approach). When close to the flare do not look directly at it. The pilot should guard against vertigo by having the co-pilot remain on instruments. After passing the flare, the pilot should shift his scan back to the instruments.

Single Aircraft Ditching Procedure by Self Illumination: After selecting a ditching heading, ditching should be made as follows:

a. Make all preparations for ditching. Complete cockpit check. Set flare to ignite 300 feet below the aircraft.
b. Take up a heading 90 degrees less than that of the selected ditching heading. Lower flaps and slow to desired pattern approach speed. Descend to 2500 feet.
c. Drop flare from 2500 feet. (2000 feet minimum may be used if unable to maintain 2500.)
d. After flare drop, begin descent of 1500 feet per minute. Maintain heading for 10 seconds.
e. Turn 90 degrees left; continue descent at 1500 feet per minute.
f. Roll out of turn, and hold heading for 30 seconds. Continue rate of descent of 1500 feet per minute. This 30-second leg is the reciprocal of the ditching heading--similar to the "downwind leg" in an airport pattern.
g. Turn 180 degrees to left. Decrease rate of descent so as to roll out of the turn on final at 200 feet. (Immediately after entering the 180 degree turn, the surface of the water can be seen, and the remainder of the approach can be made by visual reference.)
h. When entering final approach, the flare will be 40 seconds ahead. Ditch straight ahead using the light of the flare. DO NOT OVERSHOOT. A rapid descent in the early stages of the approach allows a slow rate of descent when near the water. This should prevent flying into the water at a high rate of descent due to faulty depth perception or altimeter setting. (Make turns standard rate 3°/second.)

In many aircraft, this flare ditching procedure will work effectively without power, provided the aircraft is above 3000 feet and prepared for the maneuvers. In recent tests, all power was cut on a PBM-5G at 3500 feet. A rate of descent of 1500 - 2000 feet per minute was started. When passing 3000 feet, a flare was released and the above ditching pattern followed. The 180-degree turn to final was completed at 600 feet to allow for the rapid power off descent; the aircraft completed the ditching approach without difficulty. This procedure may be modified for the power off performance of any aircraft.

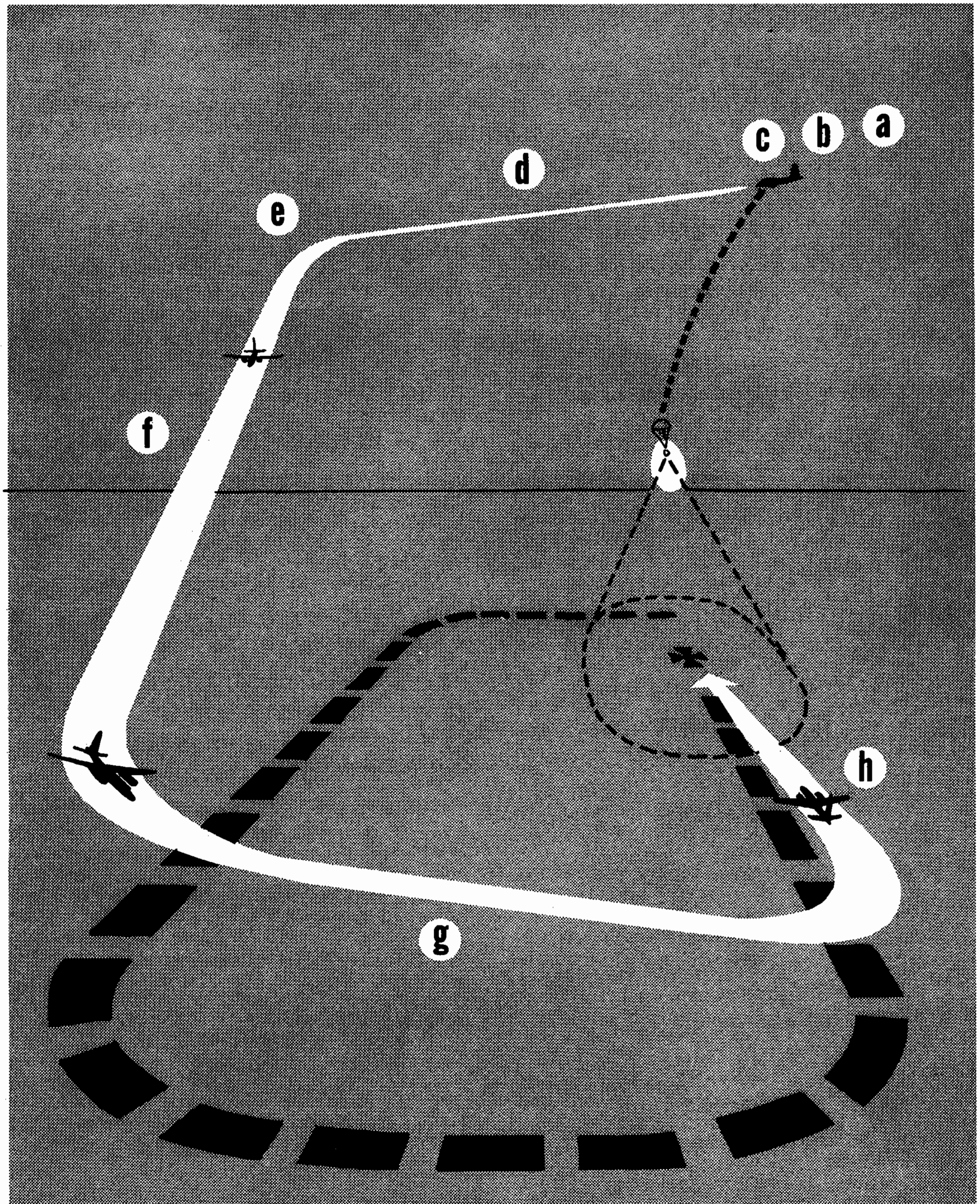
A small percentage of flares fail to ignite. A flare failure on the ditching approach can be serious. If the sea condition is know, or is believed to be moderate, it may be advisable to dispense with the sea evaluation and utilize both flares for ditching.

Ditching Without Parachute Flares: If the aircraft has no flares, but does have a supply of drift signals or smoke floats, the ditching will be made easier by dropping a line of such floats on the ditching heading at 2-second intervals. Up to 20 such markers may be profitably used. The line of markers may be used in the same manner as runway or sea drome lights. They serve as an approach line, and aid in depth perception. These open flame markers are a slight fire hazard.

## AIRCRAFT PROCEDURES WITH ESCORT

Sea evaluation: The distressed aircraft may be escorted when faced with ditching. Crews of Coast Guard SAR aircraft shall maintain proficiency in the necessary procedures, including sea evaluation, to assist and simplify ditching by the distressed aircraft. It is desirable for the SAR pilot to make the sea evaluation and assist the distressed pilot in selecting a ditching heading. The preferred method for sea evaluation by an escort aircraft is the Tail Lookout Procedure.

Ditching: The normal escort position will be 1 mile astern and 500 to 1000 feet above the distressed aircraft. This allows the escort to keep the distressed aircraft in visual or radar contact. If a ditching becomes imminent, and time permits, the escort will use the following procedure:




SINGLE A/C DITCHING PROCEDURE
BY SELF ILLUMINATION Fig. 5-4

Escort simultaneous turn ditching procedure:

a. Select a ditching heading.

b. Escort takes up position three miles from the distressed aircraft on a true (or magnetic) bearing numerically equal to the ditching heading, both aircraft maintaining base courses.

c. When the distressed aircraft is ready to ditch, both aircraft make a simultaneous turn to the ditching heading.

d. When the turn is completed, the escort aircraft will be three miles ahead and ready to illuminate.

If time does not permit the above procedure, the Escort Combination Ditching Procedure can be used. In this procedure, the escort moves ahead into position, drops a flare for sea evaluation by the distressed aircraft, then turns onto ditching heading in one continuous evolution. It is accomplished as follows:

Escort combination ditching procedure:

a. Escort is in normal position 1 mile astern and 500 to 1000 feet above distressed aircraft.

b. Both aircraft descend until escort is at 3000 feet.

c. The distressed aircraft makes a 360 degree turn to allow the escort to move about 3 miles ahead.

d. One minute after passing the distressed aircraft's turn point, the escort drops a drift signal and flare.

e. The flare illuminates the sea for the distressed aircraft during the last 90 degrees of the turn and for two miles ahead after resuming base course. During this time, the pilot must determine the ditching heading and advise the escort.

f. The escort drops a flare and turns to ditching heading. This flare marks the turn point to the ditching heading.

g. Upon reaching this flare, the distressed aircraft turns to ditching heading and begins final let down. The escort will be three miles ahead and ready to illuminate.

Final Approach: The final approach is the same in both the simultaneous and combination procedures. When passing 400 - 600 feet altitude, the distressed aircraft calls for illumination. The escort drops a line of five flares at 1000 yard intervals. The first flare will ignite $2\frac{1}{2}$ miles ahead of the distressed aircraft, and all five will be burning when the aircraft is one mile from the first flare. The illumination, totaling three million candlepower, enables the distressed aircraft to ditch under conditions approximating daylight.

The escort aircraft, after dropping its fifth flare, turns rapidly to observe the ditching point of the distressed aircraft--continuing around in a race track pattern, dropping additional flares while the ditched aircraft is being evacuated. Survival gear is then dropped.

It is only necessary for the average pilot to know the general background of escort illumination procedures. The SAR pilot may modify the above procedures when required by a particular situation. Detailed instructions will be given at the time.

By using these procedures, the escort is able to assist the distressed aircraft by providing sea evaluation, illumination for ditching and evacuation of the aircraft and flotation and survival gear for survivors. A guard over the survivors is maintained until surface rescue units arrive, or until daylight when an open sea landing may be made by a rescue aircraft.

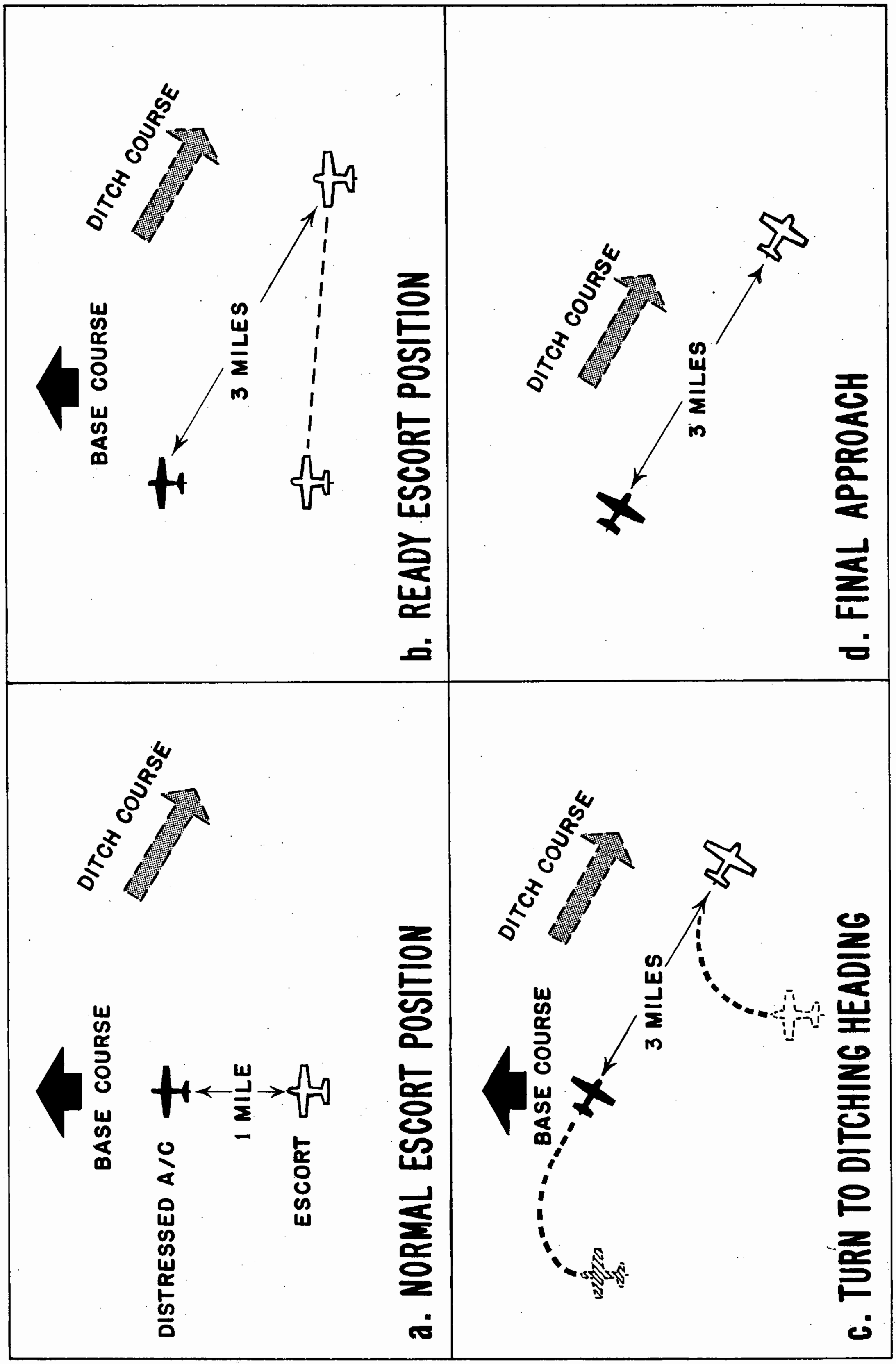
Ditching Procedure When Escort Is Not a SAR Aircraft: In the procedures just described, the escort was assumed to be a Coast Guard SAR aircraft. The escort may not be a SAR aircraft. If the escort has parachute flares, it should use any procedure which will place the flares about 3 miles ahead of the ditching aircraft on final. If the escort has no flares, but does have a supply of drift signals or smoke floats, it can assist by dropping a line of 15 to 20 of these markers on the ditching heading at intervals of 2 seconds. This will provide a very effective sea lane, and will materially aid the distressed aircraft in ditching. After the distressed aircraft has ditched, the escort should fix the position and remain overhead as long as possible, dropping available survival gear.

## EFFECTIVENESS OF FLARES UNDER IFR CONDITIONS

The question will probably arise as to the effectiveness of parachute flares with low ceilings and reduced visibility. Results are only fair, but still better than no illumination at all. In clear weather, the MK. 5 flare is normally dropped at about 2500 feet; it ignites at 2200 feet, and 3 minutes later goes out at 700 feet. With a low ceiling, the drop altitude must be changed, or the flare will burn out long before dropping below the base of the clouds. With a ceiling of 600 feet, for example, by dropping from an altitude of 1900 feet, the flare will burn out at 100 feet, or 500 feet below the base of the clouds. Though it burns only about 60 seconds below the cloud blase, the aircraft can discern the flare a considerable distance through the clouds due to the diffusion of the light.

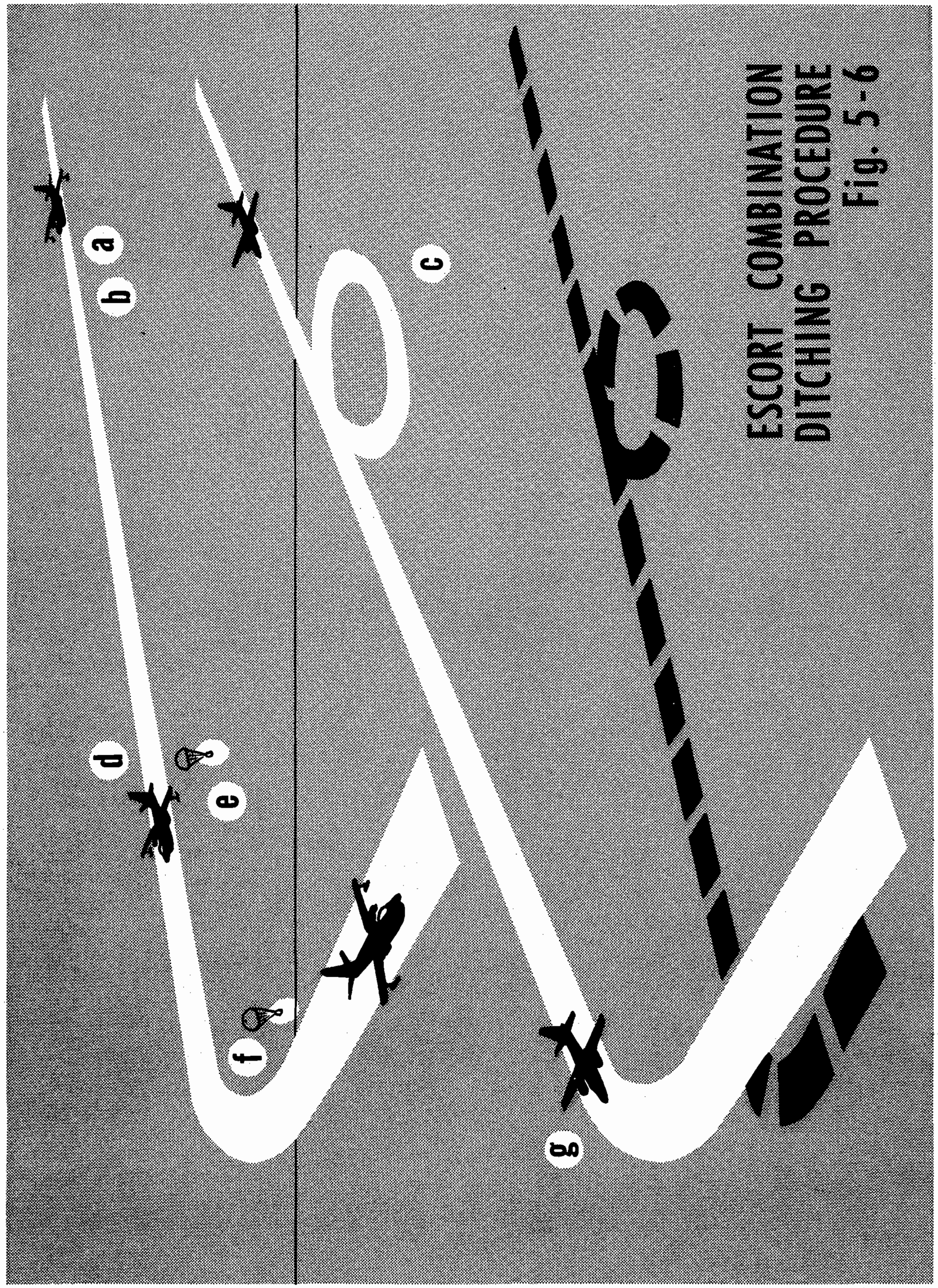
## DITCHING WITH VERY LOW CEILING AND VISIBILITY

Under very low ceiling, heavy fog, or zero visibility conditions, the pilot has little alternative other than to use an estimate for a




ESCORT SIMULTANEOUS TURN PROCEDURE

Fig. 5-5




ESCORT COMBINATION DITCHING PROCEDURE
Fig. 5-6

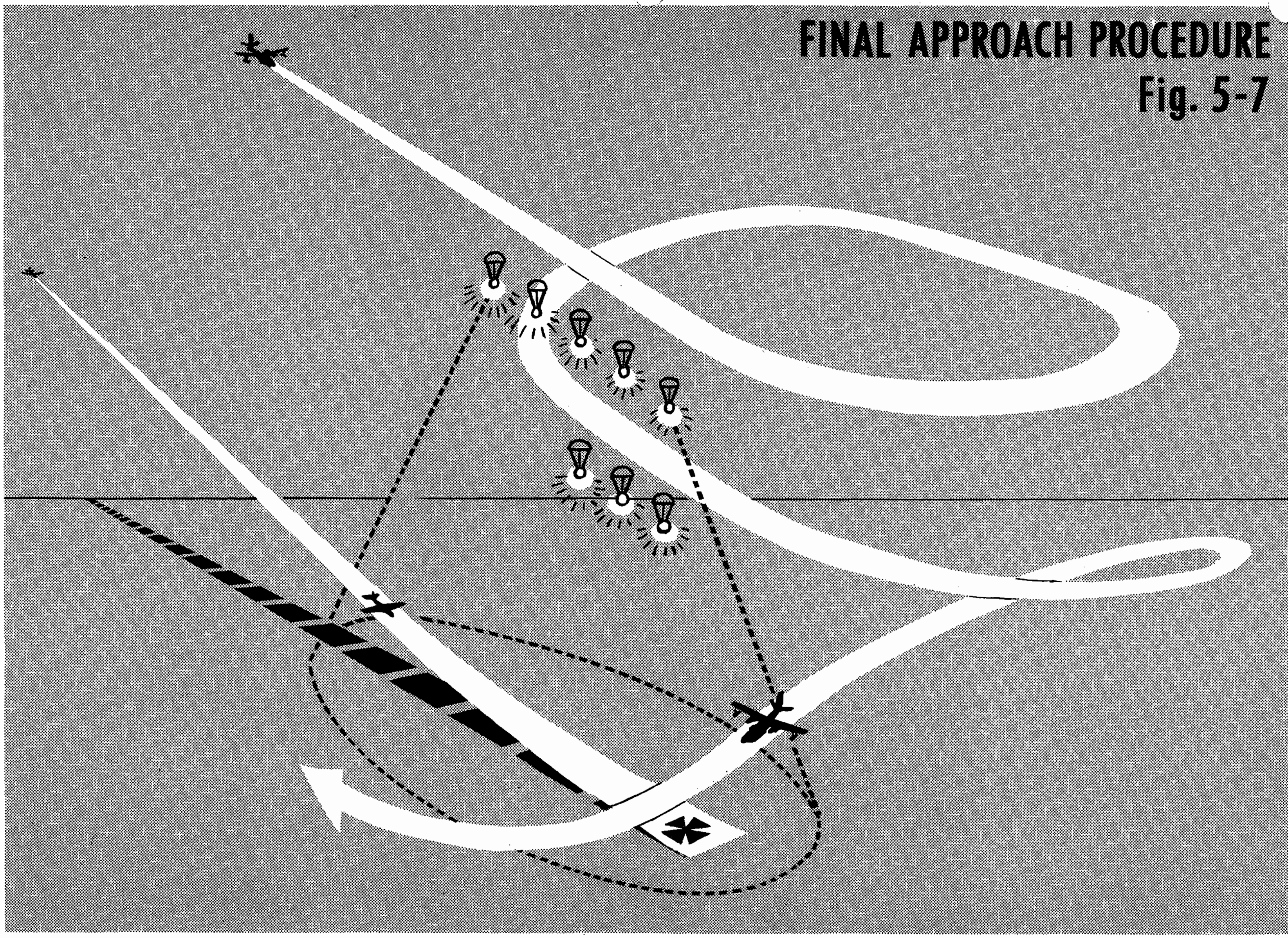



FIGURE 5-7

Final approach illumination procedure with escort. The final approach is the same with both the Simultaneous Turn and Combination procedures. A line of flares is dropped when called for by the distressed aircraft. After ditching of the distressed aircraft, the escort drops a second line of flares to provide illumination for evacuation. The escort aircraft then drops survival and flotation gear.

ditching heading. The surface wind can sometimes be estimated from navigational data, or from the radar scope presentation. The swell condition will be unknown unless it can be obtained from the RCC or a ship.

When the ditching heading is decided on, a power approach should be made. Set up a power-attitude combination for a rate of descent of 200 feet per minute and an air speed 7 - 10 knots above stall with flaps down. This approach should be maintained until the aircraft makes contact with the water, or until visual contact is established for ditching.

## ALTITUDE DETERMINATION

The pressure altimeter may be several hundred feet in error. In a recent night ditching, an aircraft flew into the water at a high rate of descent due in part to an incorrect altimeter reading. If the aircraft is equipped with a radio or radar altimeter, it should be used throughout the descent as a check against the pressure altimeter. Near the water, or with a high rate of descent, the radio altimeter is generally more reliable. Aircraft equipped with the APN-1 radio altimeter should have the altitude limit switch set to 50 feet. When the red light comes on, the pilot can expect contact momentarily. If the rate of descent is high, the limit switch should be set higher to allow earlier warning for breaking the glide.

Aircraft with a trail antenna may utilize the antenna to warn of imminent contact with the water. When the antenna carries away, contact with the water can be expected momentarily.

# Chapter 6
# THE OCEAN STATION VESSEL AS AN AID IN DITCHING

# Chapter 6
# THE OCEAN STATION VESSEL AS AN AID IN DITCHING

## INTRODUCTION

Pilots should be aware of the capabilities of an Ocean Station Vessel (OSV) as a source of assistance in potential or actual distress. Its services can be invaluable.

All Ocean Station Vessels provide the following service for aircraft in emergency:

Search and Rescue
Communication
Navigational Aids
Meteorology

Coast Guard Cutters assigned to Ocean Station duty use standard procedures in assisting an aircraft to ditch. The Coast Guard has developed these procedures from actual ditchings and through numerous realistic ditching drills and exercises performed by its air-sea team. Officers and crews of the cutters receive intensive training in these procedures in order that the most practical and timely aid can be rendered in ditching. The effectiveness of the procedures and training has been proved--in four ditchings in the Atlantic alongside Coast Guard OSVs nearly 100 persons have been rescued without a fatality or serious injury. One, a radar-controlled night ditching of a transport aircraft with two engines inoperative, was successfully accomplished under instrument conditions with rough seas and winds of gale force.

## OCEAN STATION VESSEL PROCEDURE

The problem of assisting an aircraft to ditch in the vicinity of an Ocean Station Vessel usually divides itself into three phases:

1. Effecting a rendezvous
2. Assisting the aircraft in ditching
3. Rescue of survivors

The problem is complicated in that the ditching may occur either in the daytime or at night, and with either good or poor ceiling and visibility. Adverse conditions of wind and sea introduce additional hazards in ditching of the aircraft, evacuation of personnel and rescue.

The following procedure is used by a Coast Guard Ocean Station Vessel in assisting an aircraft to ditch:

a. Establish and maintain rapid and reliable communications.
b. Locate the aircraft.
c. Vector or assist in homing the aircraft to the ship.
d. Furnish weather and sea information.
e. Provide a lighted sea lane.
f. Provide approach assistance.
g. Provide illumination.
h. Rescue and care for survivors.

If the pilot is familiar with these procedures, a ditching is easier for both himself and the OSV. A discussion of the above procedure follows.

Establish and Maintain Rapid and Reliable Communications: Pilots routinely communicate with Ocean Station Vessels. Almost daily, OSVs relay operational traffic for aircraft who have lost contact with air-ground stations--thus preventing unnecessary alerts.

An OSV may be advised of a distress case in any of several ways:

a. Directly by the distressed aircraft.
b. Relay by another aircraft or vessel.
c. By the RCC.
d. By the OATC.

Ordinarily, a pilot contacting an OSV to report a distress will have already alerted an air-ground station. If the pilot transmits the initial distress message to an OSV, the OSV will communicate with a shore radio station to alert the SAR organization.

Once an OSV establishes contact with a distressed aircraft, it is prepared to furnish rapid and reliable communications.

Locate the Aircraft: Normally, the aircraft's navigational plot is accurate. At times, however, pilots are uncertain of their exact positions, or, believing them to be accurate, furnish positions which are considerably in error. In these cases, the OSV is prepared to locate or assist in locating the distressed aircraft by one or a combination of the following means:

a. Radar: The OSV's radar provides an accurate fix, but is limited to an average maximum range of 50-80 miles. If several aircraft are in the vicinity the distressed aircraft may be requested to execute an identification turn.
b. Radio beacon: The OSV's beacon is available for continuous operation in an emergency. It provides a homing facility for the pilot when he is within range.
c. Radio Direction Finder: If the pilot can transmit on a frequency between 250 and 1500 kc/s, the OSV can obtain bearings on the transmissions by use of its radio direction finder. Due to the low power of airborne transmitters on these frequencies, bearings are seldom obtained at ranges in excess of 100 miles.

If the aircraft equipment is unable to transmit within this frequency band, transmissions can be made on 500 kc/s by attaching a Gibson Girl to the trail antennas of the aircraft.

Location by radio direction finder is not used if either the radar or beacon method is initially successful.

d. HF/DF net: Fixes obtained by the HF/DF net are furnished to the OSV and/or aircraft by the RCC.

e. Aircraft's navigational data: If the aircraft and OSV can obtain readings on the same Loran rate, a single line of position (LOP) approach can be made to the ship. A single LOP approach can also be used with a celestial sight.

f. Weather data: A report by the aircraft of weather at its position, plus any unusual weather (such as fronts) that it has encountered, may permit the OSV to estimate the aircraft's location.

g. Visual signals: To facilitate sighting by a pilot during daylight, an OSV may make black smoke, cruise at high speeds to form a wake, or other means. At night, star shells, searchlights, pyrotechnics, or water lights may be used. Star shells can also indicate general vicinity of ship to plane when overcast covers ship. Ship fires through overcast keeping star shell clear of plane.

Vector the Aircraft to the Ship: When the aircraft is within radar range and is located and identified, it is continuously tracked on radar and given headings (vectors) and ranges to the ship.

Magnetic headings and bearings are given the pilot unless he requests otherwise.

Furnish Weather and Sea Information: Weather and sea conditions at the OSV's position will be furnished. This information enables the pilot to select a ditching heading. Selection of the ditching heading is the responsibility of the pilot. The OSV will recommend a heading if specifically requested. The pilot should inform the OSV of the ditching heading as soon as possible to allow the OSV time to lay the sea lane.

Provide a Lighted Sea Lane: For a night or low visibility day ditching, a lighted sea lane is provided along the ditching heading. The lights, being battery operated, are not a fire hazard. Lights are normally placed 375 feet apart and provide a sea lane 7,500 feet long. This lighted sea lane may be varied as to length and spacing between lights according to conditions. The sea lane may have to be shortened if time to ditching is limited. Under poor visibility it is desirable to lengthen the lighted sea lane if time permits.

A lighted sea lane aids in ditching as follows:

a. It provides the pilot with a visual presentation of his ditching headings and aids him in planning his approach.

b. It provides the pilot with an aid to depth perception.

c. It aids the pilot in shifting from instrument to visual flight.

d. It aids the pilot to compensate for drift.

e. It provides the OSV a reference for illuminating the touchdown area.

Provide Approach Assistance: Approaches may be made either visually or with radar assistance by the ship.

Visual approach: Under VFR conditions, day or night, the aircraft should make a visual approach to landing. At night, a sea lane and illumination will be provided.

Instrument approach: Under instrument flight conditions, day or night, the OSV will provide a radar assisted approach. Three types of approaches are used: the full pattern radar approach, the straight in radar approach, and the radar assisted ADF approach. These are shown in diagrams below.

In all approaches, the pilot should keep the aircraft's ADF on the OSV's radio beacon as a check on the headings being given.

The pilot should realize that the OSVs have no means of determining the aircraft's altitude, and that all altitude assignments are given as recommendations. When the aircraft is turned on final, the OSV will give headings and ranges to touchdown; descent will be made at the pilot's discretion so as to establish visual contact before reaching the sea lane lights. The pilot should take over visually as soon as contact is established on final.

Provide Illumination: Flare and starshell illumination is provided for all ditchings in which it would be of value to the pilot. After laying the sea lane, the OSV takes a position to the left of and approximately 2500' from the end of the string of lights at a position which will enable high altitude mortar flare illumination to be placed ahead of the preferred ditching point and slightly to the left of the approach track. Mortar flares ignite 1000 feet in the air and each produces 80,000 candlepower. As several are burning at all times, excellent illumination is provided for ditching. Flare illumination is commenced when the aircraft is three miles from touchdown on the final approach and is continued as long as necessary during the evacuation and rescue phase.

When there is a strong wind blowing from right to left across the sea lane and approach track, it will be necessary for the vessel to take position to the right of the sea lane and approach track so that the mortar flares can be placed in proper position.

When a distressed aircraft is making an approach the Ocean Station Vessel, having taken up position, will fire a preliminary flare to assist the pilot of the distressed aircraft to fully orient himself and to demonstrate to him the type of illumination he will receive on his final approach. This preliminary flare will be fired while the distressed aircraft is heading

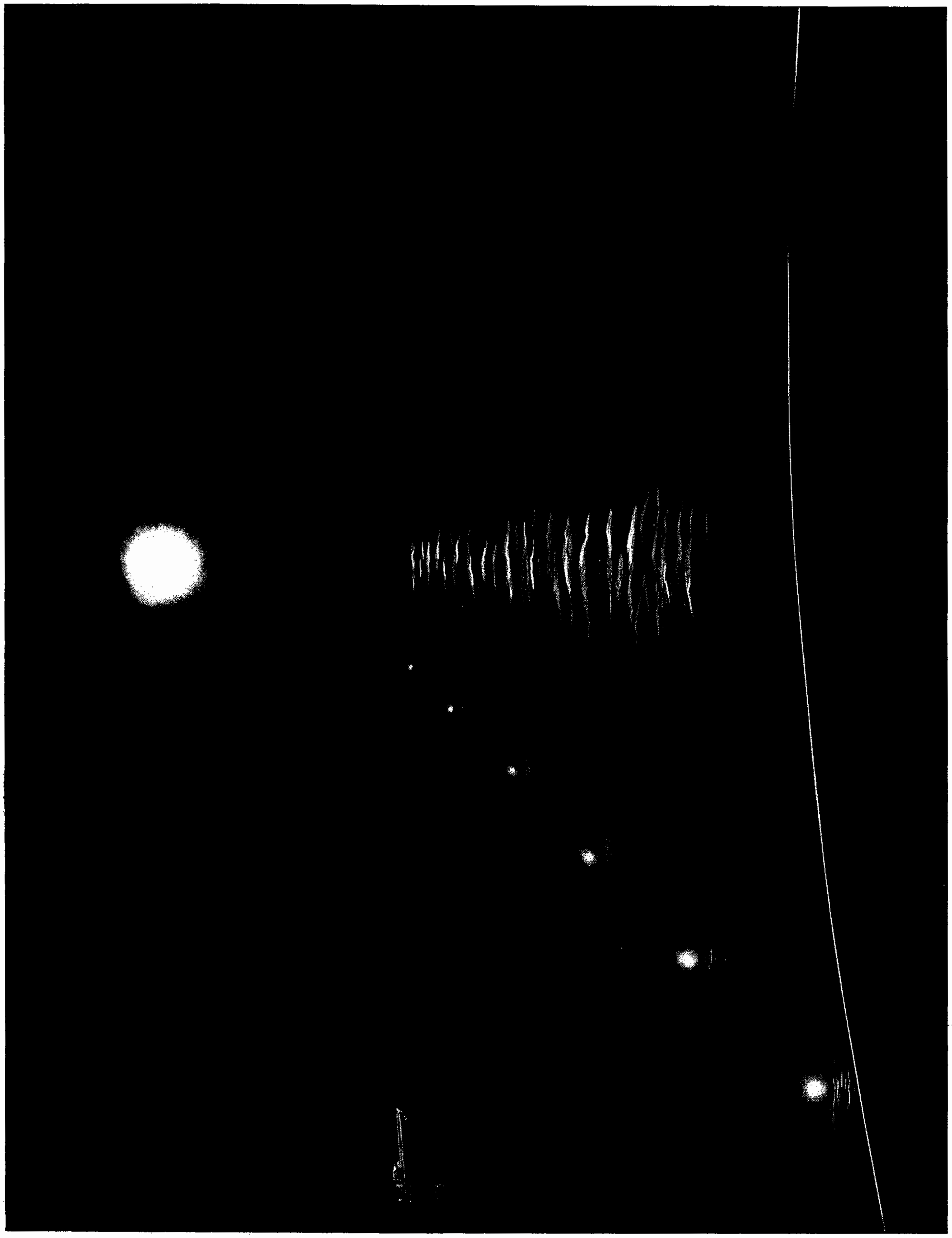


FIGURE 6-1.--VIEW OF NIGHT ILLUMINATION FROM DISTRESSED AIRCRAFT

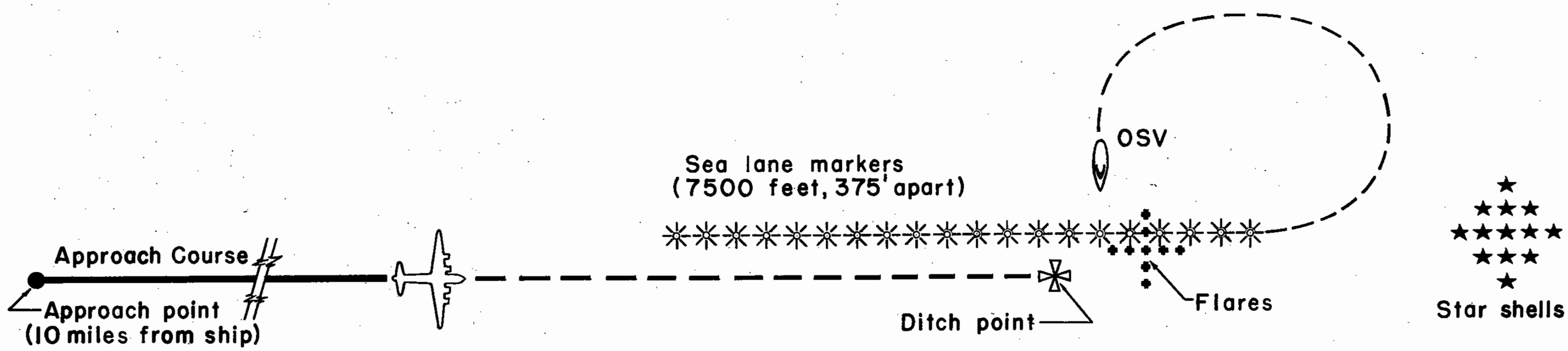



Fig. 6-2 Night visual approach
(Not to scale)

FIGURE 6-2.--NIGHT VISUAL APPROACH

Under visual conditions, a night approach is made by the aircraft with a minimum of radar assistance. Illumination is furnished by mortar flares and starshells. The starshells provide a secondary source of illumination if the aircraft overshoots the ditching point. When there are strong winds blowing from right to left across the ditch track, it might be necessary for the OSV to take station on the right of the ditching track in order to provide for the rapid drift of the flares.

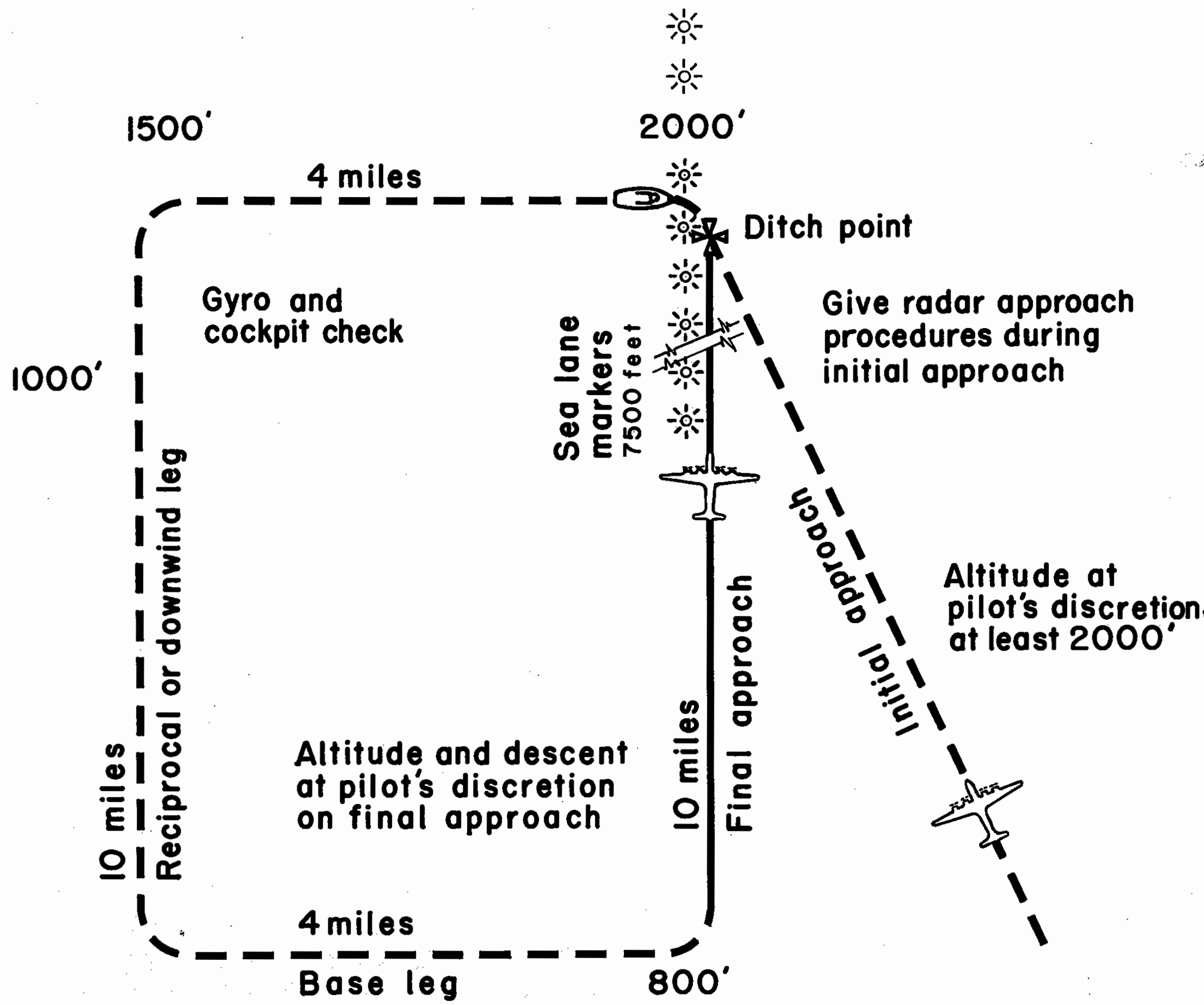



**Fig.6-3-Full pattern radar assisted dpproach**
(Not to scale)

This illustrates a typical left hand full pattern radar assisted approach to an OSV under instrument conditions. If the pilot prefers, the same pattern can be made to the right, with right hand instead of left hand turns. This type of pattern is used only when the aircraft is able to maintain altitude and has sufficient fuel. If the aircraft is unable to meet these conditions, the straight in radar approach can be made. The final approach is the same in both cases. This type approach, where no altitude information by means of the radar is available, is known to pilots as a "PPI Approach".

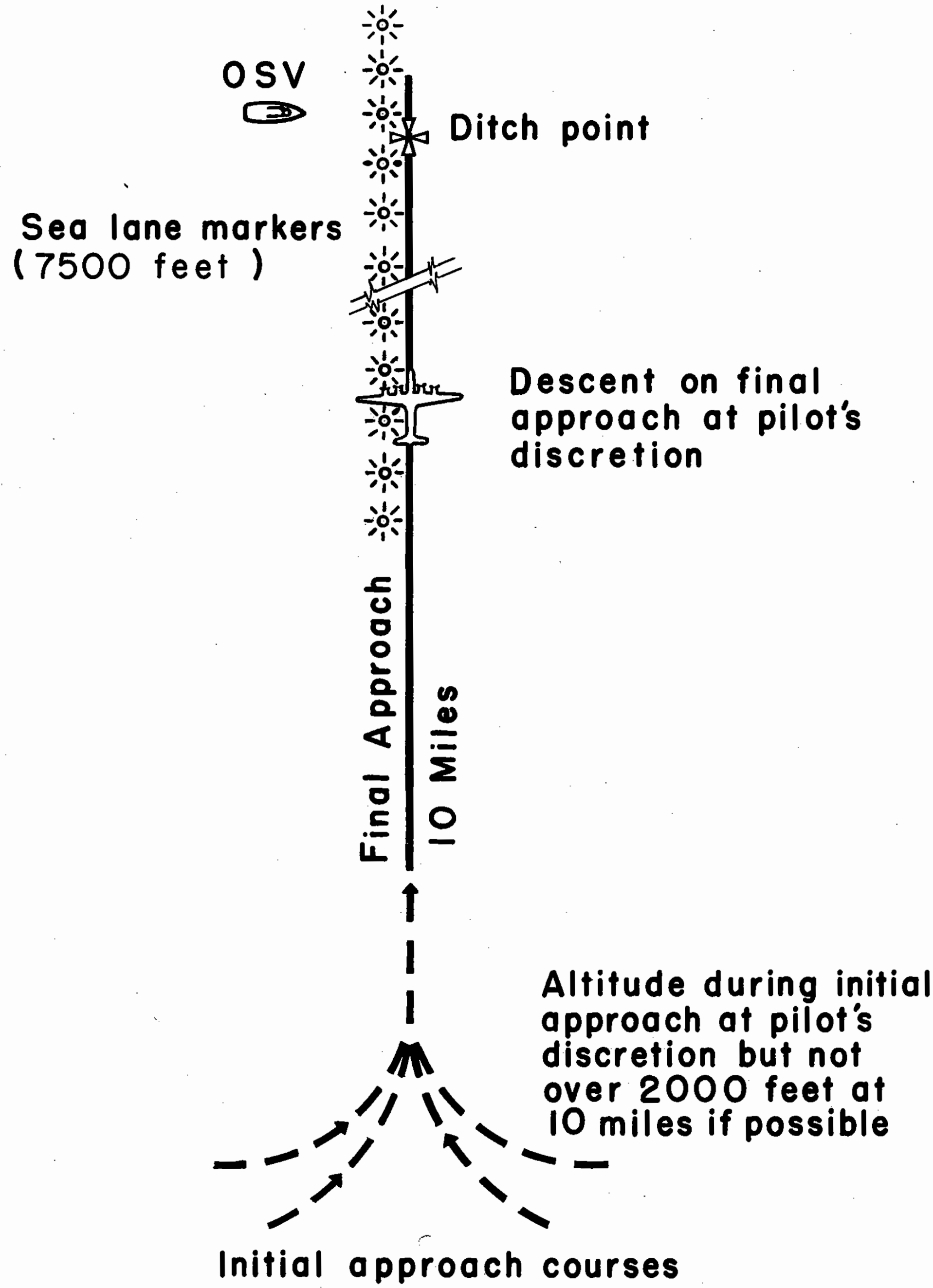



**Fig.6-4- Straight in radar assisted approach**
**(Not to scale)**

This illustrates a straight in approach for ditching under radar control in IFR weather. This is used when aircraft is having difficulty maintaining altitude and time is limited. On the initial approach, the plane should be vectored so as to intercept the final approach course about ten miles out. All essential information should be given while aircraft is still on initial approach. When ten miles out on final, no further acknowledgments are required, and procedure is the same as on final full pattern approach.

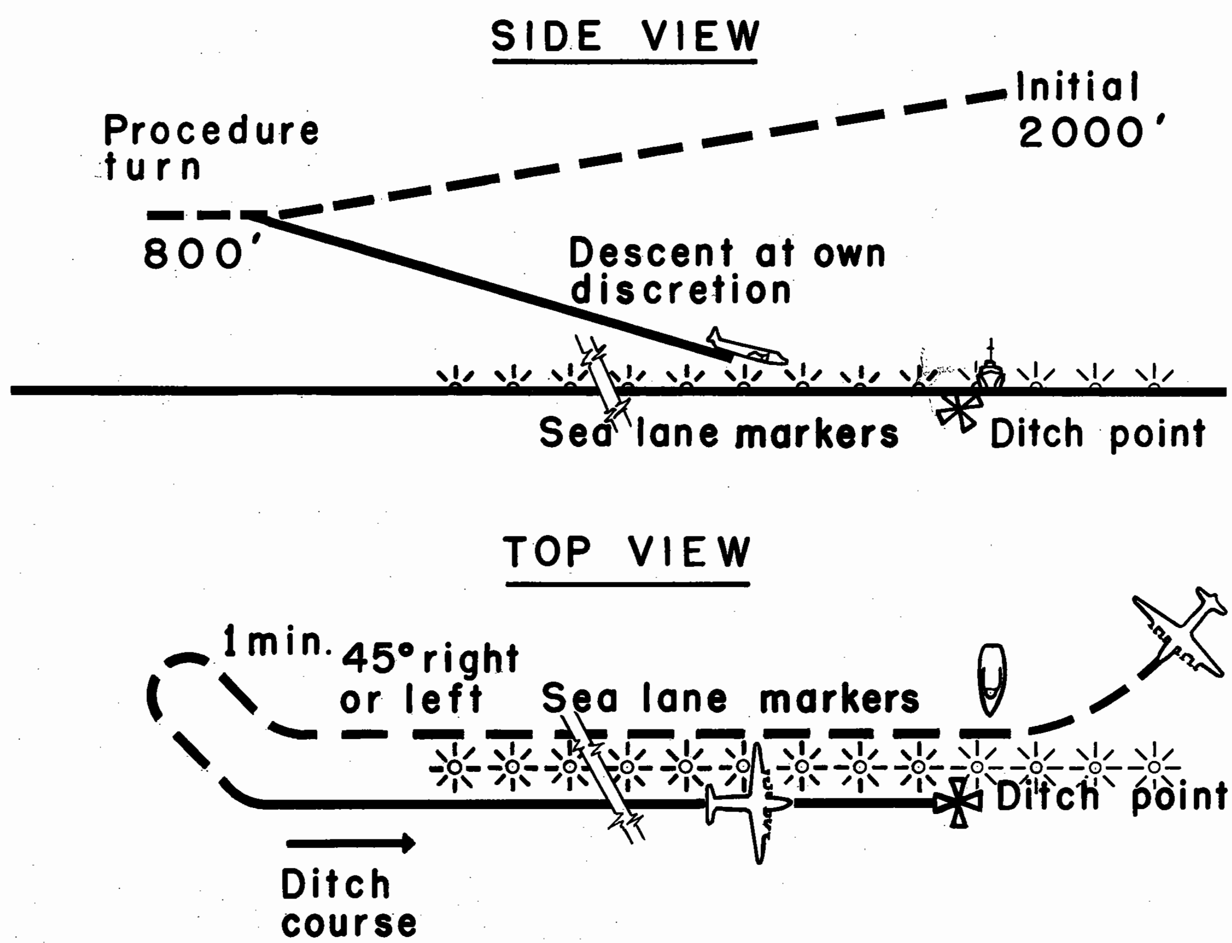



Fig.6-5-Radar assisted ADF approach
(Not to scale)

This type approach is made utilizing the aircraft's ADF on the OSV's radio beacon. The outbound heading is the reciprocal of the selected ditching heading. The touchdown point is close to the OSV. If the pilot breaks contact and sights the sea lane lights in sufficient time, a visual approach can be made and the ditching made as close to the OSV as possible. However, under extremely low ceiling and visibility conditions, this may not be possible. Under these conditions, the pilot must keep the OSV slightly on his port bow with the aid of his ADF needle and a constant flow of radar ranges from the OSV, and touchdown approximately one-fourth mile from the OSV. The OSV must be prepared to give headings to the pilot as necessary to prevent a collision or to keep the plane from being ditched at too great a distance from the OSV.

toward the Ocean Station Vessel. The Ocean Station Vessel shall advise the pilot before firing the preliminary flare.

This preliminary firing of the flare permits the Ocean Station Vessel to make necessary corrections to the firing angle or maneuver the ship so as to provide the best illumination and also demonstrate the flare characteristics to the pilot.

The aircraft should touchdown about 300 yards short of the mortar flares. This is the optimum touchdown point both for safety and illumination. It is far better to err by landing too short, rather than beyond the flares. Touchdown short of the flares.

The star shells create an illuminated area beyond a sea lane in case the pilot overshoots the area illuminated by mortar flares.

If the aircraft overshoots the illuminated area, it will pass from a brightly lighted area into darkness.

Rescue and Care for Survivors: Personnel of Coast Guard OSVs are trained in the rescue and care of survivors. The methods used are dependent upon sea and weather conditions. The subject is too broad to be covered in detail in this chapter. The ship can be expected to be only a few hundred yards from the aircraft and will effect an expeditious rescue of survivors.

## OTHER VESSELS AS AN AID IN DITCHING

It is desirable to consider the capabilities of naval vessels and Coast Guard vessels other than OSVs. They may have the equipment and personnel to provide some of the same services furnished by OSVs. They can work many frequencies and, also, some guard 121.5 Mc/s and/or 243 Mc/s. They have radar and radio direction finder equipment. Because of their maneuverability and trained personnel, they can expeditiously rescue survivors. They may also be capable of providing some altitude illumination and laying sea lane lights.

(NOTE: In the event it is necessary to use flame type water lights instead of the electric type lights, there may be a slight fire hazard to gasoline on the water from the ditched aircraft. In this case it is recommended that the vessel take position about one-half mile beyond the last water light, in which case the distressed aircraft will utilize the line of water lights purely as approach lights to a ditching beyond the lights and near the vessel.)

# Chapter 7
# THE MERCHANT VESSEL AS AN AID IN DITCHING

# Chapter 7
# THE MERCHANT VESSEL AS AN AID IN DITCHING

## INTRODUCTION

One of the nearest sources of help in an emergency over the ocean may be the merchant vessel. At all times, there are hundreds of merchant vessels at sea--principally concentrated on certain trade routes. On the North Atlantic Great Circle route an aircraft is seldom over 50 to 100 miles from a merchant or naval vessel. Therefore, ships at sea are an ever present source of assistance.

## COMMUNICATING WITH MERCHANT VESSELS

Communicating with merchant vessels may be difficult. Approximately 75% of these vessels stand a one operator watch, i.e., one operator is on watch intermittently only eight hours a day. During the remaining 16 hours, the only guard is the auto-alarm system on 500 kc/s. If an aircraft in distress is able to transmit on 500 kc/s and is close enough to the ship to trigger the auto-alarm, communications can be established on CW. If the aircraft is unable to emit sufficient signal strength to trigger the ship alarm, then the distress call may be heard by a more powerful station--this station will in turn broadcast an auto-alarm signal. The majority of merchant vessels are unable to communicate by voice, but must use CW even after contact is established. However, some merchant vessels are equipped to exchange communications on frequencies in the 2-3 Mcs band (voice emission).

## SELECTING THE NEAREST MERCHANT VESSEL

When an aircraft transmits a distress message on 500 kc/s, stations of the maritime mobile service in his vicinity hearing the message are required to answer. If, after a period of time, no stations in the immediate vicinity answer, ships more remote from the distress position are required to acknowledge. An aircraft initiating a distress message on 500 kc/s will probably receive acknowledgements, and positions, from several ships. The pilot is then faced with the problem of deciding which ship he is to proceed toward and communicate with. Obviously, if the pilot requests position reports of all ships on the circuit, a long time delay will result, together with an overloading of the circuit. The pilot must select the ship he plans to use and enforce silence on other stations. The pilot may then determine the ship's capability for using voice and a common frequency. If possible, a shift should be made to a voice frequency. If the vessel is a foreign merchant vessel, unable to use English, it may be better to stay on CW and use Q signals.

NOTE: (The block of Q signals QRA-QUZ, common to both the maritime and aeronautical services, should be used. These "Q" signals are in international use. The aeronautical block, QWA-QNZ, probably would not be known to shipboard operators, so it should not be used.)

Usually an aircraft will initiate the distress call on the air-ground frequency to the ground stations. This will, in turn, be relayed to RCC--who will provide for the broadcast of the auto-alarm alert to ships at sea. From the aircraft's position and the merchant vessel plot, the RCC controller will be able to inform the aircraft, through the air-ground station, of merchant vessels in the vicinity. The aircraft may then call the ship direct on 500 kc/s and/or 2182 kc/s. Large ships standing 24-hour watches and many smaller vessels such as yachts and fishing vessels may be able to use the voice frequency of the distressed aircraft.

It is suggested that aircraft navigators may find it desirable to enter on the chart the following information on all vessels sighted: time sighted, position, estimated course and speed. (Estimation of speed may prove difficult. As a general rule, most merchant vessels will be cruising between 9-15 knots.) This information may be useful if an emergency develops.

## RENDEZVOUSING

The aircraft's navigation plot should be the basic method used in effecting rendezvous. Homing by radio bearings may be used in two ways:

a. The most reliable method is for the merchant vessel to transmit homing signals on an appropriate frequency in the 400 kc/s band to allow the aircraft to home, using its ADF. The merchant vessel should be requested to transmit its call letters until the aircraft has made positive identification. When the signal has been identified, the merchant vessel should be directed to send 20-second dashes with its call sign after every third dash. Maritime mobile service radio direction finding frequencies are between 405 and 490 kc/s. Many merchant vessels, however, have only one operator and two transmitters. In such cases, it may be necessary for the vessel to transmit for homing on 500 kc/s in intervals of three minutes, then conduct necessary communications with the aircraft on 500 kc/s. If the merchant vessel is able to use high frequency voice, communications may be conducted on this frequency while the ship is transmitting homing signals on a frequency between 405 and 490 kc/s.

b. A second method is for the aircraft to transmit on 500 kc/s for bearings. The ship may take bearings on the aircraft with the ship's DF equipment, and advise the aircraft its true bearing from the ship. This method has the advantage that a large number of ships can be taking bearings while the aircraft is transmitting. If the aircraft ditches, a reliable DF fix is available. The aircraft should transmit long dashes, broken by identification, then cease the homing signals for other communications.

## DITCHING BESIDE A MERCHANT VESSEL

Day: If the pilot elects to ditch beside a merchant vessel, sea and weather conditions should be determined while inbound. From information furnished by the ship or determined by the pilot, the ditching heading should be selected and the vessel advised. The merchant vessel should be requested to steam on this heading. The aircraft should ditch off the ship's bow or in the wake. If the ship is a large fast vessel or liner, the pilot may land in the wake. A large vessel, proceeding at high speed, will produce a wake astern that may reduce the swell and sea system. If the ship is small or slow, no advantage will be derived from this procedure. Then it is better to ditch off the bow to facilitate early rescue. Merchant vessels will, in nearly all cases, use lifeboats to pick up survivors.

Night: Under night conditions, the merchant vessel can assist best by turning on all lights on the ship to give the pilot a reference mark and aid in depth perception.

Merchant vessels are normally unable to provide flare or starshell illumination. The pilot of a ditching aircraft should be prepared to use his own parachute flares for this purpose. This can be done by dropping the flares upwind of the ship, and utilizing the Single Aircraft Ditching Procedure prescribed in Chapter 5. A night ditching can then be made beside the ship with the advantage of illumination. Flares may be used to alert a ship when no other communications have been established. Flares should not be dropped so as to endanger the ship.

Instrument: The only feasible type of instrument letdown to a merchant vessel is an ADF approach similar to that described in procedures for ocean station vessels. Merchant vessels, however, will normally be unable to give radar information. The only assistance that can be expected in this type approach is the use of their medium frequency radio transmissions. Aircraft equipped with radar can use it to locate the ship and make an approach.

Many merchant vessels now have surface search radar, and the aircraft may be detected after ditching if within 5-10 miles of the ship.

## ATTRACTING VISUAL ATTENTION OF MERCHANT VESSELS

The procedure for an aircraft to call upon a surface craft to render assistance to survivors or to an aircraft in distress is now standardized as follows:

a. Circle the vessel at least once at low altitude.
b. Fly across the bow of the vessel at low altitude, opening and closing the throttle, or changing the propeller pitch when possible, and rocking the wings.
c. Head in the direction of the distress scene. Repeat steps 2 and 3 until the vessel acknowledges by following. The aircraft may use the Aldis lamp, radio, or message drop to explain the situation.

The surface craft should follow the aircraft--or indicate that it is unable to do so, by hoisting the international flag NAN, or by other visual or radio means. Crossing the wake of the vessel close astern at a low altitude, opening and closing the throttle, or changing the propeller pitch, indicates that the assistance of the surface vessel to which the signal is directed is no longer required.

# Chapter 8
# INTERCEPT AND ESCORT OF DISTRESSED AIRCRAFT

# Chapter 8
# INTERCEPT AND ESCORT OF DISTRESSED AIRCRAFT

## INTRODUCTION

Search and Rescue facilities are always ready to render assistance to aircraft in potential or immediate distress. Upon receipt of information that an aircraft ''uncertainty'', ''alert'', or ''distress'' phase exists, steps are taken to locate, intercept, and escort the aircraft. The ''uncertainty'' phase usually results from loss of communications; during this phase communications checks are made with appropriate units to reveal any news of the aircraft. SAR aircraft are on standby pending evaluation of the incident. If an ''Alert'' phase develops, either from continued lack of news of the aircraft or an indication that the operating efficiency of the aircraft has been impaired, the SAR organization may dispatch aircraft for a precautionary intercept. If a ''Distress'' phase develops or an escort is requested, rescue aircraft will be ''scrambled'' to intercept and assist.

## REQUEST FOR INTERCEPT AND ESCORT

When a decision has been reached that a potential or immediate distress condition exists, it is imperative that SAR be alerted immediately. Request for intercept should be made on the air-ground frequency. Rapid communication is maintained between RCC and aeronautical ground stations, so this procedure is the most expeditious. If contact is lost on this frequency, the alternate or emergency frequency must be used. In order to assure a properly planned intercept, the following information should be included with the original request for intercept:

a. Distressed aircraft's identification
b. Position: Specify type as...Unknown, DR, Estimated, Loran, Celestial
c. Time of position
d. Altitude-amplify if unable to maintain as ''descending'' or ''climbing''
e. True course
f. Ground speed
g. True air speed
h. Description of emergency ... (brief)

Intercept procedures, while well standardized, may be modified by the SAR pilot as conditions require; instructions will always be given. A discussion of basic intercept and escort procedure follows.

## INTERCEPT TECHNIQUE

Initial Action by Intercept Aircraft: Oceanic Air Traffic Control will cooperate with the rescue and distressed aircraft during intercept by controlling other traffic to keep the intercept route and altitude clear; intercept communications will be given priority. Immediately after takeoff, the rescue aircraft will begin steps to establish communications with the aircraft in distress. If unable to communicate direct on the air-ground frequencies or emergency channels, it will be necessary to relay through the air-ground station, a surface vessel, or another aircraft. When communications have been established, the rescue aircraft will request verification of the distressed aircraft's position, altitude, true course, true air and ground speed. The aircraft in distress will be requested to guard VHF/UHF emergency channels (121.5/243), and to turn on IFF and radar. By the time the rescue aircraft has reached altitude, an estimated time and position of intercept can be furnished to the distressed aircraft and Oceanic Air Traffic Control.

Basic Navigation: Experience has proved that basic air navigation for both aircraft is the most reliable means of effecting intercept. All aids must be used in order to assure accurate navigation. Shore based radar fixes may be useful. Celestial, radio, and loran fixes should be plotted as continuously as practicable. A successful intercept depends primarily upon the degree of accuracy in determining the distressed aircraft's position--whether determined by the distressed aircraft or other means.

Medium Frequency Homing: After verification of the distressed aircraft's position, the rescue aircraft may commence medium frequency homing procedure. The rescue aircraft will transmit on a specified air to air homing frequency (usually 522 kc/s)--requesting that the distressed aircraft take bearings on ADF or loop. Coast Guard rescue aircraft will continue to transmit the identification letters ''CG'' until the distressed aircraft reports that it is tuned in--thereafter 20 second dashes, broken by letters ''CG'', will be transmitted. (The ADF ''MCW-CW'' switch should be placed in the ''CW'' position for receiving this type signal.) When bearings are recorded by the distressed aircraft, they should be reported to the rescue aircraft in the following manner:

My magnetic heading is 240°; you bear 005° relative from me. This method eliminates all possibility of confusion as to what type bearing is being reported. This procedure will continue until intercept.

During long intercepts it may be necessary for the rescue aircraft to set up a ''five minute

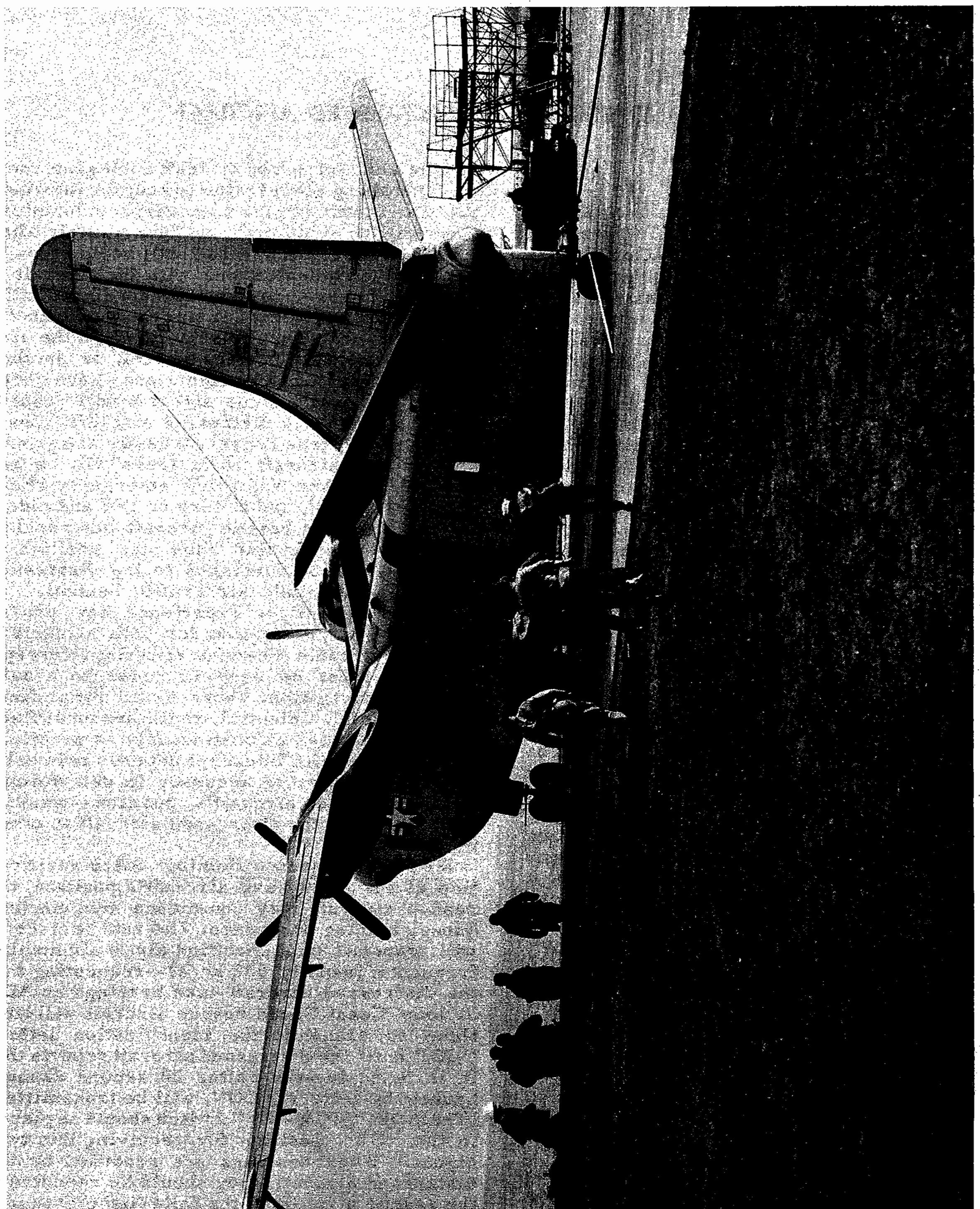


FIGURE 8-1.--COAST GUARD FLIGHT CREW MANNING P5M FOR INTERCEPT AND ESCORT MISSION

on, five minute off" homing schedule to prevent blocking its communication circuits. The rescue aircraft will alter heading to intercept. Occasionally, it is necessary for both aircraft to alter heading in order to intercept. Changes in the ADF bearing or aircraft course should be reported promptly--especially near the time of intercept. On head-on intercepts, the rescue aircraft will begin its turn around ahead of, or abeam the distressed aircraft in order not to lose valuable time in overtaking. Caution: The ADF is an aid to navigation; it is susceptible to atmospheric disturbance and internal malfunction. If there is doubt as to the accuracy of bearing--check with the loop.

VHF/UHF Homing: VHF or UHF homing will be used when distance permits. After VHF or UHF communications have been established (usually on an emergency channel), the distressed aircraft will be requested to transmit for homing by the rescue aircraft. A homing signal can be produced by holding down the mike button for about 30 seconds. If this procedure does not produce satisfactory results, it may be necessary to "hum" into the mike. (UHF installations have a tone switch on the control box; it may be necessary to use this for best signals.) VHF/UHF homing bearings will be taken by the rescue aircraft. If the distressed aircraft is within range of shore or ship based VHF or UHF DF installations, they may provide the rescue aircraft with bearings or fixes to assist in intercept.

Use of Radar: Rescue aircraft used for intercept and escort are equipped with radar. Use of present equipment for air to air intercept has not proved too successful; however, it is a valuable aid in escort. During instrument conditions, the rescue aircraft uses radar to help maintain contact during escort and to circumnavigate bad weather. Many military and commercial transport aircraft are now equipped with radar. It is advisable to use this equipment to the limit of its capabilities when making intercept. With radar in both aircraft operating, a radar interference signal is sometimes received; even this is an indication of the other aircraft's proximity.

If intercept can be made within radar range of shore or ship radar installations, they can be used to furnish a fix or "steer" to either aircraft. In many cases intercept has been made by ground or surface radar-controlled vector. This method is similar to "GCI" (Ground-Controlled-Intercept) system used by the military. It is more efficient when used in conjunction with the IFF equipment.

Use of IFF: Most military aircraft are equipped with IFF equipment. It may be an invaluable aid in intercept.

Visual Aids to Intercept: When within probable visual range (less than 60 nautical miles), use of visual detection aids will be required. Depending upon visibility, the following visual aids may be seen over great distances: flashing of landing light by both aircraft, Very's flare, and parachute flare. During daylight visual intercepts, lookouts are cautioned to be alert for flashing light caused by the sun's reflection on the other aircraft. At night they should be particularly alert for moving or flashing lights in order to distinguish the other aircraft's lights from the stars. When possible, the running lights should be flashing. All external and internal lights visible from outside should be turned on. Lights and flares should be used even during night instrument conditions. Reflection of light on a cloud, or a flare fired through or over an overcast may be seen for great distances.

Use of Loran: When the track of the distressed aircraft lies along a loran line, both aircraft may "preset" a specified loran line reading on the indicators and bracket the line in the same manner as a radio beam.

Use of Other Aids: Cloud formations or unusual weather conditions may be used to facilitate intercepts. The presence of distinct weather phenomena may be used as a reference point for both aircraft in making contact.

## ESCORT SERVICES

After making visual contact, the intercept aircraft will usually take position above and behind the aircraft in distress. If the distressed aircraft is faster, the rescue aircraft may elect to turn around ahead (within visual or radar range) in order to remain in contact longer. 1000 feet vertical separation is usually sufficient; however, turbulent instrument weather may necessitate greater separation. The search and rescue aircraft can furnish the following services after intercept:

a. Navigation services
b. Communications for both aircraft
c. Radar
d. Ditching assistance
e. Visual inspection of the exterior of the plane. This may be particularly valuable after a fire or structural casualty.
f. In applicable cases, the escort may, in marginal weather at the destination, make a let down and give the distressed plane a pilot report to help the pilot decide whether to attempt an approach in marginal weather or to attempt to reach an alternate with a crippled aircraft.
g. Under certain conditions, the distressed plane can fly close formation on the escort aircraft which will make the instrument let down for the landing.

## SAMPLE INTERCEPT COMMUNICATIONS PROCEDURE FOLLOWS

## SAMPLE INTERCEPT COMMUNICATION PROCEDURE

The following communication dialogue is intended as a guide.

CG 1234: MAYDAY MAYDAY MAYDAY This is Coast Guard 1234 This is Coast Guard 1234, this is Coast Guard 1234, ten miles west Delta One at 2304 Zulu, course 115 degrees, speed 110, altitude 3000 feet descending, starboard engine out. This is Coast Guard 1234.

New York: Coast Guard 1234 this is New York Overseas; roger your distress. You are cleared to all altitudes below 4000 feet. Stand by this frequency.

New York: Coast Guard 1234 this is New York. Coast Guard Rescue 4733 was airborne from Bermuda at 2318 to intercept. He will contact you on this frequency and 121.5 mc.

CG 4733: Coast Guard 1234 this is Coast Guard Rescue 4733. Departed Bermuda at 2318 to intercept. Altitude 4000 feet. Request your latest position, course, ground speed, and altitude.

CG 1234: Roger. My 2314 DR position 33-27 North, 69-24 West, course 115 true, heading 123 true, ground speed 110 knots, altitude 1800 feet descending.

CG 4733: Roger. Estimate intercept at 0015 Zulu, at position latitude 33 degrees-04' North, longitude 68 degrees-02' West. Turn your IFF to emergency and guard 121.5 mc. Stand by this frequency.

CG 4733: In one minute I will begin transmission on 514 kc. Tune your ADF to that frequency. I will send the identification "CG" continuously for identification. When you have identified my transmission, advise, and I will then send 20-second dashes broken by "CG". Report your magnetic heading and my relative bearing from you. Do you understand?

CG 1234: Roger. I am receiving your transmissions loud and clear.

CG 4733: Roger. Commence 20-second dashes.

CG 1234: My magnetic heading is 125 degrees; you bear 005 degrees relative from me.

CG 4733: Roger. Check bearings every 2 minutes. Report immediately if bearing begins to change. Stand by for a call on 121.5 mc.

CG 4733: Coast Guard 1234 this is Coast Guard Rescue 4733, how do you read 121.5 mc?

CG 1234: Reading you loud and clear.

CG 4733: Roger. Depress your mike button for one minute while I take a bearing.

CG 4733: Coast Guard 1234, you bear 312 degrees magnetic from me. Are you able to maintain altitude?

CG 1234: Affirmative. Maintaining altitude at 1200 feet.

CG 4733: Depress your mike button for another 30 seconds.

CG 4733: You now bear 313 degrees magnetic from me. Beginning at 0005, I will fire a Very's flare every two minutes. Advise if you have it in sight.

CG 4733: I just fired the first flare.

CG 1234: No contact.

CG 4733: Depress your mike button for another 30 seconds.

CG 4733: You now bear 315 degrees magnetic from me. What is my bearing from you?

CG 1234: You now bear 005 degrees relative from me, my magnetic heading is 125 degrees.

CG 1234: I think we have your flare in sight. Request you fire another.

CG 4733: Just fired another flare. I am also flashing my landing lights.

CG 1234: I have your lights in sight dead ahead.

CG 4733: Roger. I have you in visual and radar contact 10 miles ahead.

CG 4733: I am taking position 1 mile behind you and will maintain 2500 feet. Bermuda bears 122 degrees magnetic at 145 miles.

CG 4733: In case ditching is necessary, I will provide illumination as follows (explanation of procedure).

CG 4733: Best estimate of sea condition follows: Primary swell from 180 degrees, height 5 feet. Wind driven chop from 120 degrees. Wind from 120 degrees at 20 knots. If ditching is necessary, recommend ditch heading of 090 degrees magnetic.

CG 4733: Enroute and terminal weather for Bermuda follows: (Gives all necessary weather information.)

CG 4733: My radar indicates a large thunderstorm 35 miles ahead. Suggest you come right to 145 degrees magnetic to avoid it.

CG 1234: Roger. Coming right to 145 degrees magnetic.

CG 4733: You are passing the thunderstorm 3 miles to your left. Suggest you come left now to 114 degrees magnetic.

CG 4733: I have Bermuda on my radar, bearing 118 degrees magnetic at 75 miles.

CG 1234: I have the island in sight visually.

CG 4733: Roger. I will escort you into the landing pattern and remain overhead until you have landed.

# Chapter 9
# PREPARATION FOR DITCHING--ABANDONING THE AIRCRAFT AND LIFE RAFT SURVIVAL



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# Chapter 9
# PREPARATION FOR DITCHING--ABANDONING THE AIRCRAFT AND LIFE RAFT SURVIVAL

## PREPARATION FOR DITCHING

### INTRODUCTION

The interval between the recognition of a flight emergency and the ditching (or landing) may be too short to allow time to prepare passengers, the equipment, or even to issue additional instruction to flight crew members. On the other hand, some emergencies may be recognized a long time before the aircraft is forced down. While this manual is primarily concerned with the longer duration or anticipated ditching emergency, both types should be considered.

### SIMPLIFYING EMERGENCY CABIN PROCEDURES

Since the time for preparation in the air may be very brief and the subsequent escape time during which the aircraft remains afloat may be very short because of structural damage, every effort should be made to reduce both the number and the difficulty of the tasks which must be performed during these critical periods. In consequence, the requirements for survival of personnel should be considered and provided for successively at the time of manufacture of the aircraft, design of the survival equipment, development of routine and emergency procedures, and training of the flight crew. Adequate attention at these times will do much to ensure a constant state of readiness and greatly increase the probability of survival if an emergency occurs. Things that can be done to provide this type of "blanket insurance" for personnel survival are:

1. Provide the maximum possible protection of the flight crew from forces of deceleration. The probability of their survival can be increased through the selection of seat location and the arrangement of the seats to afford crash protection, and by providing shoulder harness and "clean" cockpit design for the pilots. In transport aircraft procedures should be established for other flight crewmen to remain at their designated stations when not occupied with the care of the passengers and during take off and landing. Passengers will be dependent upon crewmen, and especially cabin attendants, for leadership and direction in escaping from a ditched aircraft.
2. Provide intensive and repeated training of crew members by class instruction and ditching drills. Special emphasis should be placed on instruction in passenger escape. The evacuation of passengers is one of the few general emergency situations where a crewman may be required to act independently and without delay.
3. Disperse the flotation and survival equipment so that launching can be accomplished in several locations to provide for certain exits becoming inoperable or for separation of occupied portions of the fuselage. The rafts and the equipment should be at or as close as possible to the exits through which they will probably be launched. The equipment should be stowed and secured in such a way that it can be put into use with minimum delay.
4. Brief the passengers before or at the beginning of a flight so that they will be able to carry out the basic acts essential for their survival without further instruction should this be necessary. This would require that they know the location of the life jackets, how to put them on, and the location of rafts into which they may be expected to escape.

When an emergency arises where a ditching is anticipated, an early warning should be issued to all personnel.

### PERSONNEL INSTRUCTION, PRE-DITCHING PHASE

As soon as personnel have been warned, and the situation explained by the pilot, they should be instructed to don their life jackets. They should not remove any warm articles of clothing which they may be wearing, but should not be encouraged to put on any additional bulky clothing under their life jackets. Ties should be loosened, glasses or sharp objects should be removed; women should take off their shoes if wearing high heels. Crewmen should make an inspection to ensure that the jackets have been properly donned. Personnel should be paired off in a "buddy" system in preparation for evacuation. Older persons should be paired with able-bodied men to assist them. Children and non-swimmers should be paired off with swimmers whenever possible; experienced swimmers may be assigned the more dependent persons. Emphasis should be placed upon the fact that the buddy system implies a two-way responsibility during all phases of the emergency; the less physically able person may be able to give or enlist help should his partner get into difficulty.

Stationing of occupants is important. This plan will differ for passenger transport flights and for combined passenger and cargo operations. When cargo is carried, occupants should be stationed aft of any cargo which is not jettisoned. While bulkheads offer protection in the event of moderate deceleration, some bulkheads used for interior compartmentation are not stressed for high loads. Cargo, even if lashed down, may break loose, destroy structure and injure personnel. Further, since cargo may break free, personnel should not use it as a brace point.

In some operations, especially with military planes, a preferred ditching position is for occupants to sit down with their backs against a strong bulkhead. If available, blankets or other padding should be placed between the head and back and the bulkhead. If no suitable support is found for the head, the hands should be clasped firmly behind the head and neck for protection. If the area for bracing is small, a tandem arrangement of personnel may be used. As vertical and sidewise forces may be expected, occupants should use their feet to assist in bracing themselves; if the hands are not protecting the head, they should also be used. In some seated positions, the occupant may have installed equipment located directly in front of him with projections constituting potentially lethal objects. Such equipment should be covered with parachute packs or other types of padding to reduce the likelihood of crash injury and to provide a point for bracing while strapped in the seat. Some military aircraft, especially seaplanes, provide a crash mat in the aft station for crew members. This method has proved itself to be successful in numerous open sea landings. Another arrangement which has been utilized satisfactorily is a broad crash belt which may be strung from two adequately strong attachment points to form back support for one or more occupants seated on the floor facing aft. If the aircraft is of the conventional passenger transport type, appropriate instructions should be issued to the passengers so that they will obtain maximum benefit from seating arrangements provided. Passengers must remain in their seats during the ditching, and must brace themselves and be prepared to meet at least two impacts, to avoid being thrown about and injured. The method of bracing will be determined by the location and arrangement of the seat and by selection of one of a number of crash positions which have been recommended upon theoretical grounds. The objectives underlying all methods are to obtain the maximum possible restraint from the seat belt, and to interpose insofar as possible, a support in the direction opposed to the resultant force or one of its principal components. The restraint afforded by the safety belt and the body will enable the occupant to slow down with the plane and gain maximum benefit from energy absorption or dissipation by the aircraft structure. The third objective is to protect the head insofar as possible, since this is the most likely site of serious injury in both land and water crashes. Regardless of the method or location, the seat belt should be strapped as tightly as possible across the hip bones, which are capable of sustaining high stresses such as may be transmitted by the belt. The various recommended ditching positions are:

a. Adjust the seat to vertical position. Just before landing, fold your arms and rest them on your knees. Bend your body forward as far as possible and rest your head firmly on your arms. If available, hold a pillow, blanket or clothing in front of your head to cushion the possible impact.
b. A variation of (a) is: Bend forward in your seat, lower head between legs, clasp hands under your legs and tense all muscles.
c. Adjust seat to vertical position. Sit well back in the seat; bend forward; cross arms in front and hold tight against forehead, grasping the top of the forward seat with your hands.
d. A variation of (c) is: Put a pillow, folded coat or blanket across the seat in front of you; lean forward and fold your arms over the top of your head.
e. Recline seat back fully. Cross your arms and brace your head in your arms on the top surface of the seat back in front of you.
f. Adjust seat in vertical position. Brace your hands and feet against the frame of the seat in front of you.
g. Recline seat back fully. Lean back in seat and put hands above the head over the seat top. Grasp the seat back firmly when told to brace for impact. Place feet against seat legs in front of you.

Methods (a), (b) and (g) are suitable for forward facing seats where there is a bulkhead rather than a seat in front of you.

Since there have been no tests conducted for a comparative evaluation of the proposals, there is no factual basis for selecting one as the "best" crash position. Since, however, recommendations have been developed on theoretical grounds and since the effectiveness of any one method may vary with the direction, magnitude and duration of the various deceleration forces involved, choice should be left up to the operator. It is only important that he select one method in which he has the greatest confidence, adopt it and reflect that confidence in giving his instructions. The method described in (a) is preferred by the Coast Guard.

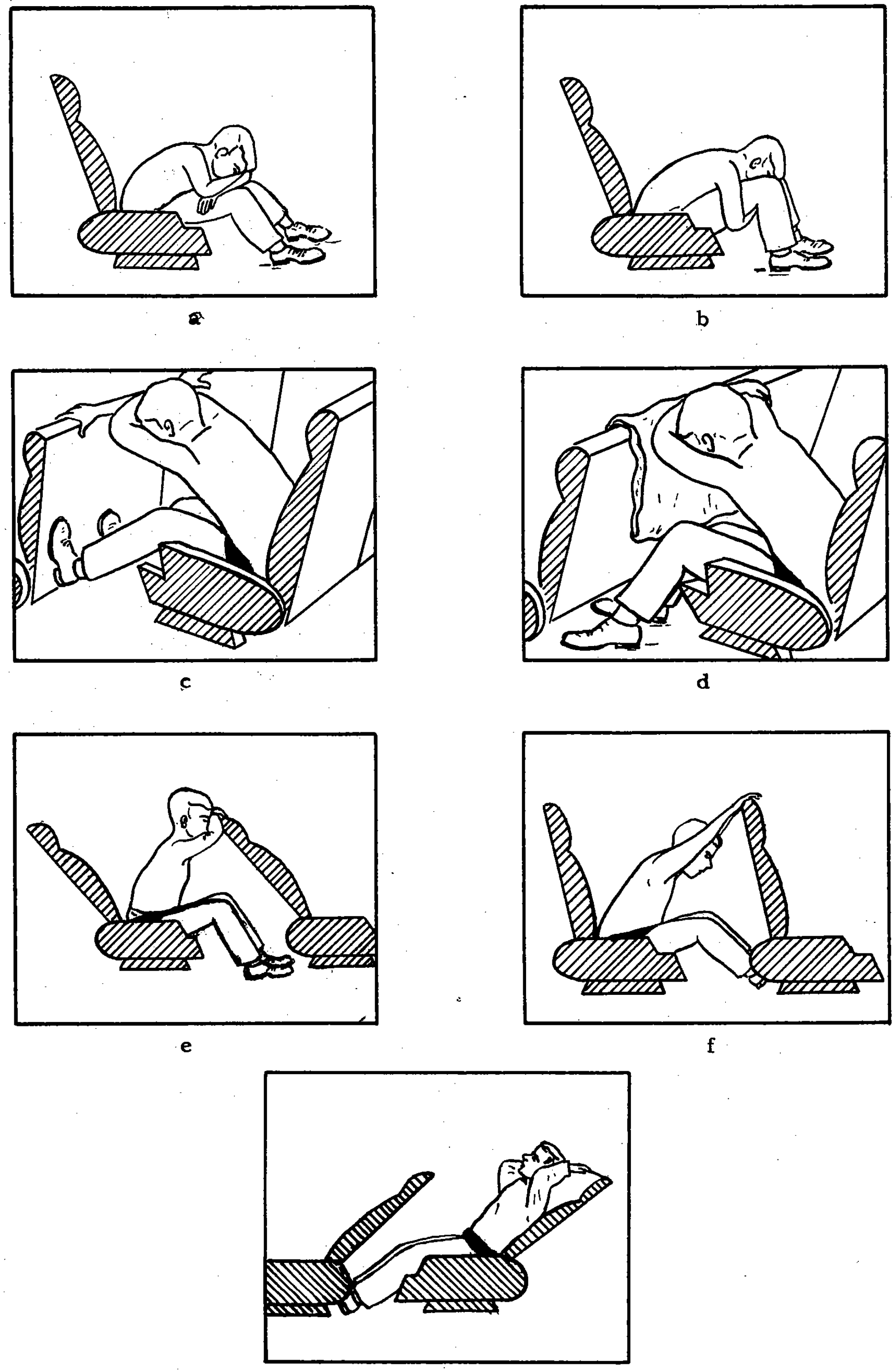

FIGURE 9-1.--DITCHING POSITIONS RECOMMENDED FOR PASSENGERS

FIGURE 9-2

Pilot's shoulder harness. This equipment is highly effective in preventing injury to the pilot during rapid deceleration of ditching.

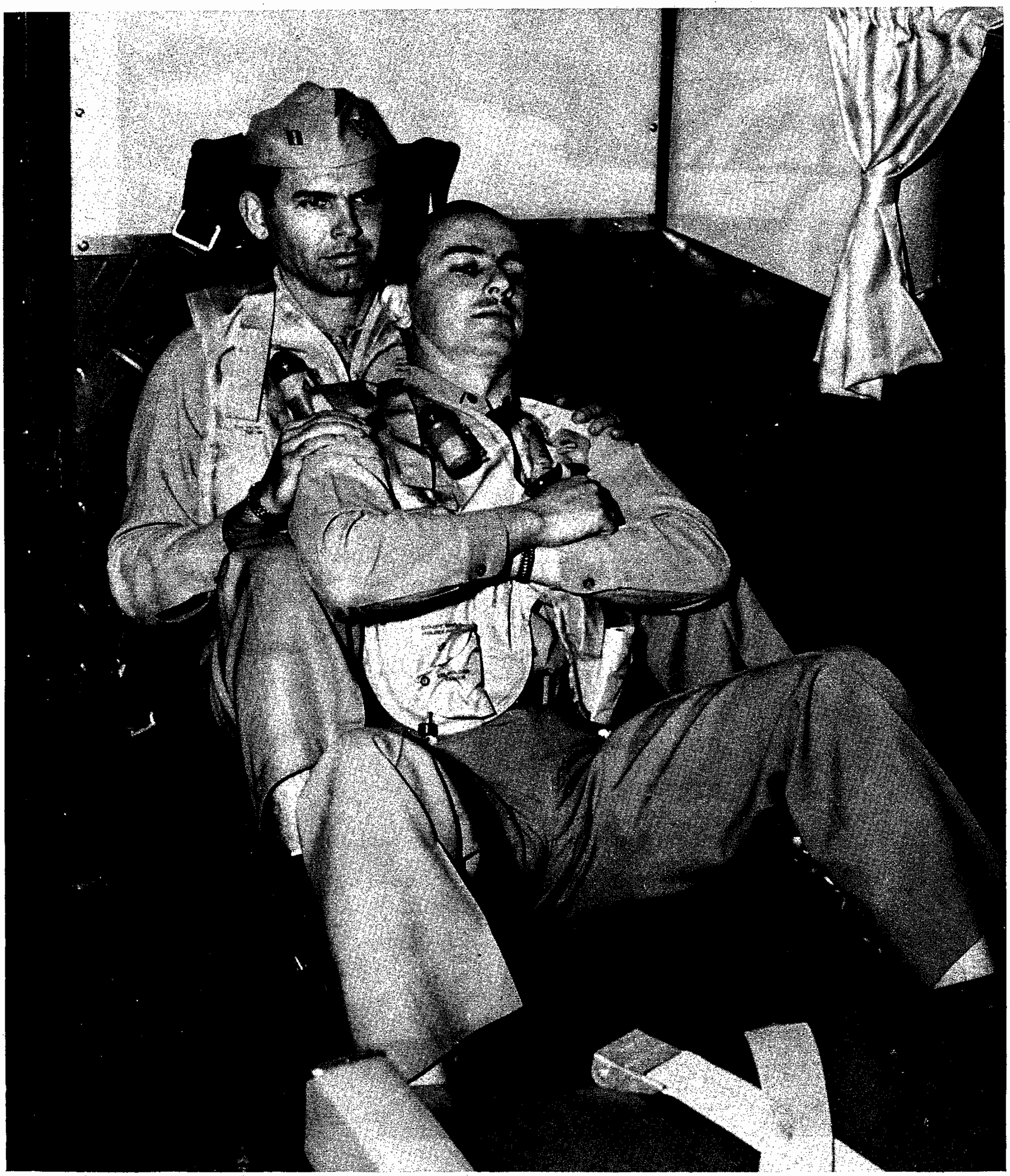

FIGURE 9-3

Personnel braced against bulkhead in tandem position. This can be used when the bulkhead area available for bracing is small.

FIGURE 9-4

Radarman braced for ditching. Safety belt is tightly fastened around the hips, while a parachute is used to pad the face of the radar equipment and provide protection to his face and chest.

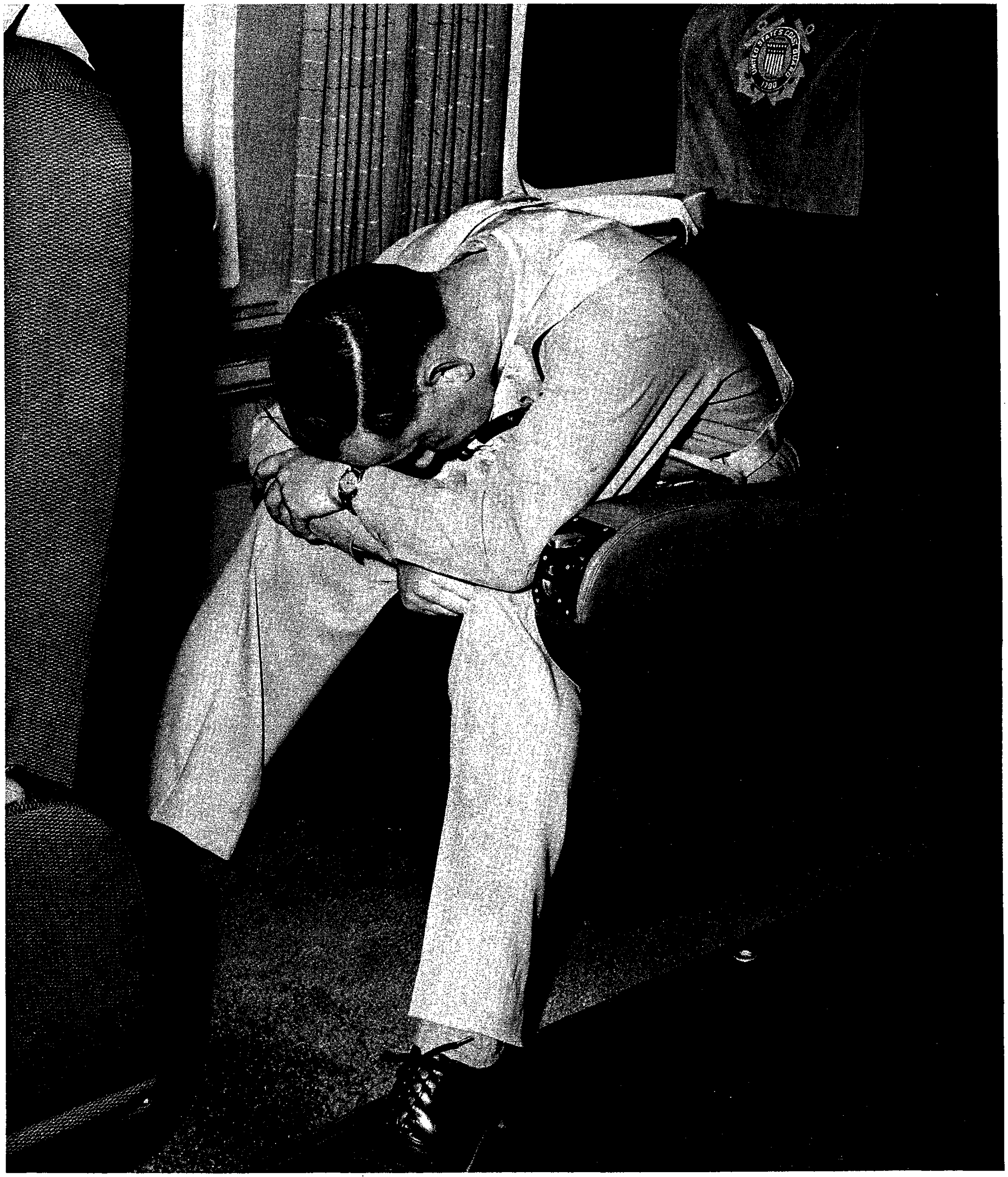

FIGURE 9-5

Recommended position for ditching in a forward facing seat. The seat belt must be worn as tight as possible around hip bones to protect the stomach.

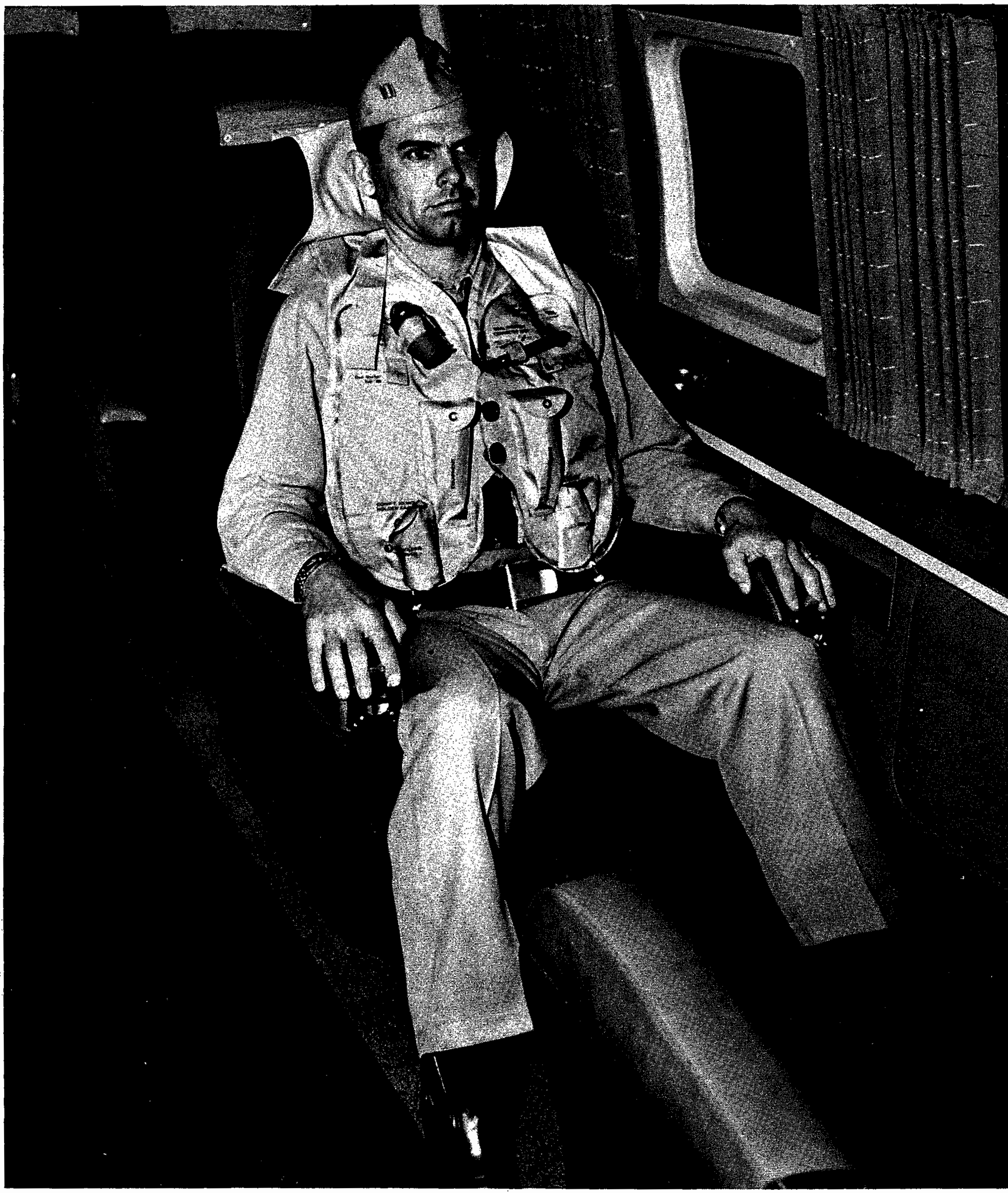

FIGURE 9-6

Ditching position in a rear facing seat. If the head can be rested against firm protection, the passenger may elect to grasp the arm rests. The rear facing seat in the forward compartment of a stratocruiser shown here is an excellent location to place infants and small children. All loose gear to the rear of the seat must be secured or moved.

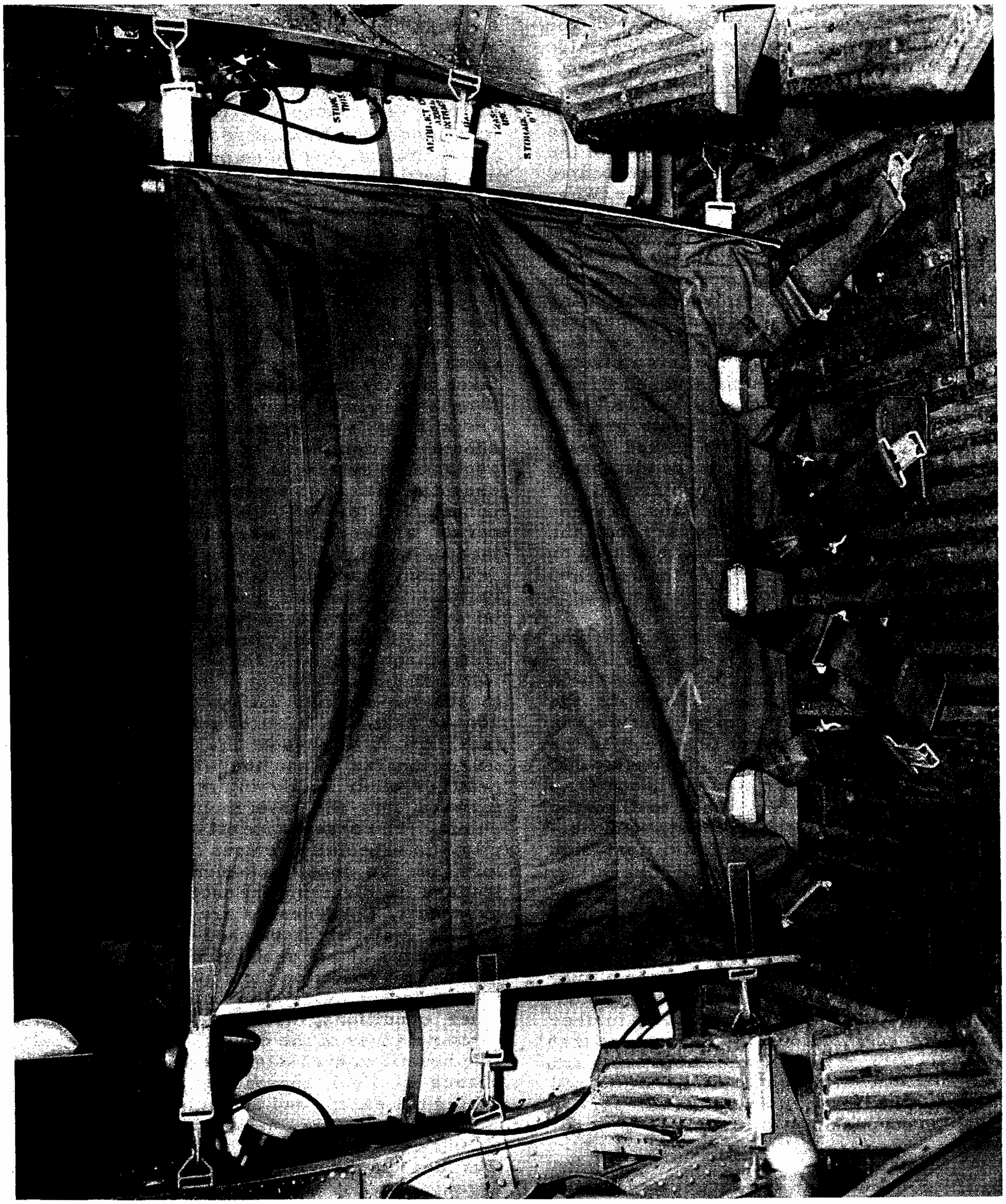

FIGURE 9-7.--SEAPLANE CRASH MAT

In well designed rear facing seating arrangements, the chances of survival of the impact without injury are excellent. They also offer a highly satisfactory solution as to what to do to protect children. Infants or small children may be safely held by adults or even placed alone in the rearward facing seat. Where only a few seats are facing aft, much of the protective value may be lost if they are located forward of banks of forward facing seats. When backing up against a bulkhead, they will benefit from such strength as may be provided by that structure. In spite of the advantage lost by a single or limited aft seating arrangement, the use of this section is recommended for young children and infants as providing far greater safety than by being held in an adult's arms.

The recommended bracing for this aft facing seat is with the back and head pressed firmly against the back of the seat with the seat belt fastened snugly and the arm rests gripped securely. If the head cannot be braced firmly against the back of the seat, the hands should be grasped behind the head for protection.

While following these instructions, passengers should be encouraged to try out the recommended position, place the blankets or padding at hand for use when required, and carry out such small acts as may aid in preparing for the ditching.

It is probable that there will have to be some rearrangement of passenger seating. Able-bodied men should be placed beside the cabin hatches and instructed how to operate the release mechanism and remove the escape panel. They should be warned not to open the hatch until they are directed by the crew to do so. It is probably better to switch seats as soon as the assignments are made to allow the assigned assistants to rehearse their responsibilities mentally and to avoid later confusion as to pairing off of buddies.

Passengers should be informed of all developments during the emergency as they occur. It is reassuring to the passengers and very helpful in establishing authority and controlling the passengers if the pilot can talk to them over the loud speaker during the pre-ditching period. It will also assist discipline and provide further assurance if he mentions the assistance that will be given by the flight and cabin crew and the rescuing facilities or craft by name and clearly stating that all possible steps are being taken for passenger safety.

## FLIGHT CREW DUTIES

Flight crew duties in the anticipated emergency include instruction and preparation of passengers, disposition of cargo and small gear, and taking all possible steps toward self-protection from crash injury at their respective ditching stations.

Cargo should be jettisoned, or if this is not indicated all or any remaining cargo should be inspected to see that it is tied down as securely as possible. In evaluating the advisability of retaining the cargo, the likelihood of its causing personnel injury and blocking exits or access to survival gear should be considered. In one ditching of a transport aircraft, some life rafts were inaccessible because of the shifting of cargo on impact. Any loose objects such as thermos bottles, packages, hand luggage, tool kits, etc., must be secured or jettisoned as they may become dangerous missles. Records of actual ditching reveal that numerous injuries have been caused by flying objects. If the provisions for raft stowage are not satisfactory for their disposition and ejection, the rafts should be placed at their planned exit location and secured against deceleration forces. Any equipment not contained in the carrying case which should be taken into the rafts should be checked, relocated if necessary, and secured. The crew members responsible for transferring the equipment should be reminded of this duty. A double assignment system is advisable for the vitally essential items of equipment, i.e., life rafts, Gibson Girl, or VHF/UHF equipment since the person assigned to take care of them may be incapacitated.

Stationing and protection of the crew are of critical importance. Shoulder harness should be available and used by pilot and copilot to prevent their being thrown forward into the instrument panel. If shoulder harnesses are worn, the pilots will have an excellent chance to survive ditching without injury and will be able to maintain a better degree of control of the aircraft throughout the period in which it is responsive. If not, they may suffer serious head or other bodily injury by being thrown forward into the instrument panel or windshield. The consequence of incapacitation of the pilots is especially serious since it means the loss of the most experienced and capable leaders for directing the escape and survival of personnel. If harnesses are not available, the copilot may be dispatched to a suitable aft position for better protection. At night or under instrument condition the copilot should remain in the cockpit. Decision on this matter under other conditions must be determined by the circumstances of the emergency and the relative benefit of his assistance during the critical phases of final approach and touchdown or during the escape and sea survival.

Flight engineers, navigators and radiomen should also receive the maximum protection that can be provided in their stations. The arrangement of the seats in a number of the current model planes is not well adapted for conventional shoulder harness, but does not preclude the use of restraining harness attached to a structural member of adequate strength. Under many conditions, it will be advisable for at least some of the flight crew to take a ditching station in the cabin. Members of the cabin crew should go to their permanently assigned crew stations prior to the ditching. The plane crew should mentally review the positions they will take during the evacuation and the various alternative stations should one or more of the exits become inoperable. Appropriate action without delay in meeting unanticipated as well as anticipated emergency conditions is of utmost importance and is the end objective of emergency training. While the basic plan of action can be established, variation from this will necessarily be determined by the circumstances of the emergency, including number and composition of the passenger group, the number of exits available following the ditching, the extent of damage to the fuselage, the number of rafts and amount of other survival equipment and injury attrition of the crew.

## EMERGENCY LIGHTING

It is extremely important to have some type of emergency lights in the cabin for a night ditching. Unless conditions are such that the fire hazard is extremely great in the pre-ditching phase, the main cabin lights should be turned on when the emergency first occurs and left on if electrical power is available. If there is a separate emergency system which does not operate automatically, the lights should be turned on manually. Crew members should have their flashlights at hand and should turn these on prior to final descent. At the same time, all persons should turn on life jacket lights if the jackets are so equipped. Light is not only reassuring to the passengers, but will contribute considerably to the efficiency of the evacuation. It is noteworthy that in several ditchings the aircraft cabin lights have remained on until the aircraft sank.

## FINAL PREPARATIONS

Before beginning final approach, the aircraft should be depressurized. The pilot should jettison as much fuel as possible before ditching, not only to lighten the aircraft before landing, but to provide additional flotation from the empty tanks. If there are overhead escape hatches, they may be jettisoned upon final approach. Side hatches and door hatches should not be opened until directed by crew members after the aircraft comes to rest. Likewise the cockpit overhead hatch should not be jettisoned in the air, since the aerodynamic noise will interfere with communication and will be a distractive influence. A warning signal should be used before ditching to allow personnel to brace for impact. The last position should be sent by radio and the transmitter set for continuous emission.

## ABANDONING THE AIRCRAFT AND LIFE RAFT SURVIVAL

### GENERAL

Studies of controlled ditchings reveal that only a small percentage of the persons aboard have been seriously injured from the decelerative forces. Most fatalities have resulted from failure to board the rafts. Here, occupants do not or cannot escape from the aircraft, or escape and enter the water but are unable to reach and get into a raft. Once the aircraft is down, the task of transferring occupants from the hull directly into the raft takes precedence over everything else. This transfer is critical in determining survival. Success will depend upon the training and preparation of the flight crew, the quality of maintenance and the disposition of the emergency equipment, and the leadership of command personnel throughout the emergency.

### RAFT STOWAGE

There is a variety of stowage arrangements and plans. In some aircraft there are compartments for outboard stowage with release mechanisms which are operated from inside the plane. This is an excellent arrangement which eliminates a number of steps required in hand launching. The inflation is started as the compartment release is activated. The lanyard or retaining line is attached to a fixture in the raft compartment. For rafts carried inside the aircraft, an overhead stowage adjacent to the site of launching is a preferred location. Where cargo is carried, a position aft of the cargo is preferable.

The importance of raft positioning has been noted previously. The need for stowage near the exits through which they will be launched is emphasized by their weight and by the difficulty of dragging or carrying them about quickly in an aircraft. Large modern rafts weigh as much as 125 to 165 pounds. In a recent ditching, the crewmen were unable to move a raft from the crew's bunkroom to the flight deck and launch it through the astrodome. The weight and bulk of rafts significantly reduce the value of overhead hatches for raft launchings. In experimental trials conducted in two transport aircraft on land, with no passengers and under ideal conditions, about 2/3 of a minute was required to transport a raft from the forward baggage compartment and launch it through the main cabin door. Attempts to launch the 20-man rafts through the astrodome were abandoned after persistent but ineffective efforts.

Rafts should always be tightly packed to facilitate their passage through exits. They should never be abused nor allowed to become flat or out of shape.

## LAUNCHING OF RAFTS

In most current aircraft, rafts must be hand launched. The raft lanyard (retaining line) should be secured to the aircraft using a D-ring, or harness snap. Crew members should carry a knife so that they can cut the lanyard and move away from the aircraft as soon as the raft is filled. This will reduce the likelihood of damage to the raft by jagged structure which may have resulted from impact. When life rafts are launched from the main cabin door exits, place the raft with the $CO_2$ handle towards the launcher, with the greater portion of the raft outside of the door. Pull the $CO_2$ inflation cable and push the raft overboard.

Extra care should be taken not to discharge the $CO_2$ while the raft is still inside the aircraft. Should inadvertent inflation occur within the cabin, the crew should attempt to eject the raft. If it cannot be readily freed and it blocks an otherwise usable exit or obstructs evacuation, it should be deflated with a knife.

An alternate method of launching a raft from main cabin doors or emergency exits is:

a. Secure the raft lanyard to the aircraft--attach the inflation cable of the $CO_2$ cylinder to a loop or hook in the lanyard, located at a proper distance to activate the $CO_2$ cylinder as the ejected raft hits the water. Whatever the length of the inflation cable and lanyard and the location of the point where they are attached together, the objectives are to:
   (1) Secure the raft until loaded.
   (2) Preclude inadvertent inflation inside the airplane.
   (3) Activate the $CO_2$ discharge mechanism as soon as possible after the raft has been ejected so that transfer of passengers may be accomplished with a minimum of delay.

Rafts carried in special external compartments in the fuselage or wing roots are released or controlled from inside of the aircraft, or by releases at the compartments on the outer skin. This type stowage has the advantage of releasing the rafts directly into the water; however, this arrangement may result in personnel getting wet in boarding the raft. On being released from an exterior compartment, rafts should be retained by a built-in lanyard that is stressed to part if the aircraft sinks.

Inflation of a raft usually requires between 2/3 to one minute under moderate conditions of ambient temperature. It is for this reason that inflation of several rafts should be carried out simultaneously, so that occupants will not have to wait at one or several exits for a second or additional raft to become sufficiently rigid for boarding.

## TRANSFER OF PASSENGERS

Controlled ditchings of modern transport aircraft show a considerable range of estimated times between touchdown and sinking. Some have floated 3, 5 and 6 minutes, others 20 minutes, and still others an hour or more. It is not safe to assume an arbitrary time value for escape; evacuation should begin immediately and should proceed as rapidly as possible. In transport operations there are frequently a large number of passengers aboard, some lacking in strength and agility, and perhaps an appreciable number who will require considerable assistance in escaping from the aircraft.

It should be re-emphasized that occupants should enter the raft from the aircraft if possible. If persons do enter the water the probability of loss of life is greatly increased by separation of occupants, cold and exhaustion, and inability to reach or board rafts. A person in dry clothes in a raft protected by a canopy can survive extremely cold temperatures, but one who has been submerged and is wet will suffer intensely from exposure.

The main cabin door (or doors) is the exit of choice since it permits rapid egress, does not require special agility, and reduces the exposure during transfer to a minimum. The raft should be pulled close to the door, with the lanyard held low and to one side of the door frame so as not to interfere with escape. A crew member or a physically fit and experienced passenger should enter the raft first to assist occupants in the transfer. Personnel should step into the raft if the sea permits, or should drop or jump into it when required to do so by the relative movement of the hull and the raft. They should be seated at the far side of the raft and dispersed alternately to right and to left insofar as is practicable. The cabin attendant should regulate the rate of entry into the raft to keep the passengers from jumping on top of one another. Extreme haste may result in inefficient movement and increase rather than decrease escape time; on the other hand, bruises or minor injury constitute a lesser hazard than entry into the water. The training and the judgment of the crew are of major importance in arriving at an effective decision on this and other problems of passenger handling.

Simultaneous use of several routes for transfer is desirable to reduce the total time to abandon the aircraft. The suitability of a particular exit or break in the fuselage will depend upon whether there are jagged edges of damaged structure which would be likely to tear a raft being boarded from that position. Escape through the over-the-wing exits and boarding from the wing provide an advantageous route. Exits should be made feet first from these stations. Since, however, maintaining footing on a wing of a ditched aircraft is usually difficult and hazardous, a life line should be rigged from the exit hatch to provide a handhold for occupants while reaching and entering the rafts. After a good ditching, where time and conditions permit, the pilots and forward crew members may find it advantageous to proceed aft and escape through the main cabin.

Escape from an exit over or near a propellor can be dangerous in rough seas because of the surging movement of the aircraft and propellors.

## SURVIVORS IN THE WATER

If the aircraft sinks rapidly the occupants will, of necessity, escape into the water. In this event, rafts should be thrown directly into the water, and each one followed by one crew member to inflate it and help the passengers. Occupants should inflate their life jackets as they leave the aircraft. Every effort should be made to keep the passengers together in groups around the raft. Passengers, in jumping, should try to build up a chain or cluster, holding on to one another (for attachment, not for support) and drifting along with the raft. Once inflated, the rate of drift of the raft downwind is far greater than that of a passenger in the water. The probability of rescue of passengers upwind to a raft decreases precipitously with increasing distance. For this reason it is strongly recommended that heaving lines, sufficiently heavy to be thrown upwind, be included in the raft equipment, and that flight crews be trained in using the lines.

Boarding the raft from the water is difficult under most conditions. If a crew member has had to inflate the raft while in rough water, he may be near exhaustion after he boards it. He or one or more able bodied passengers should crawl into the raft before it becomes fully inflated. Primary attention should be given to seeing that others attain a good handhold on the raft life line. This will probably be more effective in increasing survival, and will allow those in the raft to recover somewhat before pulling others into it. Unless the passengers are rapidly becoming helpless from cold or extreme exhaustion, it is better to pull them in one at a time. If they are able to do so, those in the water can help by moving around to the boarding area and by using the boarding handles. The rise and fall of the sea can be used to assist. The survivor should get his chest over the edge of the raft as it falls with the sea rather than trying to get in while the raft is on the top of a swell. Where there is no help from within the raft and the life jacket greatly interferes with boarding, the jacket may be removed but must be retained over one shoulder. Once in the raft, survivors should be placed first opposite the boarding station and then alternately to the left and right.

If a passenger, separated from the raft, attempts to overtake it by swimming and underestimates the distance or difficulty he may become completely exhausted, fail to make it, and drown. The chances of survival may be better if the occupant conserves his strength and waits for rescue. Two recent aircraft losses demonstrate that some occupants in life jackets can survive without rafts; however, their chances are considerably reduced unless rescue craft are close to the scene of the ditching. Those in the raft can help with heaving lines if the separation is not too great. If conditions warrant, a swimmer secured to the raft by a line may be able to effect the rescue.

## RAFT MANAGEMENT AND SEAMANSHIP

Rafts should be tied together to keep survivors in one group. All personnel should be accounted for. Lights should be displayed at night. Use sea anchors as soon as possible to keep the rafts close to the scene of ditching. Do not use open flame lights or pyrotechnics until clear of the gasoline contaminated area.

The need for an adequate sea anchor cannot be overemphasized. It will not only keep the raft near the scene of ditching, facilitating location, but it is a very important factor in preventing the raft's capsizing. Inflate the boarding station with the hand pump. If the buoyancy chambers need more air, they should be further inflated. The center floor compartment chamber should also be pumped up. Do not screw the hand pump too tightly into the valve as it has a tendency to seize.

The survival equipment should be inventoried. Nothing should be thrown overboard. In a recent ditching, the passengers in the rafts threw most of the pyrotechnics overboard. During the night rescue aircraft flew overhead; the survivors were unable to signal them. When the equipment kits are opened, all items should be secured to prevent loss. Survival studies record instances where all equipment was lost when rafts capsized. Capsizing is a possibility in high seas; if the canopy has been put up, there is some danger of persons being trapped below the raft in the canopy. The raft commander must decide from the action of the raft if this danger warrants removing it and increase exposure of the occupants. At least one person in the raft should be secured by a line to retard drift of the raft in case of capsizing; all should wear their life jackets continuously. If small children or infants are in the raft, they should be tied to an adult to prevent loss in case of capsizing; although life jackets are available for children, a child's center of gravity is such that its head may go under water. The recently developed underarm jacket was designed to overcome this difficulty.

To right a capsized raft, a man should be stationed on both the upwind and the downwind sides. A line is thrown from the upwind to the opposite side. The downwind man rights the raft by pulling on the line with his feet or knees braced against the raft.

When opportunity permits, survivors should be checked for injuries and First Aid administered. Treatment of minor injuries can be delayed until the rafts are fully organized. While the injured are being treated, the rafts should be bailed and sponged out. In cold climates this is very important; persons with wet clothing will suffer severely. A tarpaulin or other type of covering should be used to retain body heat and reduce the circulation of air around the body. Death can result in a matter of hours in a cold climate if protection against exposure is not available.

The orders of persons in charge of the life raft must be obeyed at all times. He should set watches and assign duties to all survivors. A 24-hour watch must be maintained to detect rescue aircraft and ships. Pyrotechnics must be immediately available to the person on watch. Pyrotechnics must not be used indiscriminately; the person in charge should be consulted prior to discharging them.

## SURVIVAL EQUIPMENT REQUIREMENTS

The relative importance of survival equipment requirements is normally as follows:

1. Flotation
2. Protection from exposure
3. Radio and signalling gear
4. Sustenance
5. Medical

Flotation is the primary and most important requirement for survival after escaping from a ditched aircraft. In peacetime and with the search and rescue facilities of today, the probability of survival is high if passenger transfer to rafts is successful. In addition to rafts providing protection against frequently fatal submersion in cold water, their canopies reduce exposure to chilling wind and tropical sun. If the canopy is not available, any other material available should be used as a shelter or cover. Some military airplanes carry exposure suits; these should be donned prior to ditching. If this is not possible, they should be carried into the raft and donned later, since they will provide an excellent barrier against cold.

The effective use of survival radio equipment, pyrotechnics, and visual aids is essential if survivors are to be located. A lone survivor in a life jacket is very difficult to sight unless a visual signalling aid is used. Even a large 20-man raft may be difficult to see without visual signals. In a moderate or rough sea, with whitecaps, the detection probability without signalling aids is reduced. A life raft will be sighted more quickly by searching aircraft if the survivors on the raft understand the use of raft equipment. Survivors must never assume that they have been sighted; they should continue efforts to attract the aircrafts' attention until detection is certain. The primary radio aids are the Gibson Girl, and URC-4 or PRC-17. All crewmen should be familiar with their use, especially the operation required for homing by rescue aircraft.

Visual pyrotechnic aids include the MK 13 day-night signal, the Very's pistol, various flare signals, and sea dye markers. The MK 13 signal is hand-held, has a night flare signal in one end, and an orange smoke day signal in the other. In using the night signal, the MK 13 should be held over the water on the downwind side of the raft to prevent burning embers damaging the raft. After use at night, the flare should be doused in the water and retained for use as a daytime smoke signal, or vice-versa. This type signal can be seen for 30 miles on a clear night. In daylight, the orange smoke can be seen for as much as 7 miles on a calm day; with high winds, the smoke signal's effectiveness is greatly reduced. The Very's flare can be seen as much as 30 miles on a clear night. In daylight, if a search aircraft is sighted, survivors should not hesitate to use a Very's pistol to attract attention. In moderate seas, the green sea dye marker is easily seen from a searching aircraft. Survivors should strive to make a concentrated dye slick instead of a long thin one. The slick will normally persist about 45 minutes, though in a rough breaking sea it will dissipate in a fraction of that time. Dye marker should not be used until the search aircraft is sighted.

In rough seas during daylight, the effectiveness of these signals is greatly reduced. At night, flares can be readily seen even with high winds and seas.

Other visual aids are: signalling mirrors, flashlights, paulins, parachutes, Gibson Girl lights, raft reflector paddles, and body signals. The signal mirror is especially valuable when high winds and seas reduce the effectiveness of other aids. Parachutes can be used for protection against exposure, and for signalling; if placed on the floor of the raft, they provide good insulation. If no pyrotechnics are available for signalling, survivors can set fire to inflammable articles such as clothing--holding them out from the raft on an oar or other support and taking all necessary steps to prevent raft damage. Such a practice should be limited to use at night when it is known there is a rescue craft in the area. Some life jackets are equipped with whistles for use to attract surface vessels in the immediate vicinity.

An additional detection aid is the life raft radar corner reflector which is effective in favorable sea conditions.

Remember: The probability of being sighted depends primarily on the proper use of radio and visual signals. Further, it is important to emphasize again that when an aircraft is in the area, sighting must not be assumed until it takes positive action to indicate the fact. Until that time, use all possible means of attracting attention.

In areas where search and rescue units are available, it is improbable that survivors will remain on provisioned rafts long enough for food and water to become a problem. Long term survival will not be covered here. "Survival Training Guides" NAVAER 00-80T-56 and the U. S. Air Force Manual 64-5, "Survival", are highly recommended as references on this subject.

## OTHER FACTORS AFFECTING SURVIVAL

The importance of training all aircraft crew members in swimming has not been sufficiently emphasized. The survival narratives of actual ditchings stress the fact that survival after ditching is often dependent on swimming ability. Strong swimmers can save themselves as well as others. Swimming, and wet drills with rafts should be required.

One extremely important factor, overshadowing all other considerations, is the "WILL TO LIVE". Without this, equipment, training, and knowledge are secondary. Hundreds of cases prove conclusively that those who survived had the determination and desire to live; they never gave up hope.

## ACTION BY RESCUE UNITS

Primary SAR units consisting of aircraft and surface craft are immediately dispatched when an aircraft reports an emergency. These units are especially equipped and their personnel are highly trained in search and rescue. In addition, the RCC's will take immediate action to alert and divert other surface craft and aircraft which are in the area of the emergency or distress.

When survivors are sighted, the rescue aircraft will:

a. report the position and apparent condition of the survivors
b. drop life rafts and other survival equipment, if indicated
c. direct nearby surface vessels to the scene
d. land and rescue the survivors if such action is indicated and the SAR aircraft is a seaplane or amphibian.

Open sea landings are particularly hazardous. The decision to land will be based on weather and sea states and the condition of the survivors. A seaplane can land in much heavier seas than an amphibian. As a general rule, the aircraft will not land in heavy seas when a surface vessel will arrive in time to rescue the survivors, and the delay will not unduly jeopardize the survivors. In extreme emergencies, SAR aircraft will readily land to rescue persons even though the aircraft may not be able to take off. Helicopters are dispatched if the location of the distress is within range. The helicopters are able to drop survival equipment and/or hoist survivors out of the water in a sling or rescue basket.

## ASSISTANCE BY TRANSIENT AIRCRAFT

Frequently transient aircraft will be the first to arrive at the scene of a ditching. These aircraft are capable of rendering assistance in several ways.

Of greatest importance is maintaining the survivors in visual contact to assist air and surface rescue units in the rendezvous. This will, of course, be a tremendous morale factor to the survivors. Experience has proved that it is extremely important to maintain this visual contact. Remain on the scene and orbit the survivors as long as possible or until rescue craft arrive.

Immediately notify rescue craft, or if impossible, notify OATC of the sighting and situation. Rescue aircraft are equipped to "home" on the orbitting plane.

Drop life rafts or emergency equipment if necessary. Drops should be made at altitudes and speeds as low as practicable to increase accuracy. Attach a 15-20 foot lanyard to the $CO_2$ discharge handles of the life raft to insure inflation after it leaves the aircraft. Inflated rafts and jackets should be dropped upwind from the survivors, other equipment, downwind.

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# Chapter 10
# SURVIVAL FIRST AID

# Chapter 10
# SURVIVAL FIRST AID

This chapter is concerned only with first-aid for and emergency treatment of injured survivors immediately after ditching and during the first 24-48 hours aboard a raft. For a discussion of prolonged survival at sea the reader is referred to other texts.

## SURVIVAL IN GENERAL

It is never too early or late to learn that "survival" is not synonymous with elaborate equipment. There is a quality of fortitude, of sheer will to live, in every man who has come back to tell of hardship at sea. Training in survival should begin long before we find ourselves in a precarious situation. However, whether the survivors are well prepared or not, one of the most important factors will be good leadership.

Panic and despair are the great enemies of survival. Every effort to combat these should be made from the very beginning of the survival situation. A calm and determined leader, who is hopeful and convincing, has the lives of his less stable shipmates literally in his hands. Panic may be contagious and despair a lethal disease. Control of these conditions is a primary and continuing requirement.

## FIRST-AID IN GENERAL

Some of the more likely conditions to be found among survivors will be wounds, bleeding, fractures, burns and shock. Exposure to the sun and immersion effects are common hazards. Certain other conditions will be discussed briefly below. Treatment, in general, will depend on available drugs and first-aid equipment. Directions for its use should be included with each article supplied. These directions should be followed implicitly and supplies should be conserved. A basic understanding of first-aid principles will aid in improvising treatments.

## TREATMENT OF SPECIFIC CASES

### SEASICKNESS

Cause: Motion sickness is usually caused by slow oscillations of large amplitude. Structures in the inner ear are stimulated, giving rise to symptoms in susceptible individuals.

Symptoms: The victim experiences nausea ("sick to his stomach"), pallor, sweating and vomiting.

Treatment: Persistent vomiting is dangerous because of the loss of body fluids. A seasickness remedy should be available in tablet form and a tablet should be administered every 4-6 hours.

### WOUNDS

Cause: Puncture wounds, contusions, lacerations and the like may be sustained in ditching.

Symptoms: Varying degrees of pain, bleeding and shock will be present.

Treatment: Salt water is an excellent cleansing agent for all superficial wounds. Antiseptics are not required and may be harmful. Following cleansing of the area, the wound should be covered with a sterile or improvised dressing and kept dry. The purpose of the dressing is to prevent further contamination of the wound. Frequent changing of the dressing is not required unless it becomes soggy or odorous. Do not attempt to squeeze or manipulate infected wounds.

Chest wounds: These require special attention. Penetrating wounds, which allow the entrance of air into the chest, should be covered with a sterile bandage and rendered airtight by suitable material. No attempt should be made to cleanse such wounds.

Head wounds: Morphine should not be given to these cases.

### FRACTURES

Cause: Broken bones should be suspected and examined for following ditching, particularly when restraining devices have failed.

Symptoms: Deformity, pain, and loss of use of the affected parts are present in varying degrees.

Treatment: The broken bone should be firmly splinted to prevent movement and injury to neighboring muscles, nerves and blood vessels. However, a too firmly applied splint may cause circulatory complications. Do not attempt to "set" the bone fragments.

Fractures of the neck and spine: There is danger of injury to the spinal cord and permanent paralysis if these cases are moved about. A face down position is best since it maintains the normal curvature of the spine.

### BLEEDING

Cause: Lacerations or penetrating wounds may cause bleeding.

Symptoms: Superficial wounds will ooze blood. When deeper vessels are involved the blood will flow steadily from the wound. Depending on the amount of blood loss there will be varying degrees of shock.

Treatment: A pressure dressing is all that is required for superficial bleeding. Hand pressure should be applied for five minutes and the dressing inspected from time to time for return of the bleeding. Deeper wounds require pressure on the artery leading to the bleeding area. A tourniquet applied to leg or arm should be loosened momentarily every 20-30 minutes to permit some circulation to the area below the tourniquet.

## PAIN

Cause: Severe contusions, fractures, and wounds involving destruction of tissue cause pain.

Symptoms: It is important to accurately locate and determine the amount of pain present. Severe pain may cause fainting and contribute to shock.

Treatment: Pain should be allayed by treatment of the primary cause, such as a fracture. An injection of morphine may be given every 6-8 hours except in head injuries.

## SHOCK

Cause: Severe injury or loss of blood may give rise to shock. Pain and psychic factors may contribute to its development.

Symptoms: The eyes have a vacant stare and the pupils are dilated. Breathing is shallow and irregular. The skin is pale, cold and moist. The pulse is weak or absent.

Treatment: Shock is a profound and critical condition. Once it has developed there is little to be accomplished in the absence of expert medical attention. Hence, prevention is more important than specific treatment. Control of bleeding and pain are most important. The patient in shock should be placed horizontally, with the head lowered and the feet elevated. The patient should be kept warm.

## BURNS

Cause: Burning gasoline or oil from the ditched aircraft and exposure to the sun will cause burns.

Symptoms: First degree burns will cause a redness of the skin. Second degree burns lead to blister formation. Third degree burns involve the entire thickness of the skin and cause charring. Body fluids are lost through the burned area. Pain is usually intense.

Treatment: Pain should be controlled by the use of morphine. The burned area should be covered with vaseline gauze. Then, fluffed-up gauze pads are added and elastic bandages are wrapped around the area to create a pressure dressing which will prevent excessive blister formation, stop fluid loss, and aid in the control of pain.

The sun's ultraviolet radiation may permeate clouds on an overcast day and exposure is enhanced by reflection from the water. The body should be kept covered with available clothing and sunburn ointment should be used on unprotected surfaces.

## IMMERSION EFFECTS

### Cold Injury--General

Cause: Excessive cold results in constriction of blood vessels in the skin and muscles caused by the body's effort to conserve heat.

Symptoms: Pale and cold skin; slowed pulse and respiration; weak, tensed muscles, decreasing body temperature; and stupor.

Treatment: Adequate, loose, and dry clothes are important. Rig up all available shelter from the wind and water. Stimulate circulation by movement and keep huddled together. Do not rub or handle parts of the body which have been damaged by cold. Even mild massage will break the injured skin and introduce infection.

### Cold Injury--Local

Cause: The terms immersion foot and frostbite are used to describe the local tissue reaction to various cold levels. Immersion foot results from prolonged exposure to cold in the presence of water or moisture. Frostbite is actual freezing of the skin.

Symptoms: The affected part will be pale or white, only to become red, swollen, and possibly painful when warming begins. After warming, burn-type blisters, and, later, gangrene may appear, depending on the extent of injury. A little numbness in the nose, earlobes, or toes may be the only indication of beginning frostbite. Prevention is all-important.

Treatment: Keep the feet dry and warm. Constricting shoes and garters should be loosened. At the first suggestion of excessive whiteness or numbness of hand or foot, the affected part should be warmed by contact with the body. Cramped positions and prolonged immobility should be avoided. Do not rub or handle the affected part roughly.

## HEATSTROKE

Cause: Heatstroke results from exposure to heat and sun.

Prevention: Retain all clothing and headgear. Rig up canopy, tarpaulin, or other type cover.

Symptoms: Symptoms are dizziness, nausea, vomiting, diarrhea, fever, headache, mental confusion and unconsciousness. The skin is red, hot, and dry.

Treatment: Loosen all clothing. Bathe head, face, wrists, and body in cool sea water. Give small sips of fresh water. Place the patient in a reclining position protected from the sun. Fan and keep cool.

### DEHYDRATION AND THIRST

Cause: The body loses water by breathing, by evaporation from the skin, and internally through the kidneys.

Prevention: Water is the most important item for survival. Man can exist only about 7 days without it. Loss of body moisture is hastened by heat and exercise. Delirious men may have to be restrained from drinking large amounts of salt water. Never drink urine. If water is not available, do not eat. Elimination of food wastes via the kidneys requires water and decreases the water in the body. Do not drink salt water, as this will cause diarrhea, weakness, and unbearable thirst. A recent report by a French physician indicates that it is possible to survive as long as three weeks on the juice squeezed from fish and small amounts of sea water. From his experience it should not be concluded that the average castaway can drink salt water.

Symptoms: Rapid pulse, fever, convulsions, shock, and inability to urinate. Dryness causes cracks and sores on lips.

Treatment: Give small amounts of sweetened water if the individual is conscious. Treat for shock.

### STARVATION

Prevention: A responsible person must be put in charge of all food supplies. He must divide all food fairly and schedule meals. Before any food is distributed, a complete inventory of provisions should be taken. Food should be checked periodically, especially on dry days, to see if anything has spoiled.

Symptoms: Symptoms are loss of weight, fever, and shock. Breathing may be shallow and fast. Prolonged malnutrition may cause swelling of the feet--not to be confused with immersion foot.

Treatment: Give small amounts of soft and liquid foods. Keep warm. Treat for shock.

### CONSTIPATION

With little food and water, bowel movement may be less frequent. Do not worry about this as it is not harmful. No first-aid treatment is necessary.

### FAINTING OR UNCONSCIOUSNESS

Lay the patient flat on stomach, head turned to one side.

Loosen clothing.

If patient is breathing, use ammonia inhalant.

If patient is not breathing, use artificial respiration. Use inhalant as soon as breathing starts.

### MENTAL DISTURBANCES

Cause: Usually mental disturbances are caused by severe hardships, prolonged exposure, thirst or starvation. Sometimes they develop when rescue seems probable and the victim becomes overexcited and happy.

Symptoms: Symptoms are irrational thinking, melancholia, a fixed stare, and delirium.

Treatment: Give victim rest, warmth, and quiet. Prevent the man from injuring himself or leaving the raft. Lash him to the raft if necessary.

## RESUSCITATION

Aid to breathing may be necessary with patients who have been under water, received concussion shock, or have been overcome by smoke or oil fumes.

Remember, it is all-important that artificial respiration, when needed, be started quickly. There should be a slight inclination of the body in such a way that the fluid drains better from the respiratory passages. The head of the subject should be extended, not flexed forward, and the chin should not sag lest obstruction of the respiratory passage occur. (It is most important to keep the air-way free.) A check should be made to ascertain that the tongue or foreign objects are not obstructing the passages. These aspects can be cared for when placing the subject into position, or shortly thereafter, between cycles. A smooth rhythm in performing artificial respiration is desirable, but split-second timing is not essential. Shock should receive adequate attention, and the subject should remain recumbent after resuscitation until recovery seems assured. (It may be difficult or impossible to perform artificial respiration in the close confines of a raft. A time-honored method is mouth to mouth insufflation. It is preferable to place a gauze covering between the victim's mouth and yours, but it is not required in an emergency. Simply blow your breath forcibly into the victim's mouth, holding his nose closed, in rhythm with your own breathing cycle.)

Back-pressure, Arm-lift Method (Preferred): Place the victim in the face-down position. Bend both his elbows and place one of his hands on the other. Turn his face to one side and place it on his hands.

Quickly sweep your fingers through his mouth, to clear out froth and debris, and bring his tongue forward.

Kneel at his head, on one knee, facing him. Place the knee close to his head. Place your other foot near his elbow. If it is more comfortable, kneel on both knees, one on either side of the victim's head.

Place your hands on his midback, just below the shoulder blades. Your fingers should be spread downward and outward, with thumb-tips about touching. Rock forward till your arms are about vertical and allow the weight of the upper part of your body to exert slow, steady, even pressure on your hands until firm resistance is met. This compresses the chest, forces air out of the lungs. Your elbows should be kept straight and the pressure exerted almost directly downward. Do not exert sudden or excess pressure, or place your hand high on the back or on the shoulder blades.

Release the pressure quickly. This is done by "peeling" your hands from the back without giving any extra push with the release.

Now rock backward and allow your hands to come to rest on the victim's arms, just above his elbows. Although he may be grasped anywhere along the arms, the position just above the elbows is generally best. As you rock backward, draw the victim's arms upward and toward you. When doing this, do not bend your elbows; keep your arms straight and as you rock backward, the arms will be drawn upward and toward you. Put enough lift on the arms to feel resistance and tension at the shoulders. The arm-lift pulls on the chest muscles, arches the back and relieves the weight on the chest; air is thus sucked into the lungs. Lower the victim's arms. You have now finished one full cycle.

Repeat this cycle approximately 12 times per minute, to the rhythm of:

(1) rock forward, (2) press, (3) rock backward, (4) stretch.

Remember, timing doesn't have to be to the dot. Just maintain that slow, easy rhythm--rocking forward on the back-pressure phase, backward on the arm-lift phase. This rocking motion helps keep the rhythm, aids the operation.

If you begin tiring, shift to the other knee. Or if it's more comfortable, kneel on both knees. These shifts can be accomplished with practically no break in the rhythm.

If a relief operator is available, he takes over by coming in to one side and after one of the stretch phases he carries on as the other operator moves off, beginning with the rock-forward phase.

<u>Back-pressure, Hip-lift Method (Alternate)</u>: Place the victim in the face-down position with his elbows bent. Turn his face to one side and rest it on the back of one hand. His other hand is alongside and above his head.

Quickly sweep your fingers through his mouth to clear out froth and debris, and bring his tongue forward.

Kneel on either knee at the level of the hips. Straddle the victim facing his head and place your foot on the ground near the opposite hip. Thus your heel is directly opposite the kneeling knee.

Place your hands on his midback just below the shoulder blades. Your fingers should be spread downward and outward, with thumb-tips about touching. Rock forward and allow the weight of the upper part of your body to exert slow, steady, even pressure downward on your hands until firm resistance is met. This compresses the chest, forces air out of the lungs. Your elbows should be kept straight and the pressure exerted almost directly downward. Do not exert sudden or excess pressure, or place your hands high on the back or on the shoulder blades.

Release the pressure quickly. This is done by "peeling" your hands from the back without giving any extra push with the release.

Now rock backward and allow your hands to come to rest on the victim's hips, well below his waist. Do not grasp the waist. Just slip your fingers under the hip bones.

Lift the hips four to six inches. This allows the abdomen to sag downward. The diaphragm descends and air is sucked into the lungs. Do not bend your elbows; keep your arms straight as you lift. In this way you do the work of lifting with your shoulders and back instead of with your arms.

Lower the victim's hips; you have now finished one full cycle.

Repeat this cycle approximately 12 times per minute, to the rhythm of:

(1) rock forward, (2) press, (3) rock backward, (4) lift.

Remember, timing doesn't have to be to the dot. Just maintain that slow, easy rhythm--rocking forward on the back-pressure phase, backward on the hip-lift phase. This rocking motion helps keep the rhythm, aids the operation.

The method should be maintained as long as possible. If you become tired, continue the back-pressure phase alone, at a slightly slower rate, resuming the hip-lift as soon as you can, or performing a hip-lift after each second, third, or fourth back-pressure.

If a relief operator is available, he can take over with practically no break in the rhythm. He does it by coming in to one side and after one of the lift phases he carries on as the other operator moves off, beginning with the rock-forward phase.

Do not spend time seeking apparatus to supplement these maneuvers, but if a belt, towel, shirt, or rope is available, it may be passed beneath the hips (not under the waist) and used for lifting. This adjunct should be grasped near the body, to prevent slipping.

The back-pressure, hip-lift method is preferable in cases where there have been injuries to the upper chest, neck, shoulder or arms.

Although fully as effective as the back-pressure, arm-lift method, it is somewhat harder on the operator.

## IN SUMMARY

Good leadership is the greatest psychological factor leading to survival in a liferaft at sea. People gifted with attributes of calmness and determination serve as examples, giving encouragement to the less stable survivors. They must sustain the attitude of hopefulness on the raft, bearing in mind that the desire to live is the most important factor in survival.

RAFT FIRST AID SUPPLIES - 20 Persons

1. Bible--other inspirational reading matter.
2. Seasickness remedy--200 tablets.
3. Tourniquets (10).
4. Morphine syrettes (30). (If so directed by higher authority).
5. Ammonia inhalants (10).
6. Sunburn ointment.
7. Petroleum.
8. Bandages, compress, 4" x 4".
9. Bandages, compress, 2" x 6 yds.
10. Bandages, compress, 3" x 6 yds.
11. Bandages, Triangular, Compress, 37" x 37" x 52".
12. Splints, wooden.
13. Water supply.
14. Food supply.
15. Paulin.
16. Survival pamphlets.
17. Adhesive tape.

See NAVAER 00-80T-52, Safety and Survival Equipment for Naval Aviation.

## Chapter II
# EMERGENCY CHECKOFF LIST

### ADVISE ANY STATION THAT YOU ARE IN TROUBLE BY ANY MEANS AVAILABLE

a. Emergency IFF
b. Air/ground station
c. Another aircraft
d. An ocean station vessel
e. Any surface vessel
f. Blind broadcast
g. Complete electronics failure, use Gibson Girl on trail
h. Radar alerting pattern

### GIVE FOLLOWING INFORMATION

a. Your call
b. Position and time (if you are uncertain of position, say so)
c. Altitude
d. Course
e. Ground speed
f. Nature of emergency
g. Any amplifying data and intentions

### IN EXTREME EMERGENCY, BROADCAST

"MAYDAY MAYDAY MAYDAY this is (call of aircraft three times)" and/or CW equivalent on established air-ground frequency. If time permits, follow with position and as much data as possible.

### IF SAR AIRCRAFT IS ENROUTE TO INTERCEPT

a. Guard your air/ground frequency.
b. Guard 121.5 mc VHF and/or 243 mc UHF.
c. Turn IFF to "emergency" position.
d. When in contact by radio, give SAR aircraft following data:
   1. Position and time (DR or fix)
   2. Altitude
   3. Course and heading (true or magnetic)
   4. Ground speed and true air speed
   5. Flight conditions
   6. Further remarks on nature of emergency
e. Follow instructions of SAR pilot.

### IF DITCHING IS A POSSIBILITY

a. Inform air/ground station or rescue unit.
b. Alert crew and passengers.
c. Jettison fuel and all possible weight.
d. Secure or jettison all loose objects.
e. Check emergency gear.
f. Instruct and prepare crew and passengers.
g. Evaluate sea and select ditching heading to be used if needed.

### PREPARE CREW AND PASSENGERS

a. All personnel warmly clothed, life jackets on, glasses and sharp objects removed, loosen tie. Don exposure suits.
b. If bailout not intended, remove parachutes. Don crash helmets.
c. Station personnel in best position for landing. Pair off personnel in a "buddy" system. Children and old people with able-bodied males.
d. Last minute briefing of all hands on bracing and evacuation.
e. Last check with crew members on gear to be provided.

### DITCHING IMMINENT

a. Jettison remaining reserve fuel and movable weight.
b. Depressurize cabin.
c. Make last broadcast of ditching intention and position. Lock down key for bearings. (With UHF, throw switch to tone.)
d. Jettison overhead hatches (except cockpit) if feasible.
e. Turn on emergency cabin lights, life jacket lights, and flashlights carried by crew.
f. Give warning to crew by word, bell, or light signal.
g. Turn to ditch heading and commence approach.

### DITCHING

a. Complete cockpit check. WHEELS UP and FLAPS AS DESIRED.
b. Make long slow approach.
c. If power available, drag aircraft low over water at 20 to 50 feet looking for smooth spot.
d. Cut power, throw crash switch, and touch down at minimum speed. Attempt to control any bounce by use of yoke.
e. Remain seated with safety belts fastened until aircraft comes to rest.
f. When aircraft comes to rest, check for "buddy", and proceed to evacuation station with assigned equipment.

**THIS CHECKOFF LIST IS NOT ALL INCLUSIVE, BUT IS INTENDED AS A GENERAL GUIDE.**

## Notes
*(for reader's use)*

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U. S. COAST GUARD

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