RIVERINE ASSAULT CRAFT COURSE

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RIVERINE ASSAULT CRAFT COURSE

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566 Navigation Publications & Equipment

NAVIGATION SECTION

Navigation Homework

REFERENCE SECTION

Assorted References

UNITED STATES MARINE CORPS
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Camp Lejeune, North Carolina 28542

TAB 500
MAR 99

STUDENT OUTLINE

HAZARDOUS MATERIALS

1. **Purpose**. The purpose of this period of instructions is to familiarize the student with the proper handling and disposal of the hazardous materials available during the course. Establish policies and procedures for the proper management, storage, and disposal of hazardous material (HM) and hazardous waste (HW) in a manner that will protect human life and the environment.

2. **Policy**. To preserve human and environment resources and ensure everyone fully understands the responsibilities and consequences associated with managing HM and HW.

3. The U.S. Congress and the North Carolina State Legislature have enacted a law, responsive to the threats on human life and the environment caused by mismanagement, illegal spills, and
dumping of toxic substances. These laws impose civil and crimina1 penalties. References a, b, and c pertain to occupational safety , environmental protection and transportation of hazardous materials.

4. **Training**. Adequate HW training is defined as:

a. On-the-job (continuous) by supervisory personnel.

b. Semiannual seminars on HM/HW by the Hazardous Material Officer (HMO).

5. Minimum training objectives to be accomplished prior to personnel being permitted to handle HM/HW are;

a. Be familiar with the types and characteristics of HM/HW to be handled.

b. Be familiar with applicable oil and hazardous substance spill precautions and contingency plans.

c. Understand command policy and the procedures.

d. Be familiar with the procedures for providing personal safety during HM/HW emergencies.

e. Understand specific HW responsibilities

DEFINITIONS OF WASTE TYPES

A. **Hazardous Material**: (HM) Any material, which because of its quantity, concentration, or physical, chemical or infectious characteristics is capable of posing an unreasonable hazard to human health, safety , and property when transported in commerce. Hazardous materials are designated under 49 CFR 171 and 173. In other words these are hazardous materials that are still good and ready to use.

B. **Hazardous Waste**: (HW) Any discarded material-liquid, solid or gaseous, which meets the definition of a HM and/or is designated HW by the Environmental Protection Agency (E.P.A.) or the North Carolina Department of Environmental Quality (DEQ). Contact the Environmental Quality Division (EQD) to determine if a waste is classified as hazardous or non-hazardous. In other words, these are materials which have served its intended purpose and are defined as a HW by regulatory agencies and can no longer be used, reused, or recycled and must be disposed of. Most HW requires treatment or neutralization prior to being land filled, some can't go to landfill at all. Studies have shown that improper disposal of these types of wastes destroys soil, water tables, and plants and animals. Types of Hazardous Wastes are: Acid, Benzene, Corrosives, . Fuels, Gasoline, Heavy Metals such as(lead cadmium, and chrome), Insecticides, Ketone, MEK; Oil (contaminated), Potassium Hydroxide, Toluene, Xylene to name a few.

C. **Non/Regulated Waste**: Non/Regulated Waste types are usually used or unused materials that does not meet the definition of a Hazardous Waste when disposed or discarded. This does not mean that they can't cause pollution it just means that they are not as hazardous or harmful to the environment and HM/HW are when they are improperly disposed into the water, air, or land. Types of Non-Regulated Wastes are: Used Oil, Antifreeze, Soda Lime or Soda Sorb, Used Rags, Oil Filters, Synthetic Oil, Grease, Hydraulic Fluid and the like. These items still require proper usage, storage disposal and management.

SAFETY AND HEALTH

Characteristics of liquid fuels. Although the handling of fuels presents many hazards, they can be handled safely and with remarkable freedom from accident if their characteristics are understood and proper precautionary measures are taken. The hazard in handling and storing fuels is not only in the fuel itself, which is toxic to the human body whether by skin contact or by ingestion, but also in its vapors. Vapors from fuels constitute fire and explosion hazards. Fuel vapors have been known to travel some distance and upon reaching a source of ignition, flashback to the point of origin, causing a fire. Flashbacks are extremely dangerous and are usually fatal to anyone caught in them. Moreover, fuel vapors are heavier than air and settle to the ground and

accumulate in dangerous amounts in depressions, troughs, and pits. The danger area exists not only in the immediate vicinity of the fueling operation, but may extend downwind depending on weather conditions. These vapors can be ignited by static or friction sparks, hot exhaust pipes, lighted cigarettes, electrical devices and similar ignition sources.

HEALTH HAZARDS AND FIRST AID

A**. Inhalation of Vapors**: The concentration of gasoline or other fuel vapors which can be inhaled safely is far below that required to produce combustible or explosive mixtures with air . Even one-tenth of the concentration needed for combustion or explosion is harmful if inhaled for too long a time. Avoid as much as possible breathing fuel vapors. Heavy concentration may cause no symptoms but can be fatal after a relatively short exposure. Persons showing signs of dizziness, nausea or headache must be moved out of the hazardous area immediately. Recovery from early symptoms is usually prompt after removal to fresh air. C.P.R. should be administered if necessary by trained/ qualified personnel. Danger of respiratory illness/ disease exists from inhalation of lead-treated gasoline vapors/benzene when exposure occurs in enclosed or poorly ventilated areas.

B**. Swallowing**: Fuel is exceedingly irritating when swallowed. If is swallowed, Emergency Response Teams should be called immediately. If first aid is administered, individuals must be trained/qualified.

C. **Skin Irritation**: A void getting gasoline or other liquid fuels on the skin. Such products remove protective oils from the skin causing drying, chapping, cracking, infection, and possible blood poisoning. Severe burns occur if fuels remain in contact with the skin. If a person becomes drenched with fuel, remove soaked clothing, shoes and/or gloves at once and avoid exposure to any source of ignition. Fuel will be removed from the skin by washing with soap and water as soon as possible after contact. If fuel should enter the eyes, immediately rinse with large quantities of water and secure prompt medical attention.

REFERENCES:

1. MCO P11OOO.8 *Maintenance of Hazardous Materials and Generating Hazardous Waste.*

NOTES:

ATTACHMENTS: None.

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TAB 501
MAR 99

STUDENT OUTLINE

INTRODUCTION TO THE RIVERINE ASSAULT CRAFT (RAC)

LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVES: Given a Riverine Assault Craft without the aid of and per the reference correctly identify in writing the mission, physical characteristics and deployable capabilities of the RAC.

B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, identify in writing the characteristics of the Riverine Assault Craft, in accordance with the references.

(2) Without the aid of references, identify in writing the deployable characteristics of the Riverine Assault Craft, in accordance with the references.

(3) Without the aid of references, identify in writing the mission of the Riverine Assault Craft, in accordance with the references.

OUTLINE:

1. Characteristics of the RAC.

a. Hull of the craft is known as a RIGID HULL which is made from a modem marine aluminum that is both anti corrosive and very easy to maintain. It is 3/16 of an inch in thickness and has no armor

b. Length

34 feet 11 inches.

c. Beam (width to the widest points) 8 feet 10 inches

d. Height
Freeboard (distance from keel to side rail) 5 feet

SO-501-1

Top of dome 9 feet
Top of VHF antenna 16 feet 6 inches

e. Draft (How the craft sits in the water)
Stationary (averages)
22-26 inches
Planing (averages)
9 inches

f. Fuel Capacity (two 90 gallon Tanks) 180 gallons diesel

g. Range
250 statute miles
Depending on sea state, current, wind and load

h. Operational Speed
45 mph at 2800 rpm

i. Weight
16,500 – with trailer 18,650

j. Engine Type
Two 300 HP Cummins Diesels

k. Propulsion
Two Hamilton Water Jets

l. Weapons Mounts
Two MK93 mod 0 and two

M60E3 or two M240G

m. Weapon Stations are located on the bow and aft of the craft. The .50 Cal Machine gun is mounts in the bow and can store 500 rounds of ammo. The MK19 is mounted on the aft of the craft and stores 250 rounds of MK19 ammo. These stations are often referred as Tubs. The two M60/M240 machine guns and mounts are located on the port and starboard sides. The weapons system are located on the port and starboard sides. The weapons system on the RAC cover the craft by fire with a 360 degree radius and an elevation of 30 degrees.

n. Communication and Navigation Systems on this craft enables you to navigate and communicate with any one within the operating network as well maintain contact with local port authorities.

1. RX 40 Radar
2. GPS MODEL 920
3. Depth Finder V 820
4. Ray 202 VHF Radio Telephone with Hailer
5. AN/PRC – 119A
6. AN / GRC - 231

7. AN/PRC - 113
8. AN/PSC - 3

2. **Deployable Capability of the Riverine Assault Craft (RAC)**

a. **Crew** - consists of 4 members.

1. Boat Captain
2. Coxswain
3. Forward Gunner
4. Aft Gunner

b. **Troop Capacity** – 10 - 15 combat loaded marines (excluding crew). With crew 20 marines.

c. **Sea State** of one or less, although you can operate in a Sea State of 2 safely. If the craft is used in a sea state of 3 the probability of causing damage or internal problems is high.

d. **Prime Mover** is the 5 TON truck. It is also capable of being transported by AMPHIBIOUS SHIPPING AND MILITARY SEALIFT COMMAND (C-141, C-130, AND C-5). The RAC can also be lifted by CH-53E with or without trailer.

3. **The Mission of the Riverine Assault Craft** - The RAC is designed for speed and maneuverability, this enables the Riverine Assault Craft to fit into the missions of **ASSAULT** and **SURVEILLANCE**. These missions also enable the RAC to fit into the following mission roles:

a. Armed Escort for the MAGTF assault force.
b. Command and control for riverine operations.
c. Transportation of reconnaissance and other combat missions.
d. High Speed Pursuit and Interception ofHOS11LE craft.
e. Signal Intelligence and Electronic WarFare Capabilities to the MAGTF.

SO-501-3

References:

Notes:

Attachments: None

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TAB 502
MAR 99

STUDENT OUTLINE

RAC CREW DUTIES AND RESPONSIBILITIES

LEARNING OBJECTIVES

A. TERMINAL LEARNING OBJECTIVES: This is a lesson purpose class

OUTLINE

1. **Key Personnel Embarked Aboard the RAC**:

a. The basic crew of all Riverine Assault Crafts consist of:

(1) Boat Captain
(2) Coxswain
(3) Bow Gunner
(4) Aft Gunner

b. Additionally key individuals that can be embarked aboard the RAC:

(1) Platoon Commander
(2) Platoon Sergeant
(3) Section Leader
(4) Senior man for embarked personnel
(5) M60 machine gun teams personnel
(6) RAC Mechanic

a. Boat Captain: Rank Sergeant

(1) Senior RAC crew member, responsible for all his craft and crew accomplishes and .fails to accomplish.

(2) Responsible for the control of the RAC and actions of the crew and the safety of all embarked personnel.

(3) Gives all commands aboard that RAC when the RAC platoon commander or section is not embarked aboard that craft.

(4) Maintains a constant log of the craft’s position, course and speed.

(5) Remains constantly aware of all pre-coordinated targets in and near the crafts position, their designation and how to get those supporting arms on target to support the RAC's mission.

(6) Remains constantly aware of the craft's position in the river and from where the greatest enemy threat is to his craft and section, then putting his craft in to the best position to counter that threat.

7) Ensures that all crew members of the crew and the senior embarked personnel are constantly aware of the craft's present position.

(8) Maintains communications with other RAC's in his section and in the platoon. . Remembering to use proper EMCOMM procedures using as little air time as possible to communicate and receive information relevant to the mission.

(9) Keeps the section leader and platoon commander aware of his craft position on the river and situation.

(10) Maintains crafts log of all pertinent events that take place during the course of the patrol.

(11) Ensures that his craft follows all instruction given to his craft from his section leader and platoon commander to support the present operation Anticipates up coming events so that his craft will not be out of position if something out of the unusual should occur, and his craft is in the best position to support the section and platoon movement.

(12) Maintains an engineering log of all key mechanical reading of the gauges on board the craft to observe any changes in the engines and jet drives of his craft. To include:

(a) Engine temperature both PORT/STRB
(b) Oil pressure readings
(c) Water vacuum pressure
(d) Fuel vacuum pressure

(e) Alternator readings

These readings should be taken and recorded at a minimum every hour. Any other key mechanical functions that do not seem normal should be recorded in this log, i.e., problems with the nav/comm gear.

(13) Responsible to fight his craft during enemy contact, keeping aware of his craft's position and the position of other craft in the patrol.

(14) Is the link between the craft's crew and all embarked personnel. The only embarked personnel that should have to interact with the crew is the senior embarked personnel.

b. Coxswain: Rank Sergeant or Sr. Corporal:

(1) Second in command on that craft. Support the Boat Captain and follows his instructions. Takes charge of the craft in the absence of the navigator/communicator.

(2) Navigate his craft through water ways, keeping aware of currents and water obstacles or any other danger and obstructions to his craft.

(3) Responsible with the RAC mechanic, for maintenance, operational readiness, and cleanliness of his craft.

(4) Maintains course and speed of his craft. Keeps his craft in the proper formation and always alert to changing situations on the river. Keeps the Boat Captain aware of any unexpected changes in the river characteristics or enemy situation.

(5) Supervises the loading, lashing, and distribution of equipment and personnel aboard the craft.

(6) Briefs all embarked personnel on their responsibilities and all safety procedures aboard the craft. Shows the embarked M60 gunners their sectors of fire and briefs them that all firing orders will come from the Boat Captain.

c. Bow Gunner: Rank LCPL to CPL :

(1) Third in the chain of command. Follows all directions given to him to by the Boat Captain and coxswain. Takes charge of the craft in their absence.

(2) Observes any obstacles to the front of the craft, from the 1000 o'clock position to the 0200 o'clock position. Keeps the coxswain aware of any changes in river characteristics.

(3) Maintains the serviceability of his weapon and ammunition. Stows his weapons ammo, so that it is easily accessible during contact.

(4) Keeps his weapon trained in the best position to support the movement of the riverine force. Keeping constantly aware of the positions and expected movements of other craft in the riverine force.

(5) Air-watch forward. In addition to watching for enemy aircraft the bow gunner keeps a watchful eye for any wires or chains that may be strung above the craft, or anybody traps that may be set up in the trees along the crafts route.

(6) Responsible to keep himself aware of the craft's present position and intended actions.

d. Aft Gunner: Rank PVT to CPL :

(1) Fourth in the chain of command. Follows all directions given to him to by the Boat . Captain and coxswain. Takes charge of the craft in their absence.

(2) Observes any obstacles to the rear of the craft, from the 0400 o'clock position to the 0800 o'clock position. Keep the coxswain aware of any changes in river characteristic, or changes in the disposition of other craft in riverine force that are following behind his craft.

(3) Maintains the serviceability of his weapon and ammunition. Stows his weapons ammo, so that it is easily accessible during contact.

(4) Keeps his weapon trained in the best position to support the movement of the riverine force. Keeping constantly aware of the positions and expected movements of other craft in the riverine force.

(5) Air-watch forward. In addition to watching for enemy aircraft the bow gunner keeps a watchful eye for any enemy activity to the rear of the craft or any sudden changes in local activity to the rear of the craft.

(6) Responsible to keep himself aware of the craft's present position and intended actions.

3. Additional Key: RAC Platoon Members .

a. Platoon Commander (Rank Captain or 1st L T)

(1) Plans and conducts tactical training of the RAC platoon in accordance with JMRF training directives.

(2) Directs and controls the tactical employment of the RAC platoon in combat and training operations through the use of appropriate troop leading procedures.

(3) Revises estimates of the situation continually during the conduct of operations in order to more effectively accomplish assigned tactical missions.

(4) Coordinates the employment of the RAC platoon with supported and adjacent units. Also, coordinates with units supporting the supporting the RAC platoon's mission.

(5) Ensures the timely requisitioning, distribution, safeguarding, and the economical use of supplies and equipment.

(6) Ensures first preventive and post operational maintenance of RACs, weapons, optics and other equipment through frequent inspections.

(7) During waterborne movements he positions himself where he can best supervise and control the movement of the RAC platoon and employ supporting arms as needed to effectively accomplish the platoon's mission.

(8) The RAC platoon commander is assisted in his duties by the RAC platoon sergeant and the section leaders.

b. Platoon Sergeant (Rank GySgt or SSgt)

(1) Performs those duties assigned by the RAC platoon commander.

(2) Assumes command of the platoon in the absence of the platoon commander.

(3) Assists in all aspects of supervision and control of the platoon.

(4) Maintains a casualty record and coordinates the medical evacuation of casualties.

(5) Directly responsible to the platoon commander for the supply and timely resupply of the RAC platoon in combat. Takes charge of Forward Area Resupply Point (FARP) activities.

(6) During waterborne movements he positions himself where he con best take charge of rear security for the RAC platoon and the waterborne movement.

c. Section Leader (Rank SSgt)

(1) Responsible for employment of his section. Follows all orders from the platoon commander. Is responsible for all his sections does and fail to do.

(2) Positions himself were he con best control his section. Briefs all members of his section on up coming plans and operations. Constantly stays aware of the position of his section and other sections in the patrol.

(3) Responsible to fight his section to best support the scheme maneuver of the rest of the patrol.

(4) When deployed separately from the rest of the RAC platoon assumes all the responsibilities normally carried out by the platoon commander and .the platoon sergeant.

(5) Assumes command of the platoon in the absence of the platoon commander and platoon sergeant. As directed by the chain of command and the platoon commander's instructions.

d. RAC Mechanic (Rank Private to Sergeant)

(1) Follows directions given from the BC and other senior crew members. Takes charge of the RAC and the crew in their absence according to the chain of command.

(2) Maintains an engineering log of all key mechanical reading of the gauges on board the craft to observe and changes in the engines and jet drives of his craft. To include:

(a) Engine temperature both PORT/STRB
(b) Oil pressure readings
(c) Water vacuum pressure
(d) Fuel vacuum pressure
(e) Alternator reading

These readings should be taken and recorded every hour, or as the situation requires. Other mechanical functions that do not seem normal should be recorded in this log. (i.e. problems with the navigation/communications gear.)

(3) Maintains the engines, jets and other boat systems on board the RAC.

(4) Makes recommendations to the BC concerning mechanical operations of the RAC and maintenance cycle for the RAC. Works with the coxswain to ensure all first echelon maintenance is being conducted in a timely and efficient manner.

(5) Maintains the record jackets for all systems inboard his RAC section. The RAC platoon's maintenance records will be centrally controlled by the platoon's mechanic.

4. Key Personnel Embarked Aboard the RAC

a. Mission Commander Rank as the

(1) Embarked where he can best supervise and control all elements of the waterborne force and it's supporting elements. Usually aboard the RAC platoon commander's C3 (Command, Control and Communications) RAC.

b. Senior Embarked Personnel (Rank as the Situation Dictates)

(1) Responsible for actions of all embarked personnel.

(2) Keeps constantly aware of the craft's position in the river and relationship to other craft in the patrol.

(3) Follows directions from the boat captain. Takes charge aboard the RAC only when the last crew member is unable to control the craft.

(4) Responsible to ensure that his ground force is inserted at the correct landing point.

(5) Briefs the boat captain on how the craft and its crew can best support the ground force. Briefing the boat captain on the route he anticipates traveling and the anticipated enemy situation along that route.

c. M240G Gun Teams (Rank as the Situation Dictates)

(I) Takes all fire commands and other directions from the RAC boat captain.

(2) Maintains his weapon and gun crew so that it can best support the RAC's scheme of maneuver. Stows his ammunition so that it is easily accessible during enemy contact.

5. Other Embarked Personnel

a. Embarked personnel will follow directions from the boat captain and senior embarked marine. In the case of an emergency all commands will come from the boat captain. Whether that is the RAC platoon commander, platoon sergeant, section leader, RAC boat captain or another RAC crew member.

b. Seation for embarked personnel will have personnel on the STRB side facing aft and personnel on the PORT side facing forward.

REFERENCES:

NOTES:

ATTACHMENTS: None.

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TAB 503
MAR 99

STUDENT OUTLINE

RIVERINE ASSAULT CRAFT SAFETY

LEARNING OBJECTIVES

A. TERMINAL LEARNING OBJECTIVE:

(1) Without the aid of references, conduct a safety brief for embarked personnel in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, brief use and location of and operation of safety .equipment in accordance with the references.

(2) Without the aid of references, brief passenger safety considerations in accordance with the references.

(3) Without the aid of references, brief radar operation hazards in accordance with the references.

(4) Without the aid of references, brief man overboard/search and rescue procedures in accordance with the references.

(5) Without the aid of references, brief embark troop seating and placement in accordance with the references.

(6) Without the aid of references, brief communications operation hazards in accordance with the references.

(7) Without the aid of references, explain prepare for launch and maneuver commands in accordance with the references.

OUTLINE

1. Safety for the Crew Members. Although the senior member on board the RAC is responsible There should be no one person totally responsible for safety. It is a team effort not

only for yourselves but for other embarked as well. Safety is **Paramount** and will not be taken lightly. The following are safety precautions that will used at all times.

a. A void all live electrical circuits.

a. No repairs or adjustments to be done alone.

c. Never repair energized equipment.

d. Use extreme care when removing heat exchanger and pressure control cap.

e. Ensure no personal are on deck, except forward gunner unless radar is off or in standby mode.

f. All personal clear the engine compartment before igniting Halon extinguisher.

g. Keep clear of VHF antenna at all times.

h. Fire extinguisher physically located on deck of bow at times of refueling.

i. Keep bilge free of debris.

j. No smoking on craft at any time.

k. Personal Flotation Device (PFD) will be worn at all times when not in cock pit or troop compartment.

l. Ensure pre-op, pre-launch and post-op checks are complete and detailed.

m. Visual or audio contact is made with other raid craft and the safety boat at all time. Signal for stop movement and link up will be:

(1) Radio

(2) Daytime -craft dead in water with hands moving in a rapid motion above the head.

(3) Nighttime -spotlights or chem-lights

n. The craft is filled with fuel and oil prior to departure.

SAFETY NOTE: When refueling insure that crew members man the forward fire extinguisher. When craft is being refueled by a refueler insure that a ground wire is installed between the hull and fuel supply line. Also insure that the craft is grounded to a metal source such as the refueler itself.

o. The coxswain will always maintain positive control of the craft. The right hand will always be on the helm with left hand on the throttles or buckets.

p. No personnel other than those designated will operate repair or refuel the craft.

q. There is no horse play or other behavior that might endanger the craft or those embarked.

2. Safety for Passengers. Safety for the passengers embarked on the Riverine Assault Craft is the responsibility of all crew on the craft they must know the Do's and Don'ts and adhere to safety the same as any crew members. The senior member on the craft must pass on the following information.

a. Location and use of Personal Floatation Devises

b. Location of 1st Aid Kit

c. Location and operation of distress signaling equipment

d. Location and hazards of VHF antenna

e. Location and hazards of the radar dome

f. Location and use of the fire extinguishers to include the Halon system

g. The normal and emergency use of the marine band radio

h. Man over-board procedures

i. Discuss the three point of contact when moving about the craft

3. **Location and Use of Safety Equipment**:

a. Fire Extinguishers- There are 5 located on the craft in the following areas:

(1) One in each gun tub (2)

(2) One behind the Boat Captain/Section Leader

(3) One behind the coxswain

(4) One in the engine compartment (Halon System)

To use the fire extinguishers pull safety pin out and aim at the bottom of fire, then depress handle and hold until fires out or you are in need of further assistance. To use the halon system pull safety pin located on dash under the coxswains seat and then activate halon system by pulling lever. It is paramount that the engine hatches and vents located on top of engine compartment are closed to isolate fire and to keep chemicals from entering troop and cockpit areas. Possible death could occur if the chemicals in the halon system are inhaled.

b. Danforth Compass- One is located on the top of dash in front of the coxswains seat.

c. Dansforth 20 Ib. Anchor with Line- One is located in storage compartment on bow of craft.

d. Raytheon 202 VHF with Loudhailer- One is located on dash in front of the Boat. Captain/Section Leaders seat. You should become familiar with its use and the following channels:

(1) Channel W2 -Marine Weather Forecast.

(2) Channel 82 -SOTG Operation Net.

(3) Channel 16 -International Distress-

(4) Channel 26 -Marine Operator.

e. First Aid Kit- One is located in the first storage compartment located on starboard side of craft behind coxswain seat.

f. Throw Ring with Strobe Light- One is located in troop area on the front of the engine compartment. When using this piece of equipment it should be thrown overhand to victim in the water

g. Navigation Light- One is located on the top of craft it can be used by locating NAV light switch next to coxswain seat.

h. Paddles- Two are located on in front gun tub on port side and trapped in with boat hook.

i. Search Lights. Hand Held- Two are located in the second storage compartment on starboard side behind coxswain seat. To use plug into connectors and place in the on position.

j. Signal Horn (CO2). Hand Held- One is located in the second storage compartment on starboard side behind coxswain seat to use point away from yourself toward the direction to be alerted and depress the button on top of the signal horn.

k. Hand Held Bilge Pumps- Two are located in the front gun tub on starboard side. When used the hose should be placed so that it exits the craft with the solid end placed in the flooded area. Once this has been accomplished grasp the handle and start pumping.

l. Electronic Bilge Pumps- Two are located in the aft end of the engine compartment. To use locate the operating levers on the left side of dash in front of the coxswain seat. They should already be in the-auto-position. if needed place them in the manual position. The electrical pump should be checked prior to launching the craft.

m. Boat Hook- One is located on the port side of craft in the front gun tub strapped in with the boat paddles. This piece of equipment is used to pick up rope or debris from water.

4. **Radar and Communication Hazards:**

a. Communications Hazards: There is enough current that is supplied to the electrical systems in this craft to cause death or serious bodily harm. All personnel need to be aware immediate actions if someone is electrocuted. The following applies

(1) Do not grab or pull individuals

(2) Turn off electrical power. If electrical power can not be turned off use a wooded pole or some insulated material to move the person to safety

(3) Send for help and attempt to apply lst Aid.

VHF (Very High Frequency) and HF (High Frequency) antennas are a high source of power outage it is extremely important that the location of antennas are know.

(1) HF is located on forward portion of craft port side.

(2) VHF antennas are located on aft section on port and starboard side of craft.

3) VFW/UHF antennas are located above Boat Captain/Section leaders seat on the forward arch.

(4) The gunners on the craft should become very familiar with the locations of the antennas especially when using the weapon systems. The rotation of the gun mounts could possibly cause the weapons to come in contact with one of the antennas and cause serious harm.

b. Navigation Hazard: As crew members and coxswain we should all know the dangers of the Radar systems. Although small doses of radiation mayor may not cause harm. Direct contact will. The crew and passengers need to know the following the information.

(1) Never look directly at the radar system any closer than six feet.

(2) When coming alongside another craft to dock the radar system will be turned off.

(3) No other person will go forward of the cockpit other than the forward gunner while Radar is in operation and then the forward gunner will not rise above the Radar dome itself.

5. **Embarked Troop Placement**: Embarked troops should be placed on the craft to provide additional fire support and to give the machine gunners on the port and starboard side of craft more room to function properly. Remember this craft is capable of carrying up to 15 combat loaded troops so space must be well used. To do this the following method should be utilized:

a. Troop placed on the starboard side of the craft will straddle seat and face the aft end of the craft.

b. Troop placed on the port side will straddle the seat and face forward.

6. **Man Overboard Search and Rescue Procedures:**

a. **General Procedures**: It is PARAMOUNT the victim is found as soon as possible, not only is his life at risk, the mission that has been assigned to your craft could be at risk as well. The information below are procedures that should be utilized in all man overboard situations.

(1) If the person is seen to fall overboard, yell, "Man overboard, port or starboard." try to maintain eye contact on the victim.

(2) Advise other boats in the area that a man is overboard.

(3) Immediately pick a reference point. If necessary, throw a floating object in the water

(rescue tube with beacon)

(4) If it become evident that a lost person will not immediately be recovered, radio for help, and start a search.

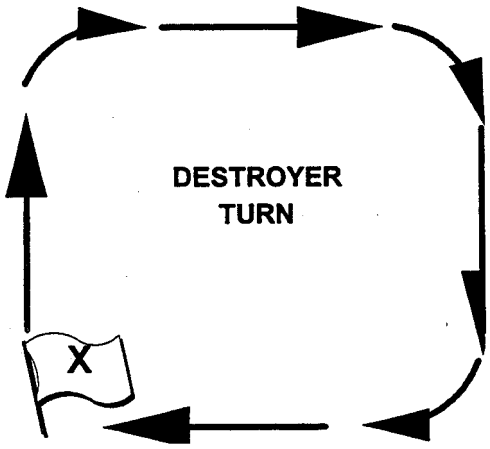
(5) Always recover the person from the aft end of the craft.

b. **Destroyer Turn**: The Destroyer Turn is used when the victim is in sight throughout the recovery operation.

(1) When the person is seen to fall overboard, make a series 'of pivot turn to bring him along the starboard side of craft.

(2) The coxswain places the craft in zero speed.

(3) Keep sight of the victim, and pick him up from the aft end of the craft on the swimmers/divers platform.

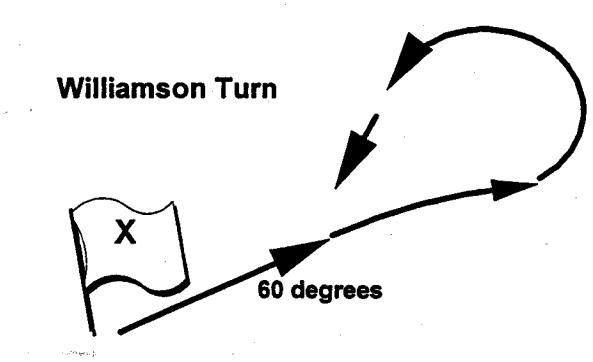


DESTROYER TURN

c. **Williamson Turn**: The Williams Turn is used when the exact time and place of the man-overboard are not know, or in cases where the victim cannot be seen.

(1) Pick a reference point and immediately turn the craft 180 degrees and retrace your original course to where the victim is assume to be.

(2) Once you find him, bring him back aboard the craft. If you don't find him after 5 minutes, return to your reference point and wait for more help or use different search patterns



WILLIAMSON TURN

d. **Expanding Square Search**: An expanding square search is used for locating objects and people in the water whose location is not known. with in close limits and when the area to be search is not extensive.

(1) Pick a reference point or place a highly visible floatation device in the water, as a reference point.

(2) Conduct a listening search by shutting down your engines and listen for sound from the victim.

(3) If victim is not heard, begin your search in a down drift direction at low idle speed, for 30 second

(4) Turn to starboard 90 degrees and run 30 seconds. Now turn 90 degree to starboard and run 2 base lengths (1 minute).

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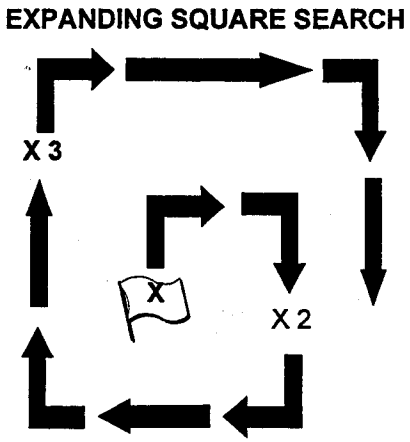
(5) The pattern of the search emerges from using multiples of the base length and 90 turns. Leg one and two are the same length; legs three and four are two lengths; legs five and six are three base length, and so on. (run legs at idle speed)

When searching for a person, do not proceed more than 1 mile from reference point. If 2nd search is necessary, return to reference point and start second search and add 45 degrees to original heading.



EXPANDING SQUARE SEARCH

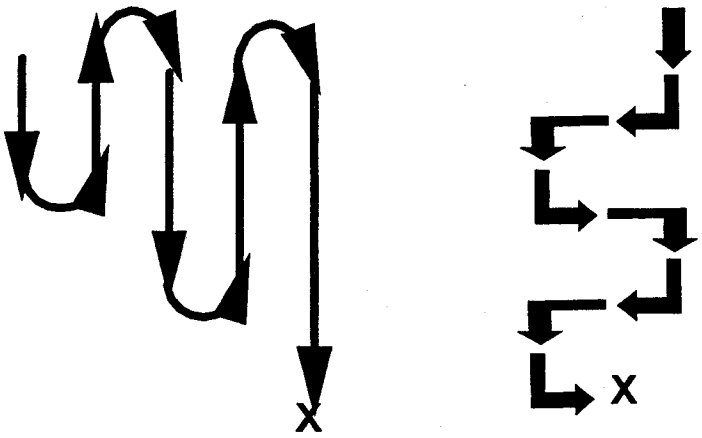
e. **Down Current Expanding Search**: In a riverine environment where there is a fast moving current and the man is not located quickly, the above search procedures are not feasible or appropriate. In this case conduct an expanding search down current using one of the two following methods.

NOTE: For both methods pick a reference point out from a prominent terrain feature on the closest bank of the river.

(1) One method is to run your leg across the river, turn 90 degrees down river, for a predetermined distance and then turn 90 degrees back across the river. Do this as many times as needed.

(2) Another method is to run your legs down the length of the river the distance that the current could have taken the man down river. Turn 90 degrees and drive a set distance

(depending on how wide the river is). Turn 90 degrees and drive back to the reference point, the second leg should be longer than the first and so on.



DOWN CURRENT EXPANDING SEARCH

DOWN CURRENT EXPANDING SEARCH

REFERENCES: *COMDJNST M16114.5, Boat Crew Seamanship Manual*

NOTES:

ATTACHMENTS: None.

SO-503-10

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 504
MAR 99

STUDENT OUTLINE

HAZARDOUS MARINE LIFE

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVE: Without the aid of references, identify hazardous marine life in accordance with U.S. Navy Dive Manual, Volume I and NAVEDTRA 10069-C.

B. ENABLING LEARNING OBJECTIVE:

(1) Without the aid of references, identify in writing the marine animals that bite, in accordance with the references.

(2) Without the aid of references, identify in writing the marine animals that sting, in accordance with the references.

(3) Without the aid of references, identify in writing the procedures for the prevention of dangerous marine life injuries, in accordance with the references.

(4) Without the aid of references, identify in writing the appropriate treatment for dangerous marine life injuries, in accordance with the references.

OUTLINE:

1. Sharks

a. Types There are more than 350 species of shark, only 20 or so are known to attack man. Four of the most dangerous are the great white, the mako, the tiger, and the hammerhead. Other sharks that have been known to attack man are the gray, the blue, the lemon, sand, nurse, bull, and oceanic white tip.

b. Distribution- Sharks are found in all oceans and seas. Many species live and feed at considerable depths while others live and hunt near the surface. It is these sharks that live near the surface that you are most likely to spot because of the high dorsal fins that frequently project above the water. Sharks often enter relatively shallow waters and may even enter river mouths, but are most common in the open ocean or sea. Sharks prefer mostly warm waters, however, there are several kinds of sharks in the Arctic and Antarctic Oceans. It is those sharks living in oceans and seas between 40 degrees north and 40 degrees south latitude that are the ones most

likely to be dangerous to man. Evidence shows the sharks in tropic waters are far more aggressive than those in temperate waters.

c. Appearance- Skin color ranges from white to black with mostly blues and grays. Spots and stripes are present on a few species. They range in size from 18 inches to possibly 50 ft. However, any shark more than 3 or 4 feet in length should be considered dangerous. Snouts vary from broad to pointy. They have prominent teeth and are extremely aggressive and fast.

d. Hazards- The normal diet of most sharks is living animals. All sharks have voracious appetites. They are guided to their food by sight, scent, or sound. When a shark attacks they are more apt to tear off pieces small enough to swallow easily than tear off a man's leg or arm. They can and will tear great gashes in a man's torso, removing large chunks of flesh at a snap. Most shark-inflicted injuries are half-moon incisions, often with good impressions of the smaller teeth left in the untorn flesh. Bites from sharks are usually severe, death is due to massive tissue loss, hemorrhage and shock. The fatality rate from shark attacks have been estimated to be from 50 to 80 percent. Severe skin abrasions may result from brushing up against a shark's skin.

e. Prevention-

(1) Get near other swimmers. Several swimmers grouped together can maintain a 360 degree watch for sharks, can ward off sharks better than a lone swimmer, and have greater striking strength should a shark attack.

(2) Stay alert for sharks. Keep your clothing on, including your shoes. Evidence shows that among groups of men, those partly clad were attacked first; and usually in the feet. In addition, clothing will protect your skin from abrasions should a shark brush against you.

(3) Urinate in short spurts, allowing the urine to dissipate between spurts. Pass small amounts of fecal matter at a time and throw it as far away as possible.

(4) If you have to vomit, vomit in your hand and throw it as far away as possible.

(5) Make just enough commotion to keep a shark at bay. This way you conserve your strength to repulse the shark if it attacks.

(6) Making noise, blowing bubbles, roaring or yelling underwater. Slapping the water surface with cupped hands. Some divers report this will sometimes scare a shark away.

(7) Kick or thrash at the shark. Strike the shark on the gills, snout or eyes if you can. Hitting the shark on the nose can cause injury to your hand by glancing off the snout and. hitting it's teeth.

f. Treatment- Hemorrhage and shock must be immediately brought under control. Control the hemorrhaging by using large pressure bandages to pack the wound and apply direct pressure. It may necessary to apply a second pressure bandage to control bleeding. Treat the victim for shock and immediately evacuate to a medical facility .

2. Crocodilians

a. Types- There are four members of the crocodilians family but many different species. They are crocodiles (American, Nile, Saltwater, Siamese and Australian), alligators (American and Chinese), gavials, and caymans. The most dangerous of the four are the crocodiles and alligators.

b. Distribution- Crocodiles live in tropical environments throughout the world. Crocodiles prefer large bodies of shallow water, sluggish rivers, open swamps, and marshes. Most true crocodiles inhabit the Eastern Hemisphere, but four species live in North and South America. The *American crocodile* lives in the extreme south of Florida, on the larger West Indies islands, and in Central America and areas near it. The usual length of an adult American crocodile is about 12 feet (3.7 meters). The *Nile crocodile* is found widely in Africa. This animal lives almost everywhere on that continent except in the Sahara and on the northern coast. The small, long-snouted crocodile of the Congo Basin grows no longer than eight feet (2.4 meters). The *Siamese crocodile* inhabits Java, Thailand and nearby parts of Asia. The *Giant Saltwater crocodile* lives in many places from India to the northern coast of Australia, and even in the Solomon Islands. The Giant Saltwater crocodile can grow to lengths of 18 feet (5.5 meters) and are known as the most aggressive of all crocodiles.

Alligators also live in tropical environments in the world. Alligators prefer large bodies of shallow water, sluggish rivers, open swamps, and marshes. However there are only two species of Alligators the American and Chinese. The *American alligator* lives in the waters and lowlands of southeastern United States and the *Chinese alligator* lives in the lower Yangtze River Valley, in the Republic of China.

c. Appearance- Skin color ranges from yellow stripes as a baby to the dull gray or dark olive color of an adult. They range in size from 2 to 3 feet as babies growing up to an average length of 11 to 12 feet. Some reports have spotted both alligators and crocodiles in the 18 to 25 feet range. Both crocodiles and alligators have a long, low, cigar-shaped body, short, strong legs, and swim by moving their powerful tails from side to side. They both have tough hides, long snouts, and powerful jaws to grasp their prey these jaws are set with many sharp teeth.
Alligators and crocodile have eyes and nostrils that sit atop their heads, this is used to provide a low silhouette in the water. They use their short, strong legs for walking only. The American crocodile is only 2/3 as heavy as an American alligator of the same length, and can move much more quickly. Alligators and crocodiles are often mistaken for each other, but they are different in several significant ways. One thing to look for if the opportunity presents itself are the lineup

of the teeth. The lower fourth tooth is extra long in each animal. This tooth fits into a pit in the alligators upper jaw, but the crocodiles fourth tooth fits into a groove on the side of the upper jaw and is visible even when the jaws are closed. Another way to tell the American crocodile from the American alligator is that the American alligator has a much broader snout. Alligators also are much less aggressive and active than crocodiles. In the United States alligators and crocodiles are found together only in the marshes at the southern tip of Florida.

d. Hazards- The normal diet of most alligators and crocodiles is living animals. Both species have voracious appetites. Crocodiles eat many small animals, such as fish, birds, and turtles which they seize and swallow whole. Occasionally they attach large animals and people. A crocodile can twist a large animal into pieces by seizing it and then rapidly spinning lengthwise in the water. Crocodiles are much more aggressive than either American or Chinese alligators. Alligators eat many kinds of small animals that live in or near the water, including small fish, snakes, frogs, turtles, small mammals, and birds. Large males sometimes attack dogs, pigs, or even cattle. They drag these animals underwater to drown them, and then tear them apart by using the same spinning maneuver used by crocodiles. When they feed, they tend to drown their victims while thrashing what ever they have in their mouth. They then store the food for later.

e. Prevention- Both animals are extremely fast on their feet and excellent swimmers.

(1) Avoid swimming in murky, brackish water inlets, swamps and river mouths inhabited by alligators or crocodiles.

(2) Kick or thrash at the alligator or crocodile. Strike the animal in the eyes or snout if you can. Hitting the animal on the nose can cause injury to your hand by glancing off the snout and hitting it's teeth.

(3) Avoidance of the area is the best preventive measure. If this is not possible, then ensure that when giving the brief for where you will be operating, you stress that crocodiles or alligators are present in that certain location and advise your people to keep hands, arms, legs inside the craft.

(4) If a Marine should fall victim to an alligator or crocodile, without endangering other personnel, beat the water around the victim to scare the animal and try to make it release the prey.

f. First Aid- First aid for crocodiles and alligators is difficult. Both the crocodiles and alligators are highly aggressive animals. Hemorrhage and shock must be immediately brought under control. Control the hemorrhaging by using large pressure bandages to pack the wound and apply direct pressure (apply a tourniquet only as a last resort). It may necessary to apply a

second pressure bandage to control bleeding. Treat the victim for shock and immediately evacuate to a medical facility.

3. Piranha

a. Types- There are at least 25 species of piranhas. Of those 25 species or so species of piranhas, 4 are thought to be dangerous to humans. The most common species is the red piranha.

b. Distribution- Confined to the South American continent, but widespread throughout the lakes and rivers of Colombia, Venezuela, Guyana, Paraguay, Brazil, and central Argentina. Some piranhas have been introduced into some rivers and lakes in the southeastern United States.

c. Appearance- Most piranhas are olive-drab to blue-black, with red or orange bellies. They have deep bodies that are flattened on the sides. There size varies from 8 inches to 20 inches long. Most weigh less than 3 pounds. All piranhas have razor-sharp teeth that they use to devour a variety of prey. Normally, piranhas swim alone and feed on smaller fish or seeds or fruit in the water. Occasionally, they swim in packs or shoals, these packs of piranhas are like a pack of dogs, and may attack a much larger animal and efficiently bite away pieces of its flesh.

d. Hazards- Their normal diet consists primarily of fish, but will also attack mammals and birds as they swim or stand in the water .

e. Prevention- Piranhas have been described in motion pictures and legends as vicious, blood thirsty predators that can tear a human being to shreds in seconds. In actuality piranhas rarely have attacked people

f. First Aid- First aid for piranha is basically the same as a dog bite. The piranha are aggressive because of this advise your people to keep hands, arms, legs inside the craft. If a Marine should fall victim to a piranha, without endangering other personnel, get the fish off the victim. If the victim is freed retrieve them back into the craft, wrap the bitten area, control the bleeding (apply a tourniquet only as a last resort), treat them for shock and evacuate as soon as possible.

4. Catfish.

a. Types- Catfish is the name of a large group of fish, most of which have two to four pairs of "whiskers". There are more than 2,000 species of catfish.

b. Distribution- Catfish are found in most parts of the world. Most catfish live in fresh water and some inhabit the oceans. Most fresh water species live in lakes, ponds, or slow moving parts of streams. Majority of the species dwell in quiet waters and feed on tiny animals

and bits of animal flesh. They find their food near the bottom of a pond or a slow-moving river. A few species of catfish live in swift streams.

c. Appearance- Skin color varies from grays to blues to greens to black. They range in size from 4 inches up to 10 feet. It has been reported that there are catfish living below the dams of the Tennessee Valley Authority, which are over 15 feet long, and capable of swallowing a human whole. In the Amazon Basin there are catfish which grow to over 8 feet in length. Catfish have whiskers called barbels which resemble the whiskers of a cat. Many of the more the species of catfish also have sharp spines on the back fin and on the fins near the gills. Unlike most fish, catfish have no scales over their skin.

d. Hazards- The normal diet of catfish is a variety of aquatic animals to include fish, frogs, crayfish, and insects. They are also bottom feeder and tend to carrion. The spines of some catfish give off a poison when they enter the body of another animal and can cause serious wounds. The barbels can puncture the skin and leave serious infections.

e. Prevention-

(1) When entering the water shuffle your feet to allow the catfish time to swim . off.

(2) A void handling or touching the catfish.

f. First Aid- If a barbel exists find some kind of material or glove to gently remove the barb and discard it. Wash the affected area with fresh water and apply rubbing alcohol, if available. No evacuation is necessary unless Marine shows signs of allergic reaction to the sting.

5. Electric Eel

a. Types- Their are approximately 500 species of fish that can generate electricity. The most commonly known is the electric eel. The electric eel is not a true eel, it is related to the catfish and carp families

b. Distribution- The electric eel is found in the muddy rivers, lakes and ponds. It is found mostly in northern South America in the Amazon and Orinoco river systems.

c. Appearance- Skin color is olive-brown in color. This fish can grow to eight feet long. It has a long pointed tail that makes up 4/5ths of its body. Electric eel's have two small fins behind their gills and they have one long fin that runs on the underside of the body from the tip of the tail, almost to its throat.

d. Hazards- The electric eel eats frogs and small fish. The eel's electricity is generated by three pairs of electric organs on each side of the body. The largest pair run almost the length of the body. Under these are two smaller pairs of electric organs. Each electric organ is made of thousands of modified muscle cells called ELECTRO PLAQUE. The charges of all electro plaques produces 350-650 volts. Enough to stun a human or kill small fish. The electric eel usually delivers 3-5 bursts of electricity each time it discharges. Each bursts last about 1/500th of a second. This eel uses its electrical discharge to; detect underwater obstacles, signal other electric eels, and to stun its prey.

e. Prevention- Avoid touching or encroaching upon this animal's territory .

f. First Aid- For the electric eel you would treat it like an electrical shock. Monitor the victim, ensure that they are breathing and have a pulse. If not apply CPR immediately and evacuate. If they are breathing and have a pulse, monitor for signs of shock, wrap the bitten area after cleansing it with fresh water and continue the mission.

6. Electric Rav

a. Types- The electric ray is also known as a Torpedo and on the Atlantic coast may be referred to as a Cramp Fish.

b. Distribution- This ray lives in the warm waters along the Atlantic and Pacific coasts of the North and Central America. Most rays are found in the warm shallow coastal waters, but some live as deep as 1,200 feet.

c. Appearance- Skin color varies, but most species are dark brown, blue, or gray with spots. Electric rays measure from 6 inches to 7 feet long. They have a flat body and a slender, pointed tail with fins.

d. Hazards- The name of this fish comes from its ability to give off electricity from glands behind its head and gills. The electric ray uses its electric power to stun fish and to defend itself. The shock from a full-grown, health ray is powerful enough to stun a full-grown man for a second.

e. Prevention- The danger is mostly from stepping on one. This danger can be eliminated by shuffling the feet upon entering the water which will make the fish move on before you step on it.

f. First Aid- For the electric ray, you would treat it like an electrical shock. Monitor the victim, ensure that they are breathing and have a pulse. If not apply CPR immediately and

evacuate. If they are breathing and have a pulse, monitor for signs of shock" wrap the bitten area after cleansing it with fresh water and continue the mission

7 .Snapping Turtles.

a. Types- Snapping turtles make up a large family of freshwater turtles that live only in the north, central, and southern United States and northern South America. There are two species of snapping turtles. The Common Snapper and the Alligator Snapper .

b. Distribution- May be found from Canada to Ecuador.

c. Appearance- Skin color is generally black, brown or dark green. They range in size from 19 inches to 24 inches long. Alligator snappers are the largest turtles of North America, except for Sea Turtles. An may weigh over 200 lbs.

d. Hazards- Snapping turtles eat small water animals, such as fish, frogs, insects, snails, and young water fowl. They also feed on plants, especially algae. Snappers have a large head and strong jaws. They may bite fiercely if disturbed. Snappers have a small shell that does not give it much protection, and so they depend upon their strong, sharp-edged jaws for defense.

e. Prevention-

(1) Avoid poking or sticking hands inside holes or logs.

(2) Keep hands, arms and legs inside the craft.

f. First Aid- First aid for turtle bite is basically the same as a dog bite. Some turtles are aggressive because of this advise your people to keep hands, arms, legs inside the craft. If a Marine should fall victim to a turtle, without endangering other personnel, get the animal off the victim. If the victim is freed retrieve them back into the craft, wrap the bitten area, control the bleeding (apply a tourniquet only as a last resort), treat them for shock and evacuate as soon as possible.

8. Snakes.

Constrictors

a. Types- Anacondas, Pythons, Boa Constrictors. Anacondas are also called Water Boas. Pythons are also among the worlds largest snakes. They may be known as the Reticulate Python of southeastern Asia and the East Indies, and the African Rock Python.

b. Distribution- The anaconda is found in tropical South America. The python is found in southeastern Asia, India, the East Indies, Africa, and Australia. Both species live in rugged tropical regions that have heavy rain fall and forests, or some type of low, dense growth. Almost all constrictors swim and climb well.

c. Appearance- Anacondas have olive-green skin often with many black rings or spots. Python's skin color varies from tan to dark green often with many black rings or spots as well. These snakes live near water, often swimming in rivers and streams. Anacondas may grow as long as 30 feet more. However, all adult anacondas will grow to lengths exceeding 15 feet. Pythons may grow anywhere from 20 feet up to 30 feet.

d. Hazards- The principle foods sources of the anacondas and pythons are birds and small animals. They are called constrictors because they squeeze their prey to death. They kill their prey by wrapping their coils tightly around their victim and squeeze just enough to stop the victim from breathing and stop the blood circulation. Only the largest constrictor will ever attack large mammals. Like most snakes, anacondas and pythons defend themselves from enemies by retreating or, if cornered, by biting. Their bite is not poisonous, but their many teeth can inflict deep wounds.

e. Prevention- The best defense against snakes is to avoid low hanging limbs or trees over the water, if one is in your path go around it and instruct your personnel to remain quiet and do not touch or aggravate it.

f. First Aid- First aid for constrictors is to first free the victim, this should be attempted after the snake has been killed. Constrictors kill their victims by strangulation, only certain types bite and that bite is nonpoisonous. The thing that you have to be concerned with is to ensure the victim is breathing, if not, check for pulse and breathing. Should the victim require CPR, administer immediately. Once the victim regains consciousness and has started breathing on his own, treat for shock and check for broken bones. Apply splints as needed for broken bones and evacuate immediately.

Poisonous Snakes

a. Types- Poisonous snakes fall into two groups: proteroglpha (fixed fang) and solenoglypha (folded fang). These two groups are best described in terms of fangs and their venom. Fixed fang usually have neurotoxin venom and folded fang usually have hemotoxic venom.

b. Distribution- Snakes live almost everywhere on the earth. They live on deserts, forests, oceans, streams, and lakes. Many snakes are ground dwellers, and some live underground. Others dwell in trees, and still others spend most of their time in water. Only a

few areas of the world have no snakes. Snakes cannot survive where the ground stays frozen the year round. Thus, no snakes live in the polar regions or at higher elevations in the mountains. In addition, snakes are often absent from islands, including Ireland and New Zealand.

c. Kinds-

(1) **American Copperhead**

Appearance- Usually pale brown with darker crossbands narrowing at the midline of the back. The markings may be few and inconspicuous on large snakes. The head is usually coppery-red in color.

Characteristics- Timid and will stay hidden; will try to escape when discovered. If cornered, may vibrate tail and produce a distinct buzzing sound.

Habit- Prefers high, dry ground. May be found in the fields or woods.

Distribution- Southern and southeastern United States.

(2) **Bushmaster**

Appearance- Coloration is tan or dark brown with some pink hues and with black blotches along the back. The scales are extremely keeled. This is the largest of all pit vipers, averaging 6 *Y2* to 7 feet, with some recorded up to 12 feet.

Characteristics- May remain motionless until touched; may attempt to escape when cornered and may strike viciously. Has know rattle but its tail vibrating against dry leaves produces a rattling sound.

Habit- Mostly in forests at low altitudes; however, may be found in cool areas. Prefers moist dry ground and often hides in animal burrows.

Distribution- Southern Nicaragua, Costa Rica, Ecuador, Peru, Bolivia, Brazil and Paraguay.

(3) **Cottonmouth (Water Moccasin)**

Appearance- Coloration is variable. The young are brilliantly colored with bands of copper and light and dark browns. In adults, the bands may be faint to total black. Adults average 3 to 4 feet, but occasionally reach 6 feet.

Characteristics- A good swimmer. Often basks on logs or leaning trees in swamps, bayous, or along sluggish streams. Usually will retreat when disturbed but may hold its ground.

Habit- Swampy areas, lakes, rivers, or streams.

Distribution- Throughout southern United States, southern Illinois, Missouri, southeast Kansas, central Texas, Virginia, the Carolinas and all of Florida.

(4) **Fer-de-Iance**

Appearance- Coloration is variable, but usually brown or olive with faint hourglass markings along the back. Adult snakes average 3 ½ to 5 feet, but 7 foot specimens have been recorded.

Characteristics- May coil its body before striking; however, can strike from any position.

Habit- The large kinds are ground snakes, and are often found in cane fields or around dwellings. Some of the small kind live in trees, especially at the base of palm trees.

Distribution- Throughout Central and South America, except Chile.

(5) **Jumping Pit Viper**

Appearance- This is a robust snake, short and husky. Average length is 2 ½ to 3 feet. The coloration is from a rich brown to black. The appearance of this snake is similar to the dreaded Bushmaster, having exceedingly rough scales.

Characteristics- Strikes with such force that its body will at times leave the ground.

Habit- Found in many different environments. Distribution- Southern Mexico through Central America.

(6) **Yellow-bellied sea snake**

Appearance- Coloration is black to dark brown on top; bright yellow on the sides and belly. Averages 25 to 30 inches in length. Tail is flattened like an oar. This is a robust snake, short and husky. Average length is 2 ½ to 3 feet. The coloration is from a rich brown to black. The appearance of this snake is similar to the dreaded Bushmaster, having exceedingly rough scales.

Characteristics- *NI* A

Habit- *N/A*

Distribution- Many of the Pacific Islands to Hawaii and to the coast of Costa Rica and Panama.

(7) **Rattlesnakes (Eastern, Tropical)**

Appearance- Coloration is dark brown with darker diamond-shaped markings along the back. These snakes average 5 to six feet in length.

Characteristics- Bold. Will readily defend itself by coiling, inflating its body with air making a pronounced hiss; rattle will usually vibrate but not always.

Habit- Found in practically any type of terrain.

Distribution- (Eastern) North Carolina southward to Florida and west to Louisiana. (Tropical) Dry areas of southern Mexico and all of Central and South America except Chile.

10. FIRST AID: All poisonous snake bites should be considered a true medical emergency, and treated as such. The first thing you must do is to decide whether the snake has injected any venom with it's bite. This is done by quickly checking the bitten area. Looking for swelling around the puncture wound, the entire limb will become swollen within one hour.

If it is only local swelling, around the fang marks, then it was most likely a nonpoisonous snake or venom was not injected with the bite. Discoloration, numbness and blisters around the bitten area are sure signs that the snake injected poison. Other signs to look for are rapid pulse, nausea, shortness of breath and shock. Keep the victim calm, treat him for shock.

Apply a **CONSTRICTING** bandage above and below the bite, approximately 2 inches from the puncture area, but never on a joint. Tighten it enough to slow the blood moving in the veins, but not enough to shut off blood flow completely.

You should still be able to feel a pulse above and below the wound. Constantly move the band to stay ahead of the swelling. This is all you can do for first aid. The victim must be evacuated within 30 minutes of being bitten. Remember to keep the victim calm and reassure them that they will be all right.

REFERENCES:

1. U.S. Navy Dive Manual, VOLUME I
2. World Book Encyclopedia, 1998 Edition
3. NAVEDTRA 10069-C Hospital Corpsman Handbook

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 505
MAR 99

STUDENT OUTLINE

TM 4700

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVE: With the aid of reference, Perform daily duties involving the Small Craft Coxswain File Folder, in accordance with the TM 4700. IG.

B. ENABLE LEARNING OBJECTIVE:

(1) Without the aid of reference, identify in writing the Technical Manual for Ground Equipment Record Procedures in accordance with the references.

(2) Without the aid of reference and given the necessary materials, identify in writing the required documents to be inside a Coxswain file folder in accordance with the references.

(3) Without the aid of reference and given a list of small craft discrepancies, indicate in writing where they would be reported at in the Coxswain File Folder in accordance with the references.

(4) Without the aid of reference and given the necessary materials, identify in writing SL-3 reordering procedures in accordance with the references.

(5) Without the aid of reference and given the necessary materials, indicate in writing annual PM requirements in accordance with the references.

OUTLINE:

1. **TM 4700._ GROUND EQUIPMENT RECORD PROCEDURES**

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542-0080

TAB 557

SEP 98

STUDENT OUTLINE

INTRODUCTION TO MARITIME NAVIGATION

LEARNING OBJECTIVES

A. TERMINAL LEARNING OBJECTIVE. With the aid of references, use the techniques of navigation for small boat operations in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references and when given a list, identify in writing the four major or classifications of navigation in accordance with the references.

(2) Without the aid of references, identify in writing the five problems of navigation in accordance with the references.

(3) Without the aid of references, identify in writing the members of the navigation team in accordance with the references.

OUTLINE

1. **Definition of Navigation**

a. "Navigation" from Latin; NAVIS (a ship) and AGERE (to direct) is the process of directing the movement of a vessel from one point to another.

b. Navigation requires both art and science to direct a vessel accurately to your beach landing site or rendezvous site at sea. Navigational art is the proficient use of all available aids, methods, and the interpretation of the resulting data with good judgment to determine (or fix) your position. Navigational science includes the use of sophisticated electronic equipment, mathematical computation for various navigational problems and the use of tables, almanacs and publications intended to increase the accuracy of your vessel's intended track. Great progress has been made during this century in advancing the science of navigation, but such progress is in vain if the navigator is not skilled in the basics of his trade.

2. **Four Classifications of Navigation**. There are four different methods of navigation used in the world today. They are piloting, dead reckoning, celestial navigation, and radio navigation.

a. Piloting is defined as the determination of the position and the direction of a vessel involving frequent or continuous reference to landmarks, aids to navigation and depth soundings. In a general sense, it is navigating a vessel by observation of visual landmarks in or near your landing area and then shooting bearings (azimuths) to these landmarks in order to fix your position. This process is similar to shooting a resection in land navigation.

b. Dead Reckoning. The navigator aboard any size vessel cannot rely totally upon electronic systems and even if available, one must still be able to lay a basic course and stay ahead of your vessel by projecting where your boat will be at some future time. To put it in simple terms, the navigator continually must ask the following questions: "Where is the boat now?" and, "Where is the boat going to be in the next minute, the next few minutes or the next hour?" Dead reckoning, as it is practiced today, may be defined as the process of determining a ship's approximate position by applying to her last established charted position (fix) a vector or series of vectors representing all true courses and speeds subsequently ordered. The dead reckoning technique is essential because it is often impossible to obtain an accurate fix of the ship's position when required, despite the use of electronic aids. Moreover, even after a fix has been obtained and plotted, it does not represent the location of a **moving ship** either at the present time or a future time, but rather it only shows where the ship was at a certain time in the recent past. To obtain the ship's approximate present or future position, the navigator must rely on the dead reckoning plot. In dead reckoning, course and speed are generally computed without allowance for wind or current.

(1) The five elements of dead reckoning are:

(a) Position. Known position of insert.

(b) Course. A course must be known and an exact heading maintained.

(c) Distance. The navigator must preplan the course distance (always plotted in nautical miles) that he intends to travel.

(d) Speed. A consistently maintained speed that is checked on a regular basis.

(e) Time. Total time must be kept from each fixed position.

(2) Dead reckoning involves a basic formula which many of you are familiar with. An easy way to remember how it works is by the phrase "D" street. By using the “D” street formula, the navigator can determine distance, time, or speed.

$$\frac{D}{ST}$$

(Distance = Speed X Time) (Speed = Distance/Time) (Time = Distance /Speed)

SO-557-2

(3) In order for dead reckoning to be effective, you must know the starting point or fix.

(4) A dead reckoning position is only approximate, with less than desired accuracy, but dead reckoning is the only method of navigation by which a basic position can **always** be determined and because of this, dead reckoning is considered basic navigation.

c. Celestial Navigation (Nautical Astronomy). The oldest of sciences uses the sun, moon and designated stars and planets to shoot lines of position to determine a fix. It is widely used; however, it requires a great deal of time to become proficient in this skill. In our situation, it is inadvisable to use celestial navigation since it is extremely time consuming and provides only an approximate position. We will not be discussing celestial navigation in this course.

d. Radionavigation is used to refer to any electronic system which interprets radio waves in order to provide navigational information. There are three major areas of radionavigation used by military units.

(1) Radar Navigation. Ships possessing surface-search radar can use the system to provide navigation information in support of nautical piloting. The radar can provide the navigation team azimuths and distances to known points of land visible on their screens. Based upon the limited electronic capability of the small-boat raid company and the requirement for EMCON conditions, radar navigation is not a feasible alternative for our purposes.

(2) Hyperbolic Navigation Systems. A series of electronic navigation systems were established in the post World War II era to provide ships with a method of determining their position, independent of piloting or dead reckoning. The main systems presently in use are LORAN and Omega.

(a) LORAN. The Long-Range Navigation system or LORAN was first developed in the 1940s to provide position information to U .S. Navy warships. Several versions of LORAN have been fielded with the "C" network becoming the predominant system. There are several independent LORAN-C chains operating to provide coverage for heavily navigated coastlines (United States, Europe, Japan). The chains consist of a series of transmitting stations which broadcast extremely accurate time. The user's passive receiver employs the "D Street" formula to compute its position. LORAN-C provides coverage out to 1,000 nautical miles from shore with accuracy ranging between 300 and 500 meters. LORAN-C receivers have been employed with the small-boat raid companies.

(b) Omega. The Omega navigation system became operational in 1982 and functions on principles similar to the LORAN network (Omega computes distance through radio wave phase angle differences). Omega consists of eight transmitting stations located throughout the world, including two on U.S. soil. The network of transmitting stations provides worldwide navigational coverage with an accuracy of between one and two nautical miles. Due to its capability to provide only general position information, the Omega system is not considered feasible for small-boat raid navigation.

(3) Satellite Navigation. The United States Department of Defense has developed two satellite navigation systems to support our country's military operations: the Navy Navigation

Satellite System (NAVSAT) and the Global Positioning System (GPS). Both networks provide extremely accurate navigation information via the interpretation of radio waves by a passive receiver. NAVSAT is used extensively by the U.S. Navy, while GPS is being employed by all branches of the military. Due to the availability of compact, durable, passive receivers, GPS is ideal for use in small-boat raid navigation. The accuracy provided by GPS, (less than one hundred meters), cannot be duplicated by any other available navigation asset.

3. Problems of Navigation Regardless of the specific method of navigation, or combination of methods used by a navigator, the procedures he applies must furnish him with a solution to the five problems of navigation. These problems are:

a. How to determine his position. The term position refers to an identifiable location on the earth or a point within a man-made system of artificial coordinates. Unless a navigator knows where he is, he cannot direct the movements of his vessel with accuracy, safety and efficiency.

b. How to determine the direction in which to proceed to one position to another. Direction is the orientation of an imaginary line joining one point to another without regard to the distance between them. It is the knowledge of the spatial relationship between two positions, the direction from one to another that makes it possible for a navigator to lay a course from where he is to where he wants to go and then proceed to that destination.

c. How to determine distance as he proceeds. Distance is the spatial separation between two points without regard to direction. In navigation, it is measured by the length of a line on the surface of the earth from one point to the other.

d. How to determine time as he proceeds. Time may be either the time of day of an event as indicated by a watch or clock or the interval between two successive events.

e. How to determine speed as he proceeds. Speed is defined as the rate of movement and in navigation is usually measured in nautical miles per hour, or knots.

4. Navigation Team. Whether you are piloting a Zodiac inflatable boat or a nuclear-powered aircraft carrier, navigation is a team effort. There are five standard members of any navigation team.

a. Navigator. The man in charge. He guides the effort of the team.

b. Assistant Navigator. Assists the navigator.

c. Bearing Taker. Determines azimuths to navigational aids.

d. Time Keeper. Tracks the time of passage using a stopwatch.

e. Coxswain. Maintains the vessel on the prescribed course.

REFERENCES

1. *Dutton's Navigation and Piloting 14th Edition*.

SO-557-4

2. *American Practical Navigator Volume 1*.

NOTES

ATTACHMENTS. None.

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 558
SEP 98

STUDENT OUTLINE

THE NAUTICAL COMPASS

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVE. Without the aid of references, during a navigation exercise, use a nautical compass in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references, identify in writing the nomenclature of the nautical compass in accordance with the references.

(2) Without the aid of references, given different combinations of variables, uncorrect for one or more of the variables in accordance with the references.

(3) Without the aid of references, given different combinations of variables, correct for one or more of the variables in accordance with the references.

OUTLINE

1. **The Nautical Compass** is the most important piece of navigational equipment on your boat. The principle of the compass may best be understood if the earth is thought of as a huge magnetized sphere. A magnetized needle, held anywhere on its surface, will tend to line up with the magnetic lines of force of the earth. If the north magnetic and south magnetic poles were exactly at the north and south poles, magnetic compasses would indicate true directions. However, in actual fact, the north magnetic pole is over a thousand miles from the north pole and situated to the north of Hudson Bay. The south magnetic pole is located far south of Australia. Because the north magnetic pole and the true north pole are almost in a line from Lake Michigan, Sailors in those waters have virtually no variation between true and magnetic directions. In the North Atlantic, however, this variation may reach as high as 30°.

2. **The Purpose of a Compass** is to locate a reference direction. The compass then can provide a means for indicating other directions. A magnetic compass depends upon the magnetic fields of the earth for its directional property; these reference directions are called either compass north or magnetic north depending if the compass is free of deviation.

3. **Compass Nomenclature**. The following components make up the standard magnetic boat .compass:

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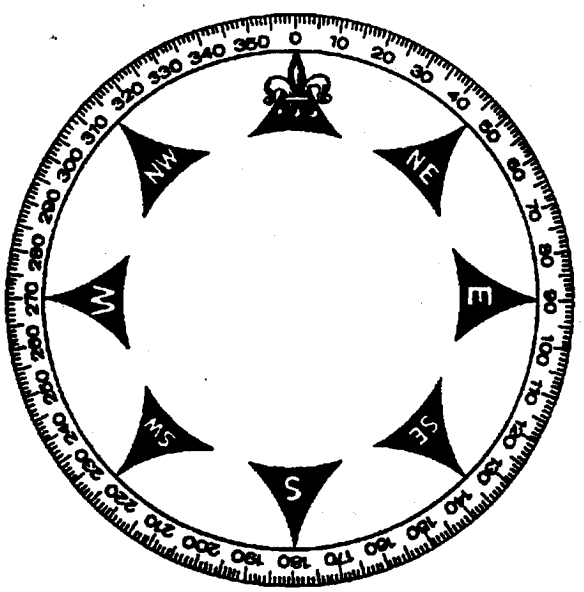
a. Magnets. Four (two in older compasses) cylindrical bundles of magnetic steel or bar magnets, which are attached to the compass card to supply directive force. Some newer compasses have a circular magnet made of a metallic alloy.

b. Compass Card. An aluminum disc graduated in degrees from 0° to 360° and showing cardinal and intercardinal points. North is usually indicated by the fleur de lis figure in addition to the cardinal point. Being attached to the magnets, the compass card provides a means of reading direction. Many compass cards will indicate direction in 1°, 5°, or 10° increments.



Compass Card

c. Compass Bowl. The outer case or body of the compass made of nonmagnetic materials which houses the internal components of the compass. The top is made of glass through which the compass card can be read.

d. Fluid. Liquid surrounding the magnetic element. According to Archimedes' principle of buoyancy, a reduction of weight results in a reduction of friction, making possible closer alignment of the compass needle with the magnetic meridian. Any friction present will tend to prevent complete alignment with the magnetic meridian. Today compasses contain a highly refined petroleum distillate similar to varsol, which increases stability and efficiency and neither freezes nor becomes viscous at low temperatures.

e. Lubber Line. Reference mark on the inside of the compass bowl which is aligned with the keel line of the ship. The lubber line is a reference for the reading of direction from the

compass card. The reading of the compass card on the lubber line at any time is the "ship's heading".

f. Gimbals. Two sets of rings, either internal or external, which allow the compass card to remain level despite any rolling or pitching of the vessel.

g. Expansion Bellows. Located in the bottom of the bowl and allows the fluid to expand and contract with temperature changes without bubbles being formed.

h. Pivot. A metal point in a jewel bearing on which the compass card rotates. Designed to permit the compass card to move with no resistance.

4. **Limitations of the Magnetic Compass**. The following characteristics of the magnetic compass limit its direction-finding ability:

a. It is sensitive to any magnetic disturbance.

b. It is useless at the magnetic poles and is sluggish and unreliable in areas near the poles.

c. Deviation (explained later) changes as the ship's magnetic properties change. Moreover, the magnetic properties change with changes in the ship's structure or magnetic cargo.

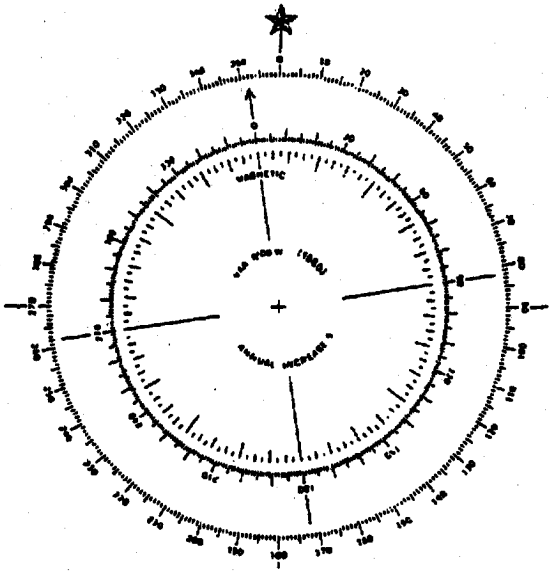
d. Deviation changes with heading. The ship as well as the earth may be considered as a magnet. The effect of the ship's magnetism upon the compass changes with the heading.

e. It does not point to true north.

5. Variation. Because the magnetic north pole and the true north pole are not located at the same point, the magnetic compass does not seek true north. The magnetic compass aligns itself with the magnetic meridian. The angular difference between the magnetic meridian and the true meridian is called "variation", because it varies at different points on the earth's surface. Even in the same locality, it usually doesn't remain constant, but increases or decreases annually at a known rate. On a nautical chart, variation and its annual change can be found in the center of a compass rose. Always remember to use the compass rose closest to the desired area, as variation changes from one area to another.

SO-558-3

589 TAB 558



590 The Compass Rose

6. **Deviation.** A magnetic compass tends to align itself with the earth's magnetic field, unfortunately, it is not free to do so in the presence of other magnetic influences. The presence of outside magnetic influences such as machine guns, radios, etc., tend to deflect the compass from the magnetic meridian. This difference between north-south axis of the compass card and the magnetic meridian is called deviation. If deviation is present and the north point of the compass points eastward of magnetic north, the deviation is named easterly, and marked E. If it points westward of magnetic north, the deviation is called westerly, and marked W. To put it in simpler terms, if the compass card rotates to the left of the magnetic heading/lubber line, then you have a westerly deviation. If the compass card rotates to the right of the magnetic heading/lubber line, then you have an easterly deviation. .

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SHIPS HEAD MAGNETIC	DEVIATION	SHIPS HEAD MAGNETIC	DEVIATION	SHIPS HEAD MAGNETIC	DEVIATION
0	5°W	120	2°W	240	6°E
15	6°W	135	0°	255	6°E
30	6°W	150	2°E	270	5°E

600 Deviation Table

7. **Types of Headings**. There are three types of directions when using a magnetic compass. Based on different reference lines, they are:

a. True. Refers to the true (geographic) meridian.

b. Magnetic. Refers to the axis of the compass card which is affected only by variation.

c. Compass. Refers to the axis of the compass card affected by both variation and deviation.

8. **Correcting/Uncorrecting Compass Error**. When the error of variation is removed from a magnetic heading, the correct true direction remains. Hence, the process of converting a compass direction to a magnetic or of converting a magnetic direction to a true direction is one of "correcting", or removing errors. The opposite of "correcting" is "uncorrecting" which is the process of applying compass errors (variation and deviation).

a. Easterly errors are additive when correcting directions (compass to magnetic or magnetic to true). They must be subtracted when uncorrecting. Westerly errors are exactly the opposite. The following rules apply:

(1) When correcting, easterly errors are additive and westerly errors are subtractive.

(2) When uncorrecting, easterly errors are subtractive and westerly errors are additive.

NOTE. When uncorrecting, "East is least, west is best."

b. In order to correct your heading to the desired course, set up your problem by taking the first letter from each of the following key words: "T" = True, "V" = Variation, "M" = Magnetic, "D" = Deviation, "C" = Compass and "CE" = Compass Error (the algebraic sum of deviation and variation). Each letter is then assigned the known direction and error. The best method of remembering the order of arrangement is by the sentence, "True Virgins Make Dull Companions." For example given a true course of 200°, a variation of 14° and a deviation of 5° W, we intend to find the magnetic heading, compass heading, and the compass error. In this problem we are uncorrecting, therefore, east is least (-), west is best (+).

E- --> <--- E+

W+ W-

T	V	M	D	C	CE	
200°	14°E(-)	(step #1)	(+)5ºW	(step #2)		(step #3)

(1) Step #1. Determine the magnetic course by subtracting the variation from the true course.

200°
-14°

Answer: 186º magnetic

E ---> <---- E+
W+ W-
T V M
200°–14°E = 186°

(2) Step #2. Determine the compass course by adding the deviation to the magnetic course.

186° mag
+5°

Answer: 191° compass

E- ---> <--- E+
W+ W-
T V M D C
200°- 14°E 186° (+)5° W = 191°

(3) Step #3. Determine the compass error by algebraic method. Remember, if the signs are the same add, if they are different, subtract, keeping the sign for the highest number.

-14°V
(-) +5°D

Answer: 9°E CE

E- ---> <--- E+
W + W
TV M D C = CE

200°	-14°E	186°	+5ºW	191°	9°E

c. When the occasion arises that you will need to make a turn while transiting, you must remember this simple rule. **Always return to magnetic bearing before initiating a turn**. For

.

example, given a compass course of 185°, we want to come to port (left) 90° (**RALS** right add, left subtract).

185° E- ---> <--- E+
+6º W+ W-
Answer: 191° magnetic **M D C**
191° (+) 6°E = 185°

Next you will add or subtract your turn

191° mag
-90°
Answer: 101 ° mag

Now you can find the deviation from a table and go back to compass

101° mag E- ---> <--- E+
+4°. W+ W-
Answer: 105° compass **M D C**
101° (+) 4°W = 1050

NOTE. Had you just made the turn from the original compass heading, you would have ended up on a new compass course of 95°, which would have sent you on the wrong bearing by 10°. So you can see how important it is to remember to go back to magnetic before making any turns.

REFERENCES

1. *American Practical Navigator (Bowditch),* Volume I.

2. *Chapmen Piloting Seamanship and Small Boat Handling.*

NOTES

ATTACHMENTS. None.

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UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditiony Force
Camp Lejeune, North Carolina 28542-0080

TAB 559
SEP 98

STUDENT OUTLINE
NAUTICAL CHARTS

LEARNING OBJECTIVES :

A. TERMINAL LEARNING OBJECTIVE. With the aid of references, use nautical charts in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references, identify in writing the classification of a nautical chart in accordance with the references.

(2) Without the aid of references, identify in writing the marginal information of a nautical chart in accordance with the references.

(3) Without the aid of references, identify in writing the publications used to make chart corrections in accordance with the references.

(4) With the aid of references, make chart corrections in accordance with the references.

OUTLINE

I. Nautical Chart. A nautical chart is a graphic representation of a region of the earth, on a planar surface, showing coast lines, water depths, navigation aids, and other information of use to the navigator. It is designed as a worksheet on which courses may be plotted and positions ascertained. It assists the navigator in avoiding dangers and arriving safely at his destination. It is one of the most essential tools of a navigator.

2. U.S. Chart Agencies. The governmental agency for charting the coastal waters of the U.S. and its possessions is the National Ocean Service (NOS), a unit of the National Oceanic and Atmospheric Administration (NOM) within the Department of Commerce. NOS conducts hydrographic, topographic and geodetic surveys from which charts are produced. Nautical charts for the rest of the world are the responsibility of the National Imagery and Mapping Agency {NIMA). This agency produces charts from its own surveys using U .S. Navy survey ships or by reproducing charts of other nations.

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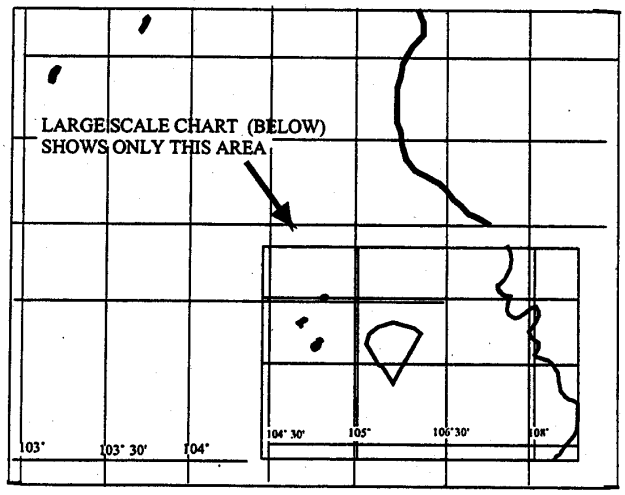
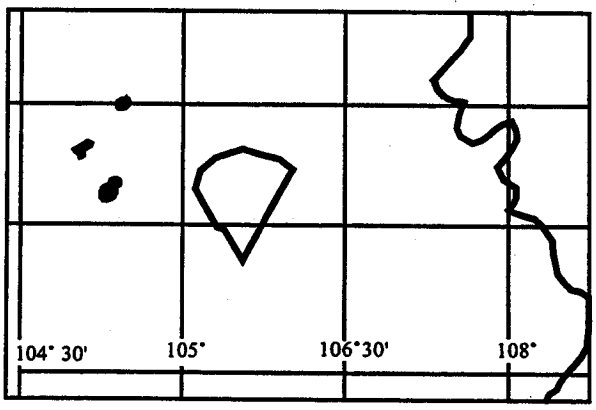
3. Scale. The scale of a chart is the ratio of a given distance on the chart to the actual distance which it represents on the earth. It is most commonly expressed as 1:40,000, 1:80,000 and 1:150,000.

a. Small Scale. Covers a relatively large area. Used for planning and for offshore navigation, i.e., 1:500,000 scale.



SMALL SCALE CHART

b. Large Scale. Covers a relatively small area. Used as a vessel approaches piloting waters, i.e.,1:40,000 scale.



LARGE SCALE CHART

NOTE. These terms are relative. There is no firm dividing line between each classification of chart. Thus, a 1: 100,000 chart is considered large scale when compared to a 1: 1,000,000 chart, but would be small scale when compared to a 1:40,000 chart.

613 4. Chart Classification

a. NOS Charts. The scale of NOS charts range from about 1:2,500 to about 1:5,000,000. Charts published by the NOS are placed into the following classifications according to their scale:

(1) Sailing Charts -1:600,000 and smaller. The smallest scale charts used for planning a long voyage.

(2) General Charts -1:150,000 to 1:600,000. Intended for coastal navigation outside of outlying reefs and shoals.

(3) Coast Charts -1:50,000 to 1:150,000. Intended for inshore coastal navigation where the course may lie inside outlying reefs and shoals or entering large bays, harbors, and intercoastal waterways.

(4) Harbor Charts -1 :50,000 and larger. Intended for navigation and anchorage in harbors and smaller waterways.

(5) Small Craft Charts -1 :80,000 larger. These are special charts of inland waters, including intercoastal waterways. These charts contain additional information such as facilities, tidal predictions and weather broadcasts.

b. NlMA Charts. Charts published by NIMA and are placed into the following classifications according to their scale:

(1) General. Smaller than 1: 150,000. Used to track long voyages.

(2) Approach Chart. 1:150,000 and larger. Used for offshore navigation and piloting.

(3) Combat Chart. 1:50,000 to 1:150,000. A special purpose chart combining a topographic map and hydrographic chart.

(4) Classified Chart. The scale varies. May be obtained through your S-2 or G-2. Due to nature of area it covers, this chart is classified.

NOTE: Charts with a scale smaller than 1: 150,000 are not recommended for small boat piloting.

5. Marginal Information.

a. Title Block. The title block may be at any convenient location. Usually it is in some area not important to navigation. It is composed of:

(1) Source. (Who published it ?)

(2) Title of chart. (Usually a major area on the chart)

(3) Projection. (Mercator, polar, oblique, etc.)

(4) Scale. (Distance ratio)

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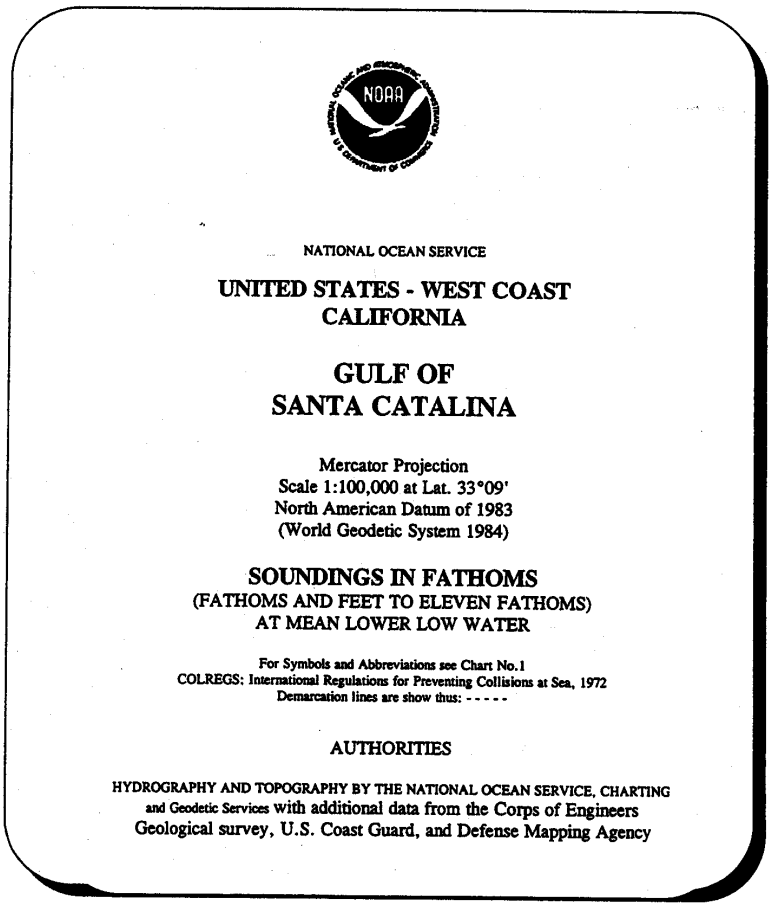
(5) Datum. (Horizontal reference planes i.e., North American Datum 1927 or World Geodetic Survey 1984)

(6) Soundings. (Units of measure for depths; usually fathoms or feet and the tidal reference plane i.e., Mean Lower Low Water)



NATIONAL OCEAN SERVICE

UNITED STATES - WEST COAST
CALIFORNIA

GULF OF
SANTA CATALINA

Mercator Projection
Scale 1:100,000 at Lat. 33°09'
North American Datum of 1983
(World Geodetic System 1984)

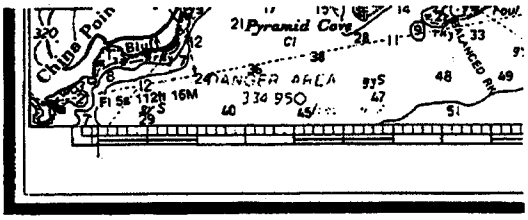
SOUNDINGS IN FATHOMS
(FATHOMS AND FEET TO ELEVEN FATHOMS)
AT MEAN LOWER LOW WATER

For Symbols and Abbreviations see Chart No.1
COLREGS: International Regulations for Preventing Collisions at Sea, 1972
Demarcation lines are show thus: - - - - -

AUTHORITIES

HYDROGRAPHY AND TOPOGRAPHY BY THE NATIONAL OCEAN SERVICE, CHARTING and Geodetic Services with additional data from the Corps of Engineers Geological survey, U.S. Coast Guard, and Defense Mapping Agency

b. Edition Number and Date. The edition number and date appear in the lower left hand comer. A new edition is made at a time corrections are too numerous or too extensive to be reported in Notice to Mariners, making previous editions obsolete. The date of this edition is the date of the latest Notice to Mariners to which the chart has been corrected.



7th Ed., Apr. 6 / 91

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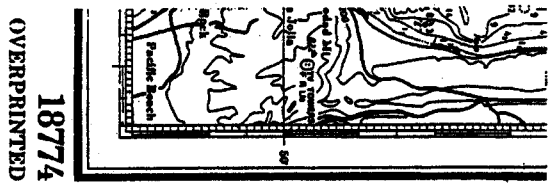
LORAN-C OVERPRINTED

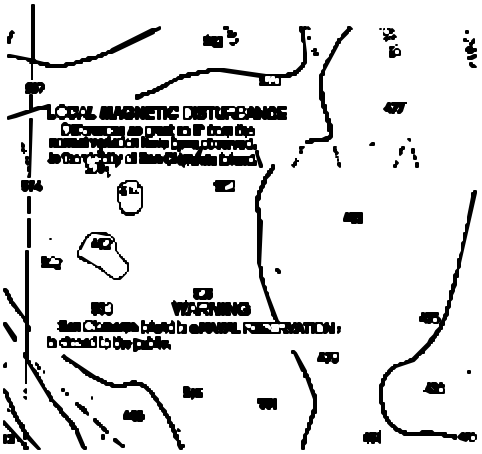
c. NIMA Stock Number. Is located at the lower right hand comer. It indicates specific information about the location and type of chart used. This number is used to order the desired chart from the National Imagery and Mapping Agency.



NIMA STOCK NO. 18AC018774

Subregion
Portfolio
(X indicates not in portfolio)
Chart classification
CO = Coastal
HA = Harbor and Approach
OA = Operating Area
GN = General
WO = World (Included in 2 or more regions)
Chart number

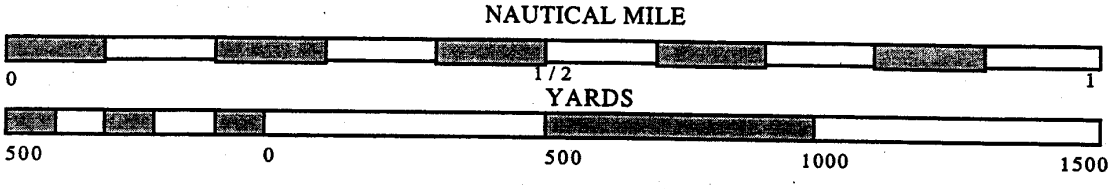
d. Notes. Charts will often have printed notes with inforn1ation of considerable importance, such as navigation regulations, hazardous conditions, etc.



e. Chart Symbols. Much of the inforn1ation contained on a chart is shown by symbols. These symbols are found in Chart No. I, *Nautical Charts, Symbols and Abbreviations.* A knowledge of the meanings of these symbols is essential to understanding the chart.

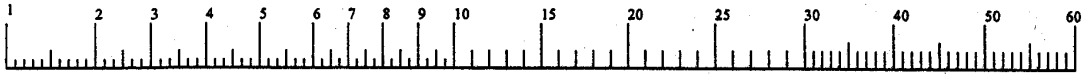
f. Scales.

(1) Bar Scales. Most large scale charts (harbor) will have sets of graphic bar scales. Each set consists of a scale of nautical miles and one of yards. Charts of intercoastal waterways will also include a set of statue miles. Bar scales are not found on small scale charts unless a harbor inset is located on the chart. (On small scale charts, the latitude bar is used to measure distance).



To find SPEED, place one point of dividers on distance run (in any unit) and the other on

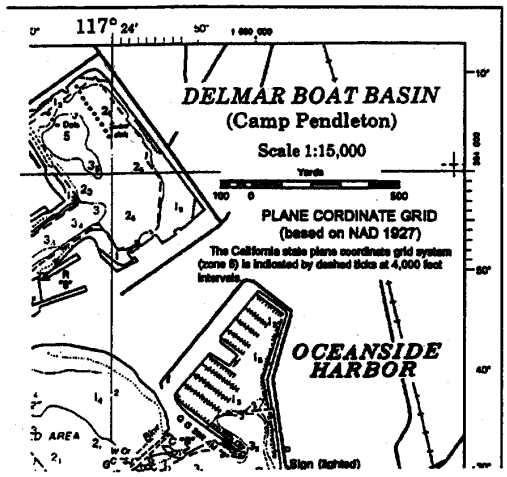
LOGARITHMIC SPEED SCALE

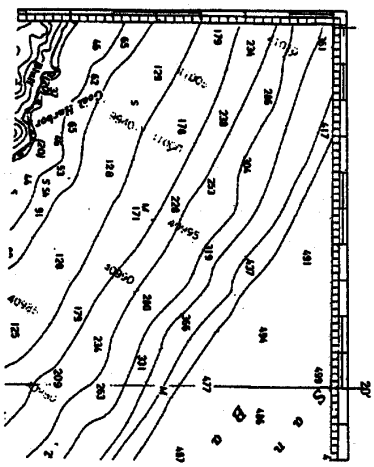


minutes run. Without changing divider spread, place right point on 60 and left point with the indicated speed in units per hour. Example: when 4.0 nautical makes run in 15 minutes, the speed is 16.0 knots.

(2) Logarithmic Speed Scale. This is a scale from which a graphic calculation of speed may be made if the time of the run is measured between two points. To find speed, place one point of dividers on nautical miles run and the other on minutes run. Without changing divider spread, place the right point on 60 and then the left point will indicate speed in knots.

(3) Latitude and Longitude Scale. The latitude and longitude scales are used to pinpoint objects on the chart, just as you use 6 and 8 digit grids on a map. There will be two scales, one on the top and bottom for longitude and one on each side for latitude. Each scale is broken down into degrees, minutes, and seconds. The latitude scale may be used to measure distance (1 minute equals





1 NM). All but the smallest scale charts display minutes and seconds.

LATITUDE AND LONGITUDE SCALES

g. Direction. Navigational directions on a chart are obtained by using the compass rose. Most charts will have several compass roses throughout the chart. Always use the compass rose nearest the line being measured. The compass rose gives both true and magnetic direction. The outer circle is true direction. Inner circle is magnetic. On some charts you will have a second inner circle giving direction using the "point" system.

h. Colors. The number of colors used on the chart will vary with the agency that published the chart. The National Ocean Survey makes use of five main colors and several shades of these on their regular charts.

(1) Yellow or Buff. Land area on the chart, certain charts will show a gray tint.

(2) Blue or White. White is used for deep water and blue for shallow water.

(3) Green. Areas that may be covered during certain tidal ranges and uncovered during others, such as mud flats, sand bars, marshes and coral reefs, are represented in green. A greenish half tone will also be used for places that have been wire dragged with the depth of drag indicated along the side.

(4) Nautical Purple. Used extensively throughout the chart. It was picked because it is easy to read under a red light. Examples: red buoys, red day beacons, lighted buoys of any color, caution and danger areas, compass roses and recommended courses.

i. Lettering.

(1) Vertical lettering is used for features which are dry at high water and are not affected, by water movement.

(2) Slanted lettering is used for water, under water and floating features with the exception of depth figures.

j. Bottom Composition. Information on the composition of the bottom (mud, sand, rocks, coral, etc.) is of interest to mariners primarily when landing or anchoring. This information is shown on charts by abbreviations, which are explained in Chart #1.

k. Fathom Curves. Lines of equal depth. Usually shown at 1, 2, 3, 5, 10 and multiples of ten. (1 Fathom = 6 Ft.)

1. Depths. Shown in figures, these indicate the depth in feet or fathoms. Some charts will use both feet for shallow water and fathoms for deep water, but are usually rare. Some newer charts will use meters and decimeters.

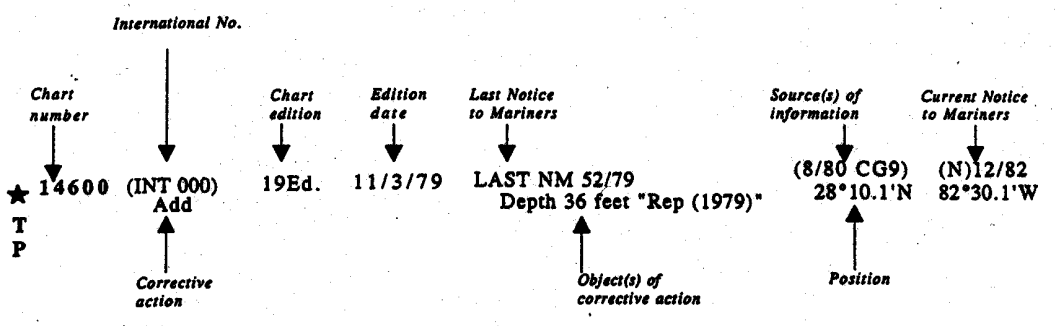
6. Chart Corrections. Periodic changes to the chart are necessary. There are three publications which contain chart corrections.

a. Local Notice to Mariners. The U. S. Coast Guard publishes the Local Notice to Mariners weekly for each Coast Guard district. These publications contain important navigational information specific to that area along with changes for charts of that local area.

b. Notice to Mariners. The National Imagery and Mapping Agency publishes the Notice to Mariners weekly to provide important navigational information and chart corrections worldwide.

c. Summary of Corrections. Published by NIMA semiannually in five volumes. Four of these volumes are regional in coverage. The fifth volume contains corrections for the world and ocean basin charts and publications for the world. The first two numbers in the chart number indicate the sub region to which the chart belongs. They will indicate the volume in which the corrections for that chart can be found.

(1) Format of Corrections. The following example explains the individual elements of a typical correction:



(2) Record of Correction. A record of corrections for each chart is maintained by the use of a 548 Chart/Publication Correction Record Card. An uncorrected chart is a danger and should be avoided.

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REFERENCES. ***American Practical Navigator.*** *Volume 1* ***Ch*** 3 & 5

Dutton's Navigation and Piloting 14th Ed. Ch 5

NOTES

ATTACHMENTS. None.

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UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542-0080

TAB 560
SEP 98

STUDENT OUTLINE

AIDS TO NAVIGATION

LEARNING OBJECTIVES :

A. TERMINAL LEARNING OBJECTIVE. With the aid of references, identify in writing aids to navigation in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) With the aid of references, identify in writing chart symbols in accordance with the references.

(2) With the aid of references, identify in writing light phase characteristics of navigation aids in accordance with the references.

(3) With the aid of references, identify in writing buoy characteristics in accordance with the references.

OUTLINE

1. A navigator usually needs more than just the charts and instruments on his vessel to fix her position and direct her course. Prominent features both natural and manmade are frequently used, but more often a navigator will make use of an II Aid to Navigation II. The tern II Aid to Navigation" includes buoys, lights, daybeacons, Radiobeacons, and sound signals such as fog horns, bells, and etc. There are over 70,000 federal aids to Marine Navigation in the United States of America and it is the responsibility of the U.S. Coast Guard for their installation and maintenance.

2. **Buoyage Systems**. A buoyage system consists of those aids to navigation, floating and fixed, lighted and unlighted, that have been established to mark a nation's waterways. Standardization was made by the International Association of Lighthouse Authorities (IALA). Two systems were accepted instead of one because certain basic long-established international differences precluded adoption of a single system worldwide. The two systems are designated as System A and System B. The two systems have exactly *opposite* meanings.

a. IALA System A is used in Europe, Africa, and most of Asia, including Australia and New Zealand. It places red buoys and day marks to port and green buoys and day marks to starboard when entering from seaward.

SO-560-1

b. IALA System B is used in North, Central, and South America, plus Japan, South Korea, and the Philippines. Buoys and day marks to port are green and those on the starboard side are red when entering from seaward.

c. The buoyage system used in the waters of other countries *may* or *may not* be similar to that of the United States. Conversion to IALA-A or IALA-B may not have been completed. A navigator *must* be familiar with the system of buoyage that he will encounter before he enters the pilot waters of a foreign country. Advance study of the appropriate *List of Lights* or the appropriate volume of *Sailing Directions* is absolutely essential. One good example is the conversion of black navigation aids to green navigation aids. In 1989, the U.S. agreed to change all black colored aids to the color of green. If you do come across a black navigational aid (foreign or U.S. waters), treat it as if it were green.

3 .**Buoy Characteristics.** The primary function of buoys is to warn of some danger or to delineate channels. However, if we consider that a buoy or day marker marks an approximate charted spot, we have a great advantage when we are alongside it, in that we know our approximate position on the chart and can orient ourselves regarding the land and any possible hazards to navigation. The size, shape, coloring, signaling equipment, and numbering on a buoy all help us to identify it and its location. The location of each buoy is shown on the chart, which **.**also shows some descriptive data. Full data on each buoy may be found in the appropriate *Light List* or *List of Lights* described in the first lesson. Another source where you can find out information about a buoy is the Chart # 1 book. When looking at a buoy the following elements need to be taken into account.

a. Shape of the buoys.

b. Top marks when fitted.

b. Coloring and the numbering of the buoys.

d. Light characteristics of the buoys.

e. Chart symbol and description of the buoys.

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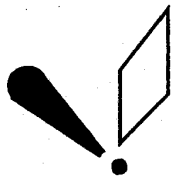
4. **Buoy Symbol and Description**. The basic symbol for a buoy is a diamond and a small circle (a dot will be shown instead of a circle on older charts). The circle denotes the position of the buoy. The diamond is used to draw attention to the position of the circle, and it may partially describe the aid in question. The description of a buoy includes the following characteristics, lights (light color), light period if fitted, height of the light, range at which the light can be seen, and the number or letter written on the buoy. The characteristics of a buoy are found on the chart or listed in the *Light List*. The table below defines the characteristics and their meaning in the illustration.



Gp Fl R(2) 10 sec

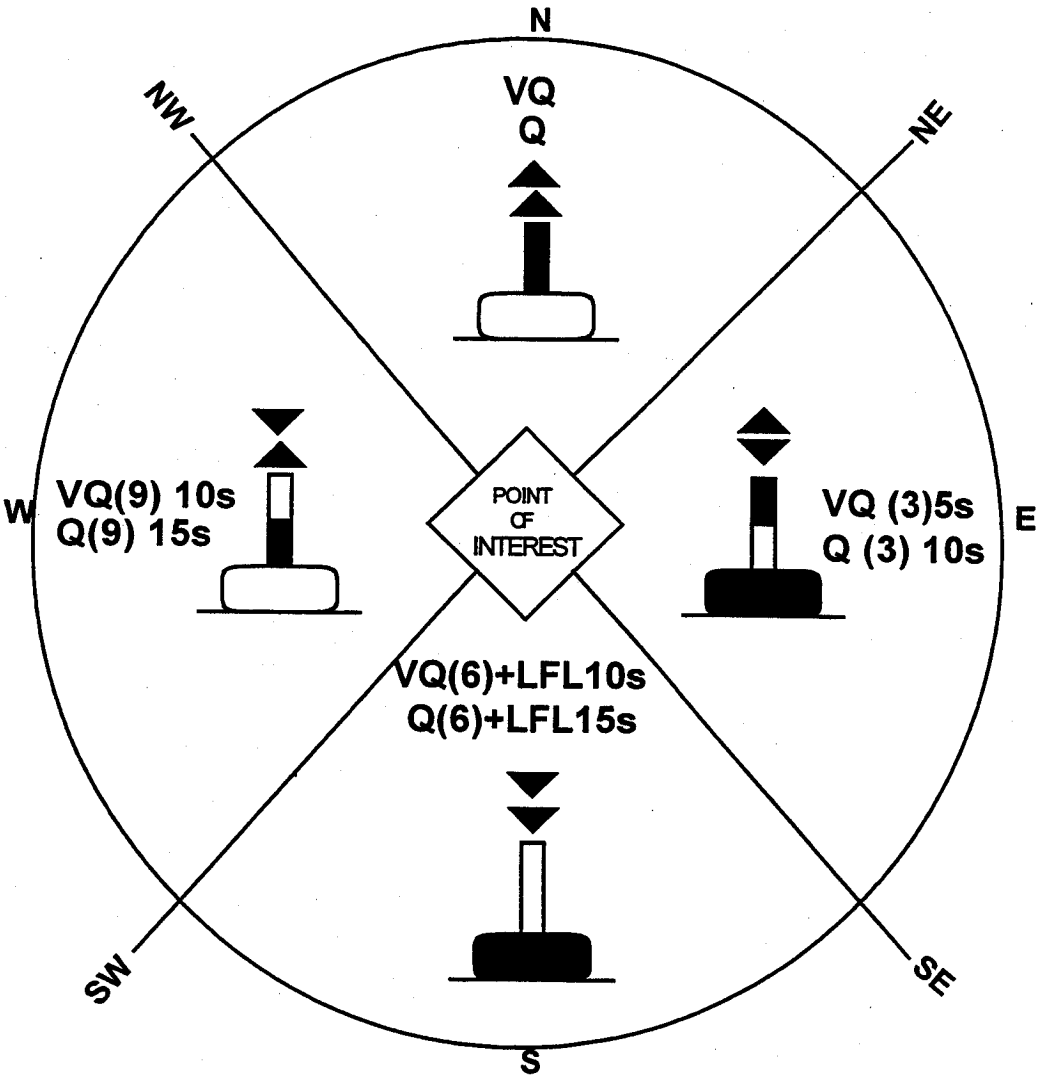
9 2M "6

CHARACTERISTICS	EXAMPLE	MEANING
Character	Gp F1	group flashing
Color	R	red
Period	(2) 10 sec	two flashes every 10 seconds
Height	9	9 feet
Range	2M	2 nautical miles
Number	"6"	light number 6

5. The following buoys are found within the IALA B system.

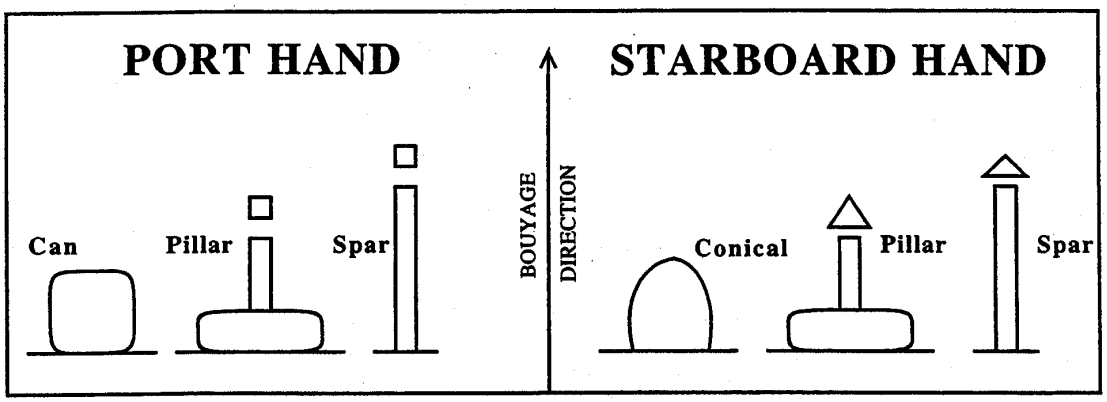
a. Cardinal System. The Cardinal system is used to mark the geographical relationship to the aid of a hazard in terms of 90° quadrants centered on the cardinal directions of north, south, east and west. The shape of the buoy is normally pillar or spar and the top mark when fitted, is two cones placed in a certain way to separate the buoys. The light phase characteristics is white in color and again shown in a certain way as to differentiate between the buoys. The chart

symbols for the cardinal marks can be found in Chart # 1 book



THE CARDINAL SYSTEM OF BUOYAGE

b. Port and Starboard Buoys. Both port and starboard hand buoys are used for marking the channel coming in from seaward. The port hand buoy is green in color and marks the left hand side of the channel. The shape of the buoy is normally Can, Pillar or Spar and if there is a top mark fitted it will be a single can. The light used, when fitted, is green and any phase characteristic other than that used for preferred channel buoys. The starboard hand buoy is red in color and marks the right hand side of the channel. The shape of the buoy is normally Conical, Pillar or Spar and if there is a top mark fitted it will be a single cone pointing upwards. The light used, when fitted, is red and any phase characteristic other than that used for preferred channel buoys. The chart symbols for both the port and starboard hand buoys can be found in Chart # 1 Book.



672 PORT AND STARBOARD HAND BUOYS

c. Preferred Channel Markers. The preferred channel to port/starboard is used to inform the mariner that the preferred channel is either to port or starboard. The preferred channel to port is the color of a starboard hand buoy with a green horizontal band indicating the preferred channel to port. The top mark if fitted is a single red cone pointing upwards. The light phase characteristic when fitted is Red, Group Flashing FL (2+ 1). The preferred channel to starboard is the color of a port hand buoy with a red horizontal band indicating the preferred channel to starboard. The top mark if fitted is a single Green Can. The light phase characteristic when fitted is Green, Group Flashing FL (2+ 1). The Chart symbols for the preferred channel buoys can be found in Chart #1 book.

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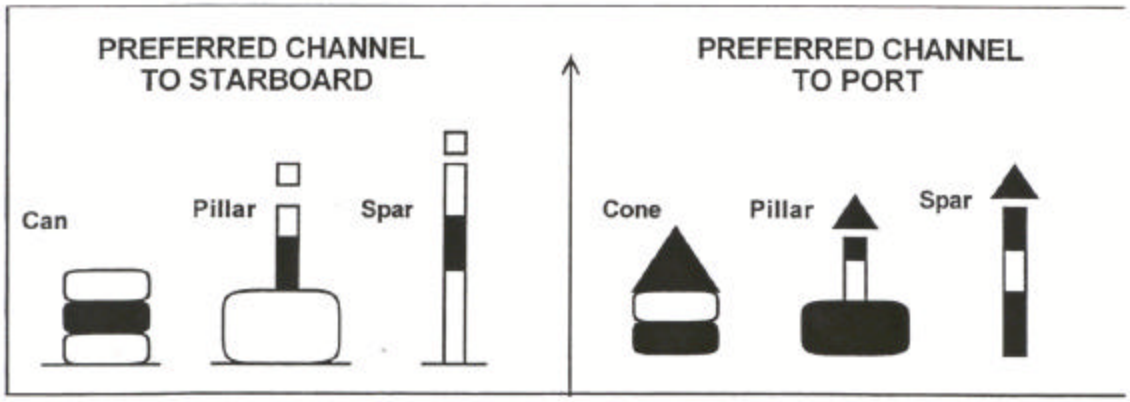
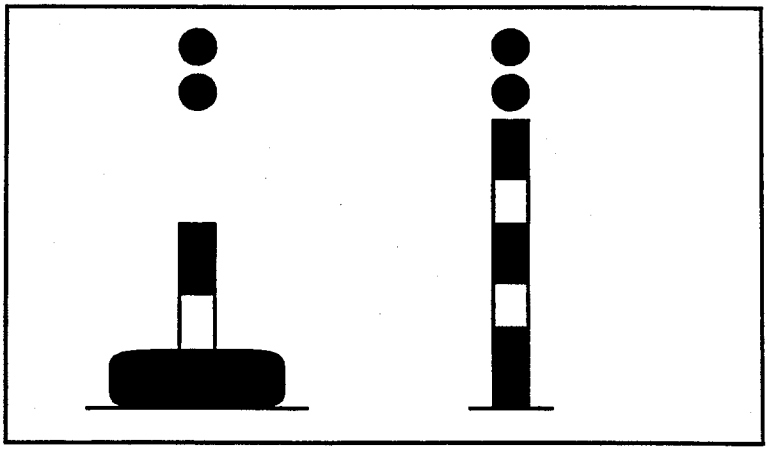


673 PREFERRED CHANNEL TO STARBOARD AND PORT BUOY'S

d. Isolated Danger Mark. The isolated danger mark is used to mark an "isolated danger" which has unobstructed water on all sides. The isolated danger mark is black in color with a horizontal red band and the top mark is two black balls. The shape of the buoy is optional, but does not conflict with the lateral marks, pillar or spar are preferred. The light when fitted is "White" and the Phase characteristic is Group Flashing (2). The chart symbols for the isolated danger mark can be found in Chart # 1 book.

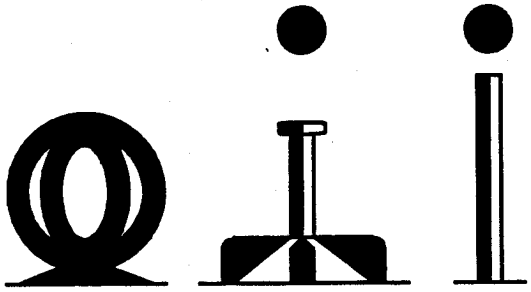


ISOLATED DANGER MARMS

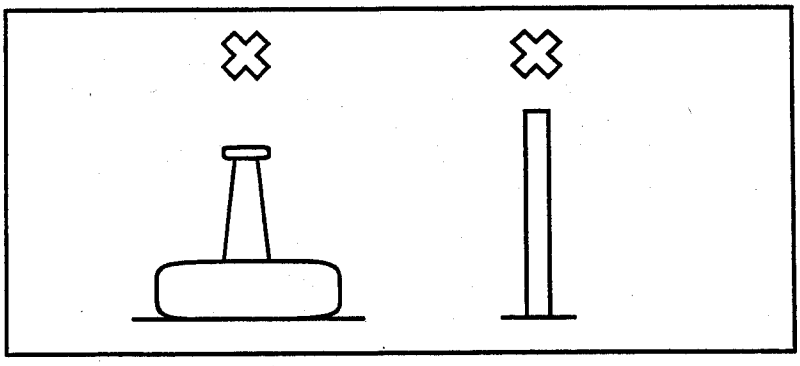
e. Safe Water Marks. Safe water marks are used for marking safe water all around that buoy or marking the middle of the channel. The safe water mark is red in color with white vertical stripes. Top mark if fitted is a Single Red Sphere. The shape is either Spherical, Pillar or Spar. The light when fitted is "White" and the light phase characteristic is either Isophaes, Occulting, One Long Flash 10 Secs

and Morse “A”. The chart symbols for the safe water mark can be found in Chart #1 book.

675 SAFE WATER MARKS



f. Special Marks. Special marks are used to mark areas of importance, such as restricted areas. The buoys have no lateral significance and the shape is optional as long as it does not interfere with any other buoys. The special mark buoys are yellow in color and the light phases characteristic is Flashing Yellow or Flashing Yellow (4) secs. The chart symbols for the special marks can be found in Chart #1 book.



676 SPECIAL MARKS

6. Day Beacons/Day Markers. Unlighted/lighted reflective aids normally consist of a pile with a day mark on top. Red day markers are depicted by small red triangles labeled “R”, while green day markers are depicted by small green squares labeled “G”. Beacons are never afloat, and have a great array of shapes. They are described in sufficient detail in the *Light List* to make identification possible. Day markers are colored and numbered like buoys.

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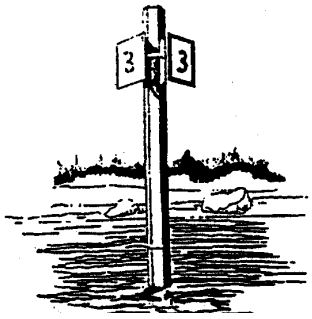


Symbol for Daymarks

7. **Lighthouses**. Lighthouses, called "lights" in the light lists, are found along the worlds navigable coastlines. Lighthouses are placed where they will be of most use, on prominent headlands, at entrances, on isolated dangers, or other points where it is necessary so that you the navigator can be guided or warned. Their principal purpose is to support a light at a considerable height above the water. The basic symbol for a lighthouse is a black dot with an overprint magenta disc or a black dot with a magenta flare symbol (the combination is much like an exclamation mark). Major lights have names and are described, while minor lights are described only. The characteristics of the light are shown as well as the height of the focal plane of the lantern above mean high water. The geographic or nominal range is shown (approximately) in nautical miles, and other equipment on the station is listed.

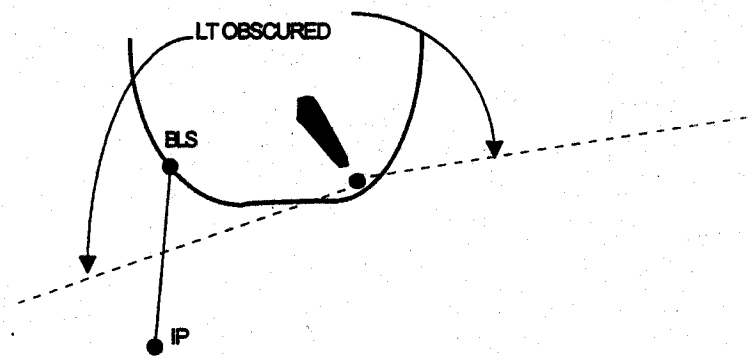
Pt Loma
Fl 15sec 88ft 23M

Symbol for a Major Light

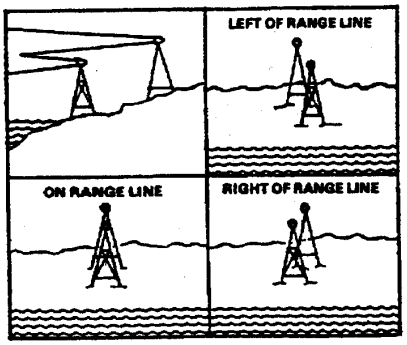
Fl R 2.5s 11ft 5M

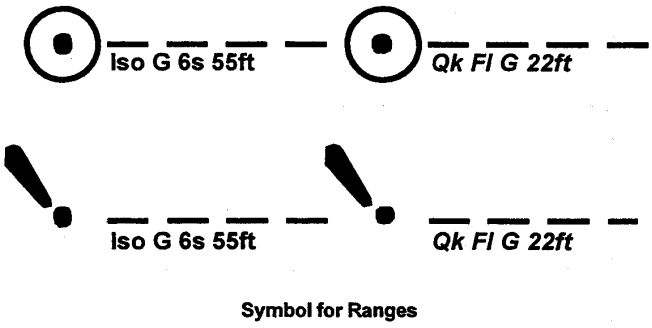
Symbol for a Minor Light

8. Certain lights are not visible through the 360° arc of the horizon, because of interference by land masses. When a light is observed through a portion of its arc, the symbol for the light on the chart is shown with an obscured sector. Some lights contain a red sector to warn of special dangers within the arc of visibility of the sector as well.



9. **Ranges**. Ranges are two man-made structures or natural features which are placed in a line. In port, ranges are set corresponding to the exact mid-channel course which insures safe navigation. They may be either on the shore or in the water. Ranges are depicted on charts by the symbols for the lights (if lighted) and a dashed line indicating the direction of the range. Since the far light is higher than the near light, the range is followed by keeping the higher light directly above the lower light. Ranges may use white, red, or green lights and will display various characteristics to differentiate from surrounding lights. Both lights will have a different light characteristic from one another.





Symbol for Ranges

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REFERENCES

1. *Nautical Chart* #1.
2. ***Duttons Navigation and Piloting***, 14th edition.
3. ***Marine Crewman's Handbook***, FM 55-501.
4. ***American Practical Navigator.***

NOTES

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ATTACHMENTS

A - ***Light Phase Characteristics.***

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ATTACHMENT A

704 LIGHT PHASE CHARACTERISTICS

LIGHT PHASE CHARACTERISTICS

ILLUSTRATIONS	SYMBOLS AND MEANING		PHASE DESCRIPTION
	LIGHTS WHICH DO NOT CHANGE COLOR	LIGHTS WHICH SHOW COLOR VARIATIONS	
	F = Fixed ----------	**Alt**= Alternating	A continuous steady light.
	F Fl = Fixed and flashing.	**Alt F Fl** = Alternating fixed and flashing.	A fixed light varied at regular intervals by a single flash of greater brilliance.
	F Gp Fl = Fixed and group flashing.	**Alt F Gp Fl** = Alternating fixed and group flashing.	A fixed light varied at regular intervals by groups of 2 or more flashes of greater brilliance. The group may, or may not, be preceded and followed by an eclipse.
	Fl = Flashing ----------	**Alt Fl** = Alternating flashing.	Showing a single flash at regular intervals, the duration of light always being less than the duration of darkness.
	Fl(2); Gp Fl = Group flashing.	**Alt Gp Fl** = Alternating group flashing.	Showing at regular intervals groups of 2 or more flashes.
	Fl(3+2); Gp Fl(3+2) = Composite group flashing.	----------	Group flashing in which the flashes are combined in alternate groups of different numbers.
	Mo (K) = Morse Code	----------	Light in which flashes of different durations are grouped to produce a Morse character or characters.
	Q; Qk Fl = Quick flashing.	----------	Showing not less than 60 flashes per minute.
	IQ; Int Qk Fl = Interrupted quick flashing.	----------	Showing quick flashes for about 4 seconds, followed by a dark period of about 4 seconds.
	ISO; E Int = Isophase	----------	Duration of light equal to that of darkness.
	Oc = Occulting.	**Alt Oc** = Alternating occulting.	A light totally eclipsed at regular intervals, the duration of light always greater than the duration of darkness.
	Oc(2); Gp Oc = Group Occulting.	**Alt Gp Oc** = Alternating group occulting.	A light with a group of two or more eclipses at regular intervals.
	Oc(3+4) = Composite group occulting.	----------	Group occulting in which the occultations are combined in alternate groups of different numbers

COLORS USED AND ABBREVIATIONS: W = WHITE, R = RED, G = GREEN.

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 561
SEP 98

STUDENT OUTLINE

RULES OF THE ROAD

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVES: Without the aid of references, follow the navigational rules in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, identify in writing the two types of navigational rules in accordance with the references.

(2) Without the aid of references, identify in writing factors governing the safe speed of a vessel in accordance with the references.

(3) Without the aid of references, identify in writing the maneuver of vessels in sight of one another in accordance with the references.

(4) Without the aid of references, identify in writing the light configurations for a vessel in accordance with the references.

(5) Without the aid of references, identify in writing the sound and light warning signals in accordance with the references.

OUT LINE

1. **Navigational Rules**

a. There are two sets of rules which govern the safe operation of vessels on the water.

(1) International Regulations for the Prevention of Collision at Sea 1972 (72 ColRegs).

(2) The Inland Navigational Rules Act of 1980 (Inland Rules).

.b. There are 38 rules within each set which are broken down as follows:

(1) Part A General rules one through three.

(2) Part B Deals with steering and sailing, rules four through nineteen.

(3) Part C Deals with lights and shapes, rules 20 through 31.

(4) Part D Deals with sound and light signals, rules 32 through 37.

(5) Part E Deals with exemptions and annexes, rule 38.

2. **Rule #1 -Application**

a. The international rules apply to all vessels upon the high seas and connecting waters navigable by sea going vessels.

b. The inland rules apply to all vessels upon inland waters of the United States and along the coast out to the demarcation line which is 12 nautical miles from shore. Many countries adopt their own set of inland rules.

c. Both sets of rules work together to prevent collisions at sea.

3. **Rule #2- Responsibility** States that the coxswain is responsible to comply with these rules and will be held responsible if his vessel fails to do so.

4. **Rule #3 -General Definitions**

a. The word vessel includes every description of water craft, including nondisplacement craft and seaplanes, used or capable of being used as a means of transportation on the water.

b. The term power driven vessel means any vessel propelled by machinery .

c. The term sailing vessel means any vessel under sail, provided that propelling machinery, if fitted, is not being used.

d. The term vessel engaged in fishing means a vessel fishing with nets, lines, trawls, or other fishing apparatus which restricts maneuverability but does not include a vessel fishing with trolling lines or other fishing apparatus which does not restrict maneuverability .

e. The term underway means that a vessel is not at an anchor or made fast to the shore or

ground.

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f. The term making way means that the vessel is moving relative to the water, under its own power.

g. The term not under command means a vessel which through some exceptional circumstance is unable to maneuver as required by these rules and is therefore unable to keep out of the way of another vessel.

h. The term vessel restricted in her ability to maneuver means a vessel which, from the nature of her work, is restricted in her ability to maneuver as required by these rules and is therefore unable to keep out of the way of another vessel. These include:

1) A vessel engaged in laying, servicing or picking up a navigation mark, submarine cable or pipeline.

2) A vessel engaged in dredging, surveyor underwater operations.

3) A vessel engaged in replenishment or transfer.

4) A vessel engaged in the launching or recovery of aircraft.

5) A vessel engaged in mine clearing.

6) A vessel engaged in towing.

5. **Rule #5- Lookouts** Every vessel shall at all times maintain a proper lookout by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

6. **Rule #6 - Safe Speed** Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions. Factors governing the determination of what a safe speed is:

a. The state of visibility.

b. The traffic density including concentration of fishing vessels or other vessels.

c. The maneuverability of the vessel with special reference to stopping distance and training ability.

.d The presence of background lights.

e. The state of wind, sea and current and the proximity of navigational hazards.

f. The draft in relation to the depth of water.

7 .**Rule #7 - Risk of Collision** Every vessel shall use all available means appropriate to the . prevailing circumstances and conditions to determine if risk of collision exist. If there is any doubt, such risk shall be deemed to exist.

8. **Rule #8 - Action to Avoid Collision** Any action taken to avoid collision shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship. Any alteration of course and/or speed to avoid collision shall if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar. A succession of small alterations of course and/or speed should be avoided.

9. **Conduct of Vessels in Sight of One Another**

a. Stand-on vessel maintains course and speed.

b. Giveway vessels will alter course port or starboard.

10. **Rule #13 - Overtaking** Any vessel overtaking any other shall keep out of the way of the vessel being overtaken. A vessel shall be deemed to be overtaking when coming up with another vessel from a direction more than 22.5 degrees abaft her beam. At night, a craft that is in such a position, with reference to the vessel she is overtaking, would be able to see only the stem light of that vessel but neither of her side lights.

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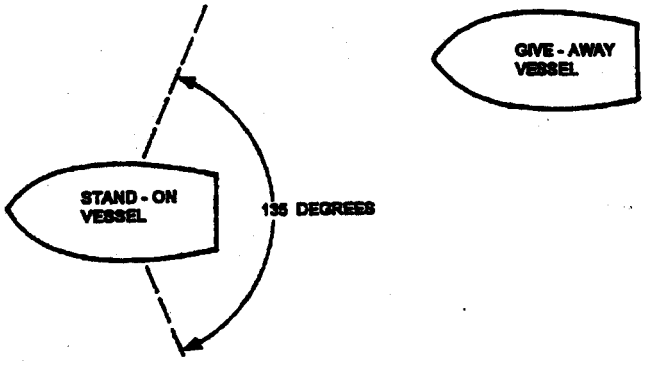

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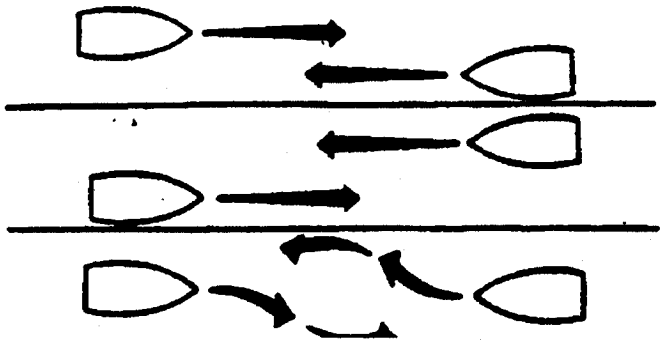
11. Rule #14- Head-on Situation When two power driven vessels are meeting on reciprocal courses, so as to involve risk of collision, each shall alter her course to starboard so that each shall pass on the port side of the other.



12. Rule #15- Crossing Situation When two power driven vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard shall keep out of the way and shall, if the circumstances of the case permit, avoid crossing ahead of the other vessel.

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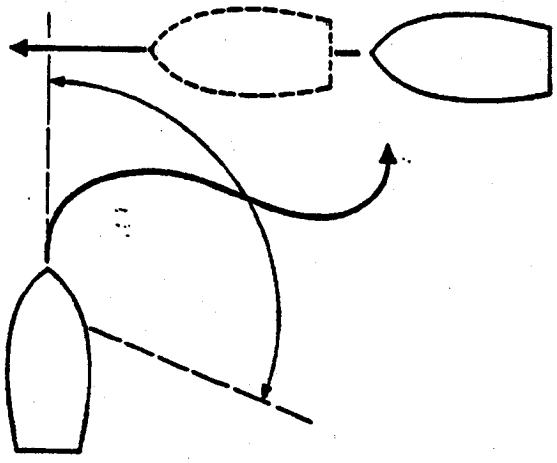

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13. **Rule #18 - Responsibilities Between Vessels** Power driven vessels underway shall keep out of the way of:

(1) A vessel not under command.

(2) A vessel restricted in her ability to maneuver.

(3) A vessel engaged in fishing.

(4) A sailing vessel.

14. Lights Lights are designed so that a vessel may be seen at night by another vessel, not for that vessel to see ahead.

a. Masthead Light A white light, placed over the fore and aft center line, showing unbroken light over an arc of 225 degrees.

b. Side Light Red port, green starboard showing an unbroken light over an arc of 112.5 degrees.

c. Stem Light White light on stem of vessel, showing unbroken arc of light over 135 degrees.

d. Towing Light Yellow light on stem of vessel showing unbroken arc of light over 135 degrees.

e. All Around Light A light showing unbroken light of an arc of 360 degrees

f. Flashing Light A light flashing at regular intervals 120 or more flashes per minute (used only on air cushion vessels and is a yellow light).

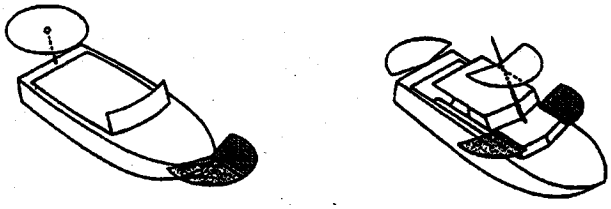
15. Light and Shape Configurations

a. Rule #23-Power Driven Vessel Underway

(1) Mast.

(2) Side

(3) Stern



VESSEL UNDERWAY

b. Rule #24- Towing

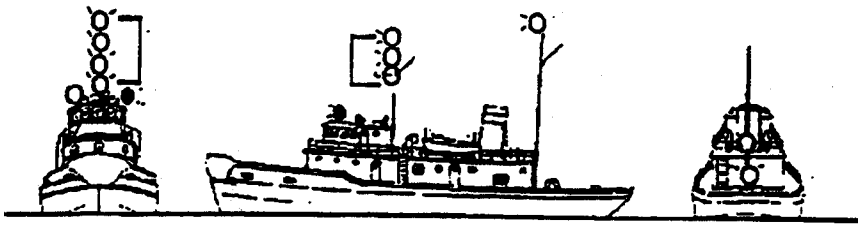
(1) Two or three mast head lights (two white mast lights for a tow of less than 200 meters or three white mast lights for a tow greater than 200 meters)

(2) Side lights.

(3) Stem light.

(4) Tow light.

(5) Day shape-diamond exceeds 200 meters



MASTHEAD LIGHTS USED IN **TOWING**

c. Rule #26 - Fishing Vessel

(1) Two all around lights

. (2) Upper red, lower white in vertical line one above the other

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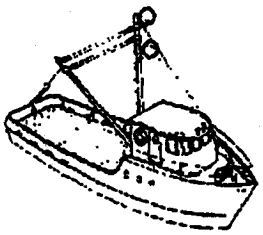
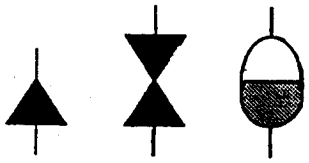
(3) Side lights.

(4) Stem light.

(5) Day Shape





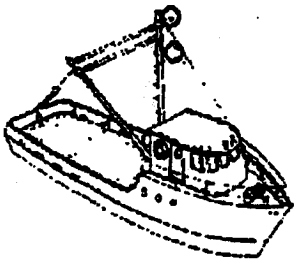
FISHING VESSEL

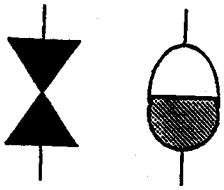
d. <u>Rule #26 - Trawling Vessel</u>

(1) Two all red, vertical line

(2) Side lights

(3) Stem light





(4) Day shape

e. <u>Rule # 27 - Not Under Command</u>

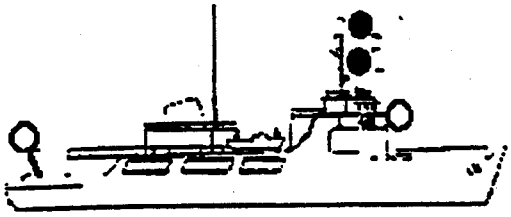
(I) Two all around red, vertical line

SO-561-8

(2) Side lights

(3) Stem light

(4) Day shape



731 VESSEL NOT UNDER COMMAND

f. <u>Rule #27 - Vessel Engaged in Minesweeping</u>

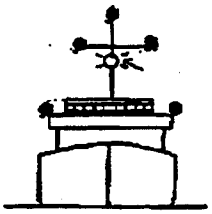
(1) Three all around green lights on mast two side-by-side third on top

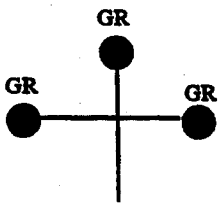
(2) Mast head light

(3) Side lights

(4) Stem light

(5) Day shape





VESSEL ENGAGED IN MINESWEEPING (CLEARANCE)

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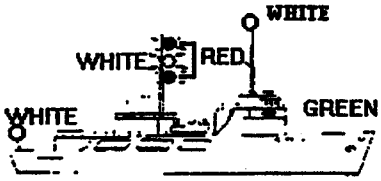
735 SO-561-9

g. Rule #27 - Restricted in Her Ability to Maneuver

(1) Three all around lights in vertical line. The highest and lowest shall be red.

Middle shall be white

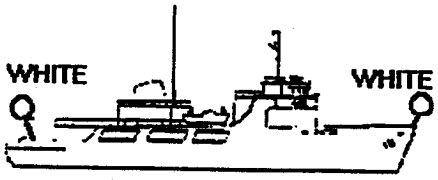
(2) Two all around red lights in vertical line to indicate side restricted
(3) Two all around green lights in vertical line to indicate side to pass
(4) Side lights
(5) Stem light



VESSEL RESTRICTED IN ABILITY TO MANEUVER

h. Rule #30 - Anchor Vessels

(1) All around white light in bow
(2) All around white light in stem
(3) Day shape

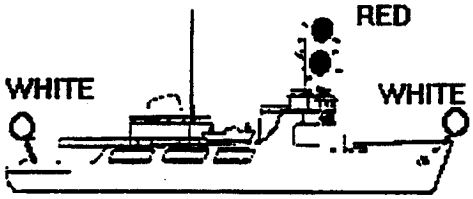


VESSEL AT ANCHOR .

SO-561-10

i. Rule #30 - Vessel Aground

(1) Two all around red lights in vertical line
(2) All around white lights in bow
(3) All around white light in stem
(4) Day shape



737 VESSEL AGROUND

16. Sound and Light Signals

a. Sounds are used for signaling approaching vessels of your action/intent. The word whistle means any sound signaling appliance capable of producing the prescribed blasts and which complies with specifications in annex III of these regulations.

(1) Short blast means a blast of one second duration

(2) Prolonged blast is a blast of four to six seconds duration

(3) Danger doubt is at least five short and rapid blasts

b. When two vessels are in sight of one another, a power driven vessel, making way when maneuvering as authorized, shall indicate that maneuver by the following signal. (Head-on-head)

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(1) International.

One short blast	**"I am altering course to starboard"**
Two short blasts	**"I am altering course to port"**
Three short blasts	"I am operating astern propulsion"

(2) Inland

One short blast	"I intend to leave you on my port side"
Two short blasts	**"I intend to leave you on my starboard side"**
Three short blasts	**"I am operating astern propulsion"**

c. Sound signals may be supplemented by light signals. These signals would be one second in duration and would be an all around white or yellow light synchronized with the sound signals.

d. A vessel intending to overtake another shall indicate her intention by the following signals.

(1) International

Two prolonged blast	**"I intend to overtake**
followed by one short blast	you on your starboard side"
Two prolonged blast	"I intend to overtake
followed by two short blasts	you on your portside"

The vessel which is to be overtaken shall indicate her agreement as follows: One prolonged, one short, one prolonged, one short.

(2) Inland

One blast	"I intend to overtake you on your starboard side"
Two blasts	"I intend to overtake you on your port side. "

The vessel which is to be overtaken shall indicate her agreement by sounding the same signal.

REFERENCES

Handbook of the Nautical Rules of the Road

SO-561-12

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542-0080

TAB 562
SEP 98

STUDENT OUTLINE

PLOTTING GEOGRAPHIC COORDINATES ON NAUTICAL CHARTS

LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVE. With the aid of references, use nautical charts in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references, locate by latitude and longitude the geographic coordinates of a given position on a nautical chart in accordance with the references.

(2) Without the aid of references, determine the distance between two points on a nautical chart within 1 NM/6 seconds accuracy in accordance with the references.

(3) Without the aid of references, determine the bearing between two points on a nautical chart within 2° accuracy m accordance with the references.

OUTLINE

1. Geographic Coordinates -The Earth's Reference Lines. The earth is approximately an oblate spheroid, a sphere flattened at the poles, with the North and South Pole located at opposite ends of the axis on which the earth rotates. To locate a position, it is necessary to use two reference lines, one running in a North-South direction and the other in an East-West direction. These reference lines are a series of great and small circles. Lines running in the N-S direction are called meridians and are great circles because they pass through the poles. Lines running in an E - W direction are called parallels. The Prime Meridian and Equator separate the earth into four quadrants; NE, NW, SE and SW.

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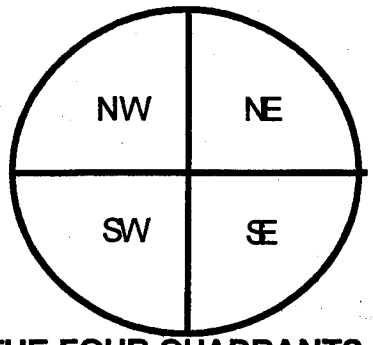
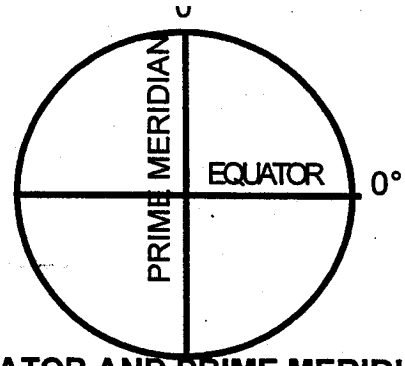
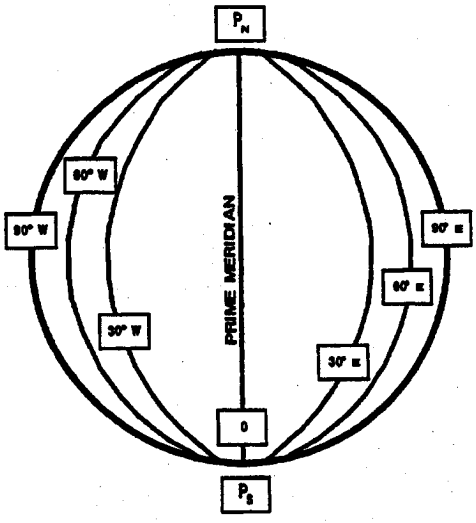


THE FOUR QUADRANTS



THE EQUATOR AND PRIME MERIDIAN

a. Meridians. The Prime Meridian 0° is the meridian which passes through the Royal Observatory in Greenwich, England. This great circle divides the earth into East (E) and West (W). All meridians are great circles and are numbered from 0° to 180° both East and West. In addition to the numbered value, each line must be identified by the letter "E" or "W" denoting the proper hemisphere.



b. Parallels. The 0° degree line of parallel is the great circle which passes through the center of the earth, halfway between the North and South Pole and is known as the Equator. The Equator divides the earth into North (N) and South (S). Lines of parallel are numbered from 0° at the equator to 90° at both the North and South Poles. In addition to the numbered value, each line must be identified by the letter "N" or "S" to denote the proper hemisphere-

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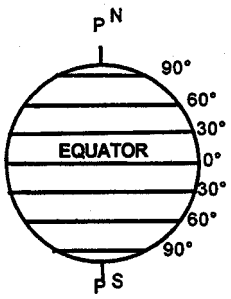
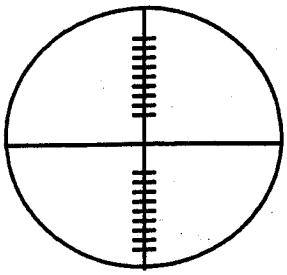
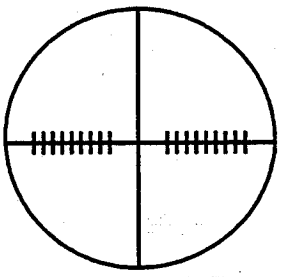


LINES OF PARALLEL

c. Latitude and Longitude. Every spot on the earth is located at a point of intersection between a meridian and a parallel. The location of every point is describable in terms of latitude and longitude. The distance along a line of meridian is called latitude. Latitude is measured from 0° - 90° North or South of the Equator which has the value of 0°. The distance along a line of parallel is called longitude. Longitude is measured from either East or West of the Prime Meridian. Each degree is divided into 60 minutes and each minute into 60 seconds. When both latitude and longitude are stated, THE LATITUDE IS ALWAYS GIVEN FIRST.



LATITUDE



LONGITUDE

1° = 60'

1' = 60"

.1' = 6"

d. Plotting Position on a Chart. A position can be plotted quickly with the use of a mechanical compass. Extreme care must be taken to ensure proper plotting. An inaccurate plot will throw off all other data obtained, i.e., course, distance, speed and time of passage. Since latitude is stated first, it is therefore natural that we plot this coordinate first

(1) Locate the correct latitude on the closest latitude scale.

(2) Open your mechanical compass so that the point is on the line of parallel running across the chart closest to your point of latitude and the pencil point on your point of latitude. Lock the compass down.

(3) Find your point of longitude.

(4) With the mechanical compass still separate the same distance you measured off on the latitude scale, place a tick mark on both the lines of meridian running up and down the chart which your point of longitude falls in between.

TAB 562

(5) Connect your tick marks.

(6) Locate and correct longitude

(7) Open you mechanical compass so that the point is on the line running up and down the chart closest to you point of longitude. Place the pencil point on your point of longitude.

(8) Walk the mechanical compass up the line of meridian and make a tick on the line you had just drawn.

(9) The tick mark is your point

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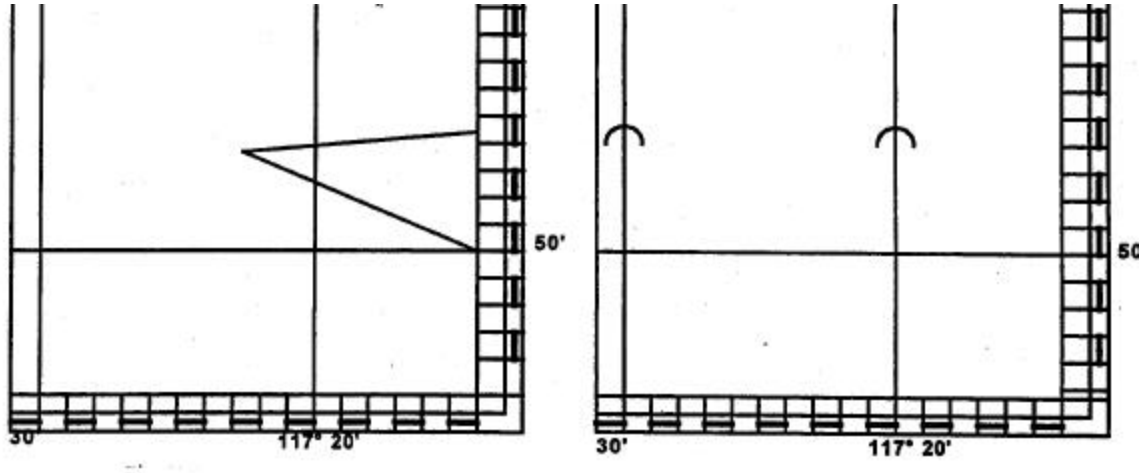

PLOTTING LATITUDE

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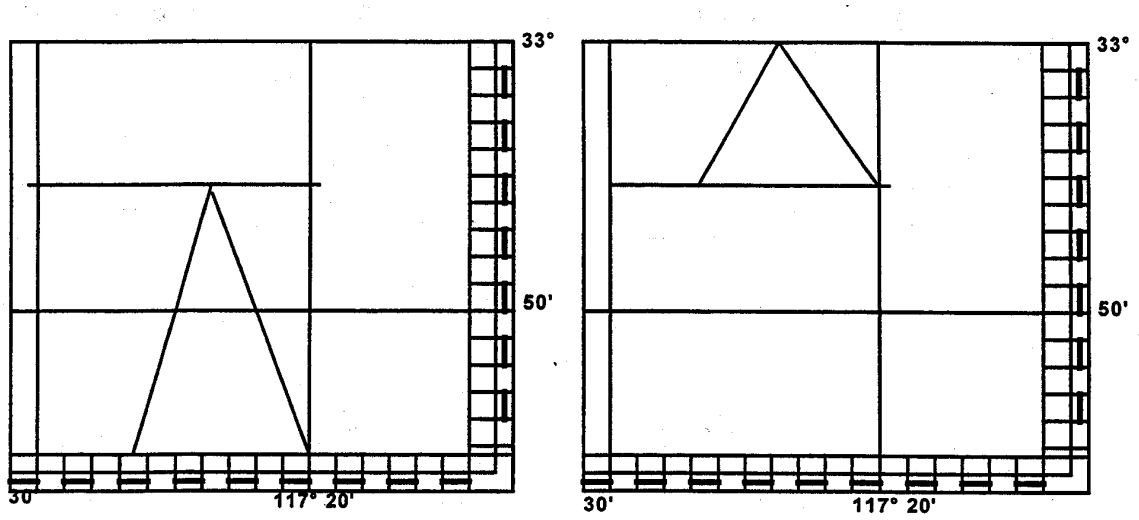


PLOTTING LONGITUDE

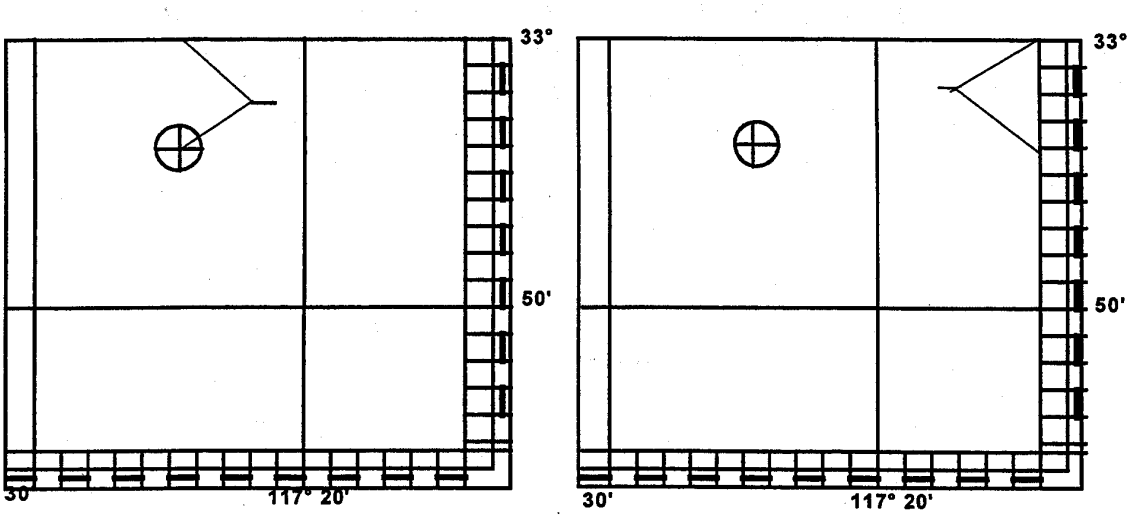
e. Determining Latitude and Longitude

(1) Place the point of the divers on your point.

(2) Place the second point on the line of parallel running across the chart closest to your point.

(3) Without changing the separation on your dividers, walk them across to the latitude scale keeping one point on the line of parallel.

(4) Read the latitude of the second point your dividers are touching.



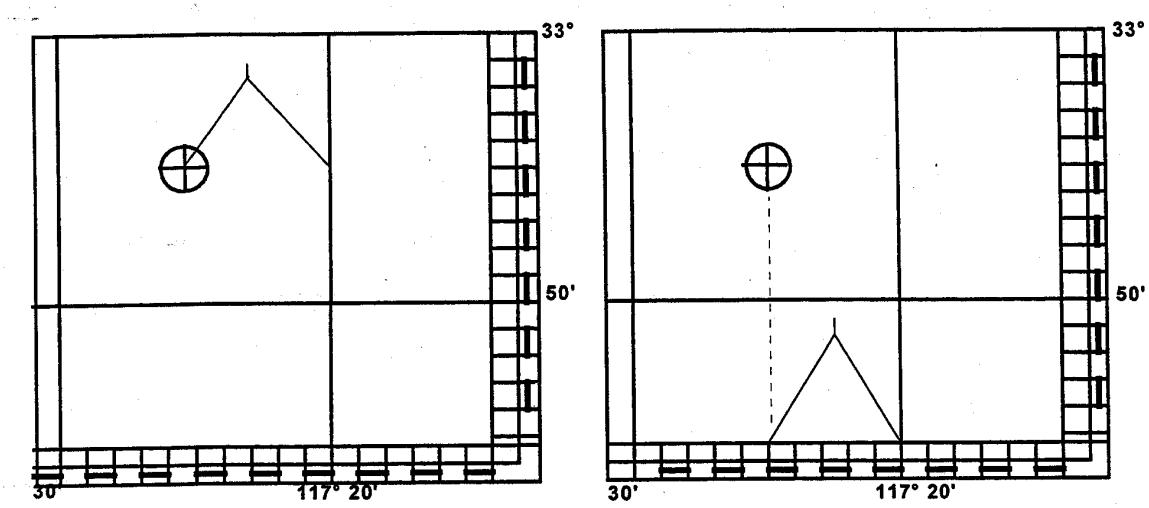
DETERMINING LATITUDE

(5) Place one point of the dividers on your point.

(6) Place the second point on the line of meridian running up and down the chart closest to your point.

(7) Without changing the separation on your dividers, walk them up or down to the longitude scale keeping one point on the line of longitude.

(8) Read the longitude of the second point your dividers are touching.



751 DETERMINING LONGITUDE

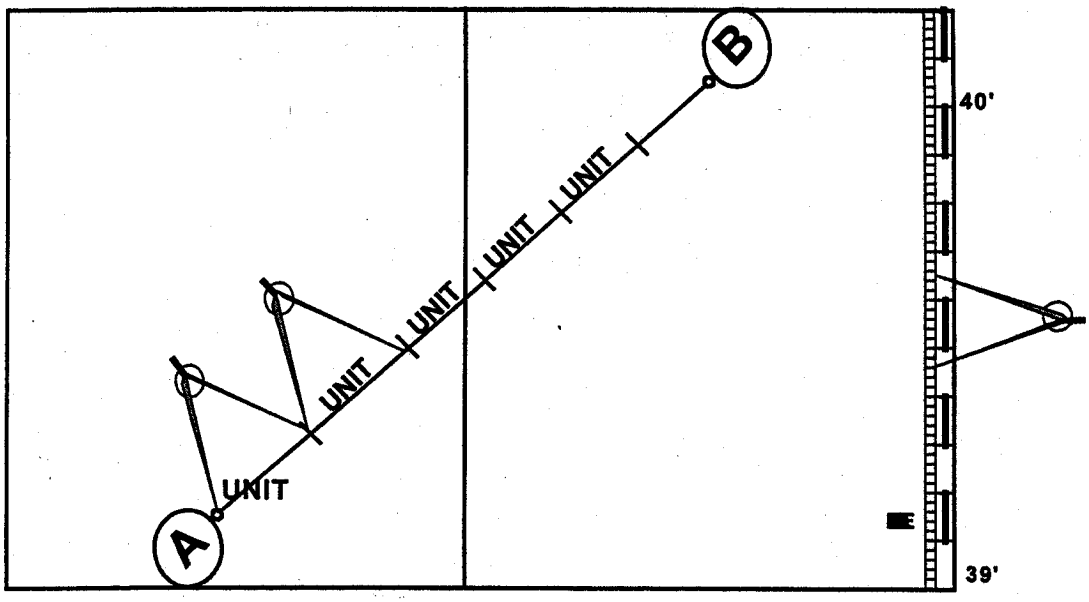
2. **Distance on a Mercator Chart**. For purposes of navigation, 1° of latitude may be considered to equal 60 nautical miles anywhere on the earth's surface, while the length of one degree of longitude varies with the latitude. The latitude scale must therefore, always be used in measuring distance.

a. A pair of dividers is the best instrument to use for this type of measurement. If the distance between points A and B is small enough, the span of the dividers may be increased until its points are over A and B. The total distance can be measured on the latitude scale.

b. If the points are so far apart that the dividers cannot reach all the way from A to B in one step, the dividers are spread to some convenient setting, such as 5 NM and the distance along a line connecting A and B is then stepped off. After the last full step there will usually be a remainder which can be measured by holding the one point of the dividers in place on the last point and closing the dividers until the other point rests on your finishing point. Measure the remaining distance on the latitude scale and add this distance to the distance you stepped off. The result is your total distance.

c. On some relatively large scale charts, such as harbor charts, there are bar scales with nautical miles. These scales can be very useful in measuring distance on that chart. The bar scale is used in the same manner as in land navigation. Tick off the distance between A and B on a piece of

paper and measure that distance on the bar scale.



3 . **Determining Direction**

a. A compass rose is used to determine direction. It consists of two or three concentric circles, several inches in diameter and accurately subdivided.

(1) The outer circle is true north expressed in degrees and emphasized with a star.

(2) The middle circle (if there are three) is magnetic direction expressed in degrees with an arrow printed over the zero to indicate magnetic north.

(3) The innermost circle is also magnetic direction, but in terms "points", and halves and quarters thereof.

(4) In the center of the rose, the magnetic variation is given.

b. When large areas are covered, it is possible for the magnetic variation to differ for various portions of the chart. Check each chart when you first use it and always use the compass rose nearest the area in which you are plotting.

c. Depending upon the type and scale of the chart, graduations on the compass rose circles may be for intervals of 1°, 2°, or 5°.

d. Azimuth from Point to Point

(1) Place parallel rulers so the edge rests on top of your track.

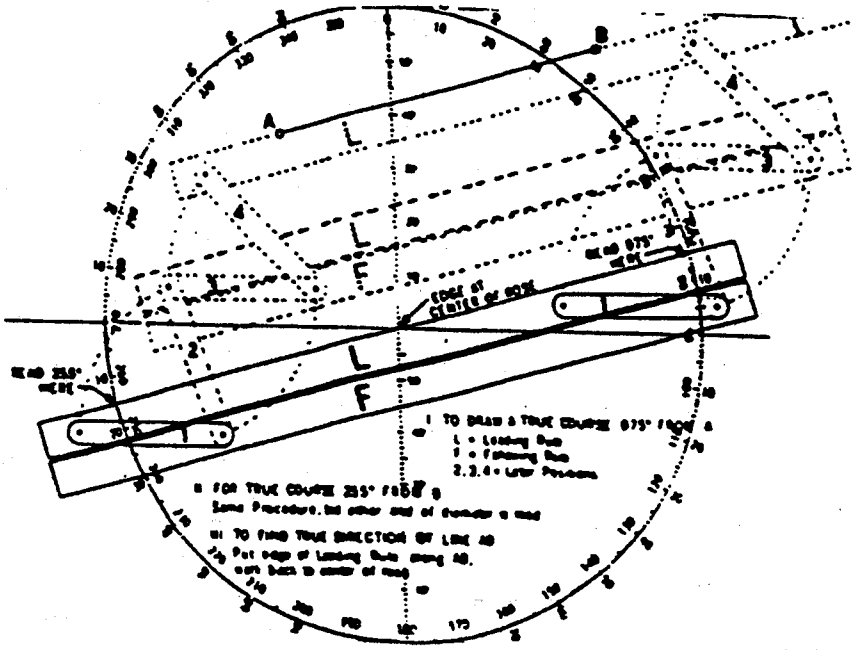
(2) "Walk" rulers across chart to the cross in the center of the compass rose.

(3) Read degrees in the direction you are heading (magnetic or true).

e. <u>To plot a Bearing</u>

(1) Place a parallel ruler on compass rose and rotate to desired bearing.

(2) “Walk” rulers across chart to start point and draw light line in the desired direction.



USE OF PARALLEL RULERS

REFERENCES

1. *American Practical Navigator Volume I. pp 260-263*

2. *Dutton's Navigation and Piloting 14th Ed. Pp 73-75*

NOTES

ATTACHMENTS. None.

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UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center.
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 563
SEP 98

STUDENT OUTLINE

PLOTTING GEOGRAPHIC COORDINATES ON TOPOGRAPHIC MAPS

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVES: With the aid of references, pilot a vessel using visual means in accordance with the references.

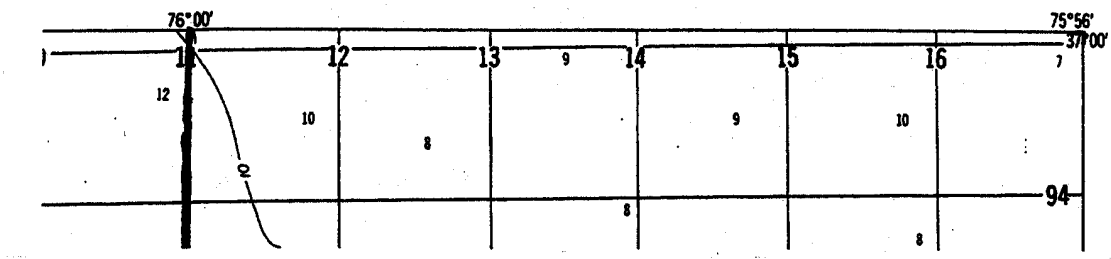
B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, determine the geographic coordinates of a given point on a topographic map in within 6 sec accuracy in accordance with the references.

(2) With the aid of references and given a latitude and longitude, plot geographic coordinates on a topographic map within 200m in accordance with the references.

OUTLINE:

1. **Modifying the Topographic Map** Geographic coordinates appear on all topographic maps, whether military or civilian. The four lines that enclose the body of the map (neat lines) are lines of latitude and longitude. Their values are given in degrees and minutes at each of the four comers. In addition to the latitude and longitude given at the four comers, there are, at regularly spaced intervals along the sides of the map, small tick marks extending into the body of the map. Each of these tick marks is identified by its latitude or longitude value. On the Camp Lejeune map, as with most standard military maps of scale 1:50,000, the tick marks are one third and two thirds of the way up the sides of the map. The interval between tick marks is 5'00". The same is true of the tick marks across the top and bottom. By connecting the corresponding tick marks, the map is now configured to locate geographic coordinates.



2. Determining Geographic Coordinates of a Point The interval between tick marks on the Camp Lejeune Map is 5'00". If the geographic interval is 5'00" and the location of a point is required to the nearest second, the interval must be divided into 300 equal parts (5'00" = 300"). Each of those 300 equal parts will have a value of 1 second. Any scale or ruler that has 300 equal parts and is as long or longer that the spacing between the lines may be used. A 30cm (1 foot) ruler is well suited for this purpose since 30cm can be divided into 300mm. For example, on the Camp Lejeune map, the following steps will determine the geographic coordinates of New River light 11 on the Camp Lejeune map in the grid square 8327.

a. Determine the value of the parallels and meridians within which the point falls. Latitude 34°30'00" and 34°35'00"N Longitude 77°20'00" and 77°25'00"W.

b. Determine the geographic interval (5'00" = 300").

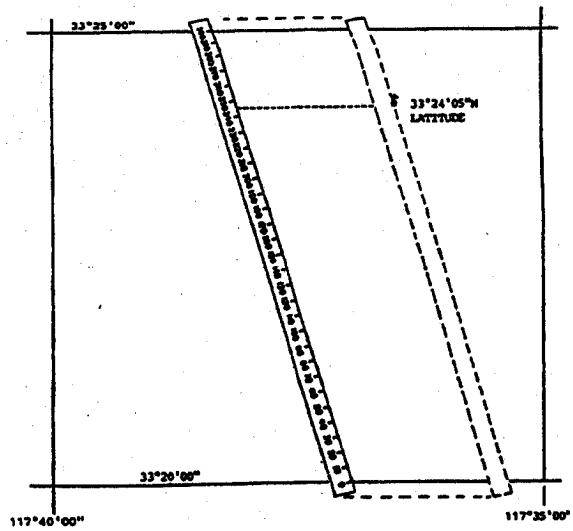
c. Select a scale that has 300 small divisions (30cm ruler)

d. To determine latitude:

(1) Place the 0 (Zero) of the scale on the parallel of the lower value number (34°30'00").

(2) Place the 300 (Three Hundred) of the scale on the parallel of the higher value number (34°35'00"). The ruler may be turned on an angle.

(3) Keeping the 0 and 300 on the two lines, slide the scale along the parallels until the New River light 11 symbol is along the edge of the numbered scale.



DETERMINING LATITUDE BY
SLIDING RULER ALONG LINES OF PARALLEL

(4) Read the number of seconds from the scale (approximately 239)

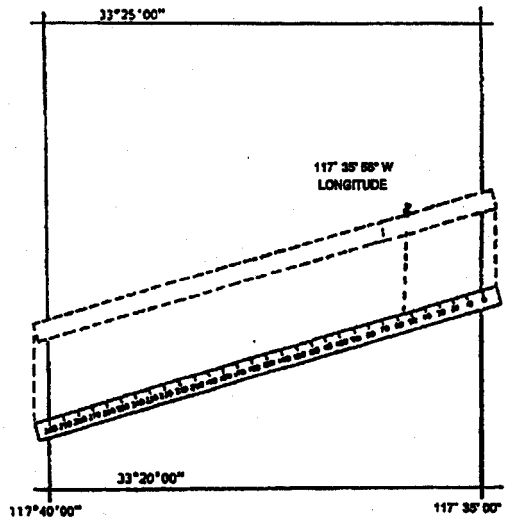
(5) Convert the number of seconds to minutes and seconds (239" = 3'59") and add to the value of the lower numbered parallel (34°30'00" + 3'59" =34°33’59").

(6) The latitude is 34°33159" , but that is not enough.

(7) This latitude could be either north or south of the equator so the letter N or S must be added to the latitude. To determine whether it is north or south, look at the latitude values at the edge of the map and find the direction in which they become larger. If they are larger going north, use N; if they are larger going south, use S.

(8) The Latitude for the light is 34°33'59"N.

SO-563-3



DETERMINING LONGITUDE BY
SLIDING RULER UP LINE OF MERIDIAN

e, To determine the longitude, repeat the same steps but measure between the lines of longitude (meridians and use E and W. The geographic coordinates of the New River light 11 should be approximately Latitude 34°33'59"N Longitude 077°21 '23"W.

3. **Locating a Point when the Geographic Coordinates are Known** Many of the same steps which were used to determine geographic coordinates are followed. F or example, to locate Latitude 34°03'05"N Longitude 077'21'23"W:

a. Find the parallels and meridians within which the point falls; Latitude 34°30'00"N and 34°35'00"N, Longitude 07720'00"W and 077° 25'00"W.

b. Draw these lines on the map.

c. For latitude:

(1) Subtract from the latitude of34°03'05"N the value of the lower numbered parallel 34°30'00"N.

(2) Change the difference of 3'05" to seconds (185").

(3) Place the 0 of the scale on the 34°30'00"N line and the 300 on the 34°35'00"N line.

(4) At the number 185 on the scale make a mark on the map.

(5) Staying on these same two lines, move the scale several centimeters to the left or right and repeat step (4) above.

(6) Draw an extended line through the two points located.

(7) For longitude, follow the same steps for latitude.

(8) The location of the point is the intersection of the two lines. The point is the wreck above Raisin Rock.

(9) To check your answer, simply follow the steps for determining geographic coordinates. The position of this point may create the need to extend the parallel or meridian beyond the body of the map to be able to slide the scale so it intersects with the point. If necessary the line can be extended out further using a piece of paper taped to the map sheet. An additional method is to change the upward side of the scale to the downward.

4. **Proportional Part Method** This technique is designed for use in the field where you may not have a 30cm ruler. A piece of paper or a protractor may be used to measure distance much the same way as in land navigation. These straight line distances are in direct proportion to the minutes and seconds of latitude and longitude and are used to set up a ratio. The following steps will determine the geographic coordinates of the bridge to Onslow Beach in grid 9127. ALL MEASUREMENTS ARE IN METERS.

a. Draw in your lines of meridian and parallel.

b. Locate your point on the map, i.e., 91602798.

c. Using the bar scale, determine the distance of five minutes of latitude by measuring from the bottom line of parallel to the top line of parallel which your point falls between.

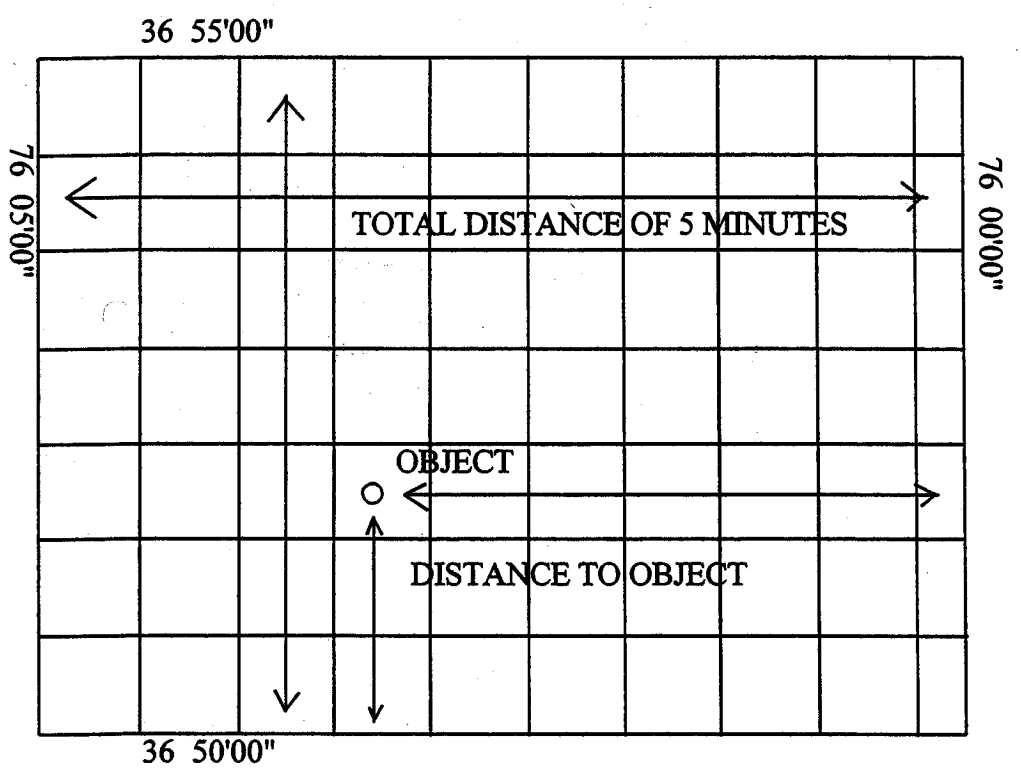
d. Measure the distance from the bottom line of parallel to the center of your point.

e. Determine the distance of five minutes of longitude from the left line of meridian to the right line of meridian which your point falls between.

f. Measure the distance from the lower value line of meridian to the center of your point.

g. With these distances and the five minute interval converted to 300 seconds (1' = 60 -5' = 300") you can determine the minutes and seconds latitude and longitude using the following formula:

Formula $\dfrac{\text{Distance to Object}}{\text{Total Distance of 5 minutes}}$ **x 300 = seconds**



(1) Latitude

(a) $\dfrac{8100}{9250}$ x 300 = 262"

(b) $\dfrac{262}{60}$ = 4'22"

(b) Add 4'22" to 34°30'00"N = 34°34'22"N

NOTE. Remember after step (b) you will need to convert the decimal to seconds by multiplying by 60.

(2) Longitude

(a) $\frac{2000}{7680} \times 300 = 78''$

(b) $\frac{78}{60} = 1'18''$

(c) Add 1 '18" to = 077°15'00" W = 07°16'18"W

REFERENCES

.

.Camp Lejeune Military Installation map Series V742S Sheet 5553 III

FM 21-26, Map Reading and Navigation

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542-0080

TAB 564
SEP 98

STUDENT OUTLINE

DEAD RECKONING

LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVE. With the aid of references, plot a dead reckoning track on a nautical chart in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references, when given a list, select the elements of dead reckoning in accordance with the references.

(2) Without the aid of references, when given a list, solve time, speed, and distance problems in accordance with the references.

(3) Without the aid of references, identify in writing the terms used on a dead reckoning track in accordance with the references.

(4) With the aid of references, label a dead reckoning track in accordance with the references.

OUTLINE

1. **Dead Reckoning (DR)** is the determination of position by advancing a known position using course, speed, time, and distance. Because of leeway due to wind, compass error, imperfect steering, or error in measuring speed, the actual course through the water is seldom determined with complete accuracy.

a. Dead reckoning, as we are concerned, will be used in planning our desired course before insertion and then used to locate our approximate position geographically at sea, using speed, time, and distance. Remember, a dead reckoned position is approximate and should be corrected when the opportunity presents itself.

b. Besides providing a means for continuously establishing an approximate position, DR also has key applications in detern1ining the predicted times of making land falls, sighting lights, estimating time of arrival, and finally evaluating the reliability and accuracy of position determining information.

2. **Elements of Dead Reckoning.** As we discussed in your introductory class, there are five elements of dead reckoning.

a. Known Position. This is the position you began your DR course

b. Course. Magnetic courses are used and must be accurately maintained by the coxswain.

c. Speed. Speed must be measured by the best method available (speed meter, log, RPM gauge, etc.). Speed must be maintained by the coxswain to the best of his ability .

d. Time. This is the total time you have traveled.

e. Distance. The distance you have run or a future distance you will run is obtained by multiplying the speed of a vessel in knots by the accomplished or anticipated time (D = S x T).

NOTE. A dead reckoning plot must start from a known position (fix or running fix). The effects of current are not considered in detem1ining a dead reckoning position.

2. **Speed. Time. Distance Solutions**. If the elements of dead reckoning are properly recorded and maintained, the formulas for solving the related speed, time and distance involve simple cases of multiplication and division.

Distance = speed x time Speed = $\frac{\text{distance}}{\text{time}}$

Time = $\frac{\text{distance}}{\text{speed}}$

a. In these formulas speed is rounded to the nearest tenth of a knot (i.e., 10.66 = 10.7, 10.64 = 10.6).

b. Time is expressed in hours and minutes. However, when multiplying or dividing, time must be converted to decimal format (see Attachment A for a conversion chart).

(1) Example 1 - Changing 1 hour and 15 minutes (1:15) into decimal format.

(a) Step 1 - Take 15 minutes and divide it by 60 (as there are 60 minutes in an hour).

```
     0.25
60 | 15.0

     120
```

300

300

0

SOLUTION. 15 minutes is equal to 25 hundredths (.25) of an hour.

NOTE. Always take your remainder to the hundredths place (two digits).

(b) Step 2 - Add the solution in Step 1 to the whole hour. 1: 15 is now read as 1.25 hours and is ready to be multiplied or divided.

(2) Example 2 - Changing decimal hours into hours and minutes. (Always multiply the fraction of an hour to the right of the decimal.)

(a) Step 1 - Take .25 and multiply it by 60.

60
.25
300

l20
15.00

(b) Step 2 - Take the solution to Step 1 and add the whole hour. 1.25 hours is now 1: 15, or one hour and 15 minutes.

c. Distance is expressed in nautical miles and is rounded to the nearest l0th of a nautical mile (i.e., 10.5, 12.2, etc.). Distance is determined by multiplying the desired or actual speed by the time of passage (TOP) (D = S x T).

d. An easy method of remembering the formula is to utilize the phrase "D Street". The "D" represents distance and the abbreviation of street, "ST", represents speed and time. When solving a "D street" problem, it is always helpful to draw the following diagram and cover the symbol for the answer you need. The formula for the answer remains uncovered.

D

S | T

.

(1) For speed cover the letter S.

(a) The formula is now:

S = D divided by T

(b) Divide distance in nautical miles by time in decimals = speed in knots.

(2) For time, cover the letter T.

(a) The formula is now: T = D divided by S

(b) Divide distance in nautical miles by speed in knots = time in decimals; then convert decimals to minutes.

(3) For distance, cover the letter D.

(a) The formula is:

D=S x T

(b) Speed in knots x time in hours = distance in nautical miles.

4. **Terms and Symbols**

a. **Fix**. A statement of fact determined by electronics or through the use of two or more lines of position.

b. **DR Position.** An approximate position at any given time based upon course and distance (speed x time). It is also serves as a log book of approximate positions and changes in course and speed as a vessel travels. A DR plot must be constantly updated, for without it, you will not know your approximate position or be able to determine current effects on your craft.

(1) A DR position shall be plotted at the time of every course change.

(2) A DR position shall be plotted at the time of every speed change.

(3) A DR position shall be plotted at the time a single line of position is obtained (estimate position).

(4) A DR position shall be plotted at the time a fix or running fix is obtained.

c. **Estimated Position (EP).** The most probable position of a vessel determined from incomplete data or data of questionable accuracy.

d. Launch Point (LP). A known position where the mother ship or intermediate vessel begins launching the craft.

e. Insert Point IP). A known position at which the launching of craft is complete and the DR track begins.

f. Beach Landing Site (BLS). A known position ashore where you intend to land.

g. Rendezvous Point (RV). A known position at sea where you intend to linkup with the mother ship or intermediate vessel.

h. Course Line. A line, as drawn on a chart, extending in the direction of a course.

---

i. Course (C) is the horizontal direction in which a vessel is steered or intended to be steered, expressed as angular distance from north, usually from 0000 at north, clockwise through 360°. The course is designated as true, magnetic, compass, or grid depending on the reference direction. Course can be either an anticipated or an accomplished direction of travel with respect to the water. The course is assumed to be a true course unless another reference is stated. In such a case, the reference must be given as magnetic (M) or compass (C). (Courses are rounded to the nearest whole degree.)

C 090°M

j. Seepd (S) is the rate of travel of a ship through the water expressed in knots. It is used in conjunction with time to establish a distance run on each of the consecutive segments or vectors of the DR plot. (Speed is rounded to the nearest tenth of a knot.)

C 090°M
S 10.0kts

k. Distance (D) is a linear measurement between two points on the surface of the earth, represented in navigation by two points on the chart. The common unit of distance in navigation is the nautical mile, which is equal to 6,076.1 feet or one minute of latitude on the Mercator chart. (Nautical miles are rounded to the nearest l0th.)

C 090°M
S 10.0kts
D 10.2NM

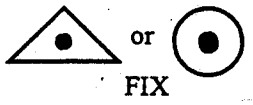
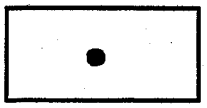
.

.

l. Time of Passage (TOP). TOP is the time, predicted or actual, for a craft to travel from one point to another point.

m. Estimated Time of Departure (ETD). The planned time of departure from a specified location in accordance with a scheduled movement.

n. Estimated Time of Arrival (ETA). The best estimate of the time of arrival at a specified location in accordance with a scheduled movement.

SYMBOL AND DESCRIPTIVE LABEL	**Figure 1** MEANING
	AN ACCURATE POSITION DETERMINED WITHOUT REFERENCE TO ANY PREVIOUS POSITION, ESTABLISHED BY ELECTRONIC, VISUAL, OR CELESTIAL OBSERVATIONS.
	DEAD RECKONING POSITION. ADVANCED FROM A PREVIOUS KNOWN POSITION ON FIXED COURSE AND SPEED WITHOUT ALLOWANCE FOR WIND OR CURRENT.
	ESTIMATED POSITION. THE MOST PROBABLE POSITION OF A VESSEL, DETERMINED FROM DATA OF QUESTIONABLE ACCURACY,

773
774
775
776

5. **Plotting and Labeling a DR Course**

a. Step 1. Plot the latitude and longitude position for the IP, BLS, and RV. Plot them as a circle with a dot in the center and label them with “IP", “BLS", and “RV".

b. Step 2. Draw a course line from IP to BLS and from BLS to RV.

c. Step 3. Determine the course to BLS and the course from BLS to RV with the use of your parallel ruler and chart compass rose. Label the start of each course line with its direction utilizing a small “C" on the top of the line. Ensure you label the heading as magnetic with a small “M".

d. Step 4. Determine your speed and label it just under the start of the course line with a small “S". The planned speed may be determined by taking into consideration the sea state, weather, and the capability of the craft. If you are given a launch time and a NL T time on the beach, then you may determine the planned speed by dividing the distance by the TOP.

e. Step 5. Determine the distance for each course using your dividers and the chart latitude scale. Label the start of each course line with its distance utilizing a small “D” just below the speed.

f. Step 6. Determine your time of passage and label it as "TOP" just below the center of each course line.

h. Step 7. Determine your ETD from the IP and BLS and label them as "ETD" at the IP and BLS.

i. Step 8. Determine your ETA at the BLS and RV and label them as “ETA" at the BLS and RV.

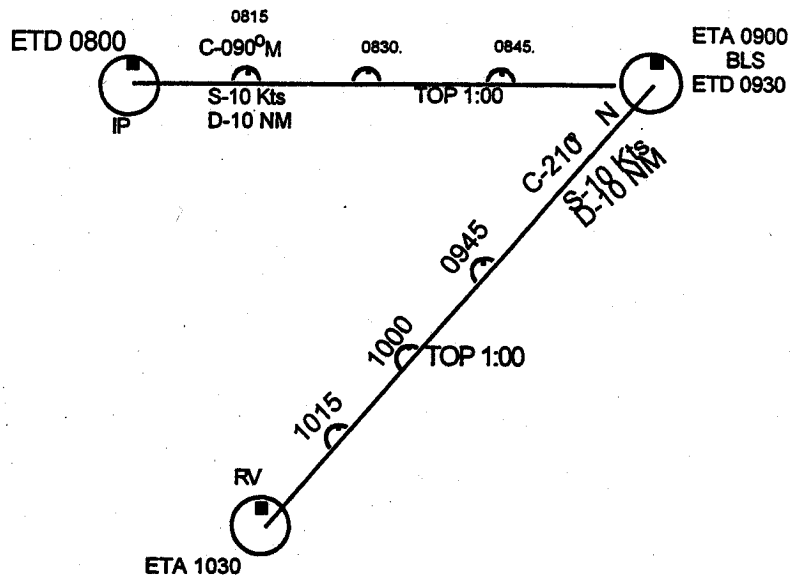


FIGURE 2 - THE DR PLOT

REFERENCES

1. *American Practical Navigator, Volume I. ch.8*
2. *Dutton's Navigation and piloting. ch. 8*

NOTES

ATTACHMENTS

A. – Minute to Decimal Conversion Table

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Forces
Camp Lejeune, North Carolina 28542-0080

TAB 565
SEP 98

STUDENT OUTLINE

PILOTING LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVES. With the aid of references, pilot a small boat in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references, identify in writing the three types of lines of position in accordance with the references.

(2) Without the aid of references, identify in writing the types of fixes in accordance with the references.

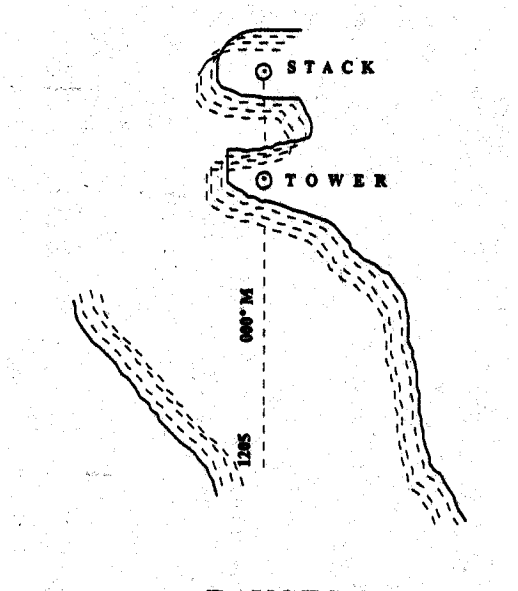
(3) Without the aid of references, during a navigation exercise, demonstrate one type of fix in accordance with the references.

OUTLINE

1. **Piloting.** Piloting involves frequent and continuous determination of a craft's position by reference to geographic positions on land or aids to navigation at sea.

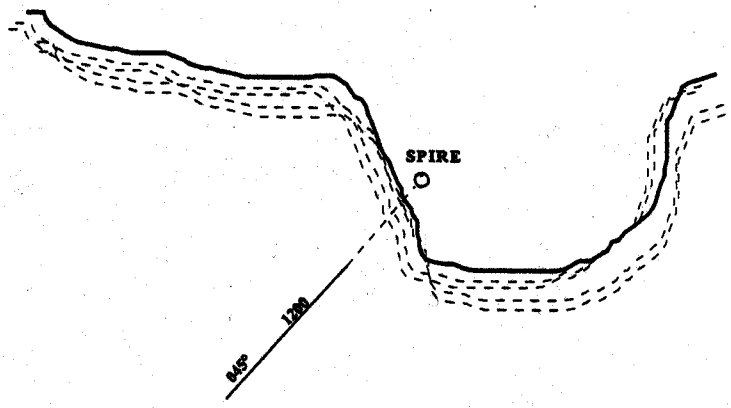
2. **Lines of Positions**. A line of position (LOP) is a "statement of fact". At the time of the observation, the observer is located somewhere along that line. In piloting as in almost all phases of navigation, the navigator must deal with lines of position. A single observation does not provide a position, but does provide a line at which on some point he is located. It must be remembered that there is no connection between the intended track and lines of position. The intended track and DR positions are statements of intention, a line of position is a statement of fact.

a. Range LOP. The simplest and most accurate LOP is the range LOP. If two fixed objects of .known position appear to be in line, at that instant, the vessel is somewhere along that line.



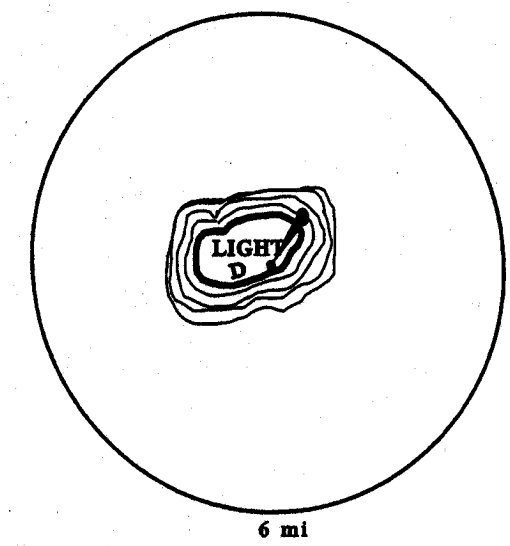
RANGE LOP

b. Bearing to the Object. An LOP is normally obtained by plotting a bearing on a chart. This is accomplished by sighting a compass at a known fixed object and determining the direction (bearing to the object). The azimuth is then plotted on a chart. The craft is somewhere along this LOP.



BEARING TO THE OBJECT

c. Circular LOP. If the distance to an object is known, the craft wi1llie somewhere on a circle centered on the object at that known distance.



Distance can be determined using a range finder or binoculars with a mil scale, provided that the height of the object is known and can be seen from bottom to top.

$$\text{DIST} = \frac{\text{Height in Meters X 1000}}{\text{Mil Scale Points}} \quad \text{or} \quad \frac{\text{Height X 1000 Mil}}{\text{Mils}}$$

3. Estimated Position (EP) An EP is the most probable position of a craft, determined from incomplete data or data of questionable accuracy. A single LOP will not give a "fix", but when used in conjunction with a DR position, can provide an estimated position.

a. Obtain a bearing to a fixed object. Draw this bearing from the object so that it crosses your intended track.

b. Label the LOP with the time of the bearing.

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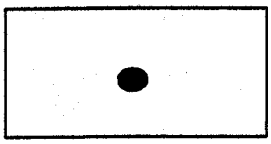
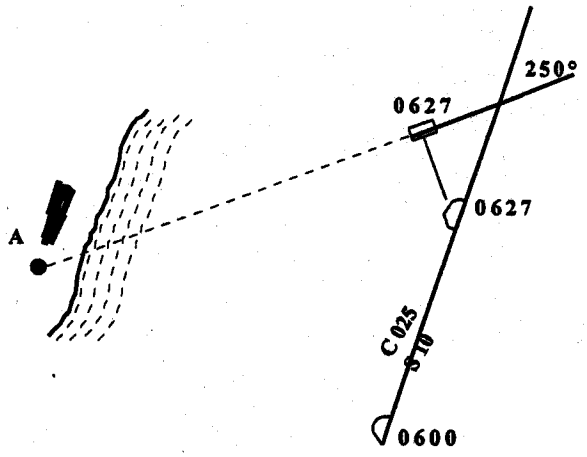
c. Draw a line perpendicular from the LOP through the DR position which coincides with the time of the LOP. The intersection along the LOP is the most probable position of the craft and should be labeled as an 'EP'.



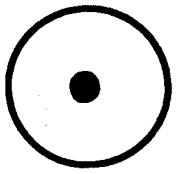
ESTIMATED POSITION

NOTE. Remember, an EP is still of questionable accuracy and can only be <u>assumed</u> to be correct.

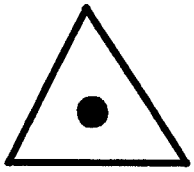


ESTIMATED POSITION (EP)

4. **<u>Fix.</u>** A fix is a position determined without reference to any former position. In concept, a fix is the common intersection of two (or more), simultaneous, non-parallel lines of position, exactly like resection in land navigation. The following are examples of how to plot a fix:

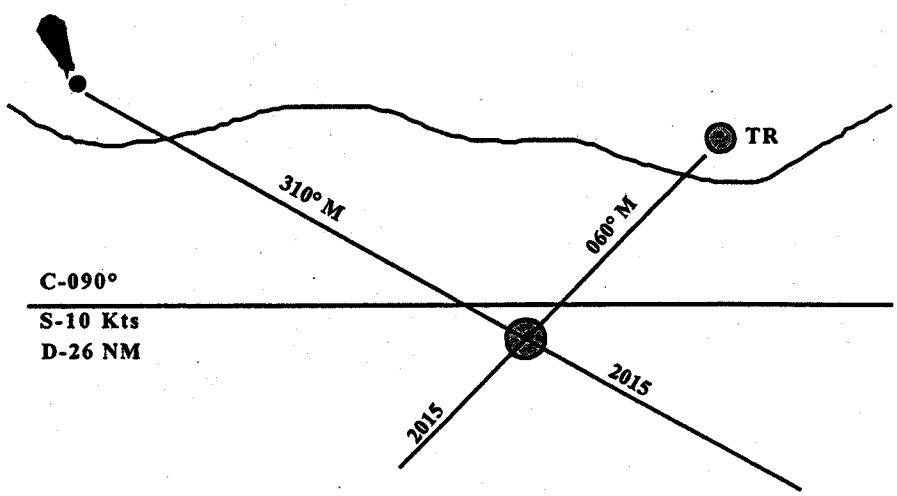


LOP

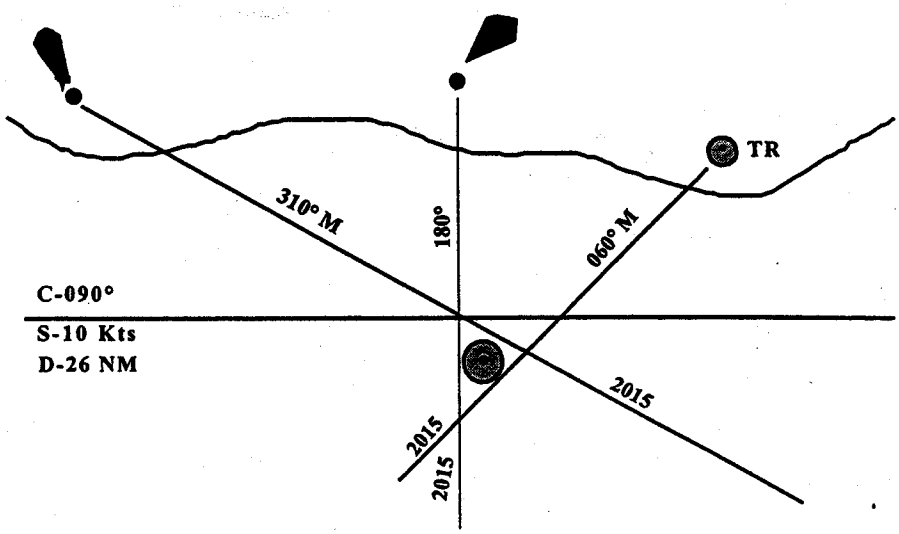


ELECTRONIC

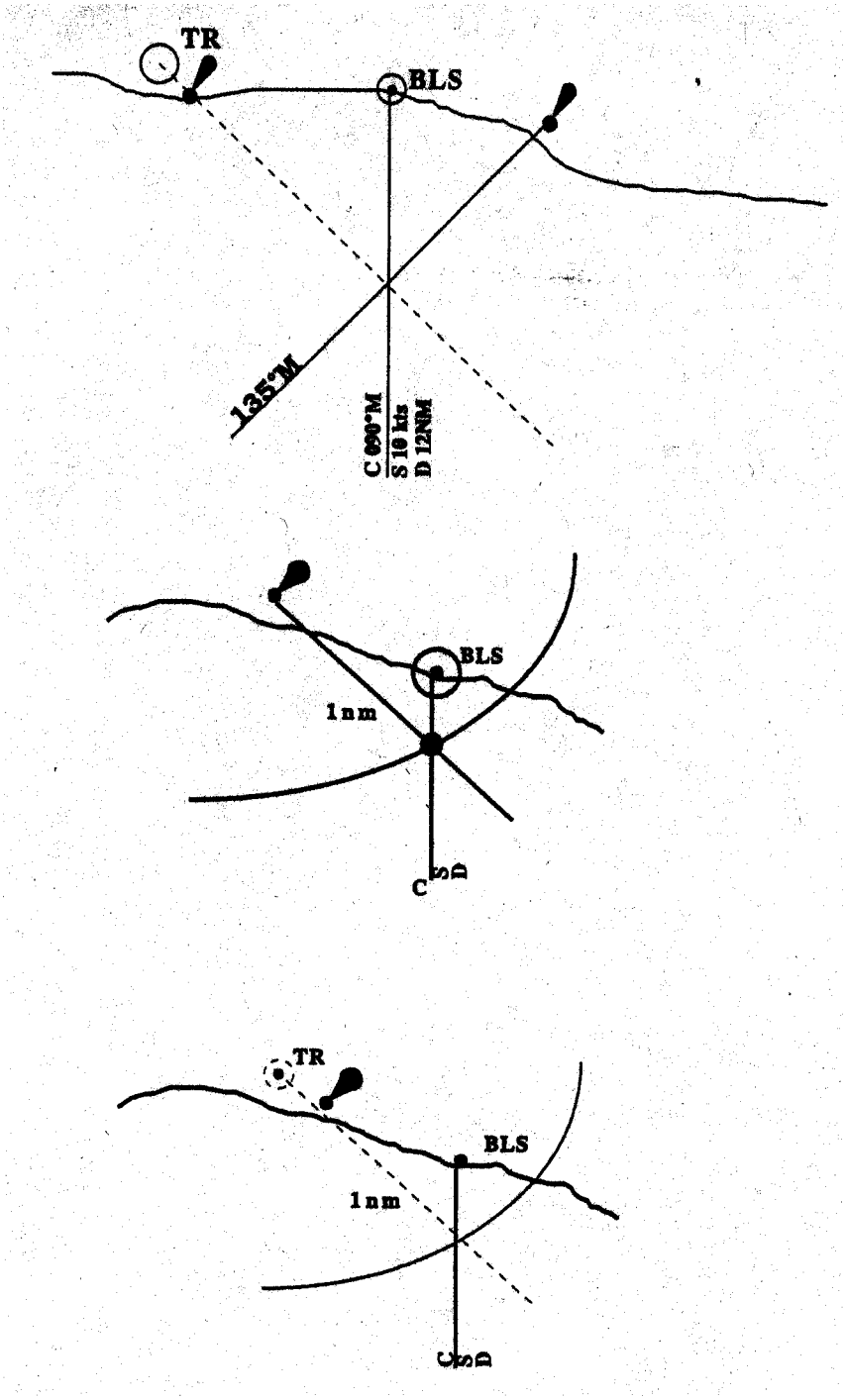
a. Two-Cross Bearing, If two selected objects are positively identified and azimuths are accurately plotted, the intersection of the LOP's is a fix and can be considered a sound position. Label "fix" with the time and LOP bearings. The ideal angle between LOP's is 90°; if the angle is smaller, distortion increases. An angle of less than 30° should be regarded with caution. A slight error in measuring or plotting either LOP will result in a large error in position.



b. Multi-Cross Bearing. This type of fix eliminates questions of accuracy by majority agreement of intersections. The fix is determined as the center of the triangle. For three LOP's, 60 degree separation is preferred.



c. Combination. You could obtain a fix by using a combination of the different types of LOP's such as: bearing and range, bearing and circular or range and circular.



d. The Running Fix (Advancing an LOP). A fix obtained by two lines of position to the same object taken at different times and adjusted by time and distance is called a running fix. The running fix is plotted by making allowance for the exact time between the first and second observations. (The navigator assumes that for the limited period between observation), the craft makes good planned course and speed). The two observations should be taken less than 30 minutes apart.

(I) Shoot a LOP to an object.

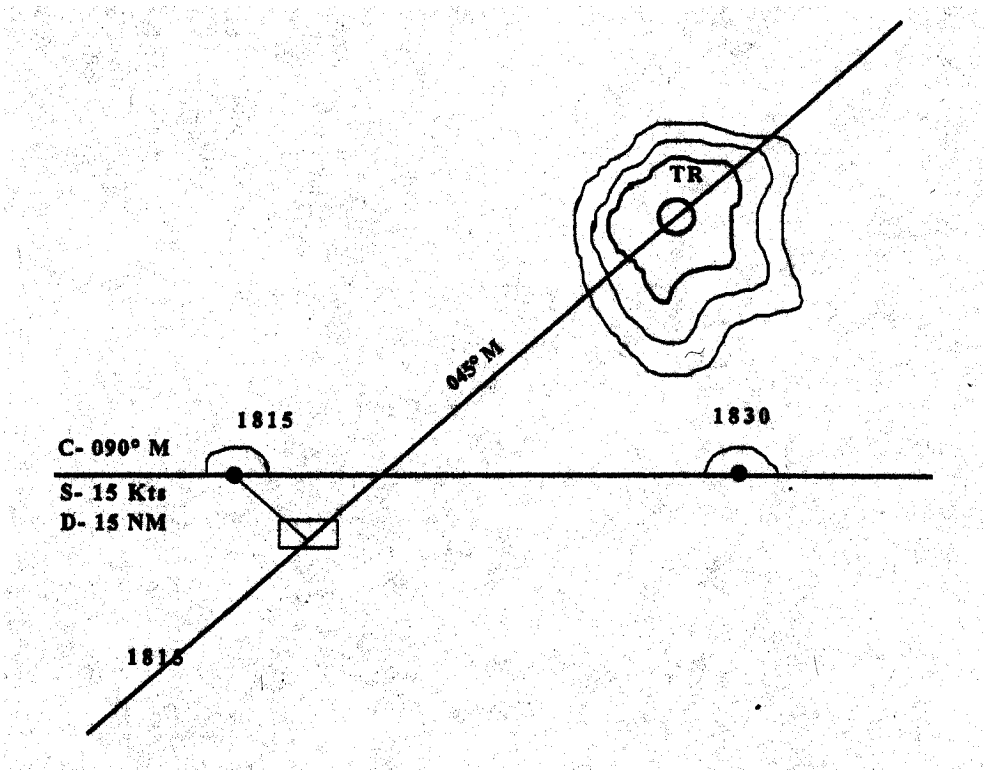
(2) Make good your course and speed for a period less than 30 minutes.

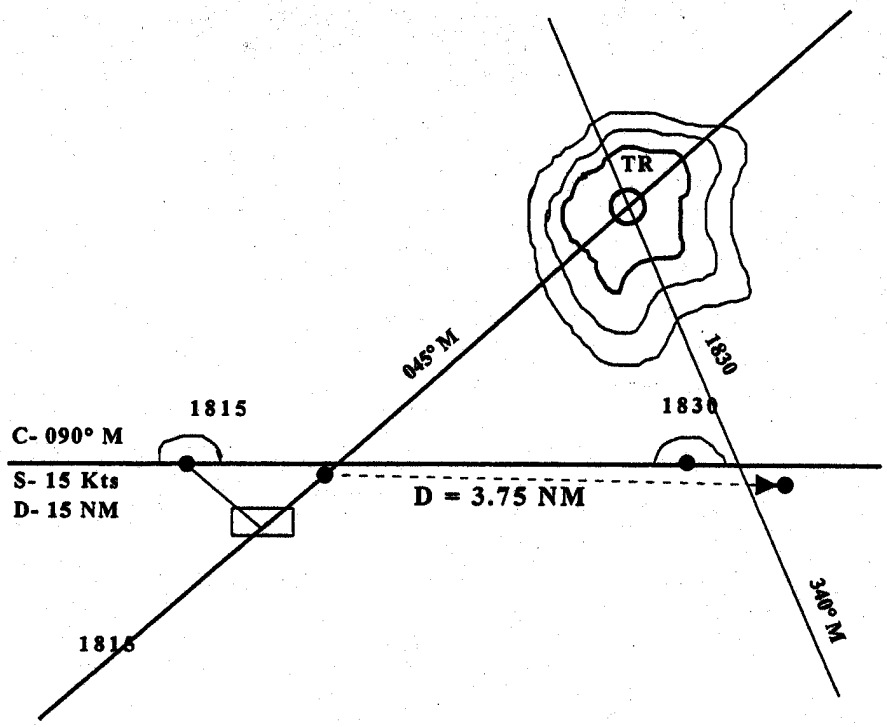
(3) Shoot a second LOP to the same object.

(4) Draw and label this second LOP.

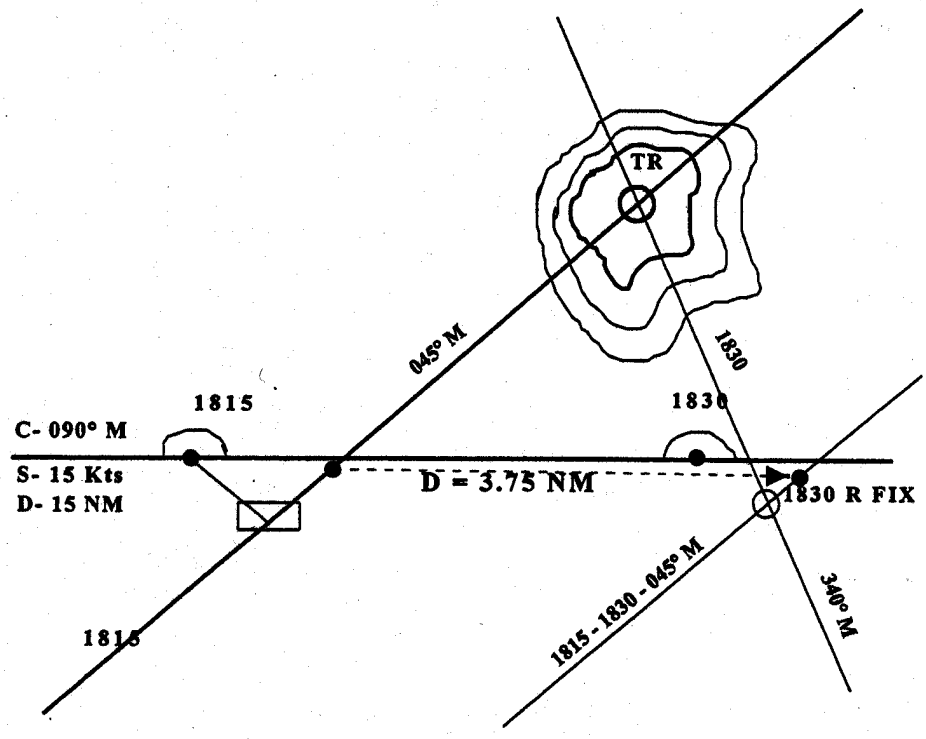
(5) Advance your first LOP. Remember D = S x T.

(5) Where advanced LOP crosses your second LOP, plot your position.





SHOOTING SECOND BEARING



REFERENCES.

1. *Dutton's Navigation and Piloting*
2. *American Practical Navigator*

Notes

Attachments. None.

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
.Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 566
SEP 98

STUDENT OUTLINE

MOUNTING AND SWINGING THE NAUTICAL COMP ASS

LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVE. With the aid of references and provided the necessary materials, mount and swing a nautical compass in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references, identify in writing the purpose of swinging a nautical compass in accordance with the references.

(2) Without the aid of references, identify in writing the procedures for mounting a nautical compass in accordance with the references.

(3) Without the aid of references, identify in writing the procedures for swinging a nautical compass on a RRC in accordance with the references.

(4) With the aid of references, construct a deviation table in accordance with the references.

OUTLINE

1. Purpose. The purpose of swinging a compass is to determine deviation. Deviation is the amount of error a compass has due to local magnetic influences and errors in the compass. Deviation can be partially eliminated with adjustments made to the compass by turning one of two adjusting screws; however, deviation cannot be completely eliminated. As a result, it is necessary to swing the compass to construct a deviation table which compensates for this remaining deviation. The compass is swung utilizing a compass rose which has been surveyed on the ground. The compass rose will have a center mark which will normally be annotated with the date and the unit which did the survey. The compass rose will be marked off with North, South, East and West and at 15 degree increments. The compass rose headings are all magnetic and are statements of fact.

2. **Swinging the Compass**. Deviation changes with a change in the vessel's heading. The deviation is determined by comparing a direction shown on the compass with a known magnetic direction. This comparison is referred to as swinging the compass. The ideal method of swinging a nautical compass is to have it on the small boat with all personnel and equipment on-board. This method is not always possible due to operational considerations.

a. Place the compass on the center of compass rose. Ensure the compass lubber line is perfectly aligned with the north-south line on the compass rose.

b. Read the compass heading using TVMDC. Determine your deviation. (If the heading on the compass is to the right of the heading on the compass rose, you have a EASTERLY deviation. If the heading on the compass is to the left of the heading on the compass rose, you have a WESTERLY deviation.)

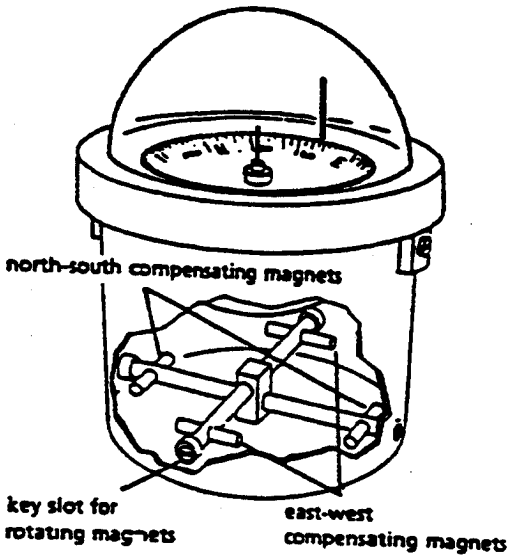
c. Swing the compass around 180° so that the lubber line points due south. Read the heading and determine your deviation.

d. Using the north/south adjusting screw, adjust the compass to eliminate an equal amount of deviation in both north and south directions. Remember that when you adjust one direction, it will also effect the opposite direction.

e. Recheck north and south deviations.

f. Write down the deviation. Follow steps (a) through (e) using east and west.

g. Follow the same step for each 15 degrees of the compass EXCEPT make no more .adjustments to the adjusting screw



3. **Constructing a Deviation Table**. The deviation for a compass is depicted on a form called a deviation table or magnetic compass table. This table is laminated and attached to the compass. The back of the table should have the person's name who constructed the table and the date. The deviation table has two columns: The first is the magnetic heading and the second column is the deviation for that heading.

SHIPS HEAD MAGNETIC	DEVIATION	SHIPS HEAD MAGNETIC	DEVIATION	SHIPS HEAD MAGNETIC	DEVIATION
0	5°w	120	2°W	240	6°E
15	6°W	135	0°	255	6°E
30	6°W	150	2°E	270	5°E
45	6°W	165	4°E	285	4°E
60	5°W	180	5°E	300	2°E
75	5°W	195	6°E	315	0°
90	5°W	210	6°E	330	2°W
105	4°W	225	7°E	345	4°W

DEVIATION TABLE

4. **Mounting**. When mounting the compass, it is imperative that the compass lubber line is parallel to the center line of the craft and that the compass is securely fastened.

a. Slightly deflate the port rear gunnel tube.

b. Tie four loops utilizing the bowline on the four comers of the compass board using 1/2" tubular nylon.

c. With the running end tie a loop on each line just below the four comers of the compass board, (approximately 1 inch below).

d. Place the compass board onto the gunnel tube. Run the two outside lines through the two carring handles outside of the gunnel tube and then back through the loops. Repeat the same process for the inside securing points utilizing either the bladder lashing lines or the stiffening bolt.

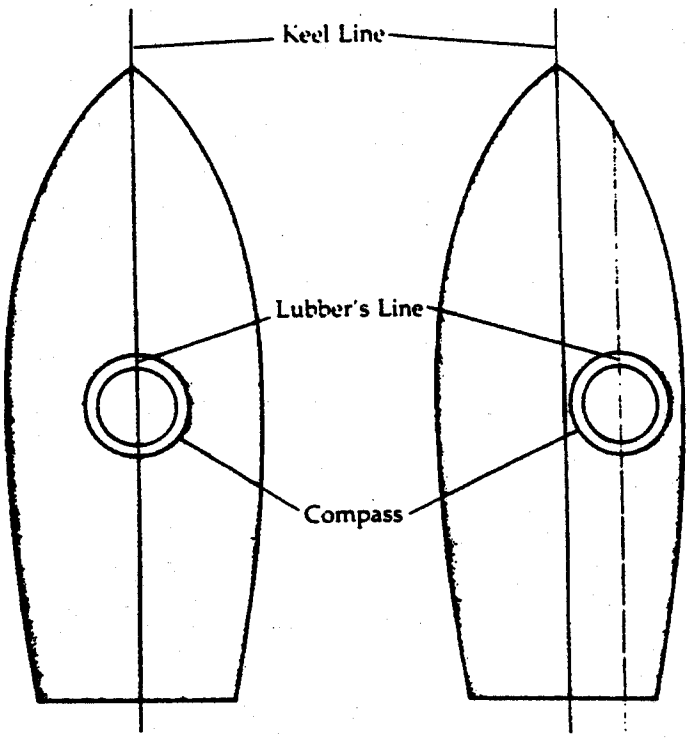
e. Place a line from the center of the transom to the center of the bow (this is used as a guide to .align the compass lubber line with the center line of the CRRC).

f. Using another piece of line, placing it just on top of the compass lubber line, align the compass so that the lubber line is parallel to the craft's center line.

g. When the compass lubber line is in line with the center line of the CRRC, tighten down each loop without moving the compass using an X pattern, then secure the end of the line with two flex cuffs.

h. Inflate the gunnel tube to pressure.

NOTE: Ensure that the compass board does not move until the all four lines have been tightened and secured.



Mounting the Compass

REFERENCES

1. *U.S. Coast Guard Auxiliary Boating Skills and Seamanship Manual, 9th ed.*
2. *Chapman Piloting*
3. *Dutton's Navigation and Piloting, 14th ed.*

NOTES

ATTACHMENTS None

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542-0080

STUDENT OUTLINE

TIDES AND TIDAL CURRENTS LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVE.

(1) With the aid of references, predict the height of tide in accordance with FM 55-501, *Marine Crewman's Handbook.*

(2) With the aid of references, estimate the set and drift of the tidal current in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references, when given a list, identify in writing tide terminology in accordance with the references.

(2) Without the aid of references, identify in writing, the three types of tides in accordance with the references.

(3) With the aid of references, predict the height of tide for any given time and location using the Tide Tables, summary of calculations for computing height of tide and tide table matrix worksheet in accordance with the references.

(4) Without the aid of references, identify in writing the three phases of tidal current in accordance with the references.

(5) With the aid of references, estimate the set and drift of the tidal current for any given time and location in accordance with the references.

OUTLINE

1**. Introduction**. When approaching a harbor or piloting waters, it becomes very important to know the depth of the water and the tidal currents. The depth of water varies due to the gravitational and centrifugal forces between the earth, moon and sun, this will cause the ocean level to periodically rise and fall and this phenomenon known as tide. Therefore, as a navigator it is imperative that you have a thorough knowledge of calculating the height of tide, which in turn allows you to determine the depth of the water and to allow for the tidal currents.

2. **Definitions**

a. Tide. The vertical rise and fall of the ocean level as a result of changes in the gravitational attraction between the earth, moon and sun. It is a vertical motion only.

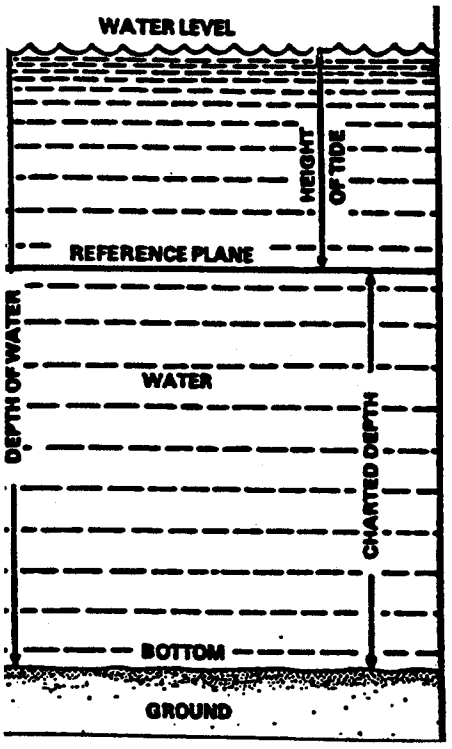
b. High Tide or High Water. The highest level reached by the rising tide.

c. Low Tide or Low Water. The lowest level reached by the falling tide.

d. Range of Tide. The total difference between high water and low water.

e. Height of Tide. The vertical measurement between the surface of the water and the reference plane.

f. Stand or Slack. A brief period between high and low water where there is little or no vertical movement of water.



RELATIONSHIP OF TIDAL TERMS

g. Tidal Reference Plane (or datum plane). A reference line based upon a selected low water average (indicated in chart marginal information). Remember, the water level occasionally falls below the tidal reference plane.

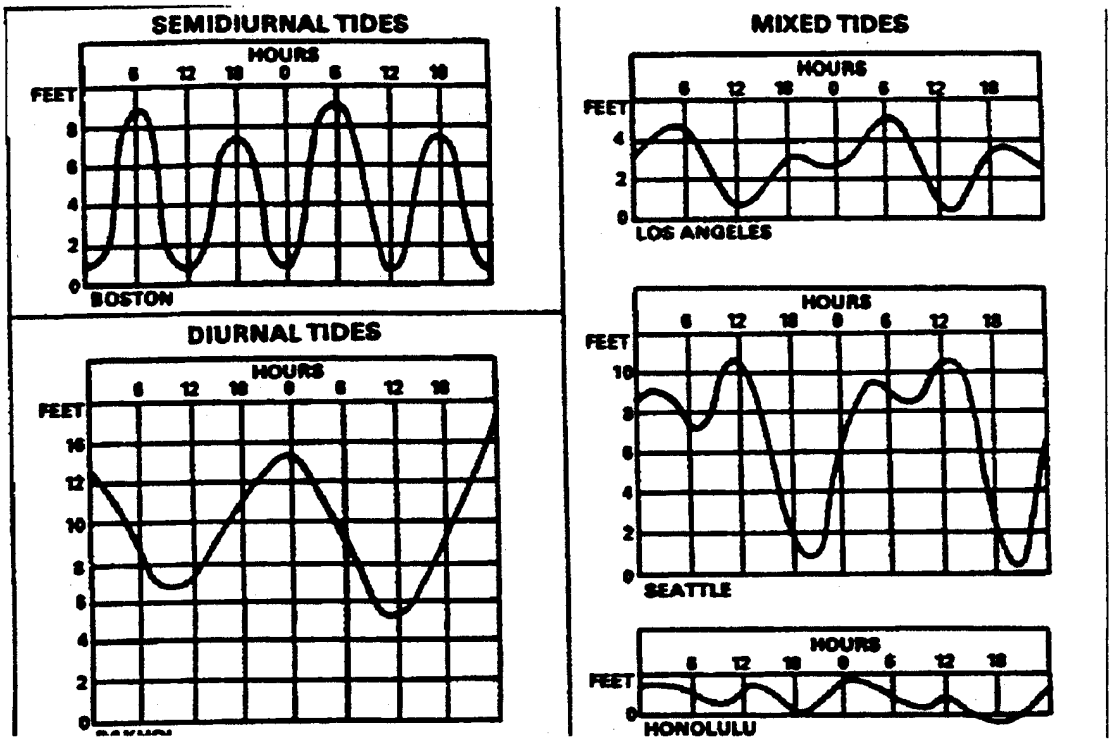
h. Charted Depth. The vertical distance from the tidal reference plane to the bottom.

i. Depth of Water. The vertical distance from the surface of the water to the bottom.

3. **Types of Tides**. The following tides are named according to the characteristics of tidal patterns in certain areas:

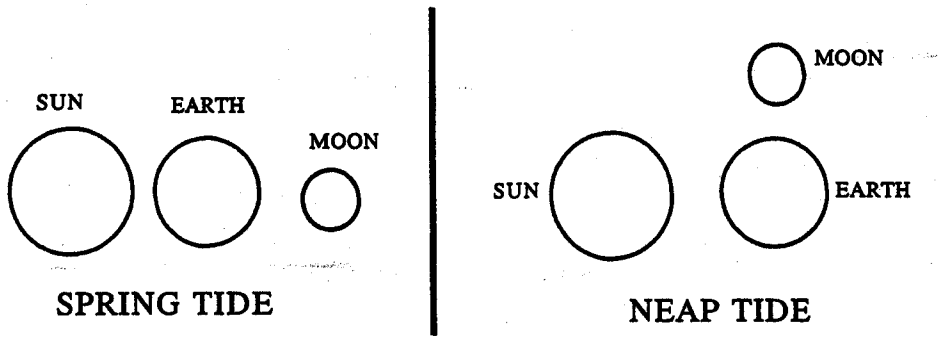
a. Semidiurnal Tide. For each tidal day there are two almost equal high waters two almost equal low waters. This type of tide occurs most commonly along the east coast of the United States.

b. Diurnal Tide. With this type of tide, only one high water and one low water occur each tidal day. This type of tide is found in the Gulf of Mexico, the Java Sea, and the Gulf of Tonkin along the North Vietnamese-Chinese coast.



TYPES OF TIDES

c. Mixed Tide. This type of tide is characterized by a large difference in the high water heights, low water heights, or in both. There are usually two high waters and two low waters each day, but once in a while, the tide may become diurnal. This type of tide is most common on the Pacific coast of the United States.



4. **Effects of the Moon and Sun**

a. Spring Tide. Normally greater than average ranges of tide occur near the time of a new moon when the gravitational effects of the sun and the moon are complimenting each other.

b. Neap Tide. Normally less than average ranges of tide occur near the times of first and third quarter moons when the gravitational effects of the sun and moon are working against each other.

5. **Tide Tables**. Predictions of tidal heights are published annually by the National Ocean Service. Tide Tables are issued in four volumes: Europe and the West Coast of Africa (including the Mediterranean Sea), East Coast of North and South America (including Greenland), West Coast of North and South America (including Hawaiian Islands), and Central and Western Pacific Ocean and Indian Ocean. Together , they contain tidal predictions for 196 reference stations and the adjustments for about 6,000 substations. Each volume is arranged as follows:

a. Table 1. Contains a complete list of the predicted times and heights of the tide for each day of the year at a number of designated reference stations. All times stated in the Tide Tables are standard times, so adjustments are required for the use of daylight savings time or for any other differences from standard time. Where no sign is given before the predicted tidal height, the tide is positive and is added to the depths depicted on a chart. If a minus (-) sign is in front of the height, then the tide is subtracted from the charted depths. While there are normally two high. and two low tides for each date, they are, on an average, nearly an hour later each succeeding

day. As a result, there will be instances when a high or low tide may skip a calendar day as indicated by a blank space in the Tide Tables.

b. Table 2. Gives differences and ratios which can be used to modify the tidal information for the reference stations to make it applicable to a relatively large number of subordinate stations (substations). These stations are listed in geographical order in Table 2. Each substation is given a number and a location in latitude and longitude given to the nearest minute. Under the "differences" column, data is given which will be applied to the predictions at a stated reference station (the specific reference station is shown in bold type). If there is more than one reference station shown on a page of Table 2, make sure that you use the reference station printed directly above the substation listed.

c. Table 3. Provides information for use in finding the approximate height of the tide at any time between high water and low water.

d. Table 4. Is a sunrise-sunset table at five-day intervals for various latitudes from 76° N to 60° S (40° in one volume).

e. Table 5. Provides an adjustment to convert the local mean time of Table 4 to zone or standard time.

f. Table 6. (Two volumes only) Gives the zone time of moonrise and moonset for each day of the year at selected locations.

6. **Predicting the Height of Tide**. As we have discussed, the height of tide can be predicted for any time at any specific location using the summary of calculations for computing the height of tide worksheet.

a. Find the Substation number in the index or go to table two to locate the latitude/longitude.

b. Write down the following information from Table 2 on your calculation sheet: reference station, time differences for high and low water, height differences for high and low water.

c. Turn to your reference station in Table 1. Find the date you are interested in. You will need the times of two tides before and two after the time you are interested in. This is known as bracketing. Note these times, the types of each tide (high or low), and the height of each tide on your calculation sheet.

d. Add or subtract the substation time difference for each tide at the reference station. This adjustment will give you the correct time for each tide at the substation.

(1) Remember when adding or subtracting values of time, there are 60 minutes in an hour and 60 seconds in a minute; Don't forget to work in decimal terms of 100 units.

(2) When subtracting, subtract earlier time from later time

ADDING

a.
```
  14 35
+  2 15
-------
 16 50
```

b.
```
  17 45
   3 30
-------
  20 75
```

$\boxed{20\ 75 = 21\ 15}$

SUBTRACTING

a.
```
  17 55
- 12 30
-------
   5 25
```

b.
```
  20 70
  21 10
- 15 30
-------
```
→
```
  20 70
- 15 30
-------
   5 40
```

c.
```
  01 20
- 19 15
-------
```

```
  25 20
- 19 15
-------
   6 05
```

e. Add or subtract the substation height difference for each tide at the reference station (height differences are not the same for high and low water). This adjustment will give you the correct height for each tide at the substation.

f. Determine the time you are interested in and locate where it falls within the tides at your substation.

g. Determine the duration of rise or fall between the tides which bracket the time you are interested in. Note this on your sheet.

h. Determine the length of time to the nearest tide for the time you are interested in. Note .this on your sheet.

i. Determine the range of tide between the two tides which bracket the time you are interested in. Note this on your sheet.

j. Determine the height of the tide which falls closest to the time you are interested in. Note this on your sheet.

k. Turn to Table 3. Looking at the left side of the table, locate your duration of rise or fall. Across the top of the table, locate the time to the nearest tide. Locate the value in the upper part of the table where the two lines intersect. From this point, move straight down to the bottom section of the table. On the left side of the bottom section, locate your range of tide. The correction for the height of tide is located where the two lines intersect in the bottom section of the table. Note this on your sheet.

1. Add or subtract the correction for Table 3 to the height of the nearest tide. The result is the height of tide at your desired location.

7. **The Three Phases of Tidal Current**

a. Flood Current. The horizontal movement of a flood current is toward the shore.

b. Ebb Current. The horizontal movement of an ebb current is away from shore.

c. Slack Water. Slack water is the brief time between flood and ebb currents when no horizontal movement can be detected

8. **Direction and Speed**

a. Direction. Direction of tidal current is referred to as set, and is expressed in degrees true.

b. Speed. Speed of tidal current is referred to as drift, and is expressed in knots.

9. **Tidal Current Tables**. Tidal Current Tables for the Atlantic Coast of North America and Tidal Current Tables for the Pacific Coast of North America and Asia are published annually by the National Ocean Survey. These tables are similar to the Tide Tables, but the coverage is not as extensive.

a. Table 1. Contains a list of reference stations, complete list of predicted times of maximum currents and slack, and the velocity (drifts) of the maximum currents.

.

b. Table 2. Is a list of secondary or subordinate stations arranged in geographic order, it includes a secondary station's position in latitude and longitude, its reference station, the difference in times of minimum and maximum currents, the maximum flood and ebb velocity ratios, and the direction of the maximum flood and ebb currents.

c. Table 3. Is used to determine the velocity of current at any intermediate time between slack and maximum current. This table is in two parts: A and B. Table A is used for all areas except where Table B is specified.

d. Table 4. Is used to find the duration of slack.

e. Table 5. (Atlantic Coast of North America only) gives information on rotary tidal currents.

10. **Estimating the Set and Drift of the Tidal Current**. Time differences are applied to the times of slack and maximum current at the reference station in the same manner that the time differences are applied when figuring tides. Application of the time difference to the tabulated time of flood and ebb current produces the time of the corresponding current at the substation. Maximum velocity at the substation is found by multiplying the maximum velocity at the reference station by the appropriate flood or ebb ratio. Flood direction is the approximate true direction toward which the flood current flows. Ebb direction is usually close to the reciprocal of the flood direction. Average flood and ebb velocities are averages of all the flood and ebb currents.

a. Find the Substation number in the index or go to table two to locate the latitude/longitude.

b. Write down on your summary of calculation sheet the following information from Table 2: the reference station, time differences for minimum before flood, flood, minimum before ebb and ebb, the speed ratios for flood and ebb, and direction of ebb and flood currents.

c. Turn to Table #I for your reference station information. Finding the reference station, you will need to locate the date you are interested in. You will need the times of two currents before and two after the time you are interested in. This is referred to as bracketing. Note these times with the type of current (slack, flood, or ebb) with their speed on your summary of calculation sheet.

d. Add or subtract the time differences from the time of current at the reference station. This will give you the corrected time of current for the substation.

e. Multiply the current from the reference station by the speed ratio for the type of current (flood or ebb). This will give you the corrected current for the substation.

f. Determine the time you are interested in, locate where this time will fall within the times of currents on your substation.

g. Determine the time interval between the nearest slack and your desired time on the substation. Note this on your sheet.

h. Determine the total time interval between slack and the maximum current. Note this on your sheet.

i. Turn to Table #3 on the left side, locate the time between slack and desired time, across the top locate the time between slack and maximum current. Where the two meet is your factor. Multiply this factor by the maximum current which was closest to your desired time, this will give you the velocity of the current for your desired time.

j. The direction will be the direction for ebb or flood as was noted in Table 2 earlier.

k. Your maximum current is the current closest to your desired time.

11. **Using Tide and Tidal Current Tables**. In using the Tide and Tidal Current Tables, you must bear in mind that the actual condition may vary. The Tide and Tidal Current Tables calculations are only an estimate for the height of tide and the Tidal Currents in that particular area at a specific time. You need to be aware of the geographical and coastline influences that can affect the estimated set and drift of the tidal currents and also, if available, reference any tidal current charts that will show a more accurate set and drift in relation to the height of tide for the specific time of operation.

REFERENCES

1. Tide Tables
2. FM 55-501, Marine Crewman's Handbook.
3. Tidal Current Tables.

NOTES

ATTACHMENTS

A - *Summary of Calculations for Predicting Height of Tide*.
B - *Index to Stations*.
C- *Table 1, Daily Tidal Predictions*.
D - *Table 2, Tidal Differences and Other Constants.*
E - *Table 3, Height of Tide at Any Time.*
F. - *Summary of Calculations for Set and Drift of Currents.*

UNITED STATES MARINE CORPS

Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542-0080

TAB 567
SEP 98

ATTACHMENT A

SUMMARY OF CALCULATIONS FOR COMPUTING HEIGHT OF TIDE

DATE:_____ **TIME:**_____

(1) SUBSTATION: _____

REFERENCE STATION:_____

HW TIME DIFFERENCE:_____

(2) LW TIME DIFFERENCE:_____

DIFFERENCE IN HEIGHT OF HW:_____

DIFFERENCE IN HEIGHT LW:_____

REFERENCE STATION: **SUBSTATION:**

(3) TIME OF TIDE	(3) TYPE OF TIDE	+ OR -	(4) TIME DIFFERENCE	(3) HEIGHT OF TIDE	+ OR -/x	(5) HEIGHT DIFFERENCE	(4)	(5) TIME OF TIDE	(5) TYPE OF TIDE	HEIGHT OF TIDE
_____	_____		_____	_____		_____		_____	_____	_____
_____	_____		_____	_____		_____		_____	_____	_____
_____	_____		_____	_____		_____		_____	_____	_____
_____	_____		_____	_____		_____		_____	_____	_____

HEIGHT OF TIDE AT:_____**AT:**_____**HRS ON:**_____

(6) DURATION OF RISE AND FALL:_____ **(7) HEIGHT OF NEAREST TIDE:** _____

(8) TIME TO NEAREST TIDE: _____ **(10) CORRECTION:** _____

(9) RANGE OF TIDE:_____ **HEIGHT OF TIDE AT:**_____**Hrs** _____**FT**

GUIDELINES:

(1) REFERENCES IN BACK OF TIDE TABLES INDEX TO STATIONS, FIND SUBSTATION NUMBER OR GO TO TABLE #2, FIND LAT/LONG.

(2) GO TO TABLE #2 LOCATE SUBSTATION NUMBER, GO TO DIFFERENCES COLUMN WRITE DOWN TIME, HEIGHT DIFFERENCES FOR HW, LW MAY HAVE (-) (+) (x). LOOK UP AT BOLD PRINT, WRITE DOWN REFERENCE STATION.

(3) TURN TO TABLE #1 FOR REFERENCE STATION, FIND DATE/TIME OF YOUR OP, AND BRACKET TIME. NOTE: TIME OF TIDES, HGT. OF TIDES.

(4) BRING DOWN HW, LW TIME DIFFERENCES FROM STEP (2) ADD OR SUBTRACT TIME DIFFERENCES FOR HW, LW. THIS WILL GIVE YOU NEW TIME OF TIDE FOR HW, LW.

(5) ADD, SUBTRACT, MULTIPLE HGT. DIFFERENCES AND HGT. OF TIDE TO DETERMINE NEW HGT OF TIDE, BASED ON SIGN FOR HGT DIFFERENCE. IF THERE IS A (-) SIGN FROM TABLE #1 FOR HGT OF TIDE YOU STILL (+) (-) (x), BUT THE NEW HGT OF TIDE BECOMES A (-) NUMBER.

(6) DURATION OF RISE AND FALL IS THE DIFFERENCE BETWEEN TIME OF TIDES.

(7) HEIGHT OF NEAREST TIDE IS THE CLOSEST TIDE TO YOUR ACTUAL LANDING ALSO INDICATE L/H.

(8) TIME TO NEAREST TIDE IS THE DIFFERENCE BETWEEN THE NEAREST TIDE AND YOUR ACTUAL LANDING TIME.

(9) RANGE OF TIDE IS THE DIFFERENCE BETWEEN THE TWO HEIGHTS OF TIDES, SUBTRACT UNLESS ONE IS A NEGATIVE NUMBER, THEN ADD.

(10) REFER TO TABLE #3, FIND DURATION OF RISE AND FALL, READ RIGHT, FIND TIME NEAREST TO HW/LW, READ DOWN WHERE YOU INTERSECT WITH RANGE OF TIDE ISTHE CORRECTION, IF THE NEAREST TIDE IS HIGH, SUBTRACT LOW, ADD FROM (7). THIS WILL GIVE YOU THE HEIGHT OF TIDE FOR YOUR ACTUAL LANDING IN FEET.

Navigation Homework

Day 2

DIRECT READING DEVIATION TABLE

(For instructional purposes only)
(Do not use on your boat)

Enter Magnetic column when converting from from a magnetic heading to a compass heading.

Example:

T 070
V 9 W
M 079
D 5 W (Table)
C 084

When converting from true to compass, add west and subtract east.

2nd Example:

T 289
V 9 W
M 298
D 2 E (Table)
C 296

SHIPS HEADING MAGNETIC	DEVIATION	COMPASS HEADING
0°	**5°W**	**5°**
15°	**6°W**	**21°**
30°	**6°W**	**36°**
45°	**6°W**	**51°**
60°	**5°W**	**65°**
75°	**5°W**	**80°**
90°	**5°W**	**95°**
105°	**4°W**	**109°**
120°	**2°W**	**122°**
135°	**0°**	**135°**
150°	**2°E**	**148°**
165°	**4°E**	**161°**
180°	**5°E**	**175°**
195°	**6°E**	**189°**
210°	**6°E**	**204°**
225°	**7°E**	**218°**
240°	**6°E**	**234°**
255°	**6°E**	**249°**
270°	**5°E**	**265°**
285°	**4°E**	**281°**
300°	**2°E**	**298°**
315°	**0°**	**315°**
330°	**2°W**	**332°**
345°	**4°W**	**349°**

Enter compass column when converting a compass heading to a magnetic heading.

Example:

C 116
D 2 W (Table)
M 114
V 9 W
T 105

When converting from compass to true, add east and subtract west.

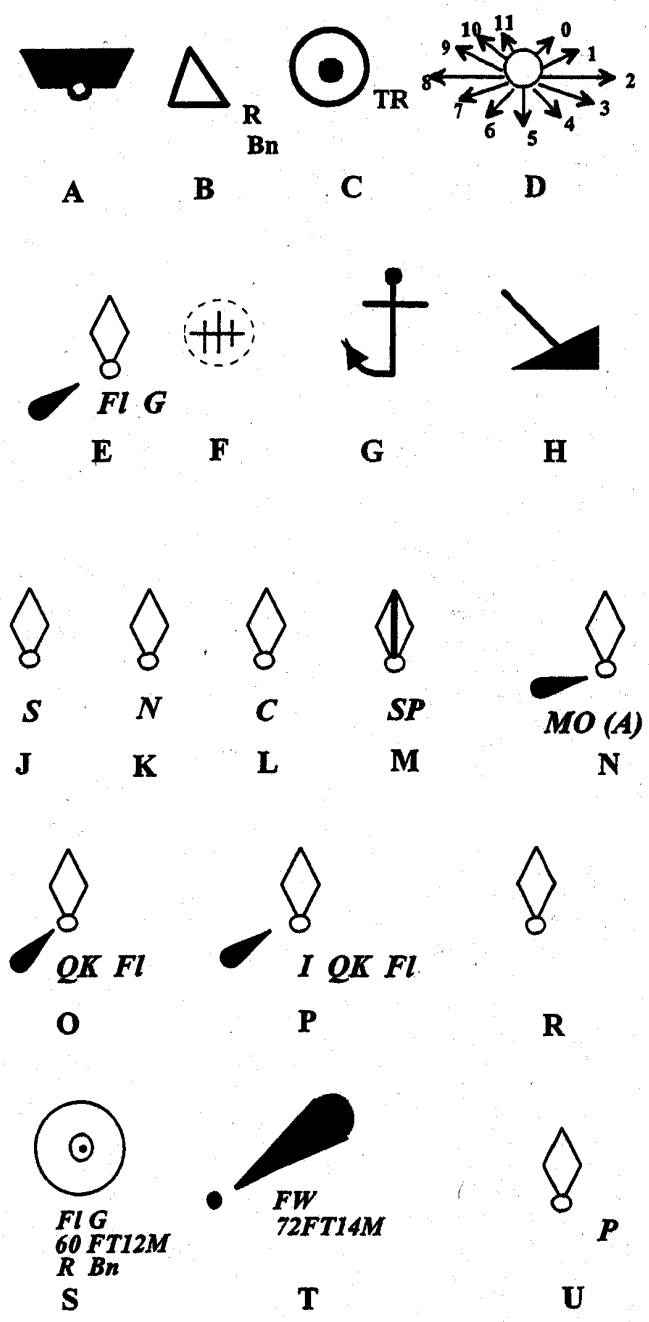
2nd Example:

C 312
D 0 (Table)
M 312
V 9 W
T 303

Navigation Homework

Day 2

1. The student will use Chart No.1 in order to detern1ine what each symbol represents. Write corresponding answers in the appropriate space provided.



A_____

B_____

C_____

D_____

E_____

F_____

G_____

H_____

J_____

K_____

L_____

M_____

N_____

O_____

P_____

R_____

S_____

T_____

U_____

Navigation-13
Navigation Homework

Day 2

Aids to Navigation

2. Plot the following coordinates of aids to navigation and identify and describe the aids and their characteristics.

a. L 34°30’19” N _____
Lo 77°24’44” W _____

b. L 34°27’10” N _____
Lo 77°29’43” W _____

c. L 34°34’45” N _____
L 77°23’41” W _____

d. L 34°30’26” N _____
Lo 77°24’08” W _____

e. L 34°34’06” N _____
Lo 77°23’11” W _____

f. L 34°30’00” N _____
Lo 77°25’45” W _____

g. L 34°44’12” N _____
Lo 77°21’16” W _____

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Nav Work
SEP 98

HOMEWORK DAY 3

1. Dead Reckoning is the determination of a position by advancing a known position using?
   _____ _____ _____ _____

2. A statement of fact determined by electronics or through the use of two or more lines of position is called a _____.

3. TOP stands for? _____ _____ _____.

4. LOP stands for? _____ _____ _____.

5. EP stands for? _____ _____.

6. When shooting a two cross bearing, an angle of _____degrees is considered ideal.

7. An angle of less than _____degrees should not be used in a two cross bearing.

PILOTING

You are conducting diving operations on the wreck located at 33°54.3'N 77°43.9' W. At 1000 you depart to conduct dives on the wreck located at 34°8.1'N 77°43.9' W. Along your route you take two cross bearings to find your position. You shoot a 290° bearing to the RW "CB" Mo(A) Whis, Carolina Beach Inlet located at 34°4.3'N 77°51.3'W, and a 353° bearing to the RW "A" Mo(A) Whis, Masonboro Inlet located at 34°10.4'N 77°47.9W. The position fix is:

L _____
Lo_____

You depart at 1500 to go to Topsail Beach. In route you shoot another two cross bearing to find your position. A 274° Bearing to the Mo (A) at Masonboro Inlet and a 34° bearing to the Mo(A) at Little Topsail Inlet gives you a fix of:

L_____
Lo_____

Navigation Homework

Day 3
Dead Reckoning Problems

1. In the following problems, determine the time difference. You must remember that you **CAN NOT** utilize your calculator to add or subtract time.

a. If it is now 0500 and we plan to leave at 1400. How long will we have to wait? ……._____

b. If we leave the IP at 1527 and arrive at the BLS at 2108, how long was the Journey?……._____

c. If we land on the BLS at 2216 and depart at 0303, how much time did we spend on shore? ……_____

d. We were transiting to the RV. At 0958 our boat broke down. It took 4 hours and 32 minutes to repair it. At what time were we ready to move out?…… _____

e. We departed the IP at 1953. We arrived at the BLS at 2112. We departed the BLS at 0048. We arrived at the RV site at 0455. How much time elapsed from leaving the IP till we arrived at the RV?…….._____

2. In each case below, write the formula and fill in the missing value. In your calculations, carry decimals to at least two figures. The degree of accuracy required for these answers will be: Time to the nearest minute, speed to the nearest tenth of a knot, and distance to the nearest tenth a nautical mile.

	Formula	**Answer**
a. We cruised at a speed of 11.6 knots for 2 hours and 14 minutes. What was the distance traveled?	_____	_____
b. It took 1 hour and 22 minutes to cruise a distance of 18.6 NM. What was our speed?	_____	_____
c. We cruised at a speed of 14.3 knots for a distance of 24.6 NM. What was your elapsed time en route?	_____	_____
d. It took 34 minutes to cruise a distance of 7.3 NM. What was our speed?	_____	_____

Navigation Homework

Day 3

	Formula	Answer
e. We cruised at a speed of 16.5 knots for 1 hour and 3 minutes. What was the distance traveled?	_____	_____
f. We wish to arrive at a point 18.5 NM away in 2 hours and 8 minutes. At what speed should we travel?	_____	_____
g. Our cruise will be a distance of 41.2 NM. We intend to cruise at a speed of 8.2 knots. What will out time be en route?	_____	_____
h. It took 2 hours and 28 minutes to cross a bay. We cruised at a speed if 12.7 knots. What is the distance across the bay?	_____	_____
i. We intend to cruise a total distance of 49.4 NM at a speed of 16.2 knots. In order to arrive at our destination exactly at noon, at exactly what time must we shove off?	_____	_____
j. We sail the measured nautical mile in exactly 13 minutes. What was our speed?	_____	_____

Navigation Homework

Day 3
Dead Reckoning Problem #1

3. Assignment: This chart problem will be plotted on 11542. Take your time and follow every step carefully.

a. IP L 34°25'11"
Lo 77°15'11"

c. RV L 34°26'57"N
Lo 77°21'19"

b. BLS L 34°32'45"
Lo 77°17'10"

Our time of departure is 2012. Our speed is 14.3 knots.

(1) What is the Mag. Course from IP to BLS?……._____

(2) What is the distance from the IP to BLS?……_____

(3) What is our ETA at BLS?……_____

(4) How far will we have cruised at 2028?……_____

(5) What is the coordinates of the 2028 DR Position?

L _____
Lo _____

We depart the BLS for the RV at 0033. You have a NLT to the RV of 0052.

(6) What is the Mag course from the BLS to RV?…….._____
(7) What is the distance from the BLS to RV?……_____
(8) What is the speed you must make in order to make the NLT?……_____
(9) You break down at 0045 what is your position?
L_____ Lo_____

(10) You spent 5 minutes at that position. What is your new speed to still make the NLT to RV?……._____

Navigation Homework

Day 3
Dead Reckoning Problem #2

4. Assignment: This chart problem will be plotted on 11543 chart.

a. IP L 34°21’55” N
Lo 76°54”35” W

b. BLS L 34°35’59” N
Lo 77°11’53” W

c. RV L 34°23’36 N
Lo 77°09’32” W

We depart IP at 2400. Speed is 15 Knots

(1) What is the Mag. course to the BLS? ……._____

(2) What is the distance to the BLS? ……_____

(3) What is our ETA at BLS?…….._____

(4) What is your TOP to the BLS? …….._____

(5) What is your position at 0100? ……L_____
Lo_____

We arrive at the BLS at 0130.

We depart the BLS at 0500 en route to RV. Speed is 10 Knots.

(6) What is Magnetic course to RV? …….._____

(7) What is distance to RV? ……_____

(8) What is our ETA to the RV? ……_____

At 0600, we are given orders to proceed to Alt RV at L 34°24'45"N, Lo 77°20'48"W. Using our present speed of l0K, from 0600 position, what is our new course and distance?

(9) Course to Alt RV ……_____

(10) Distance to Alt RV…….._____

Navigation Homework

Day 3
Dead Reckoning Problem #3

5. Assignment. This chart problem will be plotted on 11539 chart.

a. IP L 33°59'42"N
Lo 77°25’11” "W

c. RV L 34°07'41'N
Lo 77°34' 17"W

b. BLS L 34°26'31"N
Lo 77°29'48"W

TOD from IP: 0330 NL T on BLS: 0545

(1) What is the Mag. course to the BLS?……._____

(2) What is the speed you must make in order to arrive at the BLS by the NLT time?……._____

(3) What is the distance from IP to BLS? …….._____

(4) At 0405 your boat breaks down, what is your position? ……..L_____
Lo_____

(5) It takes you 20 minutes to repair your boat, what is the new speed you must make in order to still arrive at the BLS by the NL T time of 0545?……_____

TOD from BLS: 0600 NLT to RV:

(6) What is your Mag. course from BLS to RV? ……...…._____

(7) What is the distance to the RV? …….….._____

(8) What is your speed from BLS to RV? ……..…._____

(9) At 0642 you encounter an enemy patrol boat, you need air support. What is you position? …….L _____
Lo_____

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Nav Work
SEP 98

HOMEWORK DAY 4

1. Tide is the_____ rise and fall of water.

2. The vertical measurement between the surface of the water and the reference plane is called?
   _____

3. The vertical distance from the tidal reference plane to the bottom is called?
   _____

4. The depth of water is a combination of the _____ ___ _____ and the _____ _____.

5. Spring tides are characterized by what type of tide?
   _____

6. A mixed tide is characterized by?
   _____
   _____

7. High tide is at 1015. Low tide is at 1730. What is the duration of rise and fa1l?
   _____

8. Low tide is at 0030. High tide is at 0622. What is the duration of rise and fall?
   _____

9. High water is 10.3 ft. Low water is 1.6 ft. What is the range of tide?
   _____

10. Low water is -2.7 ft. High water is 5.5 ft. What is the range of tide?
    _____

Navigation Homework

Day 4
Tide Table Problems

1 Low tide is at 2346, high tide is at 0219. What is the duration of time between tides?
_____

2. Low tide is 2 hours and 46 minutes (2:46) before your ETA at the BLS. ETA is at 0012. At what time is low tide? _____

3. You have a high tide at 2037. You intend on landing at the BLS at 2215. How much time is there between your landing and high tide? _____

4. High tide is at 1947. Low tide is at 0020. What is the duration of time between tides?
_____

5. You intend to land on the BLS at 2230. High tide is at 0117. How much time is there

between your landing and high tide? _____

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Nav Work

SEP 98

HOMEWORK A

Plotting Geographic Coordinates with a TOPO Map

1. Determine the geographic coordinates of the following grids using the scale method.

a. 18STP 7650 2297
L_____
Lo_____

b. 18STP 8950 3430
L_____
Lo_____

c. 18STP 8950 3430
L_____
Lo_____

2. Convert these geographic coordinates into grid.

a. L 34°39'15" N
Lo 77°15'43" W
Grid_____

b. L 34°33’97' N
Lo 77°17.58’ W
Grid_____

3. Determine the geographic coordinates of the following grids using the proportional parts method.

a. Grid 18STP 7606 3467

L _____X 300 = _____

_____" / 60 = _____’_____”

b. Grid 18STP 8425 4265

L_____ X 300 =_____”

_____" / 60 = _____”

Navigation Homework

Lo _____X 300 =_____”

_____” / 60 = _____”

L _____

Lo _____

Lo _____X 300 =_____”

_____” / 60 = _____”

L_____

Lo_____

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DIRECT READING DEVIATION TABLE

(For instructional purposes only)
(Do not use on your boat)

Enter Magnetic column when converting from from a magnetic heading to a compass heading.

Example:

T 070
V 9 W
M 079
D 5 W (Table)
C 084

When converting from true to compass, add west and subtract east.

2nd Example:

T 289
V 9 W
M 298
D 2 E (Table)
C 296

SHIPS HEADING MAGNETIC	DEVIATION	COMPASS HEADING
0°	5°W	5°
15°	6°W	21°
30°	6°W	36°
45°	6°W	51°
60°	5°W	65°
75°	5°W	80°
90°	5°W	95°
105°	4°W	109°
120°	2°W	122°
135°	0°	135°
150°	2°E	148°
165°	4°E	161°
180°	5°E	175°
195°	6°E	189°
210°	6°E	204°
225°	7°E	218°
240°	6°E	234°
255°	6°E	249°
270°	5°E	265°
285°	4°E	281°
300°	2°E	298°
315°	0°	315°
330°	2°W	332°
345°	4°W	349°

Enter compass column when converting a compass heading to a magnetic heading.

Example:

C 116
D 2 W (Table)
M 114
V 9 W
T 105

When converting from compass to true, add east and subtract west.

2nd Example:

C 312
D 0 (Table)
M 312
V 9 W
T 303

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REFERENCE SECTION

FLOAT PLAN

UNIT:			DATE:	
BOAT TYPE	HULL #		VEHICLE TYPE	VEHICLE #
NAME	RANK	SSN	BLOOD TYPE	MISC

PURPOSE/AREAOFOPERATIONS/GENERALTIMELINE:

TIME /DATE/LOCATION OF DEPARTURE :

TIME/DATE/LOCATION OF ARRIVAL:

COMM	UHF/VHF/HF/SABRE		COMM NOTES:	
PRIM FREQ:				
ALT FREQ:				
M9	M16/M2O3	M240	MK19	M2 .50 CAL
	/			

COMMENTS:

PLT SGT/PLT CDR

Boat Manifest

Date _____

Unit _____ Coxswain _____

Name	Social Security	B-Type	Weapon	Gear

Notes:

Total Personnel *Total Weapons* *Total Optics* *Total Com Gear*

ROUTE CARD

WP#	DISCRIPTION	LAT	LONG	DEG	DIST	REMARKS

USMC RIVERINE CRAFT

CHARACTERISTICS	RIVERINE ASSAULT CRAFT	RIGID RAIDING CRAFT	COMBAT RUBBER RAIDING CRAFT
COMMUNICATIONS	MARINE BAND VHF AN PRC-119A X2 AN GRC-231 AN PRC-113 A PSC-3 (C2)	PRC-77	PRC-77
NAVIGATION SYSTEMS	RAYTHEON RX 40 RADAR GPS 920 LORAN C 780 DEPTHFINDER V820	RITCHIE COMPASS GPS HANDHELD	RITCHIE COMPASS GPS HANDHELD
CREW	(4) BOAT CAPTAIN COXSWAIN BOW GUNNER AFT GUNNER	(2) COXSWAIN A-COXSWAIN	COXSWAIN
TROOP CAPACITY	(10) TROOPS COMBAT LOADED	(8) TROOPS COMBAT LOADED[1]	(8) TROOPS COMBAT LOADED[1]
SEA STATE	1 MAX 2	3	3
PRIME MOVER	**5-TON**	**HMMWV**	HMMWV
HEIGHT	116"	69"	
WIDTH	98"	85"	
LENGTH	307.4"	180"	
WEIGHT	22.878 lbs	7.700 lbs	
FUEL CAPACITY	81 gal	25 gal	
RANGE	300 mi	337 mi	
FUEL TYPE	DIESEL	DIESEL	
OPERATONAL SPEED	55 MPH	55 MPH	
TROOP CAPACITY	18	8	
TOWING CAPACITY	30.000 lbs (pintle)	7.700 lbs	
MAX WEIGHT CAP.	20.000 lbs	2.500 lbs	

Note: 1: The Riverine Operations Handbook states eight; however, practical expierence has shown that six combat loaded troops with heavy packs is more practical.

RULES OF THE ROAD

1. Rights of way.

    a. A power driven vessel underway shall keep out of the way (give way) of:

    A vessel not under command.

    A vessel restricted in her ability to maneuver.

    A vessel engaged in fishing.

    A sailing vessel under sail power.

    b. For more information, see the reference.

2. Overtaking another vessel.

    a. Reduce speed in advance to reduce wake.

    b. Give proper sound signal to indicate your intent to alter course. Other vessel will repeat signal when understood and agreed.

.

    One horn blast - alter course to port.

    Two horn blasts - alter course to starboard.

    Five horn blasts - danger, doubt or disagree.

    c. Resume course and speed when well clear of other vessel.

3. Crossing situation (if you see their port side you are give way vessel).

    a. Stand on vessel maintains course and speed.

    b. Give way vessel alters course and speed.

    c. Allows stand on vessel to pass across their bow.

    d. Resume course and speed.

    e. Take all necessary precautions to avoid collision.

4. Meeting situation.

    a. Reduce speed in advance to reduce wake.

b. Give proper sound signal to indicate intent to alter .course, usually both alter to starboard.

Danger Doubt 5 horn blasts signals confusion.

Other signals same as previous.

c. Resume course and speed when well clear of other vessel.

5. Operate in reduced visibility.

a. Maintain safe speed (stop in 1/2 visible distance)

b. Give proper sound signals.

(1) One prolonged horn blast ever minute for underway vessel.

(2) Two prolonged horn blasts every two minutes for stationary vessel.

c. Maintain Radar watch.

d. Maintain Depthfinder watch.

e. Ensure proper lighting is maintained.

6. Identify vessel type and heading at night by light configuration.

a. Red light = port side of vessel.

b. Green light = starboard side of vessel.

c. Green and Red light = bow of vessel.

d. White light = stern of vessel.

e. Yellow light = towing vessel.

7. Visual aids to navigation IALA-B system.

a. Red/Nun/Triangular/Even Numbered buoys or day markers mark the right side of the channel when returning or going south on the intercoastal waterway.

b. Green/Can/Square/Odd Numbered buoys or day markers mark the left side of the channel when returning or going south on the intercoastal waterway.

c. Multicolored bouys are junction buoys, the top color denotes the marker for the preferred channel. For instance a green topped buoy would be marking the left of the preferred channel and the right of the secondary channel.

d. Yellow buoys or markers are used to mark hazards.

e. Red and White vertically striped buoys designate midchannel or entrances to bays.

B. Weather warning signals.

a. Small Craft Warning – day - one red pennant night - red top light, white bottom light.

b. Gale Warning - day - two red pennants night - white top light, red bottom light

c. Storm Warning - day - red and black flag night - two red lights

d. Hurricane Warning - day - two red and black flags night - red top and bottom lights, white middle light.

9. Light Rhythms

a. Flashing lights are placed only on green or red buoys.

b. Quick flashing lights are placed only on channel edge marking green and red buoys to indicate that special caution at sharp turns, channel width changes or hazards to pass on one side only.

c. Group flashing lights are placed on red and green horizontal band buoys for channel junctions and wrecks that can be passed on either side.

10. Sea State Descriptions

a. Sea State 0 - winds 3 knots or less, ripples, no foam crests

b. Sea State 1 - winds 4 to 6 knots, small wavelets 0 to .1 meters high, crests glassy, not breaking.

c. Sea State 2 - winds 7 to 10 knots, large wavelets .1 to .5 meters high, crests begin to break, scattered whitecaps.

d. Sea State 3 - winds 11 to 16 knots, Small waves becoming longer .5 to 1.25 meters high, numerous whitecaps

e. Sea State 4 - winds 17 to 21 knots, Moderate waves 1.25 to 2.5 meters high, taking longer form, many whitecaps and some spray

MINE COUNTERMEASURES

1. Maintain watch for mine/booby trap indicators.

a. Lines entering the water.

b. Unusual wakes in the channel.

c. Tripwires.

2. Avoid patterns and channel if possible.

3. Plot location on chart.

4. Mark location.

5. Report location as required.

WATERBORNE GUARD POSTS

1. Select a site that offers:

    a. Ease of entry/exit.

    b. Cover and concealment.

    c. Takes into account changing tidal and luminous conditions.

    d. Satisfies mission parameters.

h. By working the reverse and steering controls in unison a resultant thrust can be obtained in any direction giving 360 degree thrusting ability. In an emergency the reverse deflector can be lowered while underway acting as a powerful brake.

i. Designed and manufactured in corrosion resistant materials to international certifying authorities standards, the 273 is further protected by the fitting of large sacrificial anodes. The units are supplied as a complete package including steering and reverse systems with controls. A marine gearbox is not necessary .

2. **Subsystems For The 273 Jet**:

a. The subsystems of the jet are conveniently mounted to the Hamilton 273 jet itself.

(1) The Hamilton Synchronized Reverse Control (H.S.R.X.) is a simple, non electric, servo hydraulic control system where reverse duct movement is synchronized with control lever movement. Control lever position indicates reverse duct position and thus a position indicator gauge is not necessary. With the HSRX, the complete servo comes mounted on the jet.

(2) The Hydraulic Pump Unit: Hydraulic power assistance is provided by a Hydraulic Pump Unit (H.P.U.). The standard H.P.U. is driven by dual v-belts, direct drive from a pulley/flange mounted on the front of the jet's main shaft. The H.P.U .is equipped with integral flow control, relief valve, filter, and reservoir. Rotation is right hand looking at the pump shaft. The pump can be easily disassembled and reassembled for left hand rotation.

(3) The Hydraulic Oil Cooler: The hydraulic oil cooler cools the oil from the HSRX flowing back to the HPU pump. The hydraulic oil cooler is located on the top of the jet. The cooling water is picked up off the exhaust risers of the engines. The water is then expelled from the oil cooler through hoses which tie into a discharge port on the starboard side.

3. Steering Systems

1. The Components Of The Steering System on board the Riverine Assault Craft are manufactured by SeaStar. The steering is a manual hydraulic system and its components are as follows:

(a) The Helm Pump or steering wheel incorporates a hydraulic pump, reservoir, and adjustment knob. The helm pump reservoir has a fill hole at the top of the pump. The fill cap has a vent hole in it to relieve pressure. The adjustment knob located below the steering wheel gives 1 to 4 turns of the helm from full lock. (A greater number of turns reduces sensitivity of steering).

(b) The Steering Cylinder is mounted inside the transom wall. The cylinder is directly connected to the tiller arm of the starboard and port jet via a steering tie rod assembly. A steering position indicator is also located on the inside transom wall which sends an electrical reading to a gauge located on the coxswain's dash panel.

(c) The Lines. Pressure is created by turning the helm which sends fluid through hydraulic lines to either side of the hydraulic cylinder. The lines are routed through the raceway which is located in the center of the craft. The lines from the helm and cylinder are plastic and extend to the center of the craft where they connect to stationary metal piping.

REFERENCES:

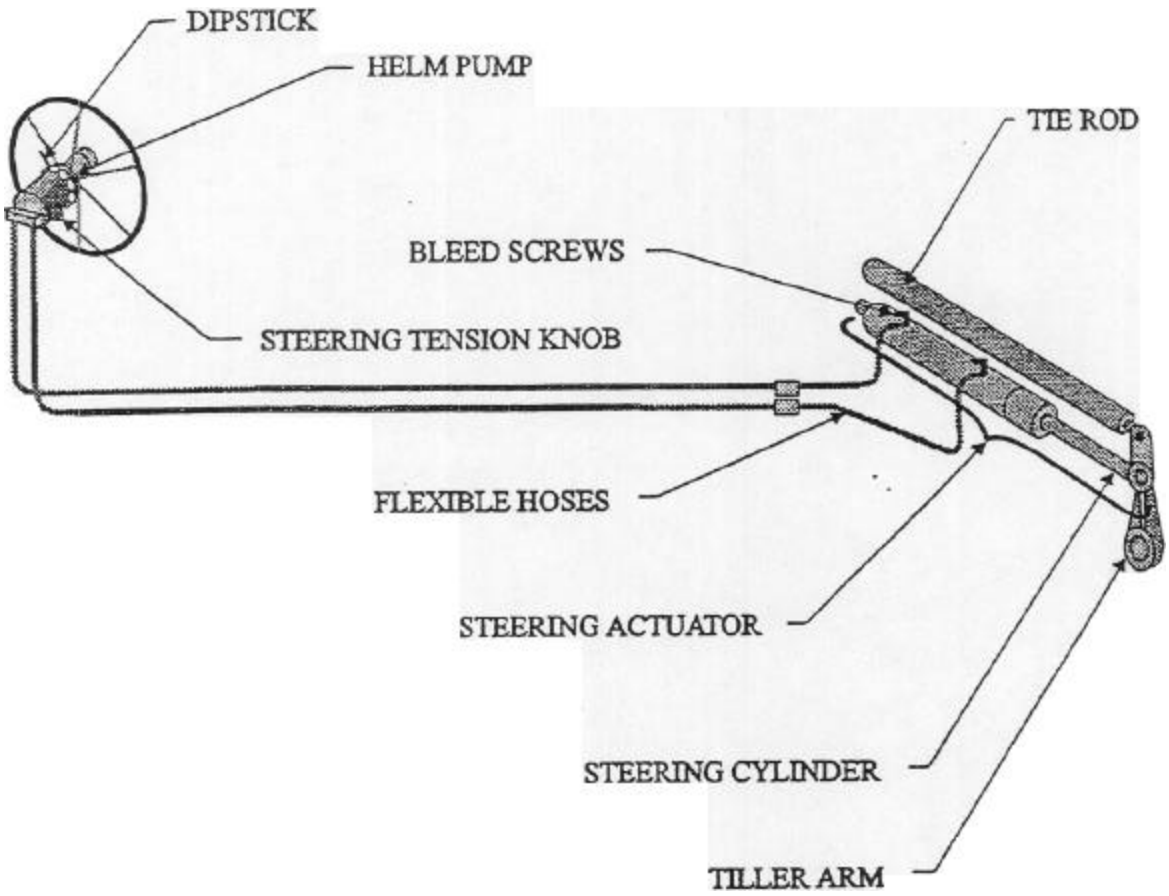
1. TM 09557A-14/1 System And Operational Manual W/ Components List For The Riverine Assault Craft

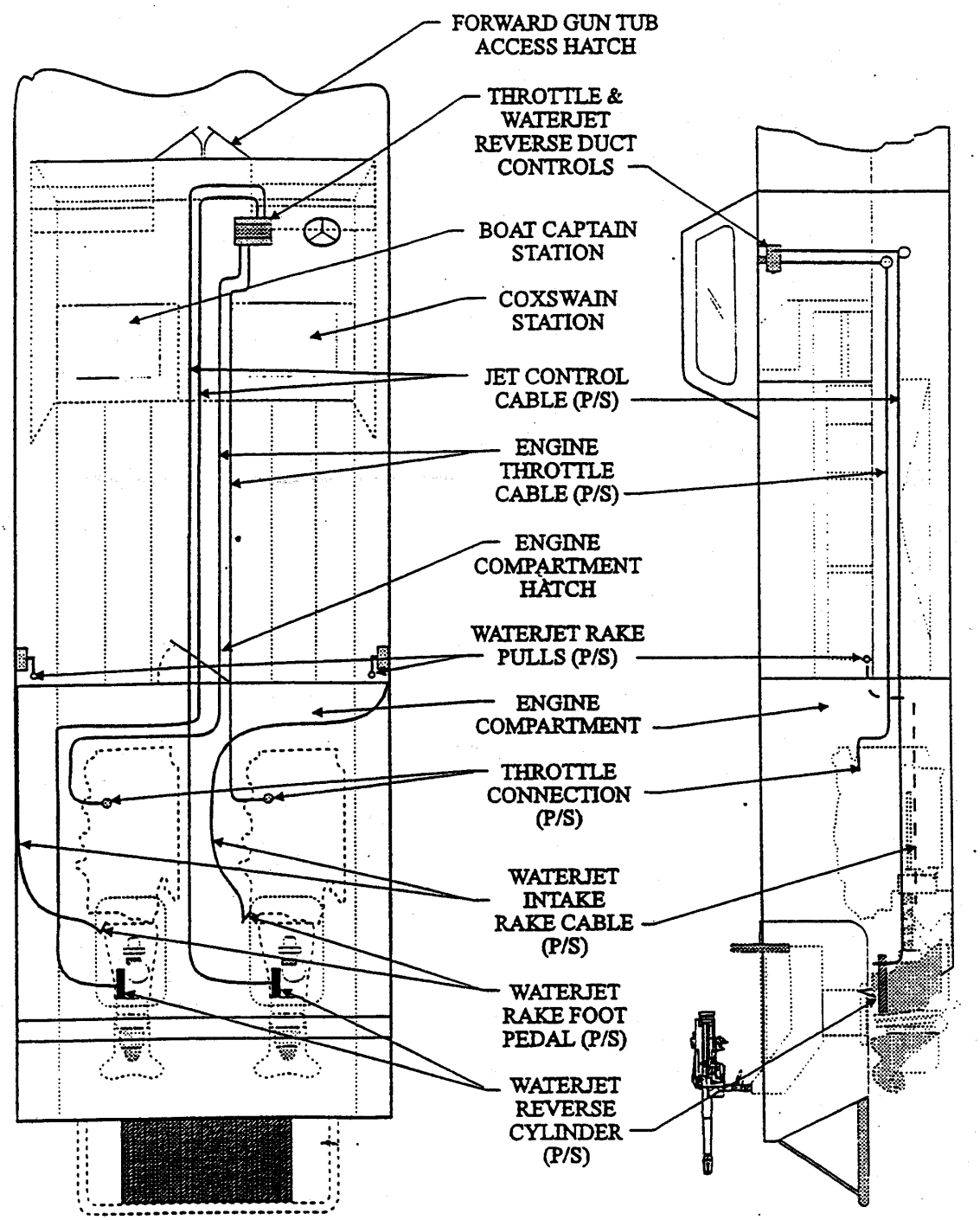
2. TM 09557A-14/3 Operation And Maintenance Technical Manual For Propulsion Waterjet 273

NOTES:

ATTACHMENTS:

1. RAC Steering System Diagram
2. RAC Internal Propulsion Diagram.


DIPSTICK
HELM PUMP
TIE ROD
BLEED SCREWS
STEERING TENSION KNOB
FLEXIBLE HOSES
STEERING ACTUATOR
STEERING CYLINDER
TILLER ARM


FORWARD GUN TUB ACCESS HATCH
THROTTLE & WATERJET REVERSE DUCT CONTROLS
BOAT CAPTAIN STATION
COXSWAIN STATION
JET CONTROL CABLE (P/S)
ENGINE THROTTLE CABLE (P/S)
ENGINE COMPARTMENT HATCH
WATERJET RAKE PULLS (P/S)
ENGINE COMPARTMENT
THROTTLE CONNECTION (P/S)
WATERJET INTAKE RAKE CABLE (P/S)
WATERJET RAKE FOOT PEDAL (P/S)
WATERJET REVERSE CYLINDER (P/S)

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TAB 513
MAR 99

STUDENT OUTLINE

TROUBLESHOOTING

LEARNING OBJECTIVES

A. TERMINAL LEARNING OBJECTIVE:

(1) With the aid of references, perform immediate action for the RAC in accordance with the references.

(2) With the aid of references, perform remedial action for the RAC in accordance with the references.

B. ENABLING LEARNING OBJECTIVE:

(1) With the aid of references, perform immediate action for a fuel system malfunction in accordance with the references.

(2) With the aid of references, perform immediate action for an electrical system malfunction in accordance with the references.

(3) With the aid of references, perform immediate action for a power plant malfunction in accordance with the references.

(4) With the aid of references, perform immediate action for a propulsion system malfunction in accordance with the references.

(5) With the aid of references, perform immediate action for raw water cooling system malfunction in accordance with the references.

(6) With the aid of references, perform immediate action for steering system malfunction in accordance with the references.

(7) With the aid of references, perform remedial action for a fuel system malfunction in accordance with the references.

(8) With the aid of references, perform remedial action for an electrical system malfunction in accordance with the references.

(9) With the aid of references, perform remedial action for a power plant malfunction in accordance with the references.

(10) With the aid of references, perform remedial action for a propulsion system malfunction in accordance with the references.

(11) With the aid of references, perform remedial action for raw water cooling system malfunction in accordance with the references.

(12) With the aid of references, perform remedial action for steering system malfunction in accordance with the references.

OUTLINE

The definition of *Trouble Shooting* is the ability of the coxswain to locate and apply immediate action or remedial action to the mechanical situation at hand. Immediate Action is the action taken by the coxswain to maintain the operation of the craft at that moment. Remedialctions the action taken to locate and fix the problem causing the malfunction.

1. **Immediate Action Fuel**:

Fuel System The fuel systems covers fuel tanks, fuel water separators, fuel vacuum gauges, 2" gate valves, fuel vents and the fuel valves. As a crew member you must understand how they work together in order to apply immediate action properly.

a. Isolating Fuel Tank **(Fuel Contamination / Damaged Tank)** -Normally you will get a high vacuum reading (7 or higher) and shifting your fuel water separator should solve your problem for a short period of time. If the fuel is contaminated the second filter used will also show a high reading, and continuing to change will become a waste of time and effort. To isolate the Fuel Tank the following applies:

(1) Close 2" Gate Valve

(2) Close Fuel Return to the contaminated tank

(3) Close Fuel Supply Line to the contaminated tank

(4) Open Fuel Return Crossover

b. High Fuel Vacuum- There are several reasons that a high fuel vacuum may appear. (Electrical, Bad Fuel, Clogged Lines, Valve Settings) The most common is usually caused by the fuel filters need to be changed. High Vacuum is a reading of 7 or higher on the gauge located on the dash in front of the coxswain. To apply immediate action for High Vacuum the following applies:

(1) Continue to drive monitoring the Gauges

(2) Switch Fuel Water Separator to the effected engine

(3) If Gauges do not drop then check:

a. The Fuel Valve Settings (Supply, Return, 2" Gate Valves, Cross Over)

b. Check Fuel Vents for Blockage

(4) As a last resort, isolate the Fuel Tank to the effected engine

2. **Immediate Action Electrical:**

The electrical system on the RAC is very complicated and immediate action is limited at the coxswain level. If the craft has lost total electrical power and continues to operate properly then continue to operate in EMERGENCY CONDITIONS ONLY, continually observing the engine gauges and components.

a. No power distribution at Coxswain station

(1) Check GUEST Switch

(2) Check Circuit Breakers (at Coxswain station)

(3) Check Battery Connections

b. Lights not Operating (nav, engine room, etc)

(1) Check switch on lights

(2) Check circuit breakers

(3) Check plug or light (flood light only)

c. Emergency Starting - used when craft will not start and has no electrical power. Two craft must be used. (Similar to jump starting an automobile)

(1) Ensure engines are off on both craft

(2) Insert Slave Cables to both craft

(3) Turn Parallel Switch to ON on both craft.

(4) Start Able Craft 1st

(5) Start Down Craft 2nd

(6) Once both craft are running Turn OFF both Parallel Switch

(7) Disconnect Cable from both craft

(8) Monitor Voltmeter

3. **Immediate Action For Power Plant**

Power plant is defined as the entire apparatus serving as the source of power for some particular operation (Engine). While dealing with the RAC our two main concerns will be Temperature (Fresh Water) and Oil Pressure.

a. Engine Temperature (OVER HEATING) is read from the Port/Starboard Temperature Gauge. High temperature is 203 deg. or higher. Normal operating temperature is 181 deg. to 203 deg. The pressure cap on the day tank is only rated to 210 deg.

(1) Engage Secondary Cooling

(2) Move to a Safe Location

(3) Check Coolant Level (after engine cools)

(4) Check Position of Cap

b. Oil Pressure (HIGH)

(1) Shut Down Affected Engine

(2) Move to a Safe Location

(3) Check Engine Oil

(4) Check for Leaks (Oil Filter)

(5) Check Sending Unit

4. **Immediate Action For Propulsion System**

Normally, the indication of a propulsion system problem is that the craft will not come up on step, and little or no water will be coming out of the jet discharge. The following is the immediate action for Propulsion System situation:

(1) Shut Down One Engine and Continue to Drive

(2) Pull the Rake to Effected Engine

(3) Drive in Reverse if Possible then Forward

(4) Close Rake

(5) Restart Effected Engine (Repeat other Engine)

(6) Repeat if Necessary

5. **Immediate Action For Raw Water System**

Raw Water system malfunction is noticeable by both a gradual and dramatic increase in vacuum. An increase in vacuum is caused normally by the raw water strainers or sea chest becoming clogged or blocked. Each is just as important as the other but should be handled differently. Failure to apply the proper immediate action procedures could cause further complications. The following immediate action procedures apply:

a. Gradual Increase

(1) Change Effected Strainer

(2) Clean Affected Strainer (Use Deck Wash Down if Necessary)

b. Dramatic Increase

(1) Engage Secondary Cooling System for Effected Engine

(2) Move to Safe Location

(3) Clean Strainers

(4) Punch Out Sea Chest

6. **Immediate Action Steering System**

When driving the craft and the craft is either too hard or easy to steer, or there is a complete loss of steering, the following immediate actions should be followed.

a. Steering to Hard / Easy or not Responding

(1) Check Adjustment Knob

(2) If adjustment doesn't work, move to a Safe Location

(3) Trouble Shoot

b. Loss of Steering

(1) Go to Emergency Steering (Buckets and Throttles)

(2) Move to a Safe Location

(3) Trouble Shoot

7. **Remedial Action For Fuel Malfunction**

a. High Fuel Vacuum

(1) Filters need to be Replaced

(2) Filters need to be Changed over

(3) Blockage in Injector Lines

(4) Valves are not properly aligned

(5) Contaminated Fuel

(6) Check Vents for Blockage

8. **Remedial Action For Electrical Malfunction**

a. No power distribution at Coxswain station

(1) Check GUEST Switch

(2) Check Circuit Breakers (at Coxswain station)

(3) Check Battery Connections

b. Lights not Operating (nav, engine room, etc)

(1) Check switch on lights

(2) Check circuit breakers

(3) Check plug or light (flood light only)

c. Alternator:

No Charge / Low Charge

(1) Loose or corroded battery connections

(2) Wiring harness connections loose / open

(3) Alternator belt loose

9. **Remedial Action For Power Plant Malfunction**

a. Engine Will Not Rotate

(1) Check craft switches

(2) Loose battery connections at battery's post

(3) Check for obstructions around the engine external rotating parts ie: pulleys and belt area and drive shaft area

b. Engine Cranks Slowly or Will Not Start

(1) Check fuel valve alignment (will not start)

(2) Check Emergency Fuel Shut Off (will not start)

(3) Have crew member check engine compartment for sparks. From starter battery or any other electrical connection. (engine cranks slowly)

(4) Loose battery connections (will not start)

(5) Check air cleaner for obstructions/restrictions (will not start or engine cranks slowly)

c. Engine Starts but Will Not Keep Running

(1) Low fuel level in tank

(2) Fuel Contaminated (strip fuel tank)

(3) Fuel filter clogged (switch selector lever at fuel/water separator)

(4) Check fuel valve alignment

(5) Check both tank vents for obstructions

(6) Air Cleaner obstructed/restricted

(7) Exhaust obstructed/restricted

d. Rough Idle Warm Engine

(1) Check for fuel leak (high pressure leak)

e. Engine Surges at Idle

(1) Low fuel level in the tank

(2) Restriction in fuel supply

(3) Check both tank vents (partly restricted)

f. Slow or No Engine Response When Throttled

(1) Obstructions at fuel pump and throttle cable connections

(2) Allow for longer engine warm up and oil pressure to build

g. Oil Pressure: Normal operating oil pressure is 10 psi at idle and 30 psi at rated speed.

(1) High oil pressure (Oil viscosity too thick)

(2) Low oil pressure

a. Oil level low

b. Oil contaminated i.e.: water, coolant, diesel

c. Oil viscosity incorrect

d. Engine temperature above 203 degrees F

h. Engine Temperatures

(1) Above Normal "HOT"

a. Low coolant level

b. Malfunctioning raw water pump or system

c. Check oil level

d. Check drive belt on water pump

e. No air circulation in engine compartment

(2) Below Normal "COOL "

a. Operating in cold weather

b. Too much airflow in engine compartment

i. Engine Will Not Reach Rated Rpms

(1) Throttle linkage obstructed

(2) Shut down solenoid partially engaged

(3) Fuel supply inadequate

j. Low Engine Power

(1) Obstructed throttle control

(2) Additional weight in craft

(3) Lubricating oil level too high

(4) Air cleaner obstructed/restricted

(5) Exhaust system obstructed/restricted

(6) Fuel water separator clogged

(7) High intake air temperature

(8) Contaminated fuel/poor grade

k. Mounting and Alignment

(1) Vibrations

a. Check engine mounts

b. While engine is running check vibration damper for wobble report to maintenance personnel

(2) Unusual Noises

a. Check all external rotating members i.e.: drive belt, jet drive shaft, alternator etc.

b. Check all gauges for normal operation ranges

10. **Remedial Action For Propulsion Systems Malfunc**tion

a. Jet

(1) Engine Rpms increase over a period of time and take off performances is poor.

a. Worn or blunt impellers

b. Excessive impeller tip clearance

(2) Sudden increase in engine Rpms, no noticeable decrease in thrust.

a. Faulty tachometer

(3) Excessive engine Rpms noisy jet unit with aerated water from nozzle

a. Screen blocked with debris or rope wrapped around shaft

b. Objects jammed in stators or impeller

(4) Poor Reverse

a. Craft has insufficient immersion at transom and air being sucked from rear into jet intake

(5) Reverse Duct Will Not Move

a. Hydraulic pump not operating

b. Duct jammed by debris

<u>NOTE:</u> HIGH RPM – JET IS AT FAULT – LOW RPM – ENGINE AT FAULT

11. **<u>Remedial Action For Raw Water Cooling Malfunction</u>**

a. No Discharge - there should be three discharges from the RAC. Two from the starboard side of the craft and one from the port side. If there is no raw water being discharged from these three points, STOP engines and investigate.

(1) Check Valves to Sea Chest (primary / Main)

(2) HSRX Discharge (Check Valve Alignment)

(3) Punch Sea Chest Out

(4) Raw Water Pump Needs to be Primed

(5) Raw Water Strainers Clogged or full

b. Sea Chest

(1) Closed when Secondary cooling system activated

(2) Can be blocked by large debris (plastic Bag)

(3) No Discharge from Primary Cooling system if closed

c. Raw Water Strainers

(1) Gradual Increase

a. Leaking Pipes

b. Strainers Need to be Changed Over

(2) Dramatic Increase

a. Blocked Sea Chest

b. Clogged Water Strainers

c. Broken Piping

d. Gauges

(1) Faulty Connection

(2) If gauges are jumping or you notice a rapid increase and decrease there is a possibility that the Impeller in Raw Water Pump Needs Replaced

12. **<u>Remedial Action For Steering Systems Malfunction</u>**

a. Steering

(1) Helm Hard to Turn

a. Check steering knob for adjustment

b. Check deflector for free rotation

c. Check Fluid Level

(2) Spongy Helm Response

a. Check fluid level

b. Check for correct type fluid

c. Check for fluid contamination

REFERENCES:

1. RAC TM 09557A-14/1 System and Operation Manual w/ Components List for Riverine Assault Craft AIO Riverine Assault Craft

NOTES:

ATTACHMENTS: None.

SO-513-13
UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 514
MAR 99

STUDENT OUTLINE

TRAILER SYSTEM

LEARNING OBJECTIVES

A. TERMINAL LEARNING OBJECTIVES:

(1) With the aid of references, perform RAC operations checks, in accordance with references.

(2) With the aid of references, perform preventive maintenance on the RAC trailer, in accordance with references.

B. ENABLING LEARNING OBJECTIVES:

(1) With the aid of references, inspect the RAC trailer, in accordance with references.

(2) Without the aid of references, when given a diagram, identify in writing the designated portions of the RAC trailer, in accordance with references.

OUTLINE:

1. **Trailer System:**

a. Bottle Jack: The RAC trailer comes SL-3 complete with a 12 ton bottle jack, the bottle jack must always be used in the upright position, the jack was not designed to be used in horizontal position.

b. Bottle Jack Placement: The jack should always be positioned as close to the tire as possible, by positioning the jack close to the tire you are creating a sturdier safer working environment.

c. Tire inspection:

(1) Tire inflation pressure is the most important factor in the tire life. Inflation pressure should be as recommended for the load, but in no case should exceed the tire or rim maximum pressure rating**. Inflation pressure should be checked cold before operation**. Do not bleed air

from tires when they are hot. Check inflation pressure weekly, to insure the maximum tire life and tread wear .

(2) Tire wear should be checked frequently because once a wear pattern becomes firmly established in a tire it is difficult to stop, even if the underlying cause is corrected. If your tires have excess center wear the cause usually will be from over inflation to correct, adjust pressure to particular load. Edge wear is caused from under inflation to correct, adjust to particular load. Excessive cupping is caused from the tire being out off balance to correct, check bearing adjustment and tire balance. Flat spots are caused from the wheel locking up and the tire skidding to correct, avoid sudden stops when possible and adjust the brakes.

d. Tire replacement and torque sequence: Place the jack in the upright position and as close to the tire as possible. Before you start to jack the trailer you should loosen the lug nuts slightly, once you've accomplished this you can jack the trailer up just enough to be able to remove the tire. Remove bad tire and install new tire. It is extremely important to apply and maintain proper wheel mounting torque on your trailer axle. The proper procedure for attaching your wheels is as follows:

(1) Start all bolts or nuts by hand to prevent cross threading.

(2) Tighten bolts or nuts in the sequence detailed below.

(3) The tighten of the fasteners should be done in stages. Following the recommended sequence. First tighten all the fasteners to 20-25 lb-ft, then 50-60 lb-ft, and finally to 85-95 lb-ft.

(4) Wheel nuts/bolts should be torqued before first road use and after each wheel removal. Check and re-torque after the first 25 miles and again at 75 miles. Check periodically there after.

e. Sure-Lube System: The purpose of the sure lube system is for bearing protection. This system allows complete greasing of outer and inner bearings. Grease is inserted through the zerk fitting and moves through the outer bearing, filling the hub, continuing through the inner bearing and out the relief route existing before the seal. Zerk fitting should be greased after every use while monitoring the grease condition exiting the relief hole located on the backside of the spindle arm. Clean grease, free of water usually indicates minimal bearing wear and little need for further service. Thin cream or thin light gray grease usually indicates the presence of water and it is advisable to visually check wheel bearing condition. Induct into maintenance.

f. Braking System: The "surge or push" of the trailer toward the tow vehicle automatically synchronizes the trailer brakes with the tow vehicle brake. As the trailer pushes against the tow vehicle the actuator telescopes together and applies the force to the master cylinder, supplying

hydraulic pressure evenly to the brakes.

g. Light System: The trailer is outfitted with a light bar that mounts to either the back of the boat or the back of the trailer. A 24 volt electrical system is used. The lights themselves are the same that are used in the fleet on most of the rolling stock the marine corps utilizes, so that means if one of the lights happen to brake you can order it through the supply system.

h. Wooden Bunks: The wooden bunks are thick pieces of wood that are attached to the trailer. The wooden bunks allow the RAC to sit on the wood vise directly on the aluminum frame. These two pieces of wood are covered with outdoor carpet so as not to damage the hull of the RAC.

i. Winch & Cable: The winch is located in the front of the trailer, mounted to the “A” frame, it is used to pull the RAC onto the trailer. The winch is equipped with 50’ of cable. Cable must be inspected for kinks and frays. Replace cable if any extreme kinks are found and if at all frayed.

j. Guide Post: The posts are located in the rear of both sides of the trailer. The post are aluminum pipes attached to the trailer frame in such a way as to help guide the RAC onto the trailer.

k. The trailer is part of the RAC system and is designed for short range multiterrain transportation. In order to save wear and tear on the trailer it is recommended that low boy trucks be used to move the RAC longer distances. The common sense saying never road march equipment long distances on its own wheels clearly applies. However, if long distance movement is a must it is advisable to completely repack all wheel bearings before you start. Once you are on the road stop in intervals check the wheel hubs, it should be slightly warm. If it is excessively hot seek maintenance help ASAP .

SO-514-3
TAB 514

REFERENCES:

1. Tm 09557A-14/1 System And Operation Manual W/Components List For Riverine Assault Craft

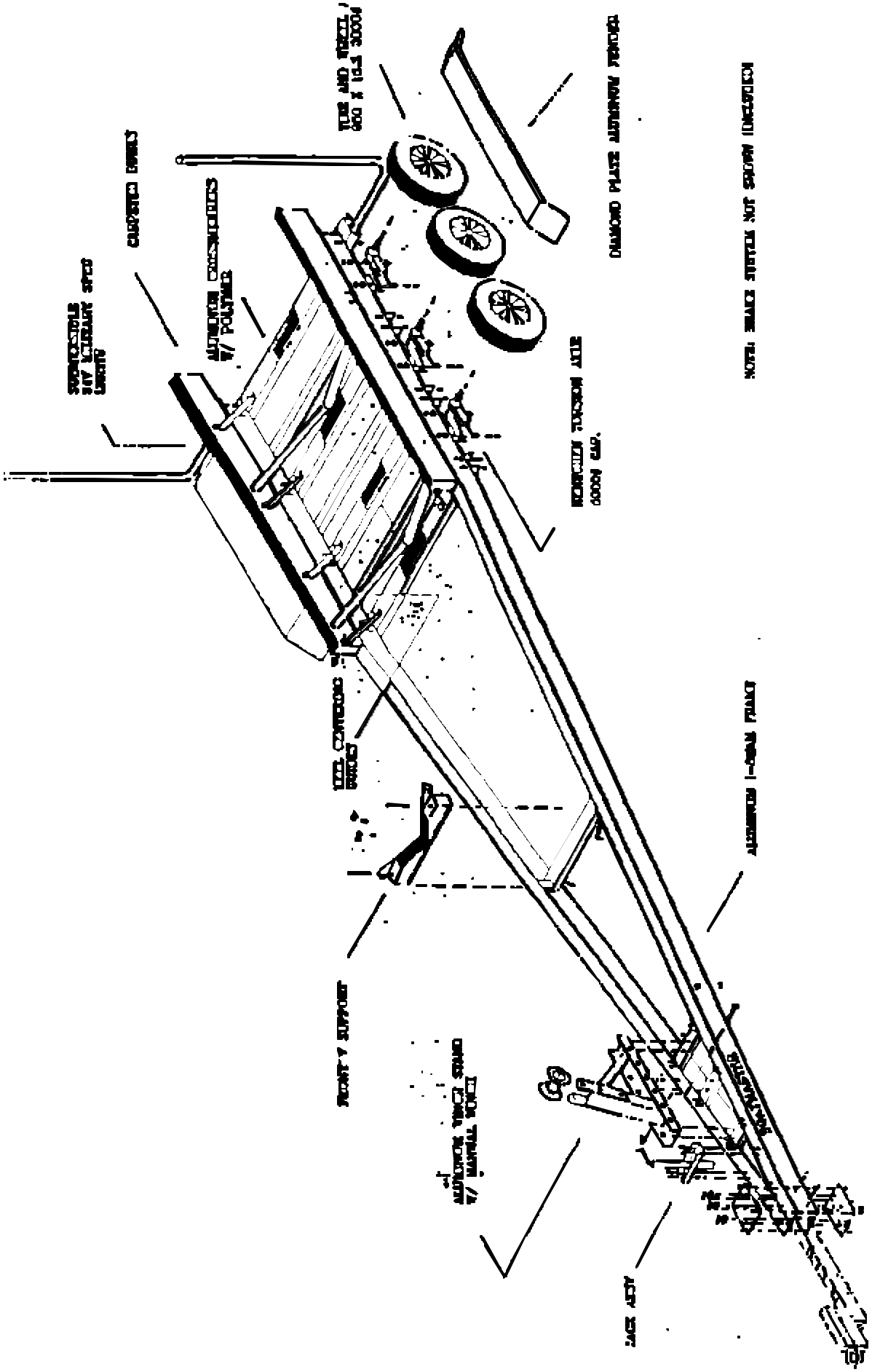
2. Boatmaster Trailer Repair And Parts Manual

NOTES:

ATTACHMENTS:

1. Trailer Diagram

SO-514-4



UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center

STUDENT OUTLINE

OPERATION CHECK LIST

LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVES:

(1) With the aid of references, perform RAC operations checks in accordance with the reference.

B. ENABLING LEARNING OBJECTIVES:

(1) With the aid of references, perform a preoperation check of the RAC in accordance with the reference.

(2) With the aid of references, perform a prelaunch check of the RAC in accordance with the reference.

(3) With the aid of references, perform a during operations check of the RAC in accordance with the reference.

(4) With the aid of references, perform a postoperation check of the RAC in accordance with the references.

OUTLINE

As long as the Marine Corps has been around there has always been equipment to help us do our jobs more easily and more effectively (Weapons, Vehicles, Duce Gear and Water Craft). With that equipment, there is a responsibility to make it last and function properly in time of need. The only way that we as Marines can count on our equipment is to maintain it properly. Most of us are new to certain equipment and its proper care, therefore we need to count on references, guidelines, and/or check lists to help us maintain the standards that are expected of us and our equipment.

Initial	Qty	Item DATE:_____RAC:_____
	1	**RIVERINE ASSAULT CRAFT**:
	1	**TRAILER**
	1	TENSIONER, CHAIN
	1	TIE DOWN, CHAIN
	1	TIRE ASSEMBLY, SPARE
	1	LIGHT BAR with HARNESS
	1	SERGE BRAKE PIN
	1	HYDRAULIC JACK W/HANDLE
	1	LUG WRENCH
	1	WENCH HANDLE
		FORDECK
	1	ANCHOR, WITH ROPE AND CHAIN
	1	TOWING LINES (1 Long -2 Short), 1 SET PER 2 BOATS
	1	LINE, MOORING
	2	COVER, GUN SEAT
	2	PUMP, BILGE HAND
	1	MOUNT, GUN, MK 93
	1	5 lb. EXTINGUISHER, FIRE
	1	BOAT HOOK
	2	PADDLES
		TROOP COMPARTMENT PORT & STARBOARD
	2	20 lb. FIRE EXTINGUISHERS (BEHIND COXSWAIN & BOAT CAPT
	1	KEY, FUEL FILL (STARBOARD WIND SHIELD)
	1	BOAT COVER
	1	STORAGE TUBE, CHART
	2	MOUNT, MACHINE GUN M240G
	3	BOAT FENDERS
	1	GALVANIZED PAIL
	2	POLES, GUIDE
	1	SLING, HOIST ASSEMBLY (1 PER 2 CRAFT)

Initial	Qty	Item
		TROOP SEAT # 1
	SET	PUBS
	1	KIT, FIRST AID
	2	SUN SHIELD R40X/V820
		TROOP SEAT # 2
	1	TOOL BAG
	1	DECK BRUSH
	1	SIGNAL HORN
	2	DRAIN PLUGS
	6	BUNGEE CORDS (2 lg, 2 med, 2 sm)
	1	BRASS UTILITY HAND PUMP
	2	SEARCH LIGHT
	1ea	FLAG MOUNT W/ENSIGN
	2	SIGNAL FLAGS
	1 roll	RIGGERS TAPE
	1	LARGE WRENCH
	1	“C” TOOL
		SLAVE CABLES (1 per 3 boats)
		TROOP SEAT # 3
	1 gal	ENGINE OIL
	1 gal	ANTI - FREEZE
	1 gal	HYDRAULIC FLUID
	1 can	SPRAY LUBE
	1	GREASE GUN
	1	CLP
	1	GREASE, TUBE
		HAZ MAT RAGS
	1	FUNNEL
	1 gal	EMPTY CONTAINER

INITIAL	TASK
	PRE-OPERATION CHECK LIST
	TRAILER
	LIGHT BAR (MOUNT, NUTS)
	ROUTE AND SECURE LIGHT BAR LEAD
	TIRES TO INCLUDE SPARE (PRESSURE, WEAR, WHEEL LUGS)
	BUDDY BEARING CAPS (LUBE AS NECESSARY)
	OVER THE ROAD GEAR (JACK, LUG WRENCH, DOWN STRAPS)
	“A” FRAME (WINCH, MOUNTING/HARDWARE, DENTS & CRACKS)
	LANDING LEG (OPERATION, CONDITION)
	MAIN WINCH & CABLE WITH HOOK
	CHAIN WITH DOG LEG
	SURGE BRAKE PIN (CONNECTED)
	BRAKE MASTER CYLINDER FLUID LEVEL (FULL)
	DONUT CONDITION & SAFETY CHAINS WITH HOOKS
	BRAKE LINES (CONDITION, MOUNTING, CONNECTIONS, LEAKS)
	AXLES (CONDITION/MOUNTING)
	GENERAL CONDITIONS (FENDERS, NUTS & BOLTS BUNKS/CARPET ,
	SECURE WINCH HANDLE
	HOOK TRAILER TO TRUCK
	- GROUND GUIDE
	- LOWER TRAILER ONTO HITCH
	- CLOSE TOW PENTLE AND INSERT PENTLE PIN
	- HOOK UP LIGHTS
	- ATTACH SAFETY CHAINS
	- ATTACH EMERGENCY BRAKE CHAIN
	- CHECK OPERATION OF LIGHTS
	REMOVE SURGE BRAKE - PIN & WINCH HANDLE PRIOR TO TOWING

INIT	**QTY**	**ITEM**
		TROOP SEAT # 4
	3	CARGO STRAPS
	1 ea	FORWARD/AFT GUN TURRET COVER
		TROOP SEAT # 5
		PERSONAL FLOATATION DEVISES (PFD) (1 per PERSON)
		TROOP SEAT # 6
	1	MARINE WATER HOSE
		ENGINE COMPARTMENT
	1	FIBERGLASS ROD
	1	BUOY RING, WITH STROBE LIGHT
		AFT DECK
	1	MOORING LINE
	1	5 lb FIRE EXTINGUISHER

INITIAL	TASK
	SL-3/SAFETY GEAR (CHECK LIST)
	CONDUCT TAG AUDIT
	HULL (dents, rub rail, paint, welds, fasteners and canopy)
	INST ALL DRAIN PLUGS
	JETS FROM OUTSIDE (seals, studs/nuts. paint, anodes, HRSX (cylinder &
	JET INTAKES W/RAKES & PEDDLES
	SEA CHEST INTAKES
	ENGINE COOLANT (1 "- 1.5" from filler neck) filler cap arrows are aligned to
	ENGINE OIL (below 1 qt low mark add 1 qt)
	JET HYDRAULIC RESERVOIR (**HSRX**) (CONDITION AND LEVEL)
	VISUALLY y INSPECT HALON SYSTEM (T -handle, corrosion, cable
	RESET AIR FILTER INDICATOR X2
	ALL PIPING, HOSE, CONNECTIONS, AND MOUNTING
	ALL WIRING CONNECTIONS & ROUTING
	HSRX BELT TENSION & CONDITION (1/2" -3/4" tolerance) X2
	DRIVE SHAFT (engine to jet mounting, bolts, & universal joints) X2
	ENGINE MOUNTS (rubber bushings, double nuts & deck mounts)
	BATTERY'S (box, connections, leaking, & hold downs) X8
	HELM FLUID (to the dot)
	VALVE ALIGNMENT
	2” GATE VALVE (**OPEN**) X2
	MAIN SEA CHEST (**OPEN**) X2
	SEA CHEST TO RAW WATER STRAINERS (**OPEN**) X2 (PRIMARY)
	SEA CHEST FRESH WATER FLUSH (**CLOSED**) X2
	SEA CHEST CLEAN OUT (**CLOSED**) X2
	HSRX DISCHARGE (**OPEN**) XI
	FUEL STRIPPING PUMP (**CLOSED**) XI

INITIAL	TASK
	FUEL PICK-UP EMERGENCY SHUT - OFF (**OPEN**) X2
	FUEL RETURN (**OPEN**) X2
	FUEL RETURN CROSS OVER (**CLOSED**) XI
	SECONDARY COOLING SYSTEM (**CLOSED**) X2
	DECK w ASH DOWN (**CLOSED**) XI
	FUEL WATER SEPARATOR (**1 OPEN - 1 CLOSED**) X2
	RAW WATER SEPARATORS (**1 OPEN - 1 CLOSED**) X2
	OPEN AND CLOSE PORT/STARBOARD JET RAKE CLEAN OUT
	ELECTRICAL SYSTEM S CHECKS
	SHIPS POWER DISTRIBUTION (**ON**)
	MILITARY COMM. POWER (**ON/OFF**)
	ENGINE STARTING BATTERY SWITCH (**ON**)
	BATTERY PARALLEL SWITCH (**OFF**)
	MAIN POWER CIRCUIT BREAKER (**ON**)
	ALL OTHER APPLICABLE BREAKERS (ON)
	ENGINE SWITCHES (**RUN**)
	AUDIO ENGINE ALARM
	EMERGENCY LIGHTS (**PORT alternator/engine**) X2
	EMERGENCY LIGHTS (**STARBOARD alternator/engine**) X2
	NAVIGATION LIGHT SWITCH (**ON**) CHECK LIGHTS, Nav X4, Anchor X1
	FUEL GAUGE / LEVEL X2
	HELM POSITION INDICATOR (**full port then starboard and back to center**)
	DIMMER KNOB / INSTRUMENT PANEL LIGHTS
	MARINE BAND RADIO (**radio check, hailer and fog horn**)
	RADAR / FLUXGATE COMPASS
	DEPTH SOUNDER (**set shallow water alarm to 4 feet**)
	GPS I LORAN "C" (**SET W AY POINTS IF APPLICABLE**)

TAB 506

INITIALS	ITEM
	SEARCH LIGHTS X2
	WELL DECK LIGHTS (**RED**) X2
	ENGINE COMPARTMENT LIGHTS (**RED**) X2 (**WHITE**) X2
	BILGE PUMPS (**AUTO**) CHECK OPERATION
	TURN OFF ALL ELECTRONIC EQUIPMENT / LEAVING BILGE PUMPS
	THROTTLE / BUCKETS CONTROLS (**SMOOTH OPERATION**)
	GUN MOUNTS SECURED
	ALL SL-3 & SAFETY GEAR STORED
	ENGINE COMPARTMENTS CLOSED
	LOG ENGINE HOURS (PORT_____) (STARBOARD_____)
	PRE -LAUNCH CHECKS
	TRUCK AND TRAILER ARRIVE AT LAUNCH SITE
	GROUND GUIDE
	DISCONNECT TRAILER LIGHTS
	INSERT SURGE PIN
	DISCONNECT CHAIN TENSIONER
	LAUNCH TRAILER UNTIL JETS ARE SUBMERGED
	DISPLAY ENSIGN
	ANTENNAS UP
	RAISE ENGINE HATCHES
	CENTER HELM
	SET THROTTLES AT IDLE SPEED
	CAUTION: No more than 30 sec. on starting of engines allowing
	of cool down time between starting attempts. No more than 4
	per engine.
	TURN PORT ENGINE TO START AND RELEASE
	IMMEDIATELY: Check engine oil pressure allow 20 sec to rise if not shut down

TAB 506

INITIAL	TASK
	ADJUST PORT THROTTLE
	OBSERVE HSRX OVERFLOW
	TURN OFF PORT ENGINE
	TURN STARBOARD ENGINE TO START. RELEASE TO RUN.
	IMMEDIATELY: Check engine oil pressure allow 20 sec to rise if not shut down
	ADJUST STARBOARD THROTTLE
	OBSERVE HRSX OVERFLOW
	RESTART PORT ENGINE (OBSERVE INCREASE TO HSRX FLOW)
	ALLOW ENGINES TO WARM UP 3 -5 MIN AT IDLE (NO MORE THAN 10
	CHECK & MONITOR ALL GAUGES
	TURN ON ALL ELECTRONICS (COMM, GPS, RADAR, DEPTH SOUNDER)
	CHECK ENGINE COMPARTMENT FOR DURING WARM UP:
	RAW WATER STRAINER (BUBBLES)
	UNUSUAL NOISES
	LEAKS AROUND PIPING, HOSES AND P.O.L,s
	AIR FILTER INDICATORS X2
	JETS FOR WATER LEAKS
	HRSX LEVEL TO THE DOT
	CLOSE ENGINE COMPARTMENTS AND OPEN SMALL VENTS
	LAUNCHING
	ENSURE CHAIN TENNSIONER IS DISCONNECTED
	ESTABLISH COMMUNICATIONS WITH DRIVER
	ENSURE RAC IS FAR ENOUGH IN WATER
	PRE-LAUNCH IS COMPLETED
	LAUNCH CRAFT INSURING AREA IS CLEAR
	DURING OPERATION CHECKS
	WATER DISCHARGE (STARBOARD) X2 (PORT) X1

INITIAL	**TASK**
	RAW WATER VACUUM GAUGE (TAKE ACTION IF NEED BE)
	FUEL VACUUM **(5-7 IS BAD HIGHER THAN 7 IS A NO GO SECURE ASAP)**
	FUEL LEVEL GAUGES
	ENGINE TEMPERATURE GAUGES (180-200)
	OIL PRESSURE (30-40 psi AT IDLE 50-60 ON STEP)
	VOLTMETER (24 VOLTS)
	AMMETER (BETWEEN 5 AND 6 AT EITHER END)
	TACHOMETER
	HELM INDICATOR
	HELM TURN FULL PORT AND STARBOARD
	EMERGENCY LIGHTS / AUDIO ALARM
	ALL LIGHTING (NAV LIGHTS AT NIGHT)
	ENGINE OPERATION
	RESPONSE TO THROTTLES
	UNUSUAL NOISES
	BUCKET RESPONSE TO CONTROLS
	ALL ELECTRONICS TO OPERATE (**COMM, GPS, RADAR, DEPTHFINDER)**
	POST OPERATION CHECKS
	TRAILERING
	CHECK POSITION ON TRAILER (**IF TRAILERING**)
	HOOK UP WINCH (**IF TRAILERING**)
	ATTACH CHAIN TENNSIONER (**IF TRAILERING**)
	BUCKETS AT "0" SPEED
	THROTTLES AT IDLE
	CENTER HELM
	TURN OFF ALL ELECTRONICS (**COMM, GPS, RADAR, DEPTHFINDER**)
	PRIOR TO SHUT DOWN ALLOW ENGINES TO IDLE 3-5 MIN TO

SO-506-10

TAB 506

INITIAL	**TASK**
	TURBO-CHARGER IF NOT ALL READY AT IDLE
	SHUT DOWN ONE ENGINE AT A TIME
	PULL RAC FROM WATER TO LEVEL GROUND (**IF OUT OF WATER ONLY**)
	CHECK RAC POSITION ON TRAILER (**IF OUT OF WATER ONLY**)
	HOOK UP TRAILER LIGHTS
	ATTACH SAFETY CHAIN
	ATTACH EMERGENCY BRAKE CHAIN
	SECURE GUN MOUNTS
	ANTENNAS DOWN
	SECURE ENSIGN
	ENGINE STARTING BATTERY SWITCH **(OFF)**
	MAIN POWER SWITCH **(OFF)** (**IF OUT OF WATER ONLY**)
	ALL CIRCUIT BREAKERS **(OFF)** (**IF OUT OF WATER ONLY**)
	MAIN AND BILGE PUMP CIRCUIT BREAKERS **(STAYS ON IF IN WATER)**
	MILITARY COMM. POWER **(OFF)**
	BATTERY PARALLEL SWITCH **(OFF)**
	SHIPS POWER DISTRIBUTION (**IF OUT OF WATER ONLY**)
	BILGE PUMPS **(OFF)**
	HULL (INSPECT FOR DENTS, PAINT, WELDS, FASTENERS & CANOPY)
	REMOVE DRAIN PLUGS (**IF OUT OF WATER ONLY**)
	JETS FROM OUT SIDE (**IF OUT OF WATER ONLY**)
	JETS IF IN WATER LOOK FOR LEAKS INTO ENGINE COMPARTMENT
	CLEAN RAW WATER STRAINERS X4
	ALL PIPING, HOSES, CONNECTORS & MOUNTS
	ALL WIRING, CONNECTORS & ROUTING
	DRIVE SHAFT X2
	ENGINE MOUNTS X8

SO-506-11

TAB 506

INITIAL	**TASK**
	BATTERY (BOX, CONNECTIONS, LEAKING & HOLD DOWNS)
	HSRX BELT TENSION I CONDITION (1/2" –3/4" TOLERANCE)
	ALL P.O.L FLUIDS AND TOP OFF **(ENSURE ENGINE IS COOL**)
	STRIP FUEL TANKS
	CLOSE FUEL RETURN X2
	CLOSE FUEL RETURN CROSS OVER XI
	EMERGENCY SHUT OFF ENGAGED X2
	CLOSE GATE VALVES X2
	CLOSE MAIN SEA CHEST IF IN WATER X2
	WASH (**TURN ON SHIPS DISTRIBUTION, MAIN, BILGE CIRCUIT BREAKER &**
	TO AUTO WHILE WASHING OUT ENGINE COMPARTMENT THEN SECURE SHIPS
	DISTRIBUTION, MAIN, BILGE AND PUMP) (**IF OUT OF WATER ONLY**)
	SL-3 INVENTORY / SERVICEABILITY & SAFETY GEAR
	CLOSE ENGINE COMPARTMENTS AND VENTS
	LOG ENGINE HOURS PORT_____) (STARBOARD _____)
	PLACE ON APPLICABLE COVERS (GUN OR BOAT COVER)
	POST OPERATION / TRAILER
	LIGHT BAR (MOUNT, BOLTS)
	ROUTE AND SECURE LIGHT BAR LEAD
	TIRE PRESSURE, WEAR, WHEEL LUGS (TO INCLUDE SPARE)
	BUDDY BEARING CAPS (LUBE)
	OVER THE ROAD GEAR (JACK W/HANDLE, LUG WRENCH, WENCH
	" A " FRAME (WENCH, MOUNTING HARD WEAR, DENTS, CRACKS)
	LANDING LEG (OPERATION & CONDITION)
	CHAIN W/TENNSIONER
	MASTER CYLINDER (FILL)
	DONUT AND SAFETY CHAINS

SO-506-12
TAB 506

INITIAL	**TASK**
	BRAKE LINES (LEAKS AND CONDITION)
	AXLES
	GENERAL CONDITION {FENDERS, NUTS/BOLTS, BUNKS/CARPET,
	WASH
	FUEL / ADDITIVE (FUEL_____/ ADDITIVE_____)

As coxswain of RAC____. I_____ have used and completed the Pre / Post operation check list in accordance the references. This craft has been P.M.ed and all SL-3 gear/craft has been properly secured, and accounted for. I also understand that Check list, Fuel cards, and Discrepancy list must be turned in to the DISPATCHER for verification of accountability and serviceability

NAME _____
RANK _____

SSN _____

SIGNATURE _____

DISPATCHERS SIGNATURE _____

SO-506-13
TAB 506

REFERENCE:

1. TM 09557 A-14/1 System and Operation Manual w/SL-3 components list for the Riverine Assault Craft.

2. Pre/post operation check list

NOTES:

ATTACHMENTS: None.

SO-506-14
UNITED STATES MARINE CORPS
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TAB 507
MAR 99

STUDENT OUTLINE

HULL

LEARNING OBJECTIVES

A. TERMINAL LEARNING OBJECTIVES:

(I) With the aid of references, perform RAC operations checks in accordance with the references.

(2) With the aid of references, perform preventive maintenance on the RAC in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) With the aid of references, inspect the RAC hull, in accordance with the references.

(2) Without the aid of references, when given a diagram identify in writing the designated portions of the RAC hull, in accordance with the references.

(3) With the aid of references, inspect the RAC anodes, in accordance with the references.

(4) Without the aid of references, when given a diagram, designate in writing the locations of the RAC anodes, in accordance with the references.

(5) With the aid of references, perform preventive maintenance on the RAC hull in accordance with the references.

(6) With the aid of references, perform preventive maintenance on the RAC anodes in accordance with the references.

SO-507-1

TAB 507

OUTLINE

1. **Foam Location:**

a. Foam has been utilized in the RAC to assure the craft will float evenly in a fully loaded condition (including troops) when swamped. The foam selected is the same as provided on the existing craft and meets the USCG requirements.

b. The foam is poured or sprayed in place and allowed to expand around the structure of the craft. The use of this type of foam increases the strength of the hull and aids in reducing noise.

c. Foam location

(1) Port and starboard from the engine compartment to the bow.

(2) Sandwiched in between the engine compartment hatches.

(3) Inside the forward bulkhead of the engine compartment.

(4) Under the well deck sole outboard of the fuel tank.

(5) Outboard of the aft weapon station.

NOTE**: Foam located in the engine compartment hatches and forward of the engine compartment in the bulkhead provides noise insulation.**

2. **Hull Inspection:**

a. Rub rail: Inspect for chips (large). Make sure the rail is intact. The rub rail runs around the entire craft, except the rear transom. This component protects the craft while docking and possibly bumping into another craft.

b. Anodes: Zinc anodes are mounted on the bottom of the transom to protect against galvanic and electrolytic corrosion. These anodes must be inspected at every opportunity and replaced when about 50 percent of the zinc material has been consumed.

c. House keeping: Dirty and/or wet bilge's or accumulation of dirt and water anywhere should be avoided. The bilge area, unless properly maintained by good housekeeping, may be subject to pitting type corrosion where bilge water and sediment remain in long-time contact with the aluminum. If corrosion does occur, it will show as a white powder (aluminum oxide) at joints or crevices. It is also found in areas where the bilge water is retained for long periods of time. A fresh water cleaning of the bilge's on a regular basis is a requirement in avoiding potential galvanic corrosion problems.

d. Paint damage The hull of this craft is constructed of aluminum. This aluminum is covered with several coats of paint. This paint will aid in the reduction of corrosion throughout the hull. Upon noticing a chip in the paint that goes all the way to the aluminum hull, it should be taken to maintenance for repairs. If not corrected the bear aluminum will start to oxidize and hull integrity has now been jeopardized.

REFERENCES:

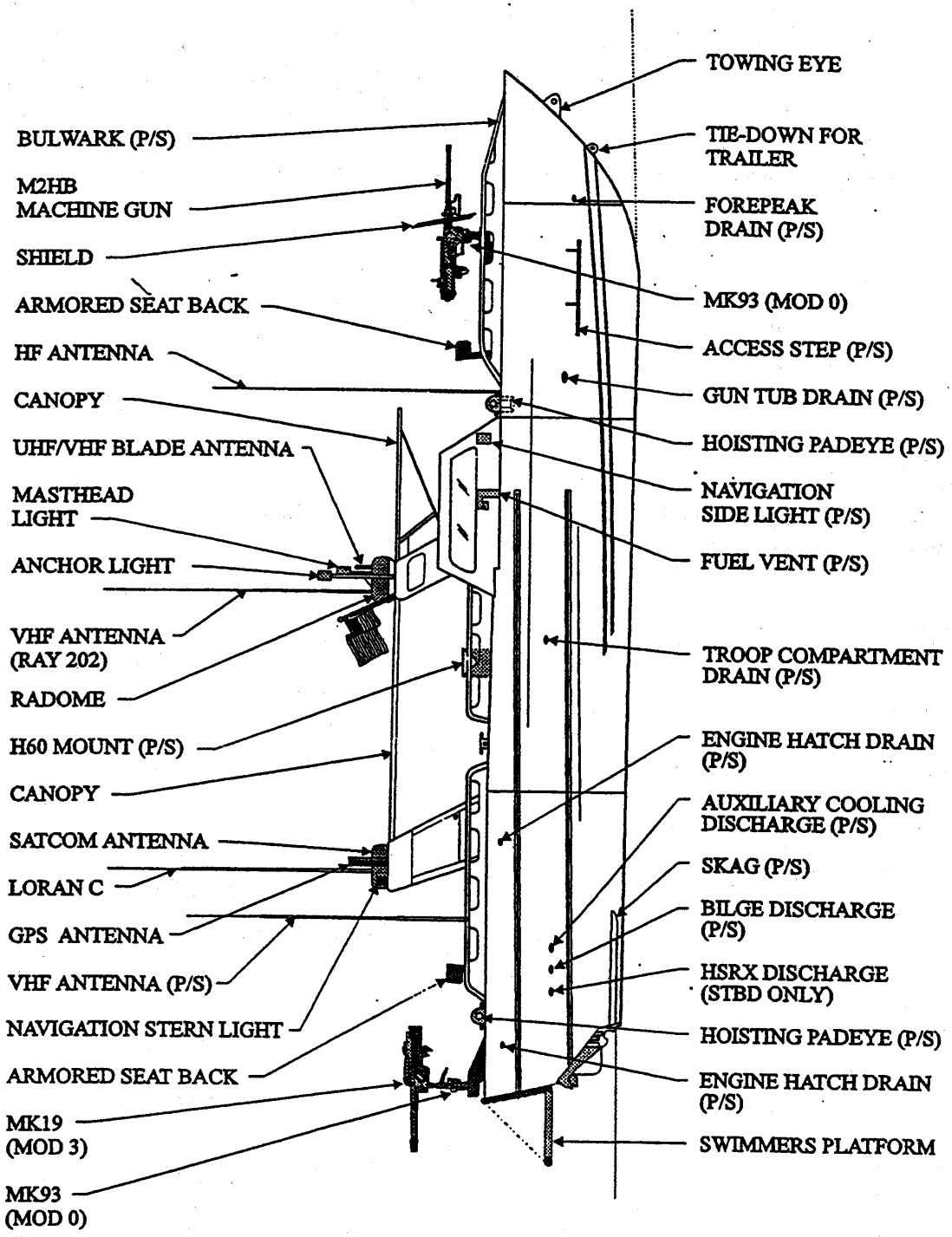
1. TM 09557A-14/1: System And Operation Manual W/ Components List For The Riverine Assault Craft

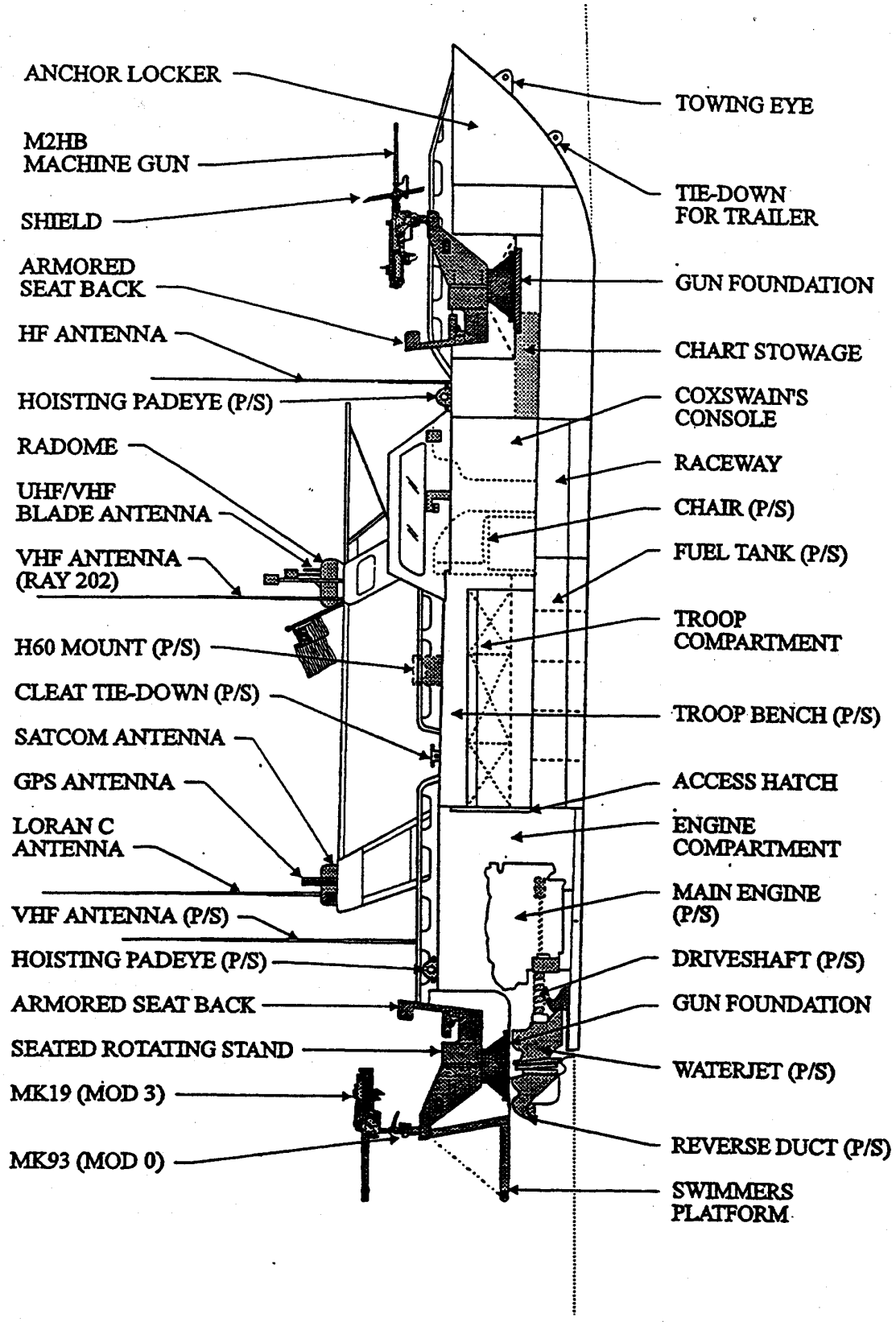
NOTES:

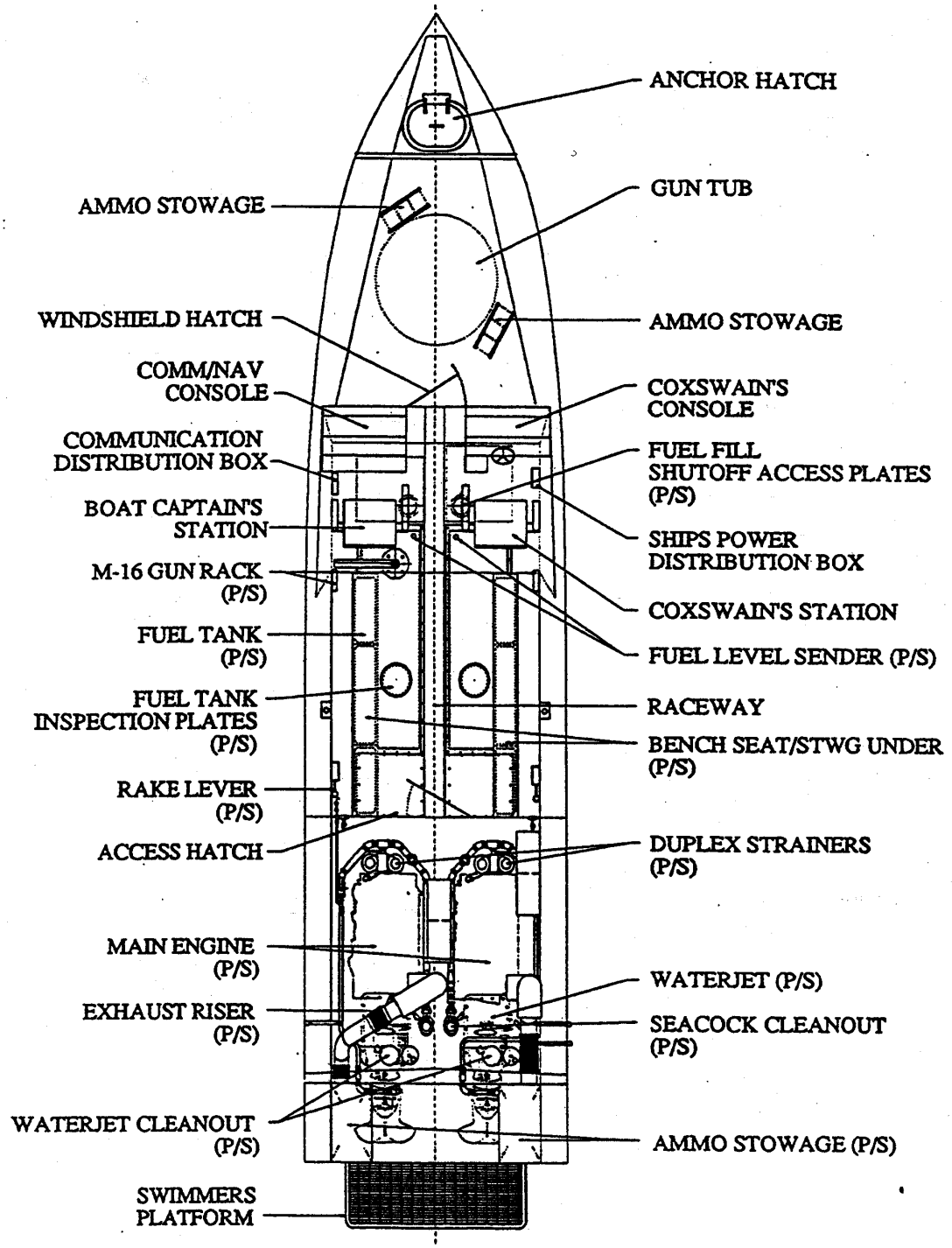
ATTACHMENTS:

1. RAC Outboard Profile
2. RAC Inboard Profile
3. RAC Maindeck Arrangements

SO-507-3


TOWING EYE
BULWARK (P/S)
TIE-DOWN FOR TRAILER
M2HB MACHINE GUN
FOREPEAK DRAIN (P/S)
SHIELD
MK93 (MOD 0)
ARMORED SEAT BACK
ACCESS STEP (P/S)
HF ANTENNA
GUN TUB DRAIN (P/S)
CANOPY
HOISTING PADEYE (P/S)
UHF/VHF BLADE ANTENNA
NAVIGATION SIDE LIGHT (P/S)
MASTHEAD LIGHT
FUEL VENT (P/S)
ANCHOR LIGHT
VHF ANTENNA (RAY 202)
TROOP COMPARTMENT DRAIN (P/S)
RADOME
H60 MOUNT (P/S)
ENGINE HATCH DRAIN (P/S)
CANOPY
AUXILIARY COOLING DISCHARGE (P/S)
SATCOM ANTENNA
SKAG (P/S)
LORAN C
BILGE DISCHARGE (P/S)
GPS ANTENNA
HSRX DISCHARGE (STBD ONLY)
VHF ANTENNA (P/S)
NAVIGATION STERN LIGHT
HOISTING PADEYE (P/S)
ARMORED SEAT BACK
ENGINE HATCH DRAIN (P/S)
MK19 (MOD 3)
SWIMMERS PLATFORM
MK93 (MOD 0)


ANCHOR LOCKER
M2HB MACHINE GUN
SHIELD
ARMORED SEAT BACK
HF ANTENNA
HOISTING PADEYE (P/S)
RADOME
UHF/VHF BLADE ANTENNA
VHF ANTENNA (RAY 202)
H60 MOUNT (P/S)
CLEAT TIE-DOWN (P/S)
SATCOM ANTENNA
GPS ANTENNA
LORAN C ANTENNA
VHF ANTENNA (P/S)
HOISTING PADEYE (P/S)
ARMORED SEAT BACK
SEATED ROTATING STAND
MK19 (MOD 3)
MK93 (MOD 0)
TOWING EYE
TIE-DOWN FOR TRAILER
GUN FOUNDATION
CHART STOWAGE
COXSWAIN'S CONSOLE
RACEWAY
CHAIR (P/S)
FUEL TANK (P/S)
TROOP COMPARTMENT
TROOP BENCH (P/S)
ACCESS HATCH
ENGINE COMPARTMENT
MAIN ENGINE (P/S)
DRIVESHAFT (P/S)
GUN FOUNDATION
WATERJET (P/S)
REVERSE DUCT (P/S)
SWIMMERS PLATFORM


ANCHOR HATCH
GUN TUB
AMMO STOWAGE
WINDSHIELD HATCH
AMMO STOWAGE
COMM/NAV CONSOLE
COXSWAIN'S CONSOLE
COMMUNICATION DISTRIBUTION BOX
FUEL FILL SHUTOFF ACCESS PLATES (P/S)
BOAT CAPTAIN'S STATION
SHIPS POWER DISTRIBUTION BOX
M-16 GUN RACK (P/S)
COXSWAIN'S STATION
FUEL TANK (P/S)
FUEL LEVEL SENDER (P/S)
FUEL TANK INSPECTION PLATES (P/S)
RACEWAY
BENCH SEAT/STWG UNDER (P/S)
RAKE LEVER (P/S)
ACCESS HATCH
DUPLEX STRAINERS (P/S)
MAIN ENGINE (P/S)
WATERJET (P/S)
EXHAUST RISER (P/S)
SEACOCK CLEANOUT (P/S)
WATERJET CLEANOUT (P/S)
AMMO STOWAGE (P/S)
SWIMMERS PLATFORM

UNITED STATES MARINE CORPS
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Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 508
MAR 99

STUDENT OUTLINE

RIVERINE ASSAULT CRAFT RAW WATER COOLING SYSTEM

LEARNING OBJECTIVES:

a. **Terminal Learning Objectives**:

(1) With the aid of references, perform RAC operations checks, in accordance with references.

(2) With the aid of references, perform preventive maintenance on the RAC , in accordance with references.

b. **Enabling Learning Objectives**:

(1) With the aid of references, inspect the RAC raw water system, in accordance with references.

(2) Without the aid of references, when given a diagram identify in writing the designated portions of the RAC raw water system, in accordance with references.

(3) With the aid of references, perform preventive maintenance on the RAC raw water system, in accordance with references.

OUTLINE

1. **Raw Water Cooling System Operation**

a. The raw water cooling system starts in the body of water that the craft will be operated in. The water from the river, ocean or lake floods into the sea chest openings. From the sea chest openings, piping and valves it enters the raw water strainers.

b. The raw water cooling system is considered primed up to the inlet (suction) side of the pump. Once the raw water is at the pump and the engine is started, the pump draws raw water through the sea chest openings and the raw water strainer then forces it through out the system. At the point when the raw water leaves the pump and is forced through out the system it is considered the pressure side of the system.

c. The next component the raw water will enter under pressure is the aftercooler. This raw water then exits the aftercooler and flows still under pressure into the heat exchanger. After the raw water circulates through the heat exchanger it is then routed in two directions. The exhaust riser, where some raw water will exit the craft by way of the exhaust piping and the remaining raw water will flow through the jet hydraulic oil cooler and exits by way of the starboard overboard discharge.

EQUIPMENT NOTE:
WHEN CRAFT PROPULSION ENGINES ARE RUNNING THERE SHOULD BE THREE DISCHARGES OF RAW WATER, TWO FROM THE STARBOARD SIDE AND ONE FROM THE PORT SIDE, NEAR THE AFT SECTION OF THE CRAFT. IF RAW WATER IS NOT BEING DISCHARGED FROM THESE THREE POINTS STOP ENGINES AND INVESTIGATE THE CAUSE

d. This system also incorporates a emergency raw water cooling system. The emergency raw water cooling system starts at the jets. Located on the top side of each jet there is a piping connection that runs through the transom to a valve just before the raw water strainers. This valve stays in the closed position for normal operation and is opened **ONLY** for emergency raw water cooling.

e. To activate the emergency raw water cooling system the coxswain has to manually pull the "T" handles located boot top high starboard side in the coxswain station. Located on the sea chest piping there are two valves inline that have to be closed. **(If the valves are not closed when emergency cooling system is activated water will flow back out the sea chest)** The "T" handles that are used for the emergency raw water cooling are the lower handles, one labeled port and the other labeled starboard. **(Labeled in red)** Once handles are pull the coxswain has to manually reset the valves by pushing them back to the original position.

2. **Raw Water Cooling System Components**

a. Sea Chest The sea chest are located on the bottom side aft of the raft. Grates are built in the openings to stop large objects from entering the system. This is were the raw water cooling system begins. There is a series of valves, piping and hoses after the sea chest openings. Valves are for isolating the sea chest from the system only if needed; For example while maintenance is being performed, fresh water flushing, clearing the sea chest while craft is in the water, when the emergency raw water cooling system is activated and for deck wash down. Pipes/hoses are used to transfer the raw water from one point to the other.

b. Raw Water Strainers The raw water strainers are located in the front of the engines, one pair per engine and are down below the water line. The raw water strainers, filters/strains out foreign debris from the in coming raw water. Each pair of strainers has a lever located in the

center of the pair to change from one strainer to the other. This will allow us to clear one strainer while still underway. The Plexiglas shells allow the operator to visually inspect the strainer.

c. Raw Water Pump The raw water pump is located port side front of each engine. The purpose of the raw water pump is to draw water through the strainer and force it through the system.

d. Aftercooler The aftercooler is also located on the port side rear of the engine. The purpose of the aftercooler is to cool down the in coming air that will be used for combustion. The incoming air passes around the core, while the raw water passes through the core. During this period of cooling the heat from the air is transferred to the core and carried away by the raw water.

e. Heat Exchanger The heat exchanger is located on the starboard side center top of the engine. The purpose of the heat exchanger is to allow the fresh water to pass around the outside of the core and the raw water to pass through the center of the core. During this period of cooling the heat from the fresh water is transferred to the core and carried out the exhaust by way of the raw water.

f. Jet Hydraulic Oil Cooler The oil cooler is mounted on the top side of the jet. The purpose of the oil cooler is to cool the hydraulic oil used in the HRSX. The cooler allows the oil to flow around the outside of the core and the raw water to flow through the center. During this period of cooling the heat is transferred from the oil to the core. Both oil coolers are connected together at the discharge sides and routes to the overboard discharge (starboard side). The inlets for the oil coolers are connected at the heat exchanger tubes.

3. **Servicing the Raw Water Cooling System**

a. Servicing the raw water cooling system is a daily performance, done by a crew member. This service will be held before operation, monitored during operation and after operation.

b. Steps for servicing the raw water cooling system;

(1) Before the craft is launched from the trailer visually check sea chest opening for any obstructions.

(2) Check valve alignment of raw water cooling system.

(3) Visually inspect raw water strainers.

(4) Check all piping/hose connections, and mounting of components.

(5) Check emergency raw water cooling system. Pull "T" handles verify movement of valve and reset for normal operation.

(6) Visually check raw water cooling system once again when craft is in the water with engines running.

(7) Visua11y check overboard discharges. Two starboard side, one port side of the craft.

(8) Monitor gauges as engines are running for warm up and when underway.

REFERENCES:

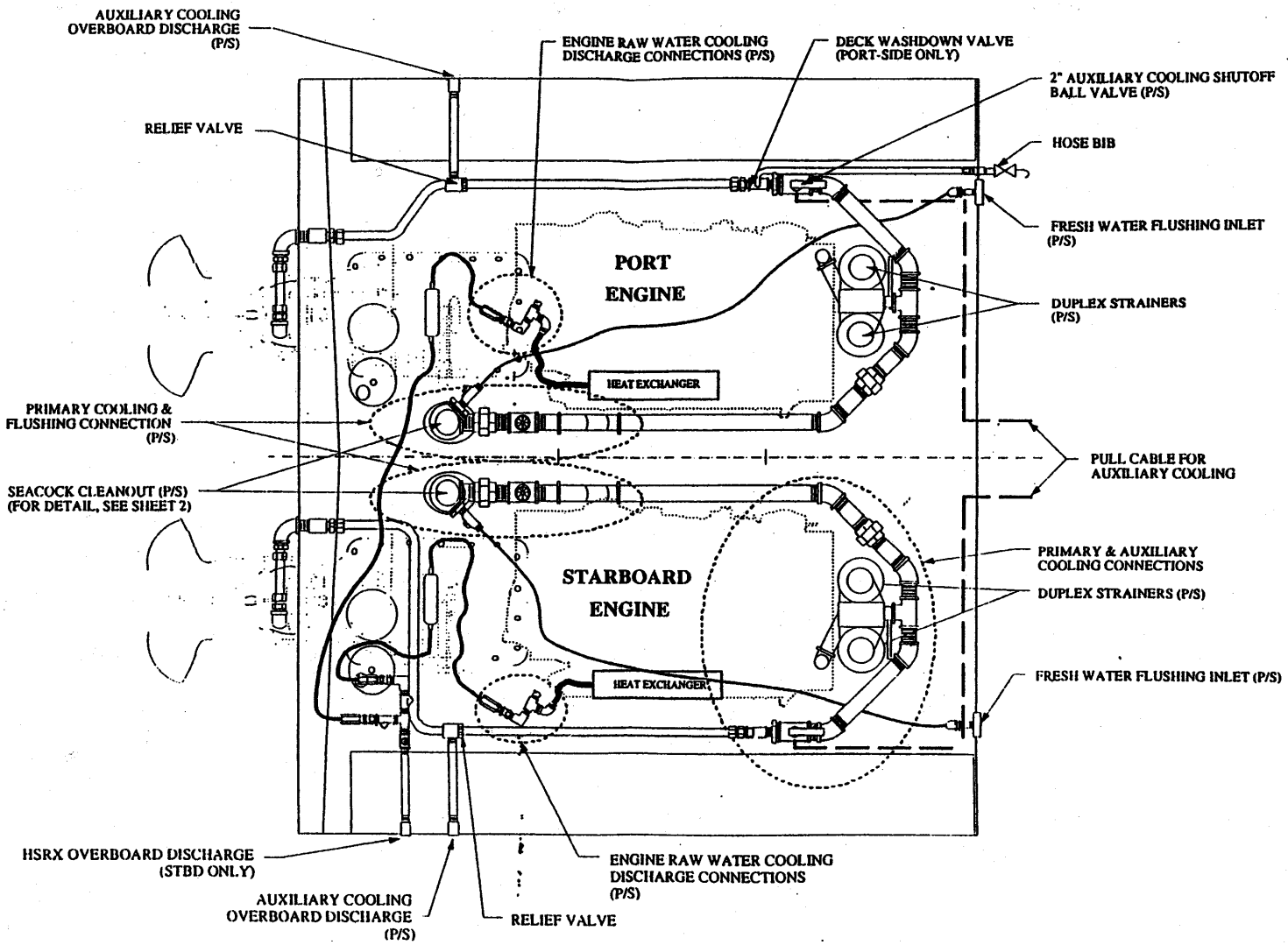
1. TM 09557A-14/1 System And Operation Manual W/Components List For Riverine Assault Craft

2. TM 09557A-14/3 Operation And Maintenance Technical Manual For Propulsion Waterjet Model 273

NOTES:

ATTACHMENTS:

1. RAC Raw Water Cooling Diagram.


AUXILIARY COOLING OVERBOARD DISCHARGE (P/S)
ENGINE RAW WATER COOLING DISCHARGE CONNECTIONS (P/S)
DECK WASHDOWN VALVE (PORT-SIDE ONLY)
2" AUXILIARY COOLING SHUTOFF BALL VALVE (P/S)
RELIEF VALVE
HOSE BIB
FRESH WATER FLUSHING INLET (P/S)
PORT ENGINE
DUPLEX STRAINERS (P/S)
HEAT EXCHANGER
PRIMARY COOLING & FLUSHING CONNECTION (P/S)
PULL CABLE FOR AUXILIARY COOLING
SEACOCK CLEANOUT (P/S) (FOR DETAIL, SEE SHEET 2)
PRIMARY & AUXILIARY COOLING CONNECTIONS
STARBOARD ENGINE
DUPLEX STRAINERS (P/S)
HEAT EXCHANGER
FRESH WATER FLUSHING INLET (P/S)
HSRX OVERBOARD DISCHARGE (STBD ONLY)
ENGINE RAW WATER COOLING DISCHARGE CONNECTIONS (P/S)
AUXILIARY COOLING OVERBOARD DISCHARGE (P/S)
RELIEF VALVE

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Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

STUDENT OUTLINE

RIVERINE ASSAULT CRAFT FRESH WATER SYSTEM

LEARNING OBJECTIVE:

TAB 509
MAR 99

A. **TERMINAL LEARNING OBJECTIVES:**

(1) With the aid of references, perform RAC operations checks, in accordance with references.

(2) With the aid of references, perform preventive maintenance on the RAC , in accordance with references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) With the aid of references, inspect the RAC fresh water system, in accordance with references.

(2) Without the aid of references, when given a diagram, identify the designated portions of the RAC fresh water system, in accordance with references.

(3) With the aid of references, perform preventive maintenance on the RAC fresh water system, in accordance with references.

OUTLINE

1. The fresh water cooling system for the RAC is a mixture of anti-freeze and water. (50% H20 and 50% ANTI-FREEZE) It will be referred to as the fresh water cooling system, because of the fresh water that is used. This section of the cooling system is not discharged from the craft when underway. It will constantly circulate through the engine and other components of the cooling system. The excessive heat from the fresh water cooling system is removed by the raw water system. (This process is similar to the radiator on your vehicle) The fresh cooling system must be brought to normal operating temperature and must be maintained. This is accomplished

by the opening and closing of the thermostat. Other components of the system are cooled and regulated as well due to this process.

2. Coolant from the expansion tank flows through a hose to the water pump. The water pump circulates this coolant through the engine block, cools the oil cooler, and cylinders, then flows into the cylinder head. While in the cylinder head the coolant will cool the injectors. Some coolant exits the rear of the cylinder head and then enters the turbo charger. (The remaining coolant returns to the water pump by way of a by-pass until the thermostat tarts to open, the engine is now reaching normal operating temperature). Coolant is then directed to the heat exchanger. While flowing through the heat exchanger it is cooled by the raw water. Then returns back to the water pump. The coolant from the turbo charger will flow through the exhaust manifold and returns back to the water pump to be recirculated.

3. **Components of the Fresh Water Cooling System**

a. Expansion Tank Expansion and over flow tanks are provided for each engine. The expansion tank is a reservoir for the coolant. This is were the coolant level is checked and coolant mixture is added. The over flow tank is a storage place for coolant that is discharged from expansion tank.

b. Expansion Tank Cap The expansion tank cap has four functions:

(1) Caps off the expansion tank and stops coolant from surging out.

(2) Pressurizes the cooling system to maintain a fixed coolant system pressure.

(3) Raises the boiling point of the coolant 3 degrees for each pound of pressure applied.

(4) Has a vacuum valve to equalize pressure when the engine is cooling after shutdown.

c. Hoses The hoses are used to transfer coolant and aids in making connections between components.

d. Water Pump The purpose of the water pump is to circulate the coolant in the cooling system. The water is located on the front of the engine. The pump is belt driven and mounted to the engine block.

e. Engine Block The engine block houses the oil cooler, cylinder (water jackets) and transfers the coolant to the cylinder head.

f. Cylinder Head The cylinder head receives coolant from the block, while in the cylinder head the coolant circulates, cooling the injectors and the hot spots of the cylinder head. Also incorporated in cylinder head is the thermostat and housing. The thermostat is no more then a hot/cold sensing device that opens and closes from changes in the coolant temperature.

g. Sending Unit The sending unit is located in the cylinder head, before the thermostat. The temperature sending unit senses the temperature of the coolant then sends a electrical signal to a gauge in the coxswain station.

STUDENT NOTE:
At this point coolant is routed into two different directions one is the turbo charger (from the rear of the cylinder head) the next is the thermostat (if the thermostat is closed the coolant routes through the by-pass until the thermostat starts to open.)

h. Turbo Charger The turbo charger is included in the cooling system because coolant from the cylinder head cools the exhaust side of the turbo charger which is exhaust driven.

i. Exhaust Manifold The exhaust manifold is subject to very high temperatures when the engine is running. To cool this component cast passageways of the manifold allow the coolant from the turbo charger to flow through and carries the heat away. This coolant is then routed back to the water pump housing to be recirculated.

j. Heat Exchanger This component of the cooling system is where the raw water aids in removing the heat from the fresh water. Coolant flowing from the thermostat enters the heat exchanger at the top/front. The coolant and the raw water will pass at this point but will not mix The coolant then returns to the water pump after the heat is removed. The heat exchanger is located port side of the engine it is cylinder/tubular shape and capped at both ends.

4. **Servicing the Fresh Water Cooling System**

a. Servicing the fresh water cooling system Servicing the RAC is a important task for the operation of the craft. As noted before the cooling system when operating properly will help bring the engines to operating temperature and maintain the operating temperature. Always make sure you set a pattern when servicing so not to miss any checks.

b. Steps for cooling system servicing

(1) Check the expansion tank coolant level. (Level should be between 1" to 1 ½ " below the filler neck)

STUDENT NOTE:
If any coolant is needed make sure the mixture is correct 50% water 50% anti-freeze.

(2) Check cap for serviceability. Dents, fit, rubber seat, corrosion, etc...

STUDENT NOTE:
If cap is found to be unserviceable replace ASAP.

(3) Check tank for mounting, any hose connections for tightness and corrosion.

(4) Check all hoses and connections for tightness and leaks.

STUDENT NOTE:
Never over tighten hose clamps.

(5) Do a 360 degree check on both port and starboard engines for any evidence of coolant leaking into the engine compartment.

(6) Visually check the fresh water cooling system during engine warm up for any leaks.

REFERENCES:

1. TM 09557A-14/1 System And Operation Manual W/Components List For Riverine Assault Craft

2. TM 09557A-14/2-1 Operation And Maintenance Technical Manual For Diesel

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejune, North Carolina 28542

TAB 510
MAR 99

STUDENT OUTLINE

FUEL SYSTEM

LEARNING OBJECTIVES

A TERMINAL LEARNING OBJECTIVES:

(1) With the aid of references, perform RAC operations checks, in accordance with the references.

(2) With the aid of references, perform preventive maintenance on the RAC, in accordance with the references.

(3) Without the aid of references, conduct fueling operations, in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) With the aid of references, inspect the RAC fuel system, in accordance with the references.

(2) Without the aid of references, when given a diagram, identify in writing the designated portions of the RAC fuel system, in accordance with the references.

(3) Without the aid of references, refuel the RAC from a refueling source, in accordance with the references.

(4) With the aid of references, perform preventive maintenance on the RAC fuel systems, in accordance with the references.

OUTLINE:

1. **Components Of The Rac Fuel System:**

a. Filler Cap The fuel tank filler cap is located on the deck forward of the coxswain station. It is surface mounted on the deck so that crew members will not trip over it and lines and ropes

will not get snagged. The fuel cap caps off the fuel tank(s), stops foreign debris from entering the tank (s) and stops fuel from shushing out when underway.

b. Filler Neck/Screen The filler neck is no more then a connection from the cap to the tank(s), it also incorporates a screen to help stop any foreign objects from entering the tank(s). The screen is usually a permanent part of the filler neck.

c. Gate Valves This craft incorporates two 2" gate valves, located forward of the tanks under the deck. Inspection ports are provided for access to the valves, ports are located center of the craft one at the coxswain station and the other at the captains station. These valves may be manually opened or closed for fueling one tank at a time. They are also used to isolate one tank from the other, if one tank becomes damaged or fuel gets contaminated. For all practical purposes, the valves should remain in the opened position.

d. Fuel Tank(s) The RAC incorporates two (2) fuel tanks: one port and one starboard. The tops of the fuel tanks form the walking surface of the well deck . Basically, the tanks are a holding place or reservoir for the fuel. Fuel is returned from the engines to the tanks, this fuel is hot, but once in the tank it will be cooled. It mixes with the cool fuel in the tanks. The fuel tank capacity is 80 gallons each.

(1) The tanks also incorporate vents and sending units. The vents relieve any air in the tanks, aids when refueling, and fuel for pick up.

(2) The sending units are located on top of the of tanks, behind the coxswain and captain stations under a protective cover. The sending units are connected to the fuel gauges in the coxswain station and send an electrical signal to the gauges for fuel level readings. There is 1 sending unit and gauge per tank.

e. Lines Fittings and Valves The lines, fitting and valves aid in transferring fuel throughout the system. Always replace lines, fittings and valves with like items.

f. Fuel Filter/Water Separator The fuel filter/water separator, filters foreign debris and separates water from the fuel. Each engine has a pair of fuel filter/water separators, located on the engine compartment forward bulkhead.

g. Lift Pump A lift pump is located on each engine. The function of the lift pump is to transfer (lift) fuel from the tank to the secondary filter then to the injection pump. It also incorporates a primer, which is used to prime the fuel system for starting. Priming the fuel system is not required after the initial start up, since system should stay primed.

h. Second Fuel Filter The secondary fuel filter is located just after the lift pump. The purpose of this filter is to filter out small particles of debris before the fuel enters the injection pump.

i. Injection Pump The injection pump is located on starboard/front of the engine. **NEVER ATTEMPT ANY REPAIRS/ADJUSTMENTS TO THIS COMPONENT**. The purpose of the injection pump is to deliver fuel under pressure to the injector at the proper time.

j. Injector Lines The injector lines are connected to the injection pump and to each injector. The injection lines are constructed of metal to transfer **HIGH PRESSURE FUEL**. For the RAC application there are six (6) on each engine one for each cylinder. **NEVER DISCONNECT /BEND/REPAIR THESE ITEMS**

k. Injectors The injectors are located in the cylinder head. The purpose of the injector is to inject metered fuel under **VERY HIGH PRESSURE** into the combustion chamber.

l. Fuel Return Line(s) Some fuel is returned back to the tank, this is fuel not used/injected into the combustion chamber. To identify the return lines: Return for the injection pump is connected to the top front of the pump. The drain off (return line) for the injectors is connected to each injector and back to the secondary filter housing. **THIS FUEL IS HOT AND UNDER PRESSURE FOR BOTH RETURNS**

m. Fuel Tank Stripping Pump The stripping pump is located on the port bulkhead/engine compartment. The purpose of the stripping pump is to strip or remove settlement and moisture from the fuel. The stripping pump can also be used to fill the filters by maintenance personnel. This procedure is done every day before launching the craft. **DISPOSE OF STRIPPED FUEL PROPERLY**

n. Emergency Fuel Shut Off The emergency fuel shut off system is used only in case of an emergency or if all else fails, when trying to stop the engines. The pull handles for the emergency fuel shut off are located at the coxswain station boot top level. The handles are labeled for port or starboard engines. **NOTE THE LABELING OF PULL HANDLES. THEY ARE COLOR CODED BLACK**. Once handles are pulled, they mechanically activate a lever and valve that will stop the fuel flow. Handles must be manually reset for normal operation. These handles must be pulled in the case of FIRE.

2. **Servicing the RAC Fuel System**

a. To service the RAC fuel system at the crew level always remember you will only be priming, visually inspecting, stripping the fuel tanks and filling tanks.

b. To start service of the fuel system, strip the fuel tanks. When stripping the fuel tanks remember once the fuel starts to flow from the hose in a clean steady flow, **STOP**.

c. Once the tanks are stripped the system can know be primed. To prime the fuel system, locate the transfer pump on the engine. The transfer pump may have either a push button or lever type primer. Activating the device pumps fuel into the filter and pump. While priming the system listen for any unusual noises, such as hissing or suction. Also look for any types of fuel leaks while priming. If nothing occurs while priming, the system is satisfactory. The lever or push button will become harder to activate once fuel system is primed. **STOP**

d. After stripping and priming the fuel system, a good visual inspection should be conducted looking for anything that may seem out of place. It is a good idea to grab and move hoses to check the security and mounting. Check the routing of hoses and lines making sure there are no hard bends or if there is any chance of them becoming chafed or cut.

e. Fuel level is one of the first items checked before we shove off. It is monitored underway and checked and refueled at the end of our mission. The fuel tanks should be topped off after every operation. This will help stop moisture build up in the tanks. If the craft is going to be sitting for a long period of time, it is recommended that a fuel additive be used to keep the fuel fresh and helps prevent moisture build up.

REFERENCES:

1. TM 09557A-14/1 System And Operation Manual W/ Components List For The Riverine Assault Craft

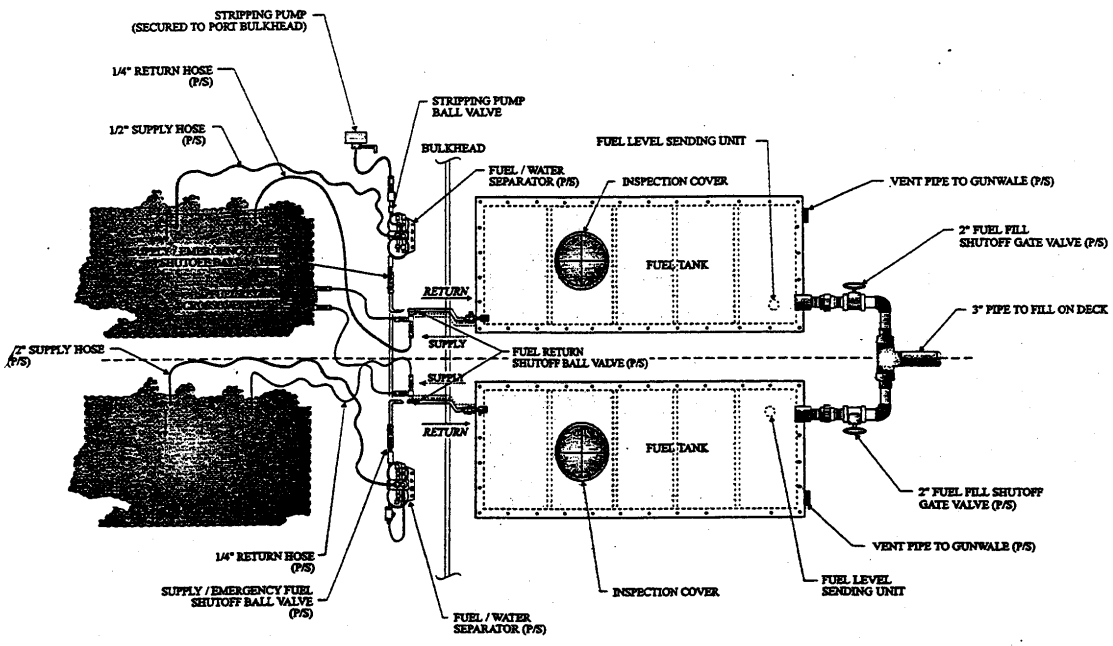
2. TM 09557A-14/3 Operations And Technical Manual For Propulsion Waterjet 273

3. TM 09557A-14/2-1 Operations And Technical Manual For Diesel Engine

NOTES:

ATTACHMENTS :

I. RAC Fuel System diagram


STRIPPING PUMP
(SECURED TO PORT BULKHEAD)
1/4" RETURN HOSE
(P/S)
1/2" SUPPLY HOSE
(P/S)
STRIPPING PUMP
BALL VALVE
BULKHEAD
FUEL / WATER
SEPARATOR (P/S)
FUEL LEVEL SENDING UNIT
INSPECTION COVER
VENT PIPE TO GUNWALE (P/S)
2" FUEL FILL
SHUTOFF GATE VALVE (P/S)
FUEL TANK
RETURN
3" PIPE TO FILL ON DECK
SUPPLY
FUEL RETURN
SHUTOFF BALL VALVE (P/S)
2" SUPPLY HOSE
(P/S)
SUPPLY
RETURN
FUEL TANK
2" FUEL FILL SHUTOFF
GATE VALVE (P/S)
VENT PIPE TO GUNWALE (P/S)
1/4" RETURN HOSE
(P/S)
SUPPLY / EMERGENCY FUEL
SHUTOFF BALL VALVE
(P/S)
FUEL / WATER
SEPARATOR (P/S)
INSPECTION COVER
FUEL LEVEL
SENDING UNIT

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TAB 511
MAR 99

STUDENT OUTLINE

RIVERINE ASSAULT CRAFT ELECTRICAL SYSTEM

LEARNING OBJECTIVES

A. TERMINAL LEARNING OBJECTIVES:

(1) With the aid of references, perform RAC operations checks, in accordance with the references.

(2) With the aid of references, perform RAC operations checks, in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) With the aid of references, inspect the RAC electrical system, in accordance with the references.

(2) Without the aid of references, when given a diagram, identify in writing the designated portions of the RAC electrical system, in accordance with the references.

(3) With the aid of references, perform preventive maintenance on the RAC electrical system, in accordance with the references.

OUTLINE

1. Electrical System

a. Battery Banks The RAC electrical system consist of two battery banks, each bank consist of two 12 volt batteries. One bank is located center of the craft in the engine compartment and the other bank is mounted on the starboard bulkhead in the engine compartment. The electrical system for the RAC is 24 volts direct current (24 VDC). The batteries are charged automatically by either of the propulsion engine driven alternators. The battery bank located center of craft (engine compartment) are used for starting. The bank located on the starboard bulkhead is use for the ship power distribution.

Student Note:
Emergency battery power is adequate to operate all critical lighting, power, electronic and emergency/safety systems for at least six hours.

b. Alternators There are two alternators one located on the starboard side of each propulsion engine. Each alternator is rated at 55 amps, 24 VDC.

c. Distribution Panels A power distribution panel, located at the coxswain station, is provided to accommodate 24 VDC for craft loads. A separate military communication power distribution panel is located at the craft captain's station. Each panel is has a 24 VDC power supply, protected by circuit breakers. (The toggle switches are the actual circuit breakers)

d. Guest Disconnect Switches There are three disconnect switches, Guest is used because this is the manufacturer brand name. These switches are very important to our system. The switches are connected directly to our power source the batteries. Once we turn the switch(s) to the on position, power form the batteries is allowed to energize the system(s). So when left in the on position," by choice" or "by mistake" we are using power directly from our batteries. This will cause the batteries to drain, when our propulsion engines are not running. The disconnect switches will prevent the batteries from draining when the craft is secured.

e. Paralleling Switch This switch is also a Guest switch. This switch is used for emergency starting only. The paralleling switch is located on the port side inside of the engine compartment forward bulkhead. When this switch is activated it connects both battery banks for more starting amps (current).

f. Voltmeters Voltmeters are provided on the coxswain console control station to evaluate the charge condition of each battery bank. The voltmeters will indicate the engine alternator's operation, with one or both engines running.

2. **Electrical Safety Precautions**

a. Do not service or adjust alone.

b. When repair and maintenance work must be performed on live circuits, the work shall be supervised by personnel fully aware of the danger involved.

c. Insulate the worker from any electrical ground by means of rubber mats or dry insulating surfaces without holes or imbedded conducting materials such as nails or staples.

d. Make sure the worker has enough work space "as much as possible" .

e. Station a person at a circuit breaker or control switch to de-energize the circuit in case of emergency.

f. Shut off all electrical power before starting work. Be sure to tag "OUT OF SERVICE". Do not work on any live conductors of any voltage except in an emergency.

g. Do not work on electrical apparatus with wet hands or while wearing damp clothing.

h. Use extreme care when measuring low voltage in equipment also containing high voltage circuits.

Safety Note: All Personnel Engaged In Electrical Work Should Be Fully Informed Of The Hazards Involved And Must Have Received Proper Instructions In Accident Prevention And First Aid Procedures.

3. **Battery Maintenance**

a. Battery maintenance is performed each and every time the craft is used and during your regular schedule maintenance cycle ie: weekly, monthly etc... Before, during and after operation. Remember all safety precautions when servicing batteries.

b. The RAC has two banks of batteries located in the engine compartment a total of four. The batteries used in the craft are maintenance free. This does not mean no maintenance is required.

c. These are the steps for battery servicing.

(1) Open all engine compartment hatches.

(2) Remove lock down straps and remove covers.

(3) Check battery post connections for corrosion and tightness.

(4) Check for water in battery box dump water if needed.

(5) Check eye on top of battery, it must be green to indicate charge, if eye is dark or black battery must be checked by maintenance personnel.

(6) Batteries do not require water to be added, checking the batteries on regular intervals is required.

(7) Battery boxes must be free of dirt and water:

Safety Note: Do Not Drill Drain Holes In The Battery Box(S) Because Electrolyte Dripping From The Box(S) Will Seriously Damage The Hull.

4. **Emergency Starting**

a. Emergency starting of the craft is just what it states. This procedure is required only when all else fails.

b. When performing an emergency start always check the cables being used to ensure that they are not frayed, that they are the proper type, and if adapters are needed for your application.

c. Emergency Starting Procedures:

(1) Come along side.

(2) Stop engines on craft.

(3) Open engine compartment door. (port)

(4) Remove caps from slave receptacles both craft.

(5) Insert cable ends to either craft.

(6) Turn paralleling switches to on for both craft.

(7) Start able craft engines.

(8) Start unable craft engine. (port or starboard)

(9) Once engines are started turn off paralleling switches.

(10) Disconnect cable from both craft.

(11) Replace caps.

(12) Monitor voltmeters while craft is operating.

5. **Electrical System Routing**

a. Routing of the electrical system for the RAC, starts with the power source which is the battery banks located in the engine compartment. From this point it is connected to the craft propulsion engines and out to the system.

b. The main wire routing of the RAC is located down the center of the craft race way.

REFERENCE:

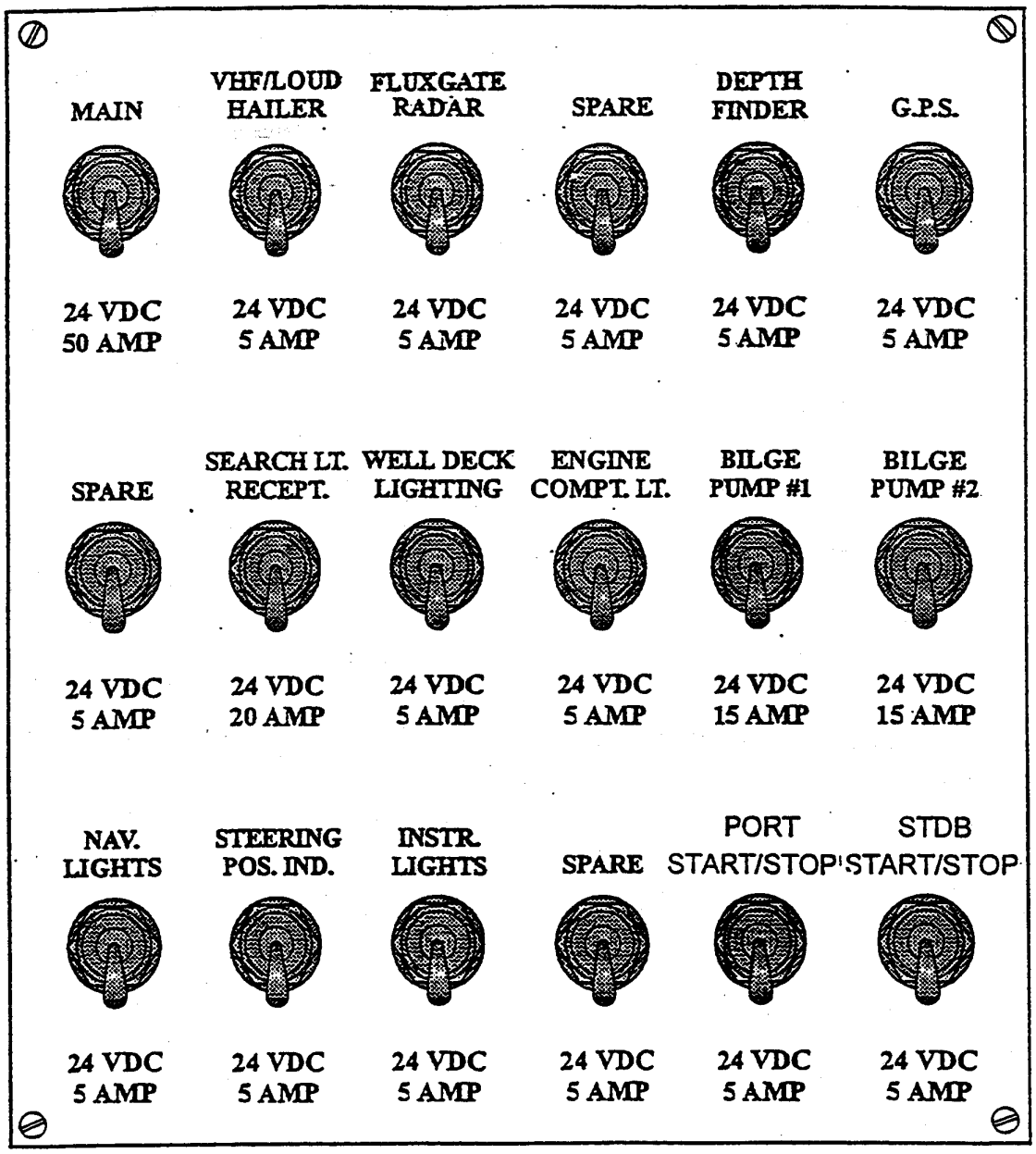
1. TM 09557A-14/1 System And Operation Manual W/ Components List For Riverine Assault Craft

2. TM 09557A-14/2-1 Operation And Technical Manual For Diesel Engine

NOTES:

ATTACHMENTS:

1. RAC Ships Distribution Panel


MAIN
24 VDC
50 AMP
VHF/LOUD HAILER
24 VDC
5 AMP
FLUXGATE RADAR
24 VDC
5 AMP
SPARE
24 VDC
5 AMP
DEPTH FINDER
24 VDC
5 AMP
G.P.S.
24 VDC
5 AMP
SPARE
24 VDC
5 AMP
SEARCH LT. RECEPT.
24 VDC
20 AMP
WELL DECK LIGHTING
24 VDC
5 AMP
ENGINE COMPT. LT.
24 VDC
5 AMP
BILGE PUMP #1
24 VDC
15 AMP
BILGE PUMP #2
24 VDC
15 AMP
NAV. LIGHTS
24 VDC
5 AMP
STEERING POS. IND.
24 VDC
5 AMP
INSTR. LIGHTS
24 VDC
5 AMP
SPARE
24 VDC
5 AMP
PORT START/STOP
24 VDC
5 AMP
STDB START/STOP
24 VDC
5 AMP

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TAB 512
MAR 99

STUDENT OUTLINE

HAMIL TON 273 W A TER JET

LEARNING OBJECTIVES

A. TERMINAL LEARNING OBJECTIVES:

(1) With the aid of references, perform RAC operations checks.

(2) With the aid of references, perform preventive maintenance on the RAC, in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) With the aid of references, inspect the RAC steering, in accordance with the references.

(2) Without the aid of references, when given a diagram, identify in writing the designated portions of the RAC steering, in accordance with the references.

(3) With the aid of references, inspect the RAC propulsion system, in accordance with the references.

(4) Without the aid of references, when given a diagram, identify in writing the designated portions of the RAC propulsion system, in accordance with the references.

(5) With the aid of references, perform preventive maintenance on the RAC steering, in accordance with the references.

(6) With the aid of references, perform preventive maintenance on the RAC propulsion system, in accordance with the references.

OUTLINE:

1. **Hamilton Jet 273 Theory**

TAB 5l2

The Hamilton 273 water jet is a highly efficient, axial-flow pumping unit which provides propulsive thrust from the reaction of the water jet stream being ejected rearwards. The rotation of the jet is LEFT HAND only (counter-clockwise looking at the engine flywheel).

a. The water jet mounts at the stem, drawing water through a reinforced opening in the hull bottom. Propulsive thrust generated is fully transferred through the jet intake to the hull - no thrust is transmitted through the drive shaft to the engine.

b. The impeller is a five bladed, 10" diameter stainless steel casting. The main shaft has a 70mm diameter shaft constructed of stainless steel supported by two bearings. The forward bearing is a thrust bearing (grease lubricated ball type), and the tail bearing is a water lubricated cutlass bearing. The intake is protected by a grate which at planing speeds is largely self cleaning.

c. The leading edges of the impeller will become "blunt" after a period of time from the action of small particles in the water passing through the jet. The performance of the impeller will drop as a result. In order to inspect the impeller for wear, the inspection cover located on the top of the housing is removed. The leading edges of the impeller blades are checked for wear at each side of the unit (not top or bottom), the clearance should not exceed .040 in. per side (Max.) (.020 Min).

d. The impeller is protected by a grating placed over the reinforced opening in the hull of the craft. Any object small enough to pass through the grate will normally cause regular wear to the impeller blades. The jet is also equipped with a raking system in which to break debris free of the grate. The rake can be employed manually with the foot paddle or by use of a pull handle via cable.

e. The pumping unit is bolted through the transom, where it is sealed with a flexible rubber seal, and discharges water directly through the aft outlet nozzle.

f. A single conical deflector cuts the jet stream aft of the nozzle. This deflects the water to port and starboard, giving powerful steering. Steering is manual hydraulic, and activated via an inboard mounted tiller.

g. A hydraulically controlled thrust reversing deflector cuts the jet stream aft of the steering deflectors providing an infinite range of forward, zero or reverse maneuvering speeds. Hamiltons Synchronized Reverse (HSRX) (X=Exponential) system gives fingertip control. Full steerage is always available even at zero speed.

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TAB 515
MAR 99

STUDENT OUTLINE

RAC TRAILERING

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVE :

(1) With the aid of references, launch the RAC in accordance with the references.

(2) With the aid of references, trailer the RAC in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) With the aid of references, conduct the preoperation check in accordance with the reference.

(2) Without the aid of references, safely move the RAC from trailer in accordance with the reference.

(3) Without the aid of references, correctly position the RAC on the trailer in accordance with the references.

(4) With the aid of references, conduct a postoperation check in accordance with the references.

OUTLINE:

1. **Launching**

a. The trailer and boat are backed into the water so that the jet intakes are under water and the aft end of the RAC is afloat. Backing the trailer until the forward end of the fenders are under water is a good guideline.

b. Before the coxswain starts an engine, he must complete the pre-launch check list. And a check is done of the rear seal on the jet for leaks.

c. Engines are started one at a time, ensuring, there is water flowing through the raw water filters. The engines are then allowed three to five minutes to warm up and everything verified to be functioning properly, prior to attempting to back off the trailer.

Safety: Note: The truck driver does not unhook the winch cable or the safety chain until the engines are warmed up and the coxswain tells him that he is ready.

d. The coxswain makes sure the helm is centered, signals the driver to unhook the winch cable and the safety chain. If the RAC is being pulled backwards by the current, wind or the angle of the ramp, the coxswain may have to place the RAC in forward holding the RAC on the trailer allowing the truck driver enough slack to unhook the winch cable.

e. If the RAC does not easily slide off the trailer the coxswain then increases the throttle slowly in the attempt to free the boat from the trailer. The only problem with throttling up when trying to back off the trailer is the amount of mud and sand that will collect in the raw water filters.

f. If the RAC cannot under its own power back off the trailer, the driver, providing the ramp is long enough, inches the trailer into the water with jerky motions on the brakes until the RAC is free from the trailer.

g. Current

(1) If the current runs parallel to the ramp, launching is no problem, but be sure engines have been warmed up and are functioning properly prior to launching.

(2) If the current runs perpendicular to the ramp, the coxswain should back into the current allowing the current to help swing the bow away from the trailer. More throttle will be required to complete this maneuver safely. If the ramp is wide enough, the trailer should be backed in so that the aft end of the boat is parallel to the current.

REFERENCES:

1. FM 55-501 Marine Crewman's Handbook

2. TM 09557A-14/1 System and Operation Manual w/Components List for Riverine Assault Craft

NOTES:

ATTACHMENTS: None

SO-515-3
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TAB 516
MAR 99

STUDENT OUTLINE

RAC HANDLING

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVES:

(1) Without the aid of references, conduct confined space maneuvers in accordance with the references.

(2) Without the aid of references, when given a scenario, perform emergency maneuvers in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of and per the references, identify in writing the effect of the jets in accordance with the references.

(2) Without the aid of and per the references, identify in writing high speed handling characteristics in accordance with the references.

(3) Without the aid of and per the references, identify in writing the procedures for handling swells at various aspects in accordance with the references.

(4) Without the aid of and per the references, identify in writing wake handling procedures in accordance with the references.

(5) Without the aid of and per the references, identify in writing the effect of wind and current on handling in accordance with the references.

(6) Without the aid of and per the references, crab the RAC in accordance with the references.

(7) Without the aid of and per the references, maintain position in accordance with the references.

(8) Without the aid of and per the references, pivot the RAC on the bow in accordance with the references.

(9) Without the aid of references, move the RAC straight astern in accordance with the references.

(10) Without the aid of references when given a scenario, select the proper emergency maneuver accordance with the references.

(11) Without the aid of references when given a scenario, give the proper commands in accordance with the references.

(12) Without the aid of references, perform an emergency stop in accordance with the references.

(13) Without the aid of references, perform an emergency 180 deg. turn in accordance with the references.

OUTLINE:

1. **Basic Handling Characteristics** There are five basic factors that effect the handling of the RAC, they are Steering, Jets, Throttles, Buckets, and Hu1l design.

a. Jets

(1) The jet is a highly efficient, axial-flow pumping unit which provides propulsive thrust from the reaction of the water jetstream being ejected rearwards. The rearward flow of water through the propulsion system is constant and can only be stopped by shutting down the engines.

(2) This constant thrust gives you continuous forward or reverse movement depending on the position of your buckets.

Safety Note: There is no neutral with jets

b. Steering

(1) Important factors to remember when steering the RAC is the pivot point in a turn. The pivot point will be approximately one-third of the way back from the bow when in forward and one-third forward from the stem when in reverse. Secondly, unlike a car, you must physically turn the helm to get out of a turn.

(2) When in forward the bow will turn in the direction you turn the helm, and the stem will go in the opposite direction. When you turn the helm the propulsion moves the stem around in a circle.

c. Reverse. When backing up, remember that the stem turns in the opposite direction that you turn the helm. The craft will continue to pivot around a point approximately one-third of the way up from the stem.

d. Throttle. The RAC has separate throttle and bucket control levers, unlike most prop boats. This gives you the ability to go from forward and reverse without adjusting the throttles/RPMs.

e. Buckets. The combination of buckets and throttles is what gives the RAC its outstanding maneuverability. Because of the Buckets, the RAC can crab side ways without moving forward or backward. They allow you to back up at full throttle and only be moving at a slow speed, other maneuvers such as Zero speed (holding your position) at any RPM, and an Emergency Stop, one maneuver that allows the RAC to come to a complete halt from full speed in three boat lengths can only be accomplished because of the buckets.

f. Hull Design

(1) The RAC's hull design is Semi-Displacement Hull, it has a deep Vee forward, and a shallow Vee aft. These characteristics mean that up to a certain speed the RAC stays in the displacement mode, when the speed is increased the RAC will plane out. Actually this type of hull will not allow the boat to be in the full displacement mode or full planing mode.

(2) In confined spaces the RAC should be level in the water, and at higher speeds the RAC should be planed to maneuver best, run easier and reach higher speeds. As the RAC accelerates from a slow speed, the stem digs into the water and the bow rises into the air. As the speed increases the force of the water pushes the stem back up in the water and the boat again levels out but this time it is actually riding higher in the water.

(3) Other considerations the coxswain will have to experiment with are how much the RAC will coast after coming of step/plane. Because of the RAC's draft which is the depth of the hull in the water, and the free board which is the amount of boat out of the water, the wind and current will be major influences during slow speed maneuvering. The key is to go slow and gently compensate for the winds and currents.

2. **Coming Alongside And Leaving A Pier** Coming alongside a pier will be a common occurrence, and control is important to avoid damage to your craft. Each pier that you work around may be different, some of them have bumpers or logs along the side to help protect the

craft but some are unprotected and dangerous. Consideration of the wind, how the craft steers, and how much the craft coasts, along with paying close attention will all be important to avoid damaging the craft. When coming alongside a pier, approach the pier slowly and pay attention to the drift caused by the wind. Make gentle steering and bucket corrections and remember the pivot point. At first you should Practice bringing the boat alongside the dock using the crabbing method to see how much throttle and bucket adjustments are necessary. Later backing and other methods should be tried. When tying off the boat to a nonfloating dock leave some slack in the lines to allow for the tides and other movement. For a floating dock, tie the craft with less slack.

3. High Speed Maneuvering Each coxswain must know the maximum handling characteristics of their craft. He must be able to operate the craft at full throttle, when making sharp turns and when operating in a high sea state. But more important the coxswain must know when to subject the RAC to these conditions. Every time you subject the boat to these types of maneuvers you subject it to excessive forces that will eventually shorten the life of the equipment and you subject the passengers to conditions that are extremely fatiguing and possibly dangerous. There are times that require the coxswain to push the boat to its limits but as a general rule use only the power that is needed to safely operate the craft.

4. Operating In Open Seas The coxswain must be aware of the conditions in which he will be operating. Both the direction of the seas and the sea state will have an affect on the force operating, along with running against and perpendicular to swells. When running with the swells the boat will slowly go up the back of the swell then quickly go down the front. As the boat goes down the front of a larger swell the stern will be lifted up and it will tend to ride of the front of the swell just like a surfer riding a wave, care must be taken to control the boat and to watch for the next swell so as to keep the bow from digging into the back of the next swell. Running perpendicular to swells is the easiest but is dangerous in high seas. Turning in high seas must be done quickly to avoid being broadside to swells. The highest sea state the RAC operate in, is a sea state two, and this is done only administratively. The RAC is A Riverine craft it was not built for the sea. If you have to operate in the open ocean in any kind of a sea state it will be very rough ride for the passengers and very hard on the RAC.

5. **Effects Of Wind And Current**

a. Tide Tide is the periodic rise and fall of large bodies water caused by the gradual pull exerted on the water by the sun and moon collectively. In general there are two high and two low tides in a 24 hour period or one day.

b. Current. Currents are horizontal movements of water. Current movements may extend over a large area or be limited to coastal regions or channels as well as coves. Some currents are caused by the wind and others. "Tidal currents", are caused by the flood or ebb tides. Tidal

currents are of particular concern when handling a small craft. Some important facts about currents are listed below:

(1) Currents have an effect on your craft when going with the current, the craft's speed over the ground is faster than the RPM indicator actually reads.

(2) When going against the current, the craft's speed over the ground is slower than the RPM indicator reads.

(3) Currents effect the maneuverability of your craft. When running with the current the maneuverability decreases as the current's speed increases.

(4) When running against the current, maneuverability increases the closer the current is on the below.

c. Wind

(1) Wind effects the velocity of currents. A wind going in the same direction as the current will increase the velocity of the current.

(2) A wind in the opposite direction will slow down the velocity of the current.

(3) Wind that is blowing at a good speed will cause your craft to move in direction it is blowing.

6. **Wakes** Entering a wake is easier than exiting one.

a. When trying to enter another craft's wake ease into it and start to straighten out as soon as you are inside the wake, this will keep you from going completely across to the other side, begin to swing from side to side as you attempt to get in behind the lead craft.

b. Exiting a wake will require you to use more throttle as you punch out at a *45°* angle.

7. **Approach**

a. Bow Turn

STEP # 1 Select the point where you will place you craft.

STEP # 2 Approach is made at a 90° angle.

STEP # 3 At 2 boat lengths set throttles at idle.

STEP # 4 If by chance you are moving to fast, ease the buckets into reverse until you have slowed down.

STEP # 5 Once the bow touches the pier, place the buckets in forward and if needed increase the throttle to hold your bow on the pier. If your craft starts to sway to one side turn the helm in the opposite direction of the sway to straighten the craft. This method is also used to counter a strong current.

b. Zero Speed

STEP # 1 Bring your craft to a stop

STEP # 2 Pick out two reference points, one to the front and one to either side of your craft. These reference points should be easy to pick out at a glance.

(a) The reference point to the front is to tell you if you are drifting to the right or left.

(b) The reference point to the side is to tell you if you are drifting backwards or forwards.

STEP # 3 Center your helm.

STEP # 4 Place your throttles in idle.

STEP # 5 Place your buckets in the Zero speed position.

STEP # 6 If you start to drift left or right crab back in to position.

STEP # 7 If you start to drift back or forth use forward or reverse buckets.

c. Crabbing: The RAC has the capability to crab sideways without moving backward or forward this can be done at idle or full throttle, however the RAC's speed will only be approximately one to three knots. Though the RAC can crab for long distances you should get as close as possible before starting this maneuver.

CRABBING TO PORT

STEP # 1 Place the RAC parallel to the pier.

STEP # 2 Pick two reference points one off the bow and one to the port side.

STEP # 3 Place your port bucket in reverse.

STEP # 4 Place your starboard side bucket at approximately half way between forward and reverse.

STEP # 5 Set your throttles at desired RPM.

STEP # 6 If while crabbing, the RAC begins to drift backward or forward use your starboard side bucket (not your throttle) to either hold your position or move your craft back into position.

STEP # 7 At half a boat length from the pier place the throttles in idle and allow momentum to carry you to the pier.

STEP # 8 Once pier side you must continue to crab port until you are tied to the pier.

d. Reverse. As stated previously when backing the RAC two important factors changes. The first being the pivot point from one third from the bow to one third from the stem. The second being that the stem will turn in the opposite direction you turn the helm.

STEP # 1 Select a reference point.

STEP # 2 Place throttles in idle.

STEP # 3 Place both buckets in reverse.

STEP # 4 Place both throttles at desired Rpm's

STEP # 5 Control the direction of the AC with the helm.

STEP # 6 Control the speed of the RAC with the buckets, (not throttles).

STEP # 7 Use forward buckets to stop the reverse momentum and Zero Speed to hold position.

e. 360 Turn At Zero Speed. The RAC has the ability to complete a 360° turn at zero speed inside its own boat length. This can be accomplished in a number of ways with slight adjustments to the throttles & buckets it can also be done at any speed from idle to full throttle.

STEP # 1 Place buckets a zero speed position.

STEP # 2 Center the helm.

STEP # 3 Adjust throttles to desired RPM.

STEP # 4 Turn helm in desired direction.

STEP # 5 Any movement forward or backward is countered by using the buckets.

f. Emergency 180 Turn. As previously stated the advantage the RAC has over other crafts is its maneuverability one of those maneuvers is its ability to at top speed turn 180 and be back at top speed in under ten seconds.

STEP # 1 Coxswain informs all embarked personnel that he is about to conduct a 180 to port or starboard.

STEP # 2 Make sure RAC is up to speed.

STEP # 3 Yell stand by.

STEP # 4 Turn the helm all the way to the port or starboard as quickly as possible.

STEP # 5 Once the RAC's bow has dug into the water and the RAC has begun to rotate immediately bring the helm back to "center helm" to avoid doing a 360 turn.

g. Emergency Stop. The second major advantage the RAC has over other crafts is its ability to be traveling at top speed and come to a complete stop in three boat lengths.

STEP # 1 Coxswain informs all embarked personnel that he is about to conduct an Emergency stop.

STEP # 2 Throttle down.

STEP # 3 Buckets in reverse.

STEP # 4 Throttle up.

STEP # 5 Once RAC has stopped throttle down.

SO-516-8
TAB 516

REFERENCES:

1. Fm 55-501 Marine Crewman's Handbook

2. TM 09557A-14/1 Systems and Operation Manual w/Components List for Riverine Assault Craft

3. COMDTINST M16114.10 Vol I Boat Crew Qualification Guide, USCG

NOTES: The following maneuvers will be performed for confined space handling.

1. Bow Touch
2. Zero speed
3. Crabbing (port & stbd)
4. Reverse (Backdown)
5. 360 Turn Zero speed (Dolphin)
6. 180 Turn Zero speed
7. Emergency Steering

The maneuvers will be performed by the students, one movement at a time, each student will spend ten (10) minutes maximum at the helm.

ATTACHMENTS: None

SO-516-9
UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 517
MAR 99

STUDENT OUTLINE

ANCHORING

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE**: Without the aid of references, given the appropriate tackle, anchor a small craft in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) Without the aid of references, given a diagram, name the parts of an anchoring system in accordance with the references.

(2) Without the aid of references, describe in writing the three considerations necessary for selecting a safe anchorage in accordance with the references.

(3) Without the aid of references, given the appropriate equipment, demonstrate the procedures for setting the anchor in accordance with the references.

(4) Without the aid of references, given the appropriate equipment, demonstrate the procedures for getting underway from anchorage in accordance with the references.

(5) Without the aid of references, demonstrate the precautions taken while at anchor in accordance with the references.

6) Without the aid of references, demonstrate the use of a sea anchor in accordance with the references.

OUTLINE

1. Parts of an Anchor

   a. Anchor ring

   b. Shank

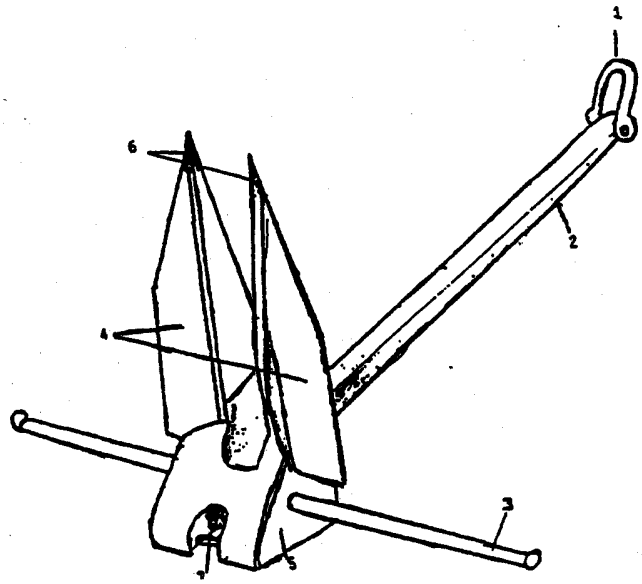
   c. Stock

   d. Flukes

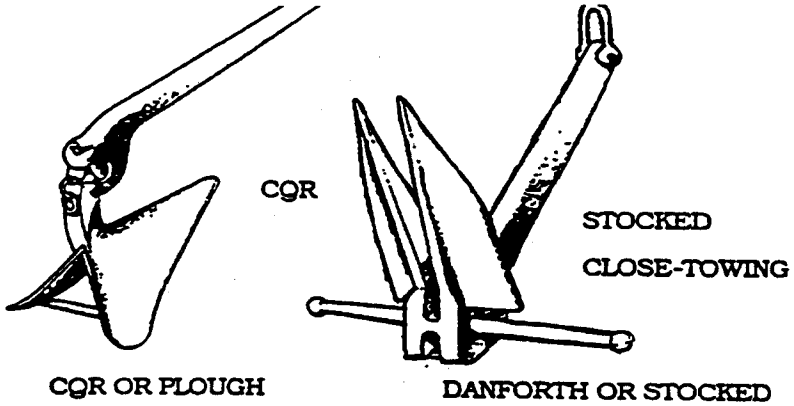
   e. Crown/tripping palm

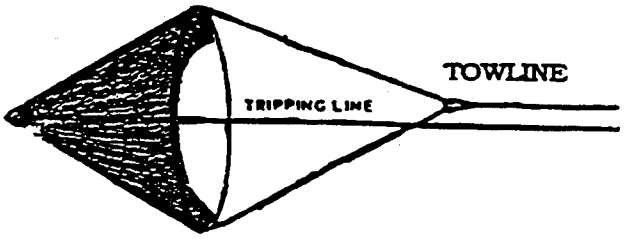
   f. Pea or bill

   g. Gravity ring



2. **Types of anchors in use on Marine Corns Raiding Craft.**





DROGUE OR SEA ANCHOR

3. **Considerations when anchoring**:

a. Depth of water.

b. Length and draft of craft.

c. Composition of seabed:

(1) Clay, soft chalk, mud and sand are considered good for anchoring.

(2) Shingle, shell and rock are considered bad for anchoring.

d. Whether to anchor in a land locked area or open water.

e. Strength and direction of prevailing wind.

f. Rise and fall of tides.

h. Proximity of other vessels.

I. Proximity of landing places such as piers.

4. **Anchoring**. When anchoring, head your boat into the in or current. Reduce speed and make sure your anchor line is ready for free running. Reverse the engine and when the boat starts to make a slight sternway through the water, lower the anchor. Make sure that you are not standing on any part of the line as it goes over the side and always be sure that the end of the anchor cable is secured to the boat. When sufficient cable is out, usually five to seven times the depth of the water, stop the engine and make the cable fast to a forward cleat or bitt to make the anchor dig into the bottom. A definite halt in the drifting of the boat should be felt as the anchor digs in. At this time, take a azimuth to some stationary object on shore to make certain that your anchor is not dragging on the bottom.

5. **How an Anchor Holds**. The figure on the following page shows how an anchor beds itself into the bottom after it has been let go and strain is put on the line. The anchor lays flat on the bottom until the pull of the craft on the line drags the anchor along the seabed. After a small amount of dragging the anchor embeds itself completely until it holds. For the anchor to maintain its hold, the pull of the line must always be horizontal to where the line emerges from the sea bed.

6. **Getting Underway from Anchorage.**

a. Move your boat ahead slowly using your engines.

b. Take a turn on a bitt or rail to take up slack, thereby ensuring the anchor line does not get caught in the props.

c. When the anchor line is vertical you should be able to pull up the anchor. If the anchor is stuck take a turn on a cleat or rail and move forward. If that doesn't work, then you may have to change directions to pull the anchor free. Ensure that you do not get any part of your body caught in the anchor line.

7. **Lookouts** While at anchor you need to have a lookout posted to ensure that all other craft avoid your anchor line, and that the anchor stays embedded in the seabed. If you are anchored close to the surf zone, ensure you do not let out so much anchor line that you could drift into breaking waves.

8. **Sea Anchors** A sea anchor or drogue is a cone shaped device made of nylon canvas, open at both ends. It is equipped with a towline secured at the large end. The tripping line is attached in such a way, that securing it and slacking off on the towline caused the anchor to invert and lose its drag. A sea anchor towed some distance behind a craft serves to keep the stem or bow as appropriate, into the seas/surf. When a large breaker approaches, the tripping line is slacked off and the sea anchor then fills and drags. After the wave passes, the tripping line is secured again. In this way the anchor will not impede the progress towards the beach, but definitely assists in preventing the boat from capsizing.

REFERENCES:

1. U.S. Coast Guard Boating Skills and Seamanship COMDINST M 16114.5

NOTES:

ATTACHMENTS None.

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Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 518
MAR 99

STUDENT OUTLINE FORMATIONS

LEARNING OBJECTIVES

A. **TERMINAL LEARNING OBJECTIVE**: Without the aid of references, maintain position in formation in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) Without the aid of references and when given a signal and a RAC, move to the appropriate position in formation in accordance with the reference.

(2) Without the aid of references maneuver the RAC into a wedge formation in accordance with the reference.

(3) Without the aid of references maneuver the RAC into a column formation in accordance with the reference.

(4) Without the aid of references maneuver the RAC into a staggered column formation in accordance with the reference.

(5) Without the aid of references maneuver the RAC into an on-line formation in accordance with the reference.

(6) Without the aid of references maneuver the RAC into a flanking movement in accordance with the reference.

(7) Without the aid of references maneuver the RAC from a column / staggered column formation in accordance with the reference.

(8) Without the aid of references maneuver the RAC from a staggered column to an on-line formation in accordance with the reference.

(9) Without the aid of references maneuver the RAC from a staggered column to a wedge .formation in accordance with the reference.

SO-518-1

TAB 518

OUTLINE:

1. **Waterborne Movement** is the use of a craft on riverine waterways to provide tactical mobility. Waterborne movement may simply be a means of transporting a Ground Combat Element (GCE) in the area of operations or may be the means by which patrolling and area control functions are accomplished on waterway systems.

2. **Basic Patrol Craft Formations.** Regardless of the type of waterborne movement or mission, the patrol will be dependent upon the objective and tactical situation. All formations are designed to:

a. Provide organization, command and control.

b. Provide adequate space for maneuvering and limitation of damage.

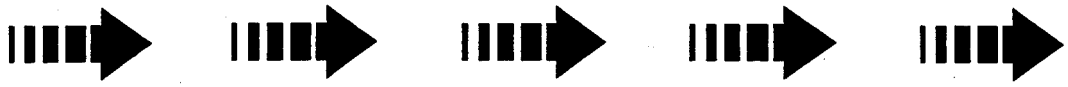
c. Prevent craft from colliding, engaging, or otherwise interfering with each other's safety during the patrol and in the event of enemy contact.

d. Direct the Area of Responsibility (AOR) and Field/Sector of Fire into specific locations.

e. Be easily assumed with minimal visual, radio, or voice signals.

3. **Types Of Formations.** There are several basic fonnations utilized by river patrol craft. These . fonnations which are between two to three boat lengths can be modified or combined to accommodate the size of the riverine force and the constraints of the water way and tactical situation. They include:

a. **Column**. A basic formation in which the craft are in a line astern of the lead craft. The column



COLUMN

is used in a medium, or low threat environments in high or low speed patrols.

(1) **Advantage:**

(a) Pennits rapid, controlled movement.

(b) Favors fire and maneuver to the flanks.

(c) Trailing crafts have no wake to maneuver with.

(d) Narrow waterway or suspicion of mine threat.

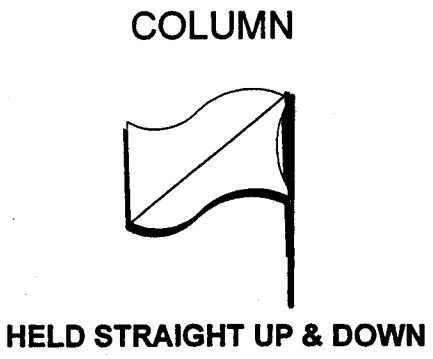
(2) Disadvantage:

(a) Vulnerable to fire from the front and provides the least amount of fire to the front.

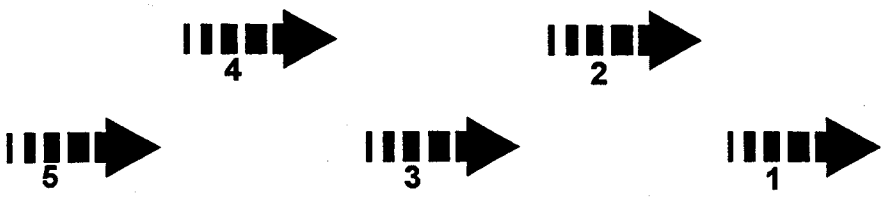
(b) Risk of running into craft in direct front.

(c) Weak command and signal from lead craft.

(3**)** **Hand and Arm Signal**: Placing a single hand/flag over the head in a parallel fashion.



b. **<u>Staggered Column</u>**. Each craft trails the lead craft, alternately offset to the right or left, Used also in a high, medium or low threat area for high or low speed formations.



(1) **Advantage**:

(a) Less risk running into craft in direct front.

(b) Permits fire maneuver to flanks.

(c) Command and Signal stronger.

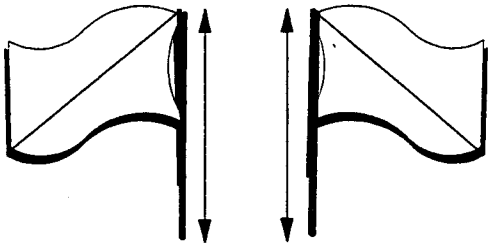
(2) **Disadvantage:**

(a) Fire power to front and rear weak.

(b) Narrow waterway.

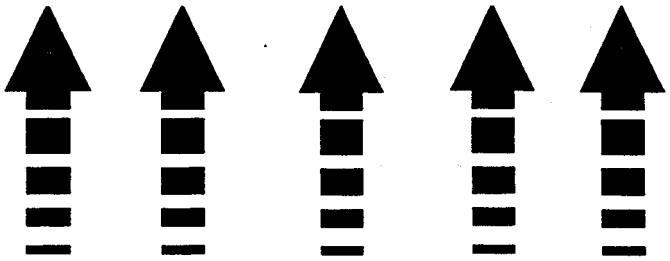
(3) **Hand and Arm signal**: Both hands/flag extended vertical over head, and in a pumping motion

STAGGARD COLUMN



PUMPING MOTION (UP & DOWN)

c. **On Line**. All craft are centered on the flanks of the center craft. It is usually employed in low threat environments and during assaults.



(1) **Advantage:**

(a) Maximum firepower forward and aft of the formation.

(2) **Disadvantage:**

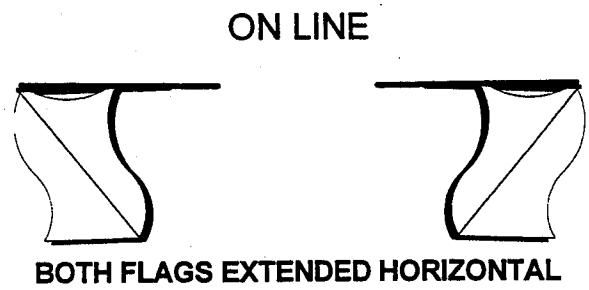
(a) Requires a fairly wide waterway with good depth.

(b) Not a good formation for transiting suspected mined areas.

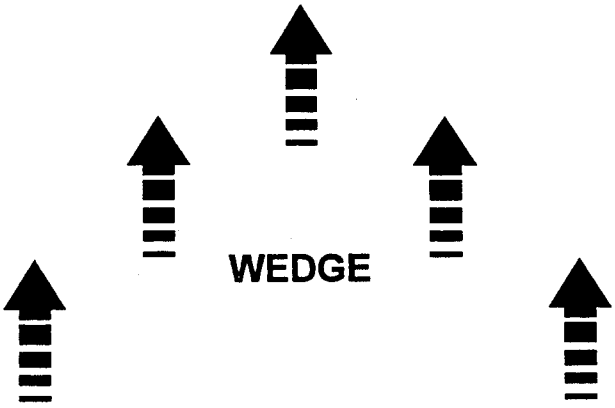
(c) Very vulnerable to ambush from concealed positions on the river bank.

(d) Difficult to maintain formation over a long period of time.

(3) Hand and Arm signal: Raise both arms until horizontal, flags/hands extended, palms down.



d. Wedge. In this formation the craft are positioned in a inverted "V". This formation is normally used in a medium to high threat environment.



(1) Advantage:

(a) Good control from lead craft.

(b) Provided all-around security.

(c) Formation is flexible.

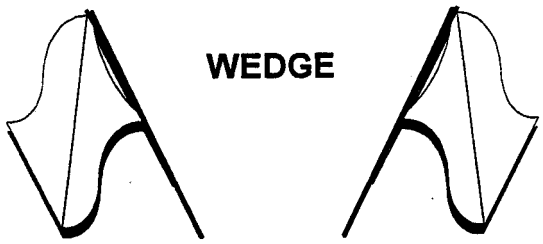
(d) Fire is adequate in all directions.

(2) Disadvantage:

(a) Not recommended for a suspected mined area.

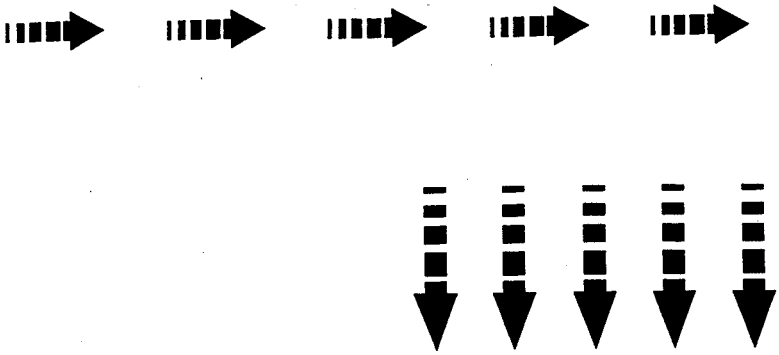
(b) River must be wide enough for boats to maintain their interval.

(3) Hand and Arm Signal: Hands extended over head at the 10 and 2 o'clock position.



BOTH FLAGS HELD UP AT A 45' ANGLE

e. **Flanking**. Crafts are generally in a column formation when given flanking signal they execute either port or starboard on line formation. Used when the location and strength of the enemy are known. Also during the assault for quick surprise of the enemy and debark or embark of troops.



(1) Advantage:

(a) Surprise of enemy

(b) Fire power forward and aft

(2) Disadvantage:

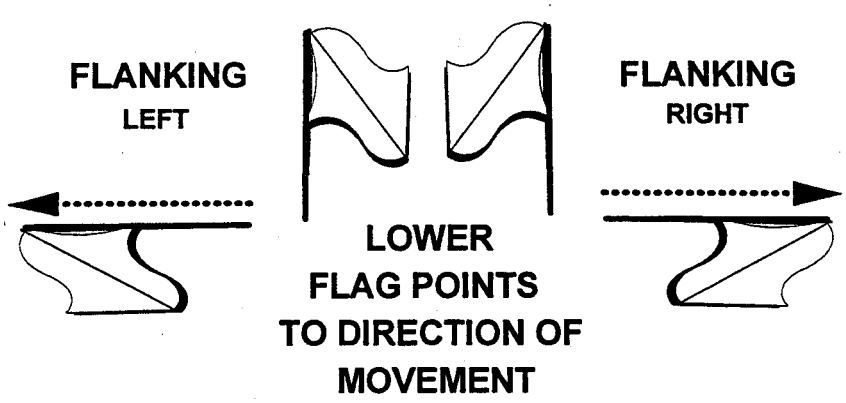
(a) Requires a fairly wide waterway with good depth.

(b) Not a good formation for transiting suspected mined areas.

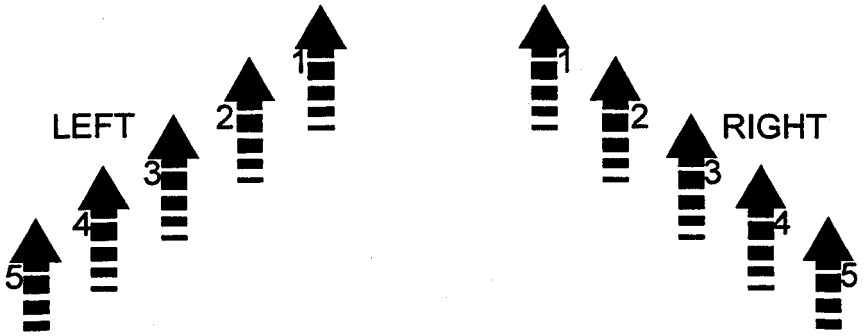
(c) Very vulnerable to ambush from concealed positions on the river bank.

(d) Difficult to maintain formation over a long period of time.

(3) **Hand and Arm signal**: Arm/flag raised lateral until horizontal in the direction of movement then dropped to execute.



g. **<u>Echelon (Left or right).</u>** In this formation, craft are deployed in a diagonal line left or right and aft of the lead craft. They can be used in all levels of threat environment as well as high or low speed movement.



(1) **Advantage:**

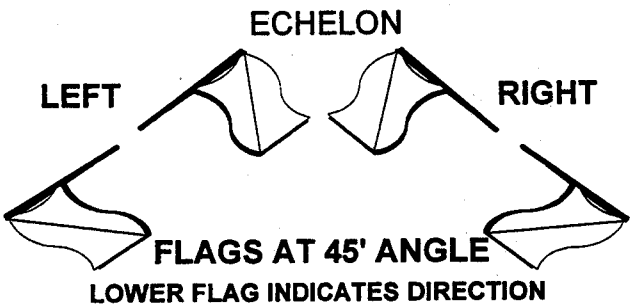
(a) Strong field of fire forward and the strong flank of the patrol.

(2) **Disadvantage:**

(a) Trailing craft will have more difficulty maintaining position (wakes and width of waterway). It is generally used in a wider waterway.

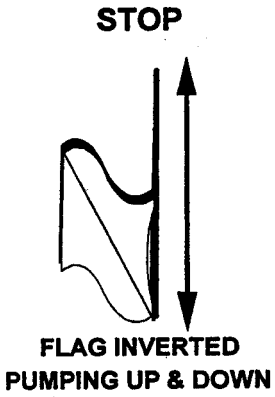
(b) Command and signal weak.

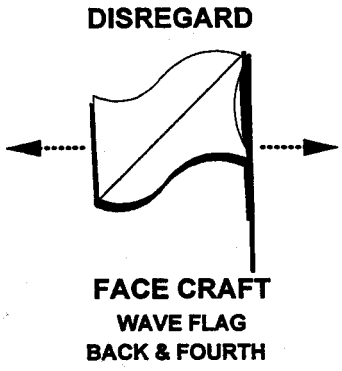
(3) **Hand and Arm Signal:** Extend one arm/flag 45 degrees below the horizontal, palms to the front. The lower arm/flag indicates the direction of echelon.



4. **<u>Hand and Arm Signals</u>**. Are used to transmit commands or information when voice communications are difficult, impossible, or when silence must be maintained. All following craft repeat signals from the lead boat to ensure prompt and correct execution. Bow gunner and coxswain who will most likely be looking forward repeat (vocally) the signal to aft gunner. All signals must be understood and rehearsed prior to their use. The following are additional signals which are general used with signal formations.

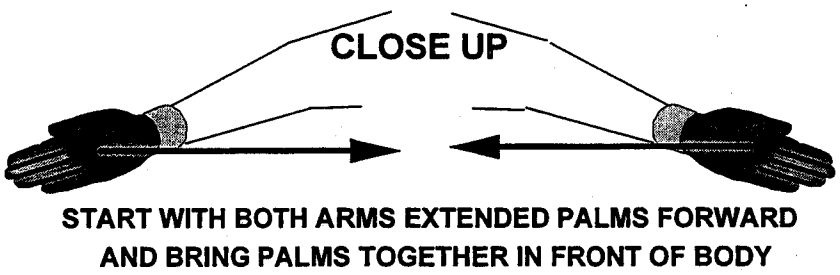
a. **Stop** - Right arm extended forward with a signal flag inverted drop arm down to waist then back to forward position repeat until signal is understood.



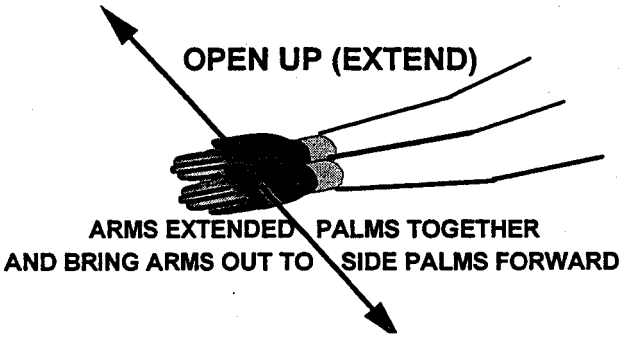


b. **Disregard** - Face craft being signaled, then raise both arms and cross them over the head palms to the front. .

c. **One Minute to Mark** - Arm extended forward with flag rotating in a figure eight motion.

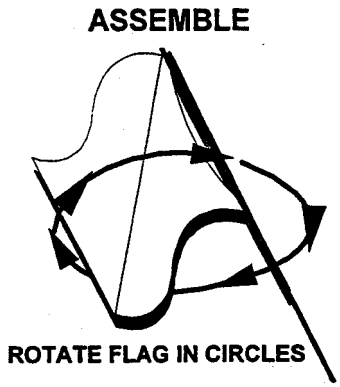


d. **Close Up** - Start signals with both arms extended vertical, palms forward, and bring pals together in front of the body momentarily. When repetition of this signal is necessary, the arms are



returned to the starting position by movement along the front of the body.

e. **Open Up, Extend** - Start signal with arms extended in front of the body palms to together, and bring arms to the horizontal position at the side, palms forward, Repeat until signal .is understood.

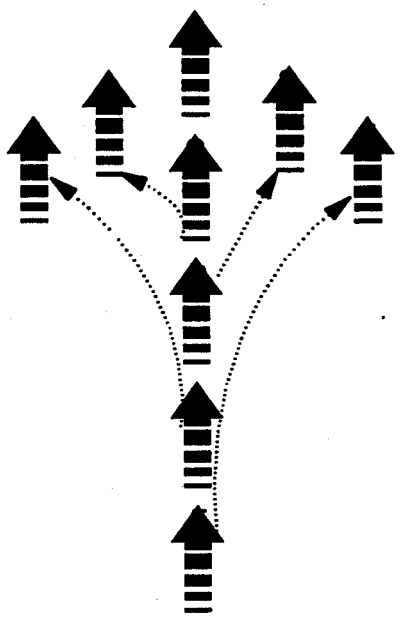


f. **Assemble** - Raise the flag vertically to the full extent or the arm, and wave the flag in large horizontal circles.

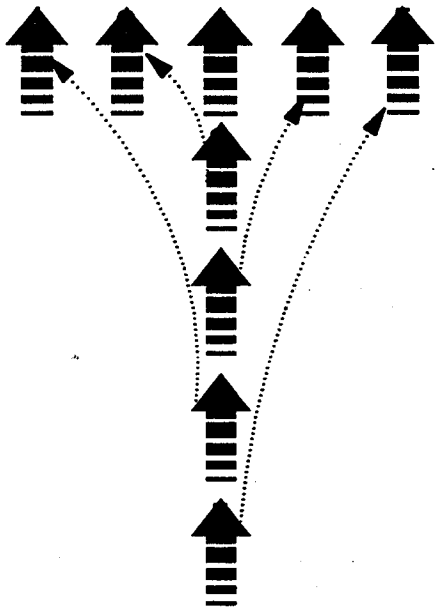
5. **Reduced visibility Signals**. Craft operating at night, fog or smoke may use chem lights attached to signal flags. Role flag around handle tape chem lights to top and bottom of flag and signal normally. Crafts may have to close formation to ensure communication is maintained.

6. **Formations Transitions**. Because no signal formation will need the tactical requirements for each phase of an operation, patrol crafts will fined it necessary to transition from one formation to another at various times. To do so a "travel order" must be established. Crafts are numbered for ease of control even number on the starboard and odd number are on the port.

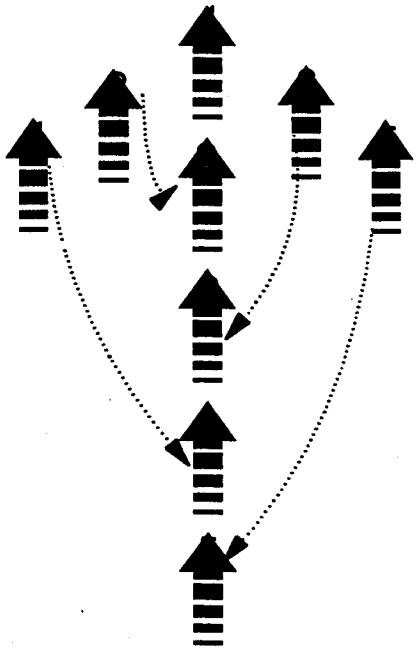
a. **Movement from Column to Wedge**. When moving from column to the wedge, the even numbered craft pull into position on the starboard side and the odd numbered craft move up on the port side. Moving into this formation requires that the lead craft reduces speed or all the other craft increase speed.



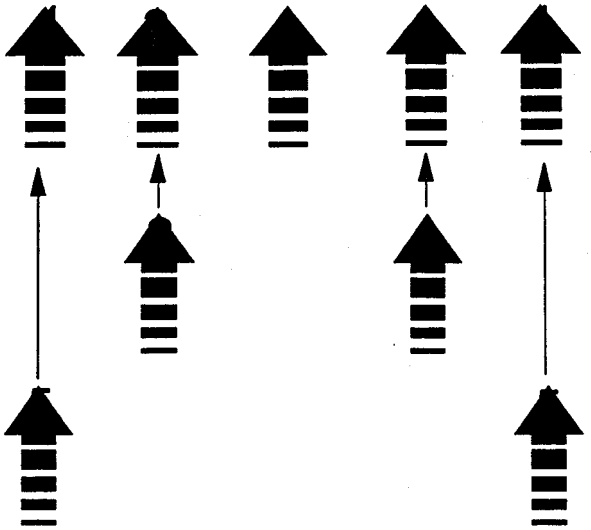
b. **Movement from Column to Line**. When moving from column to line, the craft moves as if to form the wedge and continue on until they pull on line with the lead craft.



c. **Movement from Wedge to Column**. When moving to from a column from a wedge, the craft will fall in behind the lead craft. The lead craft may maintain his speed and all other will have to throttle back or the lead craft can increase speed and allow the trailing craft to shift in behind.



d. Movement from Wedge to Line: Movement from the wedge to line is simple. All craft simply pull straight ahead until they are on line with the lead craft.



REFERENCES: 1. Handbook of the Nautical Rules of the Road.

NOTES:

ATTACHMENTS: None.

SO-518-12

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542 I

TAB 519
MAR 99

STUDENT OUTLINE

COME ALONGSIDE

LEARNING OBJECTIVES

A. **TERMINAL LEARNING OBJECTIVE:** Without the aid of references, come alongside another craft in accordance with the references.

B**. ENABLING LEARNING OBJECTIVES**:

(1) Without the aid of references, request permission to come alongside in accordance with the reference.

(2) Without the aid of references, prepare the RAC to come alongside another craft in accordance with the reference.

(3) Without the aid of references, match stand on craft heading and speed in accordance with the reference.

(4) Without the aid of references, select a suitable point on the stand on craft to come alongside in accordance with the references.

(5) Without the aid of references, maintain position alongside another craft in accordance with the references.

(6) Without the aid of references, breakaway from another craft in accordance with the references.

OUTLINE:

1. **Communication With The Moving Vessel**

a. Have primary and alternate frequencies prior to operation.

b. Establish communication with the craft master/boat captain.

c. Request permission to come alongside. The craft master/boat captain will grant or deny you permission due to the following reasons:

(1) Sea state too rough

(2) Moving vessel is not positioned into the waves properly

(3) Craft master/boat captain hasn't decided which side ofhis craft he wants you to come alongside

(4) Craft master/boat captain's crew is not ready to accept you aboard his vessel

d. The command "fenders out on Port or Starboard" side will be called.

e. Assign someone in your boat crew to monitor the radio throughout the entire operation.

2. **Come Alongside A Vessel With A Craft On The Port or Strbd Side**

a. Approach. Match the speed of the vessel and gradually ease your craft into it, always .keeping an eye on your reference point.

Safety Note: When using a reference point to a vessel that's larger than your own, stay away from his stern and bow wake. Position your craft between his stern and bow wake. His stern and bow wake will pull you underneath the vessel and possibly into his propeller. If the craft is the same size as your own, your reference point is the center of the craft.

(1) As the riverine craft decreases its distance to the moving vessel, keep your bow pointed in the same general direction of the moving vessel's.

(2) Ease into the moving vessel, maintaining a 45 degree angle

(3) Never approach a moving vessel at an angle greater than 45 degrees-

(4) Stay out of the moving vessels wake. If you get into his wake near the stem, the wake will push your bow into his stern, thus losing control of your steering and speed.

(5) Lines are not used at any point during the approach or disengagement phase of the operation.

<u>CAUTION:</u> In order to keep alongside the moving vessel, you will have to steer into it slightly. You must keep your craft against the moving vessel at all times. This becomes very important when embarking and debarking troops and equipment.

b. Disengagement. In order to disengage from the moving vessel.

(1) Request permission to the stand-on vessel to breakaway

(2) Once permission is given, do a visual 180 degree check toward your stem

(3) Once your 180 degree check is complete you should increase speed slightly and steer away from the craft at a 45 degree angle.

c. **<u>Speed</u>**. Speed is important during these operations. The coxswain needs to use only the amount of speed necessary to maintain control when moving into and away from the moving vessel.

<u>REFERENCE:</u>

1. FM 55-501 Marine Crewman's Handbook
2. TM 09557A-14/l System and Operation Manual w/Components List for Riverine Assault Craft

<u>NOTES:</u>

<u>ATTACHMENTS</u>: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
.Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 520
MAR 99

STUDENT OUTLINE

TOWING PROCEDURES

LEARNING OBJECTIVES

A. **TERMINAL LEARNING OBJECTIVES**: Without the aid of references, given a fully equipped small craft, conduct towing operations in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references, prepare tow lines in accordance with the references.

(2) Without the aid of references, maneuver the RAC for a bow to stem tow in accordance .with the references. .

(3) Without the aid of references, rig the RAC for a bow to stem tow in accordance with the references.

(4) Without the aid of references, maneuver the RAC for a side to side tow in accordance with the references.

(5) Without the aid of references, rig the RAC for a side to side tow in accordance with the references.

(6) Without the aid of references, maneuver the RAC for a hasty tow, in accordance with the references.

(7) Without the aid of references, rig the RAC for a hasty tow, in accordance with the references.

OUTLINE

1. Towing Operations Equipment

a. Four mooring lines [15 feet each, two from each craft]

b. One tow line

c. One guide line

d. One large 'u' bolt complete

e. Six fenders [three from each craft]

2. **Types Of Tows**

a. The side by side tow is used in confined spaces during calm seas for short distances.

b. The long tow astern method is used in calm to rough open seas for long distances.

3. **Types Of Approaches**.

a. Shallow approach -used in calm seas when the disabled boats rate of drift is slow. The towing craft approaches from the stern on the windward side of the disabled boat. The towing craft must pass close enough to pass the towline and stop a short distance ahead of the disabled craft.

b. Steep approach- used when there are calm to moderate sea conditions. The towing craft approaches on a heading about 45 degrees from that of the disabled crafts bow.

c. Crossing "T" approach - used when there are heavy seas or when the disabled craft's rate of drift is rapid. The towing craft crosses the bow of the disabled craft on a heading perpendicular to it. This heading should be into the sea wind if possible. The towline is passed just before the towing craft passes the bow of the disabled crafts bow.

d. Stern approach- used only if absolutely necessary to do so. The rescue craft maneuvers in front of the disabled craft, passing the towline, and backs toward it. Do not pass the tow line while backing.

Safety Note: Throughout the maneuvering associated with picking up a tow the coxswain must be particular mindful of the set and drift of his craft in relation to that of the disabled craft, as well as his crafts heading relative to the existing conditions. It is important that the coxswain not be placed in the situation necessitating a radical correcting maneuver during the critical towline passing process.

4. **<u>Attaching The Tow Line For The Long Tow Astern Method</u>**

a. Prior to any towing operations, make sure all gear is inspected and serviceable.

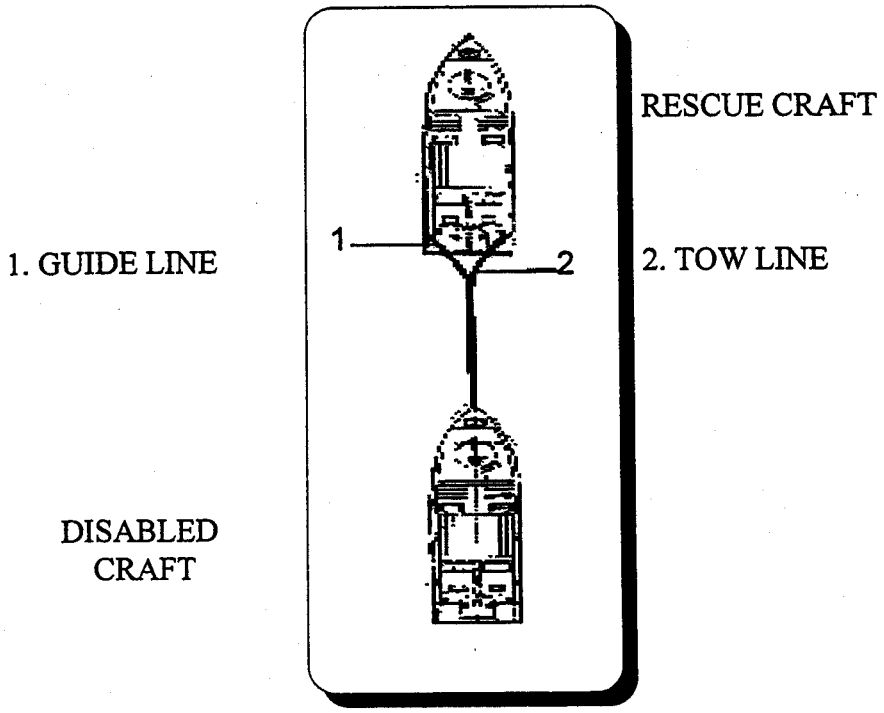
b. The aft gunner of the rescue craft will hand the running end of the towline complete with 'U' bolt to the bow gunner of the downed craft.

c. The bow gunner will then secure it to the external bow eye of the disabled craft.

d. The aft gunner will secure the guide line to either port or starboard aft cleat. Then with the tow line, he will run it through the fixed loop of the guide line-

e. During this time, ensure rope management is being employed, [i.e. taking up slack]

f. At this time he will put a couple of turns on the opposite cleat that the guide line was secured to.



5. **Setting The Distance**

a. The aft gunner on the rescue craft will play out line astern until the correct distance [At slow speeds possibly 25 ft.] is achieved. During this time the coxswain must move out slowly and pay attention to the situation forward and aft.

b. If possible enough line is played out to set a centenary [a curve in the tow line to absorb shock] but not so much that the slack is in the water.

c. Enough line is played out so that both vessels are on step and riding the troughs and swells at the same time. [possibly all 75 ft.]

6. **Attaching The Mooring Lines For A Side To Side Tow**

a. Make sure that the mooring lines are ready and fenders are out before coming along side.

b. The bow gunner of the rescue craft will secure the mooring line to the inside forward cleat using an anchor knot. He then hands it to the bow gunner of the disabled craft, who wraps once around the inside forward cleat and hands it back to the bow gunner. The bow gunner of the rescue craft then secures it on the same cleat with an anchor knot or figure 8 wraps.

c. The same steps are repeated by the aft gunners with one exception, the outside aft cleat of the disabled craft will be used.

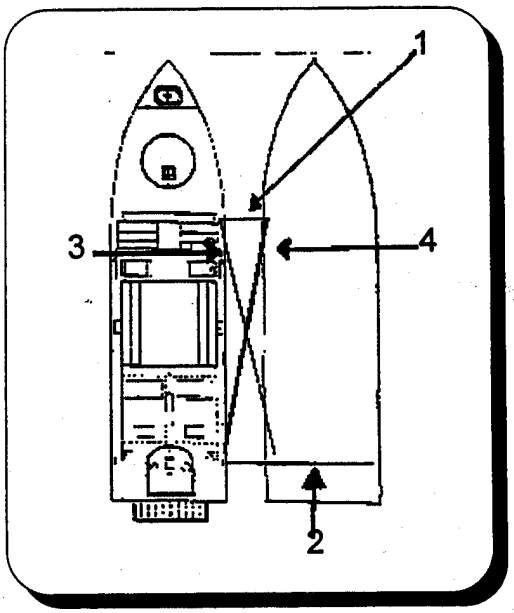
d. Once the bow and aft lines are secured, securing the spring lines will be next.

e. The first spring line is called a tow strap. It prevents the downed craft from sliding forward. It is secured from the downed crafts forward inside cleat to the rescue crafts aft inside cleat.

f. The second spring line is called a tow strap. It prevents the downed craft from sliding backward. It is secured from the downed crafts forward inside cleat to the rescue crafts aft inside cleat.

SIDE TO SIDE

1. BOW LINE
2. STERN LINE
3. TOW STRAP
4. BACKING LINE



RESCUE CRAFT

DISABLED CRAFT

TAB 520

7. **Actions While Towing.**

a. The effective length of your craft is now your craft plus the tow line and the downed craft.

b. Watch for other boats which may cut between the two crafts.

c. Make gradual maneuvers and speed changes.

d. Maintain a tow watch.

e. Take tension on the tow line gradually.

f. Do not tow so fast as to exceed the strength of the tow line and fittings. g. The coxswain of the towing craft is in charge of the tow.

h. Don't get your body in between a line and a fixed object.

i. If possible a minimum amount of people should remain in the towed craft.

j. Maintain communications between crafts.

k. Take up slack in lines when starting or stopping.

8. **Releasing Procedures**

Upon receiving the signal to stop, the rescue craft will slow down until the craft comes to a halt. At which time all line handlers will retrieve there respective tow lines.

REFERENCES:

1. COMDTINST MI6114.5, *BOAT CREW SEAMANSHIP MANUAL*

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 521
MAR 99

STUDENT OUTLINE

RAC MOORING

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVES**: Without the aid of references and provided the necessary materials, moor a Riverine Assault Craft to a pier but in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) With the aid of references, identify in writing the number of deck fittings on the RAC, in accordance with the references.

(2) Without the aid of references and provided the necessary materials, secure the bow and stern lines to the RAC, in accordance with the references.

(3) With the aid of references, inspect the lines and mooring equipment for the RAC, in accordance with the references.

(4) Without the aid of references and provided the necessary materials, secure the bow and stern lines of the RAC to a pier side deck fitting, in accordance with the references.

(5) Without the aid of references and provided the necessary materials, secure any fenders to the RAC's internal deck fittings, in accordance with the references.

OUTLINE:

1. **Deck Fittings** - Lines are used in conjunction with deck fittings. Deck fittings are attachments or securing points for these lines. They permit easy handling and reduce wear and friction on them. There are three basic types of deck fittings, they are cleats, chocks and bitts. The Riverine Assault Craft has a total of 6 deck fittings. All 6 are cleats, there are (2 bow, 2 midship and 2 stern cleats).

2. **Lines & Fenders** - There are two types of mooring lines, the bow line and the stern line.

a. These lines are generally located on the back of the bow and aft gunner seats. Both the bow and stern line should be 15 feet long. However, if the lines are unequal in length, the bow line should be considered longer than the stern line. Both lines should have loops sewn into them, if not a bowline will suffice. When securing the lines to a mooring cleat, take hold of the eye and run it through the center of the cleat from the outside. Then loop the eye back over the horns of the entire cleat and secure by pulling the line taught.

b. The fenders onboard the RAC will be done in the same fashion. However, tires that are used will not. Onboard the RAC there are three fenders which will be used on whichever side is being put alongside the pier or vessel. (**NOTE**: The mooring lines will always be secured after the fenders so that they can be removed and positioned as necessary).

c. Once alongside a pier or vessel it may become necessary to moor the RAC up to it. This procedure will vary according to what type of deck fitting is available. The two most common types of deck fittings used are: Cleats and Bitts.

(1) Cleat - There are two types of cleats: Standard & Mooring.

A. Standard Cleat- Securing a line to a standard cleat

(1) Take a complete round turn around the base of the cleat.

(2) Lead the line over the top of the cleat and around the horn, to form a figure 8.

(3) Make one more figure 8 and finish with a half-hitch forming a bight to allow for quick release.

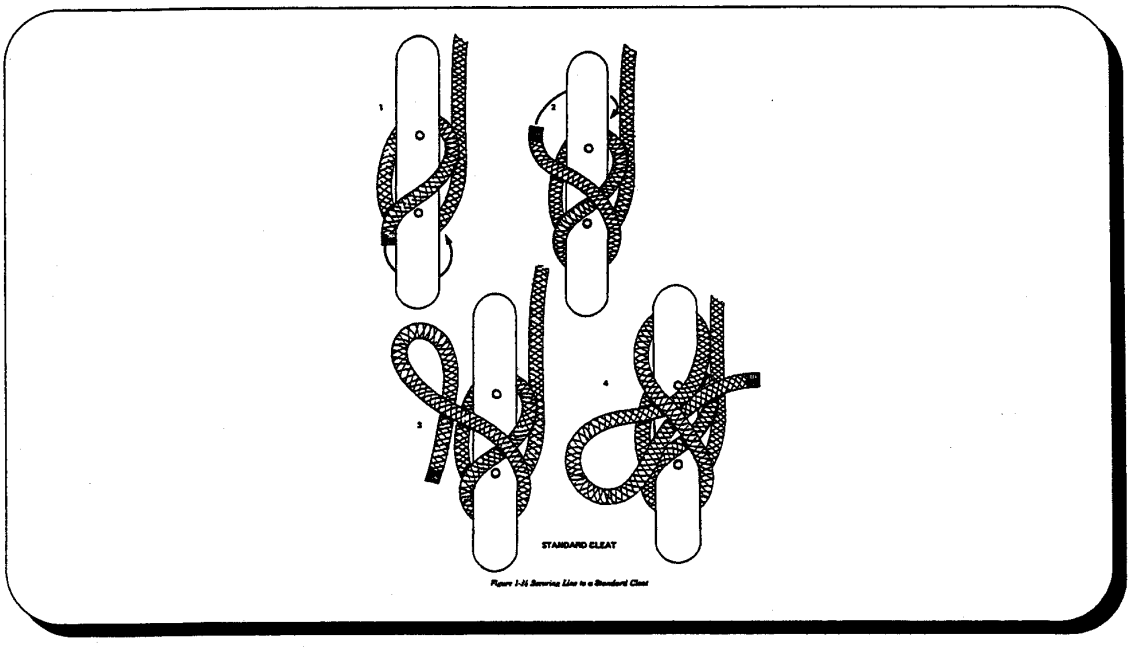
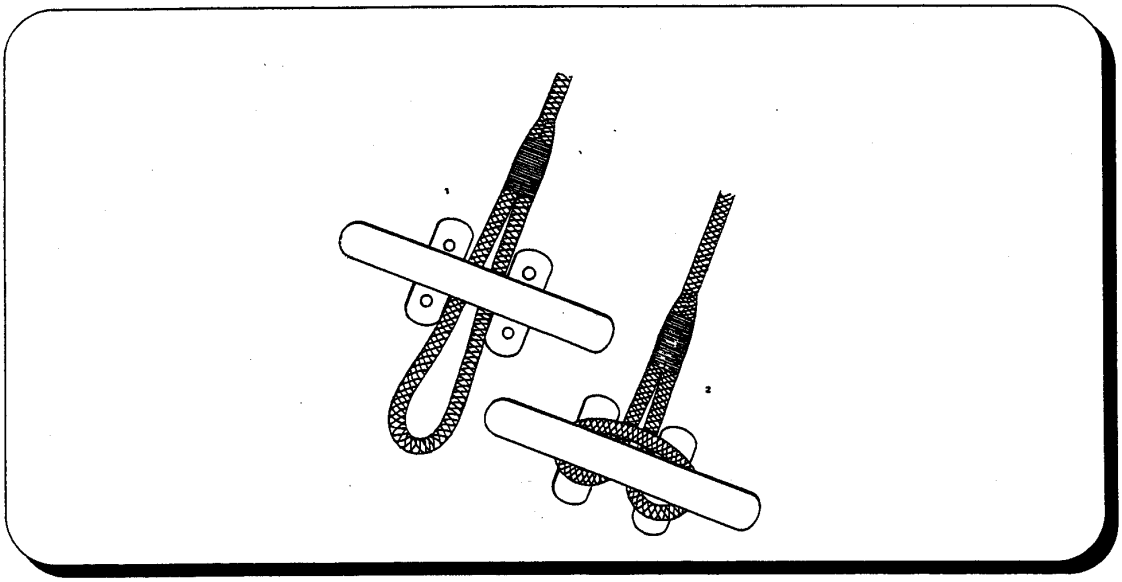


Figure 1-16 Securing Line to a Standard Cleat

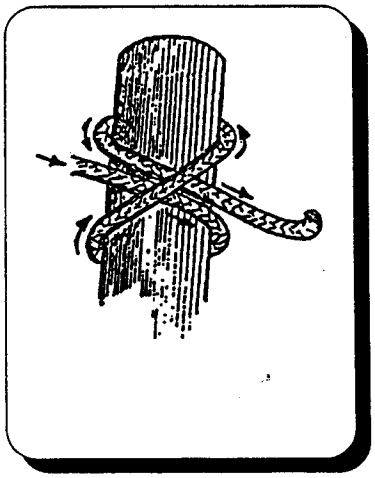
B. Mooring Cleat- Securing to a mooring cleat.

(1) Feed the eye of the line through the opening.

(2) Loop the line back over both horns and pull the line taught-



(2) Bitt - Securing a line to a bitt is done by simply placing a clove hitch around the bitt and cinching it tight-

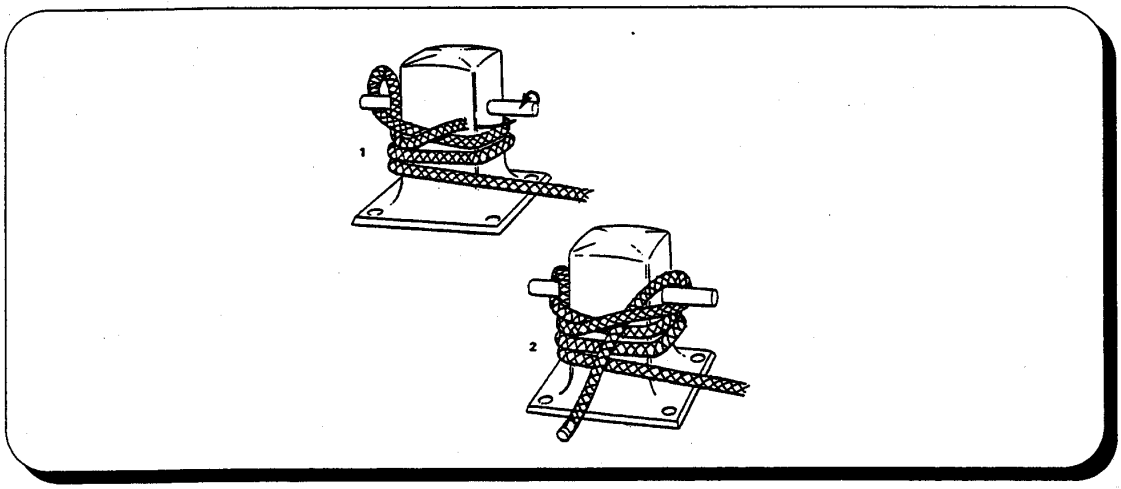


(3) Samson Post - A Samson post is a special type of deck fitting you may find in place of a standard cleat.

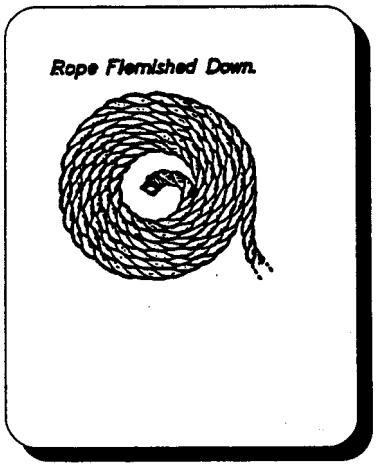
A. Take a complete round turn around the base of the samson post.

B. Form several figure 8's around the horns of the samson post.

C. Finish by taking a half -hitch around each horn



(4) Flemishing - Flemishing is a decorative method to store a short length of line. It is usua11y done on the deck near a cleat or other fastening device where the line was secured.



(5) With all these types of deck fitting the second option and the one most commonly used with the RAC is where the working end of the line is wrapped around an object (cleat, bitt or samson post) with a round turn then the working end is returned back to the bow or aft cleat and tied off as you would a standard cleat. Ensuring that at no time does the line cross over itself. Any excess line that is left either on the dock or the Riverine Assault Craft will be flemished down.

d. It is imperative to inspect lines for serviceability on a daily basis. To do so, start at one end of the line and slowly pull it through your hands checking for cuts, areas that might have worn by rubbing on itself, any unraveling, and the general appearance of the line (grease and dirt). Remember that no matter how strong a line is or what it is made of, it will need care at all times. Some things that will help line last longer:

(1) Do not overload your line- Line has a certain breaking strength, usually 1/5 of its breaking strength is acceptable. However, do not max this line to its breaking strength and expect it to be as good as new everyday.

(2) Protect your line against abrasion- Both the outer and inner fibers of your line contribute equally to its strength. So it stands to reason that if the line is worn or cut it will be weaker in the area. Usual occurrence is anywhere the line rubs against something.

(3) Keeping your lines clean- Dirt acts like a sandpaper on lines. It is an abrasive and is dangerous to the line if it is allowed to work its way into the fibers. Wash your lines thoroughly with clean water and allow to dry before putting them back into use.

REFERENCES:

1. COMDTINST M16114.5 Boat Crew Seamanship Manual

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 522
MAR 99

STUDENT OUTLINE

PREPARING THE RAC FOR INTERNAL AIR EMBARK

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE**: Without the aid of references, prepare the RAC for internal air embarkation in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) Without the aid of references, describe in writing the two methods of RAC internal air embarkation in accordance with the reference.

(2) Without the aid of references, describe in writing the steps required for preparing a RAC for internal air embarkation without a pallet in accordance with the reference.

(3) Without the aid of references, describe in writing hazmat considerations while preparing the RAC for internal air embarkation in accordance with the reference.

OUTLINE:

1. Embarkation - Preparation for RAC air embarkation is essential for mission accomplishment. The Riverine Assault Craft is certified for transport aboard C-130, C-141, C-5 and C-17 aircraft, at a gross weight of 16,500 pounds, a reduced height of 104 inches and a width of 110 inches. On the C-5 and C-17 only the antennas need be removed. Any changes to the previous mentioned dimensions will result in the RAC having to be recertified. If the RAC is shipped as rolling stock a truck at least 2 1/2 tons is required for loading. For palletization, three 463L pallets are required. Two pallets are fitted together for the three axles and one pallet for the tongue.

2. Rac Preparation - The personnel and equipment required can and should be provided by the unit itself. The RAC must be reduced in height and width in order to fit inside the fuselage of the C-130 and C-141 aircraft. This can be accomplished by following the air embark checklist-

a. Boat Cover. Remove the boat cover fold into sections of three and place into the crew compartment of the craft.

b. Antennas. Remove the Ray 202 antenna, located on the forward arch, starboard side. Care needs to be taken when removing the antenna. The antenna wire may not be long enough to separate the antenna from the mount, if this is the case, unbolt the antenna from the mount and secure the bottom of the antenna with a zip tie or 550 cord to the mount. Leave enough play as to lay the antenna down on the starboard side crew compartment seats, but not so much that the antenna wire separates from the antenna. Unscrew the Loran C antenna from its base and place it inside the crew compartment of the craft.

c. Seat Rotating Stand. The seat backs on the seat rotating stands have to be removed to allow for the 104 inch max allowable height. Remove the six, three on each side, allen screws for both the front and rear seat rotating stands, place them in the crew compartment of the craft. Be sure to replace the allen screws in the seat rotating stand to prevent loss.

d. Canopies There are two canopy sections to the RAC. The forward canopy section is located over the coxswain/navigator section. The second canopy is located over the crew compartment. There is no particular order that these canopies have to be removed. However once the canopy has been removed place it on the rear deck over the engine covers, out of your way. There are two bolts on the forward compartment and four spacers. Once the canopy has been removed, replace the spacers, nuts and bolts into the arch section. On the rear canopy, there are four nuts and bolts and eight spacers. As with the front canopy replace the nuts, bolts and spacers into the front and rear arch to prevent loss.

e. Arches. Like the canopy there are two arches. Front and rear. When lowering the front arch, loosen the forward bolts, do not remove them. The rear set of bolts are removed and replaced back into the window section of the craft. Lower the front arch to the rear, towards the crew compartment. Safety Note: **If the antenna has not been removed from the base, have another individual hold and guide the antenna down out of the way while the front arch is being lowered**. Move to the rear arch, loosen the forward bolts, do not remove them. Remove the rear set of bolts. Lower the rear arch forward into the crew compartment. Replace the bolts back into the base(s) located in front of the engine covers on the rear deck.

f. Taping and Padding. There are few items that must be taped and padded when preparing the RAC for air embarkation. The forward rear canopy mounts must be rapped and taped to prevent puncture damage to the crew seats. The entire outside portion of the radar dome must be wrapped and taped to prevent damage to the dome and crew seat. Both antennas should be wrapped and taped then placed in a secure area inside the crew compartment to prevent damage. Tape and pad the large air vents to prevent damage to the canopies. Tape and pad anything that the coxswain or boat captain section leader deems necessary to prevent damage to the craft or equipment.

g. Canopy Placement. Once the canopies have been removed, the arches have been folded down, place the rear canopy on the rear deck, far enough forward to rest inside the rear arch as it lays. Place the front canopy onto of the rear canopy. These canopies are held in place by putting two cargo straps over the canopy and securing them to the guide rails on the port and starboard side of the RAC.

h. Additional Cargo Straps. You will need two additional cargo straps to secure the front and rear arches in place. One cargo strap for each arch. Place the strap through the guide rail and over the respective arch and back through the opposite guide rail, tighten down and secure in place.

i. Light Bar. Once the RAC has been brought to the airfield for loading on the craft and prior to inspection, disconnect and unbolt the light bar, ensuring to replace the nuts and bolts to prevent loss. Place the light bar inside the crew compartment of the craft, tape and pad any portion that may cause damage to other equipment inside the craft.

3. Air Embarkation

a. For the air embark personnel to properly compute the center of balance of the craft all sl-3 gear and cargo intended to remain on the craft during flight must be present on the craft at the time of weigh-in. Both fuel tanks must be at a quarter tank or less for embarkation.

b. Once the craft has been weighed, ensure that the center of balance is marked and taped prior to loading.

4. Resources.

In order to ship the RAC via air transportation, certain materials are required for preparation

a. Dunnage Requirements. Wooden approach ramp shoring, sleeper shoring, and parking shoring are the only types of dunnage required to properly and safely embark the RAC. The only case in which approach shoring would not be required is when the RAC is palletized. Sleeper and shoring are required regardless.

b. Approach Ramp Shoring. Approach ramp shoring is necessary in order to floor load the RAC aboard both the C-130 and C-141 aircraft. Naval Air Station, Norfolk maintains ramp approach shoring in the amount and dimensions specified in figure 1-2. This approach shoring is heavy and cumbersome enough to require a fork lift to transport it. Every C-130 and C-141 carries two auxiliary ramps. Once positioned near the aircraft ramp a four man load team is required to assist in positioning the auxiliary ramps. Approach ramp shoring is not always

available at all air stations. The auxiliary ramps may have to be transported with the RAC. Always verify that ramps are available at the departure and arrival airfield.

c. Sleeper Shoring. Four stacks of 2"x 30"x 12" sleeper shoring with an approximate height of 15 inches must be placed under the fore and aft axles on both sides of the trailer. When floor loading no parking shoring is needed. When palletizing, the RAC and trailer require the same type of sleeper shoring.

d. Parking Shoring. When palletized, the RAC requires parking shoring for all three axles, one layer 3/4" thick, 90" long by 12" wide, to expand the tire pad area so aircraft pallet roller limits are not exceeded. This shoring must be emplaced prior to setting the RAC onto the 40k loader. The RAC can only be loaded stern first, due to the compartment and aircraft center of gravity limits, this places the RAC between fuselage stations 470 and 480 on the C-130 creating 76-86 inch overhang onto the ramp. The eye of the trailer must be shored using one stack of 2"x 24"x 12" construction grade lumber with an approximate height of 21".

e. Alternate Loading. An alternative to ramp approach shoring for the loading of the RAC and trailer aboard C-130 and C-141 aircraft is to use a forklift with a fitted adapter for the trailer eye. While backing the RAC onto the aircraft the forklift operator must ensure that at least two axles remain in contact with the aircraft ramp.

5. Personnel And Equipment.

a. The craft crew is all that is needed in preparing the RAC for air embarkation. The crew should remain with the craft throughout the loading onto the aircraft. They will assist the air crew in loading the RAC.

b. The following is a list of minimum of equipment needed to prep and load the RAC onto the aircraft:

1. 5 ton truck
2. fork lift
3. portable scales (4)
4. hydraulic jacks (2), (10,000 LB)
5. boat straps (4) (yellow)
6. cargo straps (4)
7. stiff cardboard, (24 pieces)
8. duct tape (2 rolls)
9. 3/4" crescent wrenches (2)
10. 7/16" Allen wrench (1)
11. rope, 1/2" (20 ft)

6. **Air Embark Checklist**

a. The following is the checklist that the coxswain or boat captain section leader should use when preparing the RAC for air embarkation. See **Attachment #1**

REFERENCES:

1. Standard Operating Procedure for the Air Transportation of the RAC
2. TM 09557 A-14/1 System and Operations Manual w / Components List for Riverine Assault Craft

NOTES:

ATTACHMENT8:

1. Air Embark Checklist

ATTACHMENT # ITEM	QTY	YES	NO	REMARKS
1. 5 ton truck	(1)			
2. fork lift	(1)			
3. portable scales	(4)			
4. hydraulic jacks (10,0001b)	(2)			
5. boat straps (yellow)	(4)			
6. cargo straps	(4)			
7. stiff cardboard,	(24 pieces)			
8. duct tape	(2 rolls)			
9. 3/4" cresent wrenches	(2)			
10. 7/16" Allen wrench	(1)			
11. rope, 1/2"	(20)			
CHECK:				
RAC IS SL-3 COMP.				
FUEL, 1/4 OR LESS				
WEIGH RAC/TRLR				
CTR OF BLNC MARKED				
PLUGS IN				
FWD CANOPY RMVD				
REAR CANOPY RMVD				
EQUIP SECURED				
ANTENNAS RMVD				
FWD ARCH DWN				
REAR ARCH DWN				
ARCHES SECURE				
RAC SECURE TO TRLR				
TAPE & PAD IN PLACE				
DUNNAGE PRESENT:				
a. apprch shoring				
b. 2"x 12"x 12"	48			
c. 3/4"x 90"x 12'	2			

PAGE 2 ITEM	QTY	YES	NO	REMARKS
40k LOADER	1			
LOAD CREW	4			
ADDITIONAL EQUIP:				

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Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 523
MAR 99

STUDENT OUTLINE

PREP ARE THE RAC FOR EXTERNAL AIR EMBARK

LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVE: With the aid of references, prepare the RAC for external air embarkation in accordance with the reference.

B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, list in writing the steps required for preparing the RAC for external air embarkation in accordance with the references.

(2) Without the aid of references, list the safety considerations when preparing the RAC for external air embarkation, in accordance with the references.

OUTLINE:

1. Embarkation- Preparation for RAC external air embark is essential for mission accomplishment. The Riverine Assault Craft is certified for transport aboard CH-53E rotary wing aircraft, at a gross weight of 16,500 pounds, without trailer, and 18,650 pounds with trailer. It must be transported at a minimum speed of 70 knots and a maximum airspeed of 110 knots.

2. **Rac Preparation**.

a. Secure the RAC to the trailer using three tie-down straps and the forward bow chain and binder. Ensure the straps are padded at all points that make contact with the RAC. This is to prevent chafing or rubbing on the craft.

b. Place the RAC into the proper position on the pick-up zone

c. Fully retract the forward jack wheel on the trailer

d. Place a suitable piece of dunnage under the tongue of the trailer

e. Disconnect the prime mover from the trailer

f. Place wheel chalks in front of and behind the front and rear axles respectively

g. Stack and secure any additional equipment at the lowest point possible inside the craft with CGU-l/B cargo tie down straps and 550 cord.

h. Secure the weapons in place, install sight covers to the dial sights with 550 cord or tape.

i. Secure hatch covers, firing platforms, unused lines and equipment in place with nylon cord or tape

j. Lower all antennas and secure in place with 550 cord or 1/4" cotton webbing.

3. **Personnel And Equipment**.

a. The craft crew is a11 that is needed in preparing the RAC for air embarkation. The crew should remain throughout the hookup of the raft. They will assist the HST master in the hookup of the RAC.

b. The following is a list of minimum of equipment needed to prep the RAC for transport:

1. Sling set, (40,000 LB's)
2. Apex fitting (40,000 LB's), (2)
3. Tie-down straps, (10,000 LB's), (4)
4. 550 cord, (20 ft)
5. Duct tape, green, 2" (1 roll)
6. 1/4" cotton webbing, (80 LB's), (1 roll)
7. CGU-1/B, cargo tie down straps (5 ,000 LB's), (4)
8. Masking tape, (1 roll), (2")
9. Static discharge wand (2)

4. **Rigging:**

a. Forward sling set: (two sling legs)

(1) Connect two sling legs to apex fitting number 1

(2) Position apex fitting number 1 on top of the bow hatch

(3) Loop the chain end of the sling legs through their respective lift fittings. Pull the sling legs taught.

b. Aft sling set: (two sling legs)

(1) Connect two sling legs to the apex fitting, number two.

(2) Position apex fitting, number 2, on top of the canvas cover.

(3) Loop the chain end of the left and I right sling legs through their respective lift fittings. Insert link into the grab hook. Pull the sling legs taught and remove all slack in the chain.

(4) Cluster tie or tape (breakaway techniques) all sling legs together on top of the RAC to prevent entanglement during hookup and lift-off.

5. **Hook-Up:**

Safety Note: Only The Hst Master Will Hook The Rac Up To The Ch53E

a. Placement of hook-up men

(1) One man secures the forward apex fitting, number 1, The second man secures the apex fitting at the rear of the craft, number 2.

(2) Each position, forward and aft will have a man with a static discharge wand, positioned in front of the men with the apex fittings in hand.

Safety Note: Ensure The Static Discharge Wand Has Been Grounded Prior To Taking Up A Position Aboard The Rac.

b. Aircraft hook-up:

(1) Once the aircraft is at a stable hover above the RAC the static discharge men will make contact with the appropriate aircraft cargo hook, using their static discharge wand.

(2) The forward and aft apex men wil1 hook-up their apex fittings the corresponding aircraft cargo hook.

(3) The static discharge men will ensure they keep contact with the cargo hook until the apex men have released control of the apex fittings.

(4) The hook-up team, apex and static discharge men, will then carefully dismount the RAC but remain close to the load until all slack has been removed from the sling legs.

(5) Once a successful hook-up is accomplished the hook-up team will move quickly to a designated rendezvous point.

6. **Derigging:**

a . Derigging is accomplished by reversing the steps, listed in 5 b, a and 4 b, a. Ensure to pay particular attention to disconnecting from the CH-53E using the static discharge wands.

b. Stow all dunnage and trash with the craft or in the appropriate receptacle.

c. Hook-up prime mover to RAC and continue the mission.

REFERENCE:

1. SOP for Air Transport of the RAC

2. TM 09557 A -14/1 System and Operation manua1 w/Components List for Riverine Assault Craft

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune North Carolina 28542

TAB 524
MAR 99

STUDENT OUTLINE

BASIC RADIO PROCEDURES

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVES**: Without the aid of references, communicate using proper procedures in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references, employ net security measures in accordance with the reference

(2) Without the aid of references, employ message handling procedures in accordance with the references.

OUTLINE:

1. **Operating Principles**

a. Reliability is our first principle. A reliable communicator can be counted on to accomplish the mission even in the most complicated situations.

(1) Before transmitting a message, always write it down.

(2) When given a message to transmitted, always transmit what is written.

A. If in the course of transmitting a message you come across a peculiar word or any word that may appear difficult to pronounce, you must use the proper procedure for spelling a word on a radio net.

B. Also in communications, we pronounce numbers differently than we do in everyday language. This is especially necessary when communicating with our allies over the radio. For example, what does, "nine," me in German? It means, "no," and this may cause some confusion, so we say "niner" for the number nine.

C. Procedural words, or prowords as they are commonly referred to, are words or phrases which have been assigned meanings or the purpose of expediting message handling. These prowords and any other references to radio procedures may be found in the Allied Communication Publication (ACP)-125. All the armed services and our allies use this publication to maintain uniformity in our communications. It can be located through the communications-electronics office or publications officer.

b. Security. In an electronic warfare (EW) environment, your survival may depend on good communication security (COMSEC) practice. The definition of electronic warfare (EW) is military action involving the use of radio waves to reduce or stop enemy use of radio communications, while maintaining friendly e of radio communications. The definition of communication security is the protection resulting from all measures designed to deny unauthorized persons information of value which might be derived from the possession and study of communications or to mislead unauthorized persons in their interpretations of the results of such a study.

(1) One means of establishing CO MSEC is radio silence. Radio silence is necessary for a variety of combat circumstances, like moving to an objective. Radio silence may be imposed with the order to reestablish the net at a particular time or emergency silence may be ordered.

(2) Transmitting too often, no matte that the content of the traffic, can weaken our security effort. A radio check done too often can allow the enemy to locate us through direction finding. Radio checks should only be given twice: upon establishing a net, and when in doubt about the equipment's operational capability .

(3) By the same token, unauthorized from personal messages allow the enemy the same opportunity to defeat us through EW. Many messages that could be transmitted via alternate means are instead transmitted on the radio, giving the enemy an opportunity to gain intelligence information.

(4) Our best defense in an electronic warfare environment are our authentication tables and cryptographic equipment. Failure to use these defenses will hamper our effectiveness in communicating or even compromising your unit.

c. Speed is our third principle. You've got to be fast when dealing with communications because tactical situations and lives depend upon how fast the communicator transmits or receives messages and responds to them.

(1) Precedence is a set of guidelines used to determine the maximum allowable processing time between the drafter and the addressee. The more urgent the information is, the higher the precedence.

A. The writer of a message is the drafter. He assigns the precedence.

B. The addressee is the unit to which the message is sent. The drafter considers the urgency of the information to the addressee when assigning the precedence.

(2) You must give your undivided attention to the transmission you are receiving. Don't make that other operator say again his message because you were not paying attention. This just extends the time spent over the air.

(3) Some radio procedures which will help to speed up message traffic are:

A. Always transmit at the speed of the slowest operator on the net.

B. A rule of thumb, from experienced operators is to transmit in 3-5 word bursts and pause. This will allow the man on the other and a chance to copy down everything. If nothing is heard, continue with 3-5 word bursts. By pausing, you will make it possible for the distant station to interrupt your transmission, if needed, and make it difficult for direction finding units to lock in on your position. It is much easier to send a message slowly once than 5 times fast,

C. To be fast, you also have to speak the same language. By that I mean use only authorized prowords. Do not use slang or "CB" language, because people will not understand you. Trained communicators all speak the same by using prowords.

D. In addition to speaking the same language through the use of prowords, you also have to speak clearly and use natural phrases on a radio.

d. flexibility. This is the most important principle. Flexibility refers to the capability of the radio operator to adjust to rapidly changing situations without a loss of communication. To help us be more flexible, we should ensure the following:

(1) The radio must be in good condition. Before going to the field, conduct a good operation check

(2) Conduct continuous training of radio operators in all areas of communications.

2. **Procedural Words**

a. Procedural, words or prowords, are pronounceable words or phrases which have been assigned meanings for the purpose of expediting message handling on circuits where radio-telephone procedure is employed. In case shall a proword or combination of prowords

be substituted by the operator for any part of the text. For radio-telephone communication between units of different nationalities, the pro words may be replaced by their equivalent prosigns, where these exist, spelled out using authorized phonetic equivalents.

b. Prosigns are the operator's shorthand then keeping circuit logs. (See below).

PROWORD	EXPLANATION	PROSIGN
ALL AFTER	The portion of the message to which I have reference is all that which follows.	AA
ALL BEFORE	The portion of the message to which I have reference is that which precedes.	AB
BREAK	I hereby indicate the separation of the text from other portions of the message.	BT
CORRECTION	An error has been made in this transmission. Transmission will continue with the last word correctly transmitted.	EEEEE
FIGURES	Numerals or numbers to follow.	
FLASH	This message must be handled as fast as humanly possible, but within ten minutes.	Z
FROM	The originator of this message is indicated by the address designation immediately following.	FM
INFO	The addressee designations immediately following are addressed for information.	INFO
I READ BACK	The following is my response to your instructions to read back.	G

THIS IS	This transmission is from the designation immediately following.	DE
TO	The addressee whose designation immediately follows are to take action on this message.	TO
UNKNOWN STATION	The identity of the station with whom I am attempting to establish communications with is unknown.	AA
WAIT	I must pause for a few seconds.	AS
I SPELL	I shall spell the next word phonetically.	
MESSAGE FOLLOWS	A message which requires recording is about to follow.	
IMMEDIATE	This message must be handled within thirty minutes. It is the second fastest assignable precedence.	O
OUT	This is the end of my transmission to you and no answer is required.	AR
OVER	This is the end of my transmission to you and response is necessary. Go ahead and transmit.	K
PRIORITY	This message must be handled within thirty minutes to three hours. It is the third fastest assignable precedence.	P
READ BACK	Read the entire transmission back to me exactly as received.	G
RELAY (TO)	Transmit this message to all addressees or designations immediately following.	T

ROGER	I have received your last transmission satisfactorily.	
ROUTINE	This message must be handled within six hours. It is the lowest precedence assignable.	R
SAY AGAIN	Say again all of your last transmission. Followed by your identification data.	IMI
SILENCE	Cease transmission immediately. Silence will be maintained until instructed to resume.	HM HM HM
SILENCE LIFTED	Resume normal transmission. Silence can be lifted only by the imposing station or a higher authority.	
THAT IS CORRECT	You are correct, or what you have transmitted is correct.	C
WAIT OUT	I must pause longer than a few seconds.	AS AR
WILCO	I have received your message, understand it, and will comply. To be used only by the addressee to which the questioned message was directed.	
WORD AFTER	The word of the message to which I have reference is that which follows.	WA
WORD BEFORE	The word of the message to which I have reference is that which precedes.	WB
WORDS TWICE	Communications are difficult. Transmit each phrase or group twice.	

	This proword may be used as an order, request, or as information.
WRONG	Your last transmission was incorrect. The correct version is .

c. Repeat. As radio operators, we use the words, "Say Again." Only artillery radio operators would ever say "repeat" over the radio. This tells artillery units to fire their last mission again. Never say repeat to have a transmission repeated.

3. **Phonetic Alphabet**

a. The phonetic alphabet is very important in voice radio communications because it allows us to spell out words or send abbreviations that may be otherwise misunderstood or misspelled.

b. Through your military experience, you have heard or used the phonetic alphabet from time to time. For those of you who are not familiar with it, let's all recite the phonetic alphabet starting at ALPHA and ending at ZULU. The cover of a field message book (NAVMC-694) has the phonetic alphabet on it for quick reference.

c. Underlined syllables of the phonetic alphabet carry the accent. (See below)

LETTER	PHONETIC	SPOKEN AS
A	ALFA	AL FAH
B	BRAVO	BRAH VOH
C	CHARLIE	CHAR LEE OR SHAR LEE
D	DELTA	DELL TAH
E	ECHO	ECK OH
F	FOXTROT	FOKS TROT
G	GOLF	GOLF
H	HOTEL	HOH TELL

I	INDIA	IN DEE AH
J	JULIETT	JEW LEE ETT
K	KILO	KEY LOH
l	LIMA	LEE MAH
M	MIKE	MIKE
N	NOVEMBER	NO VEM BER
O	OSCAR	OSS CAH
P	PAPA	PAH PAH
Q	QUEBEC	KEH BECK
R	ROMEO	ROW ME OH
S	SIERRA	SEE AIR RAH
T	TANGO	TANG GO
U	UNIFORM	YOO NEE FORM OR OO NEE FORM
V	VICTOR	VIK TAH
W	WHISKEY	WISS KEY
X	X RAY	ECKS RAY
Y	YANKEE	YANK KEY
Z	ZULU	ZOO LOO

d. When you write letters or words in a message, they'll always be in capital block letters. Sometimes we need to distinguish between numbers and letters. The letter "Z", why do we draw

a horizontal line through the middle? To distinguish it from a number "2." What about a zero, why do we put a diagonal line through it? We do it to distinguish it from the letter “OSCAR."

e. Remember, when given a written me message to transmit, proofread it first to ensure that it is legible and to note any words that may give the receiving operator difficulty in spelling or misinterpretation of the message. Avoid any confusion.

(1) The first procedural word that you will be introduced to is, "I Spell." This procedural word will be said to alert the receiving station that you are about to spell phonetically.

(2) First, say the word to be spelled, and then say, "I spell," and spell the word phonetically.

(3) After you have spelled the word phonetically, say the word again.

(4) There are other types of words which should be spelled phonetically. Those are the words that sound similar to others, but have different spellings and meanings, (i.e., to, too, two or their, there and they're).

f. The pronunciation of numbers over a radio or telephone is as follows:

1 - WUN	6 - SIX
2 - TOO	7 - SEV-EN
3 - TREE	8 - AIT
4 - FOW-ER	9 - NIN-ER
5 - FIFE	0 - ZERO

g. Whenever numerals have to be transmitted, use the proword, “figures,” to alert the receiving station that numerals are about to bE transmitted. Numbers will always be transmitted digit by digit. (See below)

4 - FOW-ER
90 - NIN-ER ZERO
136 - WUN TREE SIX
7000 - SEV-EN ZERO ZERO ZERO

h. The date time group is always transmitted digit by digit over the radio. The proword, "Time," will be used prior to giving the time over the radio or telephone.

4**. Net Control**

a. The net control station (NECOS/NCS) will usually be the senior station on the net, but it can also be any station which can best fulfill the duties and responsibilities.

b. NECOS Responsibilities.

(1) Open and close a net.

(2) Monitor and maintain discipline on a net.

(3) Correct violations of radio transmissions.

(4) Report all security violations to the watch supervisor or watch officer.

(5) Maintain an orderly flow of message traffic on the net.

c. The alternate NECOS is designated for use in emergency situations so that it takes charge of the net when the normal NECOS is inoperative for any reason. When in control of the net, the alternate NECOS assumes the regular NECOS's responsibilities.

5. **Types Of Calls** A call is simply one station attempting to communicate, with or call another station or group of stations. There are four types of calls that you will come across as an operator.

a. A single call is one station attempting to contact another station.

(1) If the battalion commander wants to call Alpha Company, the battalion commander uses his call sign to identify himself and then uses Alpha Company's callsign to let them know they are the called station.

(2) The battalion commander would then say the proword, "over," and wait for Alpha Company to respond to his callsign.

b. A multiple call refers to two or more stations being contacted by a station.

(1) If the battalion commander wanted to call two or more stations in one transmission the radio operator would use each station's single callsign.

(2) The call signs are transmitted in alpha-numeric order.

c. A collective call designates more than one station, but not all stations on a net.

(1) If the battalion commander wanted to call a selected group within the battalion, he would assign this group one callsign which they would respond to if called.

d. The net call goes one step further in that a single callsign designates all of the stations on a net. Since all of the stations are alerted by a net call, there is always a problem of the stations answering at the same time.

(1) Many operators are under the misconception that they answer a net or collective call t in alphabetical order of their unit . For instance, Company "A", Company "B", etc. They are partly right, in that they do answer in alphabetical order, but they answer by order of the callsigns. (Alpha-numeric) For example:

N8N DE D2Y (CO C) - OVER
N8N DE E7W (CO B) - OVER
N8N DE O1A (RECON) - OVER
N8N DE O2B (CO A) - OVER
N8N DE S5Z (SPT CO) - OVER
N8N DE T6J (CO D) - OVER

(2) The alpha-numeric order starts with the first letter of the callsign. In this case D2Y responds before E7W and so forth. What happens if two stations have the same first letter, for instance, O1A and O2B? In a case such as this, we refer to the numerical order of the callsigns.

(3) These callsigns change every 24 hours, so one day you may be the first station to respond to a net call, but tomorrow, due to changing callsigns, your are last.

e. Once the net has been established, it will normally work with abbreviated procedures and call signs. The NECOS will, however, order the net to work with full or abbreviated procedures or call signs required by the conditions.

6. **Opening A Net**

a. There are two types of nets: directed and free. A NECOS is required on both nets, as follows:

(1) NECOS plays the traffic cop on both a free net and a directed net. On a directed net NECOS will maintain an even flow of message traffic.

a. When a directed net is established, the NECOS (N8N) uses the net call (F8E) callsign to alert all stations on the net, then transmits a standard net opening statement, as in the following example:

> F8E DE N8N. THIS IS A DIRECTED NET, FOR WHOM AND WHAT PRECEDENCE ARE YOUR MESSAGES? AUTHENTICATION TIME IS_____, I AUTHENTICATE _____, OVER.

(1) NECOS establishes that he is net control and that this is a directed net, which means subordinate stations must go through the NECOS prior to transmitting any traffic.

(2) For NECOS to play the traffic cop role, it now needs to know for whom and what precedence are the messages. Remember that precedence tells the operator how fast the message should be handled. It also helps net control decide in what order message traffic will be transmitted.

(3) To show NECOS's authenticity to the stations on the net, transmission authentication is used when the radio net is not covered. In this way all of the stations on the net immediately recognize net control as a valid station.

b. The subordinate stations now respond:

N8N DE F1P	NEG TRAFFIC, OVER.
N8N DE R5V	1 ROUTINE FOR YOU, OVER.
N8N DE S5S	2 ROUTINES FOR T6J, OVER.
N8N DE T6J	1 PRIORITY FOR YOU, OVER.

(1) Which station would go first? T6J because it has a priority message. Net control makes the determination and instructs T6J that he is first.

(2) Net control's reply: ROGER 6J SEND YOUR TRAFFIC, OVER. This response is called an abbreviated call. Once initial contact has been made, it is not necessary for

NECOS to continually use full call signs until a new message or transmission with another station is initiated unless it conflicts with other callsigns.

(3) After T6J transmits it's message, the next station in line transmits it's message. Net control determines the order of traffic flow.

b. When a free net is established, NECOS uses the same procedures except the operator says, "THIS IS A FREE NET ," and gives the correct transmission authentication. If the radio is covered there is no need for transmission authentication. The subordinate stations respond with their call-sign and "Roger, Over." NECOS does not need to know the messages or precedence because a free net doesn't require stations to request permission the from net control to prior to transmitting a message.

7**. Securing From A Net**

a. When the net is to be secured, what callsign does net control use? A net callsign in most situations. Once the net is called, the instructions to secure are passed with a transmission authentication, if the net is covered there is no need for transmission authentication. For example:

N8J DE N8N, THE NET IS SECURED UNTIL_____
AUTHENTICATION TIME IS_____, I AUTHENTICATE
_____,OVER. N8N DE R8J, ROGER, OVER.
R8J DE N8N, ROGER, OUT .

b. Net control cannot secure until all stations are accounted for.

c. The subordinate station's reply, if they understand, is "Roger, Over."

d. The net control station's reply, is understood, is "Roger, Out."

8. **Radio And Emergency Silence**

a. Radio Silence:

(1) Radio silence may be imposed or lifted by the net control station on the net, or nets, for which it is responsible. Do not turn the radio off when in radio silence.

(2) Radio silence may be predetermined or may occur in an emergency. When predetermined, instructions for imposing, lifting, or breaking radio silence are to be passed by any secure means available.

(3) Radio silence will normally be imposed by codewords, nicknames, or other predetermined designator. Lifting or breaking radio silence may be achieved in the same way, or by the use of self-authentication.

a. Imposing radio silence by use of a nickname:

The NCS transmits to all subordinate stations:

A3C –THIS IS -B4D -PAPER DOLL -OVER

Each subordinate station answers in turn:

THIS IS- A3C-ROGER-OVER
THIS IS- SlY-ROGER-OVER

The NCS transmits:

THIS IS -B4D -PAPER DOLL (NOW) -OUT

b. Breaking radio silence by means of transmission authentication:

B4D – THIS IS - A3C -Sighting Report -AUTHENTICATION TIME IS_____,
I AUTHENTICATE , OVER.

B4D Transmits:

THIS IS-B4D-ROGER-OUT

The remainder of the net maintains radio silence. A break by one station does not lift silence. The remainder of the net will continue to monitor, but will not transmit.

c. Lifting radio silence by means of transmission authentication:

The NCS transmits:

A3C - THIS IS - B4D -SILENCE LIFTED - AUTHENTICATION TIME IS_____, I AUTHENTICATE_____, OVER.

d. Emergency Silence:

(1) Emergency silence may be imposed or lifted only by competent authority Never impose or lift emergency silence without authorization.

(2) When a transmission authentication system is in force, a station must always authenticate a transmission which imposes or lifts emergency silence, or which calls stations during periods of emergency silence.

(3) Transmissions imposing emergency silence will be made twice through and ended with the proword OUT. Stations do not answer or receipt such transmissions.

(4) The proword SILENCE spoken three or more times means "Cease transmissions immediately." Silence will be maintained until lifted.

(5) After such call, use of the proword SILENCE spoken three or more times means " Stations addressed are to cease all transmissions on this net immediately, and continue to, monitor only." Do not transmit.

To impose emergency silence on the net, the NCS transmits:

A3C -THIS IS -B4D - SILENCE, SILENCE, SILENCE, AUTHENTICATION TIME IS_____, I AUTHENTICATE _____ .I SAY AGAIN -A3C -THIS IS -B4D SILENCE, SILENCE, SILENCE, AUTHENTICATION TIME IS_____, I AUTHENTICATION_____, OUT.

(6) Emergency silence is lifted by the use of the proword SILENCE LIFTED, followed by transmission authentication or an assigned codeword.

Lifting emergency silence for all stations on a net, the NCS transmits:

A3C -THIS IS - B4D - SILENCE LIFTED -AUTHENTICATION TIME IS_____, I AUTHENTICATE , OUT.

b. Following a period of radio silence, the NCS needs to consider the requirement to reestablish communications by means of a radio check with the entire net.

9. **Radio Check Procedures**

a. A station is understood to have good signal strength and readability unless otherwise notified. Strength of signals and readability will not be exchanged unless one station can clearly hear another station.

b. A station that wishes to inform another of its signal strength and readability does so by means of a short and concise report of actual reception such as, "weak, but readable," "loud, but distorted," "weak, but with interference."

c. The following prowords are recognized as proper methods for requesting and answering radio checks.

(1) When requesting a radio check from another station the radio operator: says, "T6J DE N8N. Radio Check, Over."

(2) If the signal is loud and clear, the distant station's response is "Roger, Out". If reception is other than loud and clear it must be described with the following prowords. First the signal strength:

Loud - the signal is very strong.

Good - the signal strength is satisfactory.

Weak - the signal strength is very faint.

Very Weak -Your signal strength is very weak.

Fading - At times the signal weakens to such an extent that reception cannot be relied on.

(3) These prowords are used to report the signal strength for readability.

Clear - excellent quality .

Readable - quality is satisfactory.

Unreadable - the quality of transmission is so bad that I cannot understand it.

Distorted - the signal is impaired.

With Interference - having trouble receiving due to noise (electrical, atmospheric, etc.).

Intermediate - Having trouble receiving due to periodic noise. (i.e, electrical, atmospheric).

(4) An accurate description of a station's signal strength and readability will help that station take corrective action to improve the quality of communication.

10. **Field Message Book** (See figure 1.)

a. The Field Message Book is the standard form used in the Marine Corps for transmitting or receiving radio messages. The front cover lists the phonetic alphabet and precedence as a convenient reference. Also, a line is provided for recording classified messages which may be received or transmitted. The pages are self carbonated to allow the drafter to make as many copies as needed. The radio operator should maintain a copy, and record the highest classification on the line provided on the cover. This message book, or one sheet, is commonly referred to as a yellow canary .

DTG (COMM USE) FM:

Z O P R

TO:

BT TOPSEC SECRET CONF UNCLAS

BT

RELEASING OFFICER'S SIGNATURE TOR/TOD PAGE

____OF ____

Figure 1. Field message book NAVMC-694.

b. The message book is not essential when writing a message, any material will do. The message book helps the drafter organize his thoughts for handling a message.

c. The first item on the message blank is the precedence, which is used to determine how much time the message should take from originator to addressee. The prosigns for the precedence are preprinted on the message blank. The drafter need only circle the correct precedence. The time limits for handling messages are as fast as humanly possible, with a maximum of:

R-	Routine	06 Hours
P-	Priority	03 Hours
O-	Immediate	30 Minutes
Z-	Flash	10 Minutes .

d. The date-time-group (DTG) provides a means of identifying the message. Messages are I referred to by the date-time-group. In this case, the date is 19 and the time 1000R. What is ROMEO? That is the local time zone here during the eastern standard time. Per the unit SOP, the DTG may be in local time. The importance of applying this to military operations is obvious. With units spread allover the globe, any statement of time must be followed by a zone designator to provide a common reference for time.

(1) Zulu time is used when assigning the DTG to messages or changing cryptographic codes such as authentication tables and encode/decode tables. Also, call- signs and frequencies change at a predetermined time using Zulu time. This is because units in other time zones change at the same time when using Zulu time. There is a chart which will indicate the conversions to Zulu time anywhere in the world. (See figure 2.)

Standard Time Zone of the World

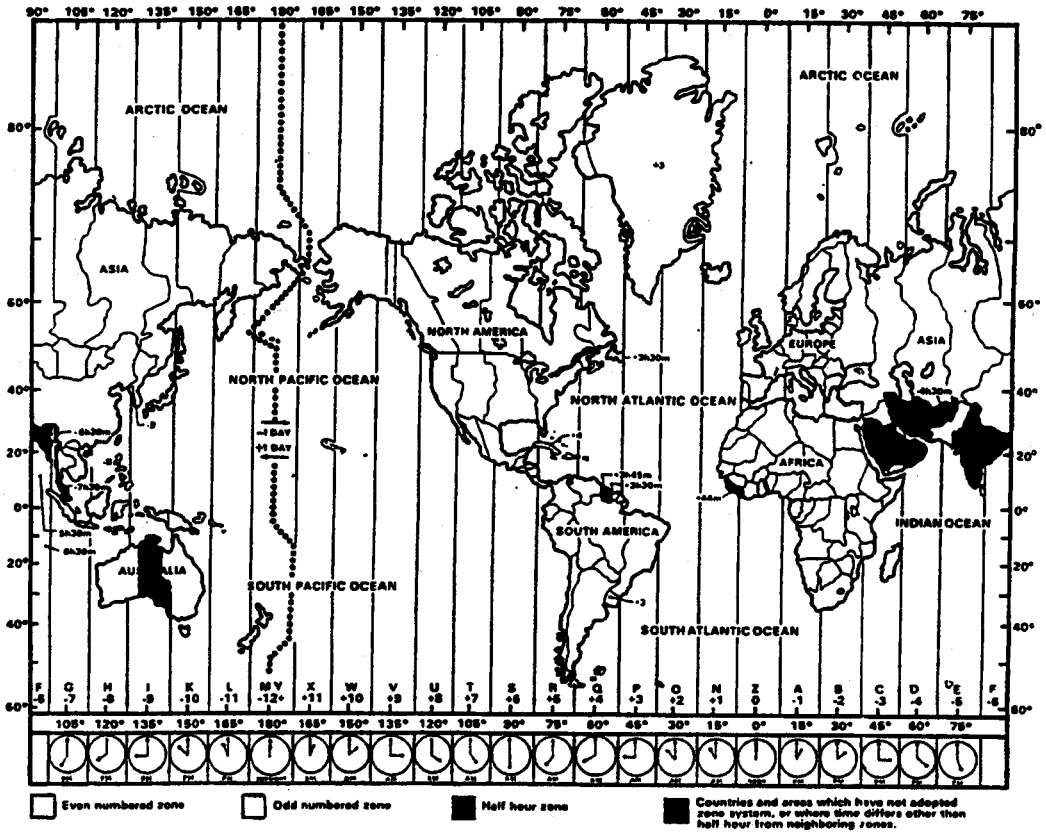


Figure 2

(2) When we change to Daylight savings time (DST), we add an hour to local time. This affects time conversions. As an example, to convert Romeo time to Zulu, we add five hours normally. However, when DST is observed we add only four hours. The other hour is not considered because of DST .

e. The next line on the form is the address component. FM is the prosign for the proword "from." The originating unit's plain text name is written here. This will be converted to a call sign upon transmission of the message. It is important that the call- sign not be entered on the form, since that would link a call sign to a particular unit. It can also be very confusing to look at field messages with an old call sign on this line.

f. The other address component is the plain text name of the units to receive the message. The radio operator will convert this to a call sign when transmitting messages. When a message is received, the call sign must be changed to the plain text name.

g. "BT" overscored is the prosign for "Break." "Break," is said to separate the heading from the text. It is pre-printed and no entry is required on the operator's part. Some operators like to circle BT as a reminder to transmit the "Break." Remember, you are reading left to right starting at the precedence line just like reading a book.

h. Another pre-printed item is the "Classification Block." One of these classifications will be circled. Selection of the classification is the responsibility of the drafter. The radio operator must ensure that one of the four classifications is circled.

i. After the heading is read, transmit the text of the message. The text contains the thought or idea the drafter desires to pass. Think back to principles of reliability. When writing a message, use the ABC's: ACCURATE, BRIEF, and CLEAR. Remember to transmit in three to five word phrases and pause a couple of seconds between phrases.

j. Another break is used to inform the distant station that the text of the message is ended. It is pre-printed and no entry is required on the operator's part.

k. Prior to the message being transmitted, the drafter must route it through the releasing officer. This is more the case in a formal field environment than on a patrol in the bush. The releasing officer will normally be a watch officer or an officer who has authorization to release messages for his command. The releasing officer's name and the remainder of the bottom line information is not read as part of the message.

l. Once the message has been transmitted or received, it is important to write some closing information which may be referred to in the future.

(1) The time of receipt (TOR) is assigned to a message when it is received. This is done after acknowledging receipt of the message. It will contain the time the message is received, the operator's initials, and the frequency the radio is on.

(2) The time of delivery (TOD) is assigned to a message after it has been transmitted. The information the TOD contains is the station called (written in plain text), the frequency, the operator's initials, and the time the message was transmitted.

11. **Communication Security** Communication Security is the protection resulting from all measures taken to deny unauthorized persons information. There are four components of Communication Security which are defined to you below.

a. Cryptographic Security is that component which results from the provision of technically sound cryptographic systems and their proper use.

b. Transmission Security is that component which results from all measures designed to protect transmissions from intercept and exploitation.

c. Emission Security is that component which results from all measures taken to deny any information of value derived from intercept and analysis.

d. Physical Security is that component which results from all physical measures necessary to safeguard classified material, equipment, tiles, and documents.

12. **Authentication Using Akac-874**

a. The AKAC-874 is used for challenge and reply, time authentication, and also to encrypt or decrypt numbers. This booklet is used to identify friendly stations on a net and to verify the authenticity of messages or orders from another station on the net.

b. To use this table we must be aware that the time zone to be used is usually spelled out in the operations order. Each AKAC-874 book covers an entire month with one page per day of that month, which is indicated on the cover of the booklet.

(1) Each page consists of four tables which cover a six hour period. So, if each page represents a day of the month, and each table of that page represents six hours of that day, times four tables, then we can cover an entire 24 hour period of authentication or encryption.

(2) Numerical cipher, for authentication is on the front of the page, and transmission authentication, for time authentication is on the back side.

13. **Challenge And Reply Authentication.** This table is called the AKAC-874A, and is used for challenge and reply authentication. This system identifies friendly stations on the net and verifies the authenticity of messages and orders. We can use the acronym READ to help us remember the procedure for using this table, READ means Right Encrypt Authenticate Down. (See figure 3.)

a. To challenge a station, this type of authentication requires the random selection of two letters between the letter A and the letter Y. The letter Z is exempt from this chart.

NUMERICAL CIPHER

	ABC	DEF	GHJ	KL	MN	PQR	ST	UV	WX	YZ
	0	1	2	3	4	5	6	7	8	9
A	TQPR	HIE	VBN	WG	LK	XUO	CJ	DF	MS	YA
B	DVNT	ALJ	CQS	YR	UE	HOI	PX	KF	BW	GM
C	NDFL	WOC	BRP	HA	VM	XYS	QI	GU	JE	KT
D	RQJH	OAF	WKV	SX	CM	DNL	EI	YG	PT	BU
E	FPCR	YVN	HBE	AS	JL	DWO	UG	MX	QK	TI
F	XJAN	VIT	MPK	OL	FY	SRQ	BC	UW	EH	GD

	ABC	DEF	GHJ	KL	MN	PQR	ST	UV	WX	YZ
	0	1	2	3	4	5	6	7	8	9
G	QBJD	LWA	XES	CY	KF	TIG	PO	VR	NM	UH
H	IGMK	JOV	BEU	XN	AC	SPH	YL	TF	RQ	DW
I	EWJT	VUF	LGQ	KY	PX	MSN	HB	IO	RD	CA
J	VBCK	DMI	QWF	AX	YE	RPS	HG	LN	TU	JO
K	FLWY	IRH	NOK	MB	DC	ETP	UX	JG	SQ	AV
L	TDEQ	FIC	XGM	UW	PN	ASY	JK	HR	OV	BL

	ABC	DEF	GHJ	KL	MN	PQR	ST	UV	WX	YZ
	0	1	2	3	4	5	6	7	8	9
M	FAMH	PTR	YEB	QG	KO	UCJ	WI	DS	NX	LB
N	LOFA	IKN	SYE	XJ	RD	TMP	UW	GV	BC	QH
O	XWPU	NVK	IGE	JS	QA	TCO	YL	HF	RM	DB
P	ECHP	UQW	IGR	AJ	NS	TML	YF	VX	KD	OB
Q	QMHP	OGF	VER	LB	NJ	KWA	YS	XU	DC	IT
R	HFJK	LWA	YIQ	DN	CG	VTX	BU	OE	PM	SR

	ABC	DEF	GHJ	KL	MN	PQR	ST	UV	WX	YZ
	0	1	2	3	4	5	6	7	8	9
S	OLXB	GVQ	EUI	YR	AP	KJT	FD	HS	MC	WN
T	OVFS	TWQ	MGP	LC	IH	JNR	YD	EU	AK	BX
U	JFXS	HQG	BUT	VY	OW	EMK	PD	LI	AR	CN
V	UHPJ	XKI	MVF	BQ	OD	ENR	LS	YC	WA	TG
W	KPRJ	WTC	BHO	SU	QA	FNE	XV	IM	YD	GL
X	YSXE	CIF	DWM	OT	QG	KLN	PA	UR	HJ	VB
Y	HUVM	POQ	FTL	JX	GK	YWN	SB	CI	ED	RA

Figure 3. Challenge and Reply Authentication.

(1) Select the first letter from the bold column of letters on the left margin of the AKAC-874A authentication table, which run from top to bottom on the chart.
right until finding the second letter.

b. To challenge a station, call the station and tell the operator to authenticate those same two letters you randomly selected. Locate the letter directly below the second letter and that should be the challenged stations reply.

(1) If a reply is not given within twenty seconds, then challenge the station again. No more than three attempts should ever be given to one station, and never the same combination of letters.

c. Once a station has issued a challenge and the other has replied, a counter-challenge is appropriate. Just because a station challenged another station does not mean that the challenger has the AKAC-874. Counter-challenge ensures the authenticity of each station without doubt. Again do not use the same letter combination twice.

d. If a station does not authenticate after the allowed chances, it is not your determination to disregard transmissions. You still must deliver the message, but note on the message that the station transmitting the message failed to authenticate properly. Let higher authority determine the necessary action for the message.

14. **Encode/Decode Numerals** (See Figure 3.).

a. We will not always have cryptographic gear available, yet some of our transmissions must be encoded. In the case of numbers, we can use the AKAC-874A for another purpose, encoding/decoding numerals or encryption/decryption.

(1) To encode numerals, randomly select two letters in the same manner as with the challenge and reply method, then locate the letter to the right of the second letter instead of the letter directly below the second letter, as was the case for authentication. Remember our acronym READ. RE- right encrypt. AD- was used to authenticate down. This letter will be the set line indicator letter. Once this letter is located, move to that line from the bold column on the left margin. This is your encode line. Now just substitute letters for numbers located across the top of every sixth line.

(2) Using the same set letters more than once should be avoided if possible. And use different letters that correspond to the numbers to confuse the enemy.

For example:

I SET - K,R, (PAUSE) INDIA, JULIETT, BRVO, XRAY , ALPHA, SIERRA

[K,R]	(H)	O	1	2	3	4	5

b. When receiving encoded numerals, do not attempt to follow on the chart while the other station is transmitting. Set the chart aside and concentrate on writing down the incoming encoded numerals. After receiving the message, refer back to the table and decode the numerals.

c. The letters listed in alphabetical order across the top of every sixth line are used only for the encryption of Universal Transverse Mercator (UTM) grid zone designators. No other letters, words or phrases will be encrypted with this system. UTM grid zone designators are transmitted only when their omission would cause confusion or if doubt might arise as to the location of coordinates within a given grid zone.

(1) When transmitting grid coordinates, use the same procedures used to encrypt numbers for transmission using the AKAC-874A.

(2) The grid zone designator will be incorporated into the same line of letters as the rest of the encrypted numbers and will precede the numerals.

15. **Transmission Authentication** (See figure 4.)

a. This table is called the AKAC-874B. It is used for time authentication or when a response to your authentication is not required. It is primarily used by net control.

b. To use this table, we must be aware of the time zone. Each table of the page also covers a six hour period as with the AKAC-874A used for challenge and reply. The hours are listed across the top of the table in bold numbers, with even number minutes corresponding to each hour column.

c. The station transmitting the message gives the authentication time, followed by the two letter group printed adjacent to the minute indicators. Since the table only consists of even number minutes, the operator should always refer back to the previous even number in the event of an odd numbered minute, or simply transmit the last even number to avoid any confusion with the other operators on the net.

For example:

N7G -THIS IS - N8N, COMMENCE THE ATTACK, AUTHENTICATION TIME IS_____, I AUTHENTICATE_____, OVER.

d. If the transmitting station uses an authentication that is four minutes behind the correct time, be suspicious that the transmitting station may be a bogus station (an enemy station operating on a friendly net). If not in radio silence, challenge the station for authenticity. The bogus station may have heard the time authentication on another net.

TRANSMISSION AUTHENTICATION

06	**07**	**08**	**09**	**10**	**11**
00-QN	00-ED	00-EP	00-PB	00-UB	00-OY
02-NW	02-KC	02-JC	02-HV	02-YR	02-YE
04-NM	04-GP	04-HY	04-IF	04-WP	04-ED
06-HP	06-IP	06-CK	06-ZU	06-OF	06-UF
08-KS	08-VJ	08-CW	08-HH	08-WK	08-HF
10-GM	10-TI	10-JX	10-ZW	10-SZ	10-OW
12-PW	12-IU	12-XJ	12-HT	12-KL	12-WQ
14-WT	14-VK	14-HC	14-IQ	14-NE	14-UD
16-RU	16-LN	16-YM	16-LA	16-FO	16-FY
18-FI	18-YF	18-LI	18-ZH	18-PF	18-OX
20-DT	20-BK	20-FZ	20-AF	20-II	20-RX
22-KK	22-LO	22-UG	22-GK	22-AE	22-ZG

24-KF	24-MA	24-OO	24-XU	24-PC	24-AT
26-RY	26-BP	26-SF	26-GA	26-XI	26-UW
28-LJ	28-YT	28-GO	28-HU	28-GI	28-SK
30-NC	30-QH	30-TO	30-PE	30-IY	30-UM
32-JD	32-MB	32-FF	32-UL	32-CX	32-OT
34-BB	34-YA	34-WF	34-CF	34-IT	34-BV
36-KW	36-CY	36-ST	36-FA	36-NK	36-VF
38-HB	38-QB	38-WB	38-BY	38-HX	38-JB
40-ZS	40-JO	40-HZ	40-HD	40-TC	40-OM
42-RM	42-SG	42-OG	42-JS	42-CN	42-ZQ
44-YJ	44-VU	44-OS	44-VE	44-RS	44-LD
46-SU	46-BC	46-EA	46-WH	46-CE	46-DM
48-YI	48-KU	48-OJ	48-JW	48-UO	48-QW
50-XY	50-ER	50-TP	50-WZ	50-AA	50-VM
52-FB	52-KU	52-VS	52-FC	52-OG	52-RV
54-TX	54-AO	54-LU	54-WM	54-CI	54-BN
56-FE	56-DV	56-UJ	56-HJ	56-HR	56-RL
58-AY	58-UU	58-GW	58-TA	58-GZ	58-YS

0600 - 1159 ZULU **DAY 02**
AKAC - 874

Figure 4. Transmission Authentication.

16 **Beadwindow Procedures**'

a. When essential elements of friendly information (EEFI) are disclosed on an unsecured radio net, the procedure to alert the disclosing station of this violation is called, "BEADWINDOW ." The word, "BEADWINDOW ," will bring immediate attention to operators that intelligence information has been disclosed. (See figure 5.)

b. When information listed in the EEFI is disclosed, the net control or any station on the net contacts the disclosing station and says, "BEADWINDOW ," followed by the number of the EEFI disclosed. The only reply by the disclosing station is, "Roger, Out."

c. In receiving a, "BEADWINDOW ," it should be considered a professional helping a professional. Sometimes the communicator may not be aware of the violation, but another .operator has heard it and is alerting the transmitting station of the violation.

d. See figure 5 for some standard categories of EEFls. Normally, an EEFI list will be issued prior to an operation. But all operators should always have the list from figure 5 on hand.

(1) Here is an example of a properly transmitted BEADWINDOW:

B6D -THIS IS -N8N, BEADWINDOW 04, OVER.
N8N -THIS IS -B6D, ROGER, OVER.
B6D -THIS IS -N8N, ROGER, OUT.

17. **Gingerbread Procedures** The term, "GINGERBREAD," is used to alert net stations that voice imitating deception is suspected on the net. GINGERBREAD procedures for unsecured voice circuits are as follows:

a. Any station failing to authenticate correctly shall be treated as an unauthorized subscriber on the net, and you would alert the net of a suspected bogus station on the net.

b. Unauthenticated transmissions from a station being imitated are to be challenged until the imitating station has apparently abandoned its efforts.

c. The station reporting, "GINGERBREAD," will be prepared to establish its own authenticity through the use of the transmission authentication.

d. Any unauthenticated messages should be passed on with a note that the station could not authenticate properly. Do not disregard the message. Remember, this is only a suspected enemy on the net, but should be treated as an authorized subscriber on the net.

ESSENTIAL ELEMENTS OF FRIENDLY INFORMATION (EEFI)

01 - FRIENDLY OR ENEMY POSITION, MOVEMENT OR INTENDED MOVEMENT: Position, course, speed, altitude or destination of any air, sea, or ground element, unit, or force.

02 - FRIENDLY OR ENEMY CAPABILITIES OR LIMITATIONS: Force composition or identity, capabilities, limitations, or significant casualties to special equipment, weapons systems, sensors, units, or personnel: Percentages of fuel or ammunition remaining.

03 - FRIENDLY OR ENEMY OPERATIONS, INTENTIONS, PROGRESS OR RESULTS: Operational or logistic intentions; assault objectives; mission participates; flying programs; mission situation reports; results of friendly or enemy operations.

04 - FRIENDLY Y OR ENEMY EW /EMCON INTENTIONS, PROGRESS, OR RESULTS: Intention to deploy ECM, results of friendly or enemy ECM objectives; results of friendly or enemy ECCM; results of friendly or enemy of ESM; present or intended EMCON policy; equipment affected by EMCON policy.

05 - FRIENDLY OR ENEMY KEY PERSONNEL: Movement or identity of friendly or enemy flag officers; distinguished visitors; unit commanders; movements of key maintenance personnel indicating equipment limitations.

06 - FRIENDLY OR ENEMY COMSEC LOCATIONS: Linkage of codes or codewords with plain language; compromise of changing frequencies or linkage with line numbers;
circuit designators linkage of changing callsigns with previous callsigns or units; compromise of encrypted/classified callsigns; incorrect authentication procedures.

07 - INAPPROPRIATE TRANSMISSION: Information requested, transmitted or about to be transmitted which should not be passed on the subject circuit because it either requires greater security protection or is not appropriate to the purpose for which the circuit is provided.

08 - 10- FOR NATO ASSIGNMENT AS REQUIRED

11 -29 -RESERVED FOR CINCUSNAVEUR

30 - 49- RESERVED FOR CINCLANTFLT

50- 69- RESERVED FOR CINCPACFLT

Figure 5. Essential Elements of Friendly Information. (EEFI)

REFERENCE:

1. ATP-38 Amphibious Operations

2. FM 24 -18 Field Radio Techniques

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 525
MAR 99

STUDENT OUTLINE

AN/PRC 119 SINCGARS RADIO SYSTEM

LEARNING OBJECTIVES

A. **TERMINAL LEARNING OBJECTIVES**: In a field environment, without the aid of and per the references, operate the AN/PRC-119 to send and receive message traffic.

B. **ENABLING LEARNING OBJECTIVES**: Given a Radio Set, AN/PRC-119 with accessories, without the aid of references and per the procedures demonstrated in class, the student will:

(1) State in writing the operating characteristics of the AN/PRC-119.

(2) Identify in writing the components and accessories of the AN/PRC- 119.

(3) State in writing the function of the control switches on the face plate of the AN/PRC-119.

(4) Perform set up and operating procedures of the radio.

(5) Demonstrate troubleshooting techniques.

(6) Perform preventive maintenance on the radio.

OUTLINE:

1. **Marine Corps SINCGARS ICOM Systems**

a. **General** The purpose of SINCGARS ICOM is to provide the Marine Corps communicator, with a means of short range voice and data communication in manpack and vehicular configuration.

b. **The definition of SINCGARS ICOM**

(1) The acronym SINCGARS stands for SINGLE channel GROUND and AIRBORNE RADIO SYSTEM.

.

(2) The acronym ICOM stands for INTEGRATED COMSEC (Communications

Security) meaning that the KY-57 or compatible component has been integrated or built into the radio.

2. **Characteristics**

a. Types of Modulation - Frequency Modulated/FM

b. Frequency Range - 30-00 to 87.975 MHz

c. Channel Spacing - 25 KHz

d. Channels of Operation - 2.330

e. Frequency Offset Ability - +/- 5 and 10 KHz

f. Number of Preset Channels

(1) 8 in Single Channel (SC)

(2) 6 in the Frequency-hopping, (FH) Mode .

g. Emissions

(1) Voice

(2) Secured Voice

(3) Digital Data

h. Power Requirements

(1) Manpack- 3.5 VDC

(2) Vehicular- 27.5 VDC

i. RF Power Ou:tput

(1) LO (Low) -500 Microwatts

(2) M (Medium) -160 Miliwatts .

(3) Hi (High) -4 Watts

(4) PA (Power Amplifier -50 Watts

Equipment Note: PA is used only in the vehicular configuration.

j .Rated Range

(1) LQ -0 to 330 Yards

(2) M- 330 Yards to 2.5 Miles

(3) HI -2.5 Miles to 5 Miles

(4) Vehicular -5,Miles to 22 Miles

k. Modes of Operation

(1) Voice (SC) and (FH).

(2) Retransmission- SC to SC. SC to FH. FH to FH. ERF- (Electronic Remote Fill) relay.

(3) Digital Data- SC. FH.

(4) Remote - With AN/GRA-.39 or Control. Receiver-Transmitter C-11561(C)/U (RCU).

(5) Plain Text or Cipher Text

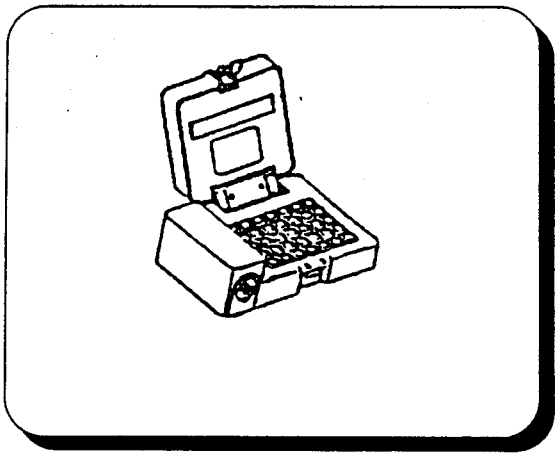
1. Tuning

(1) Electronic. Frequency, entered manually by using keyboard. Up to eight 8C channels and six FH channels can be loaded and later selected using CHAN (channel) switch.

(2) Electronic Protect (EP) Capability Protect EP is nothing more than the capability to overcome or avoid jamming. SINGARS is capable of frequency hopping randomly changing frequencies while maintaining communication). -These systems will frequency hop at a rate of 6.000 frequencies per minute.

3. **Auxiliary Devices**

a. Automated Net Control Device (ANCD)/AN/CYZ- 10. Loads and stores the lockout set and hopset. It is also used to load and store the COMSEC variables used with the SINCGARS radio systems. (See Figure 1)



DATA TRANSFER DEVICE AN/CYZ-10 .

Figure 1.

b. TSEC/KYK-13. Loads and stores the COMSEC variables into the RT- 1523/U. See Figure 2.

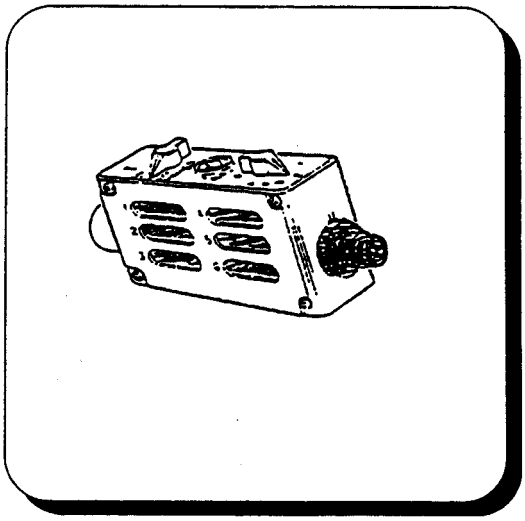


Figure 2. TSEC / KYK -13

4. SINCGARS VICE VRC-12 SERIES RADIO EQUIPMENT

a. Frequency Range. The VRC-12 family of radios frequency range is 30.00 to 75.95 MHz. SINCGARS is 30.00 to 87.975 MHz. Thus. Allowing for an additional 12 MHz of usable frequency range.

B Power Range. The VRC-12 series power range is limited to two settings of LO PWR at 5 watts and HI PWR at 35 watts. SINCGARS has four settings allowing for LO PWR at 500 micro-watts. MED PWR at 160 micro-watts, HI PWR at 4 watts and in the mobile configuration with external power amplifier of 50 watts.

c. Channel Spacing (KHz) The VRC- 12 series utilizes a 50 KHz spacing between channels for a total of 920 channels. SINCGARS uses 25 KHz channel spacing for a total of 2320 channels. The 25 KHz channel spacing also allows the SINCGARS/ICOM to meet NATO standards.

d. Tuning- The VRC- 12 series depends on manual tuning to change frequencies. With the .exception of the RT-246, which allows for 10 preset channels. All SINCGARS radios are capable of storing 8 preset channels and 6 frequency hopping networks.

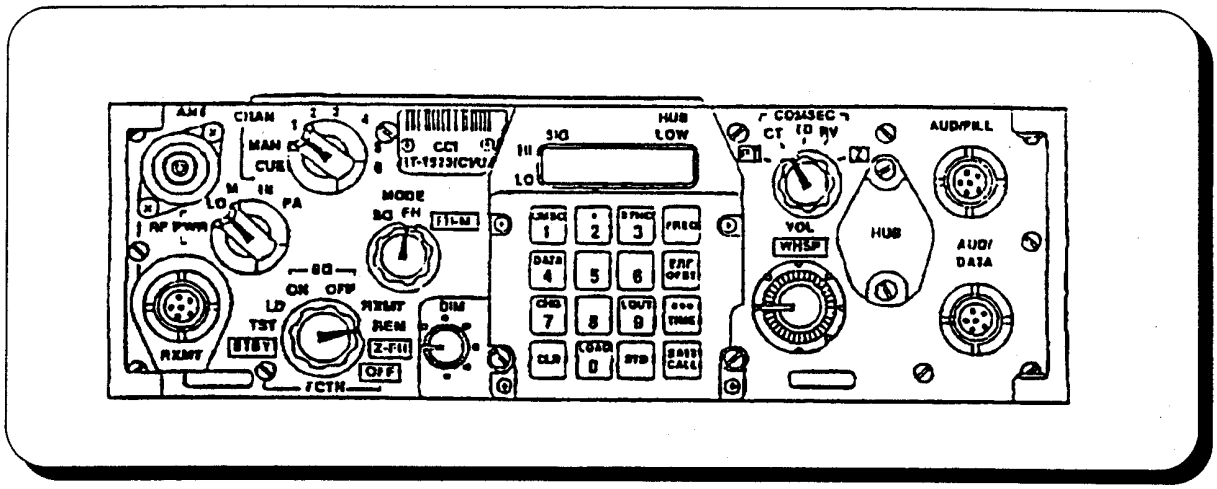
e. EP Capability. The VRC- 12 series has no special capabilities and is easily jammed. SINCGARS is capable of frequency hopping (randomly changing frequencies while maintaining communication). The SINCGARS frequency-hopping rate is 6.000 frequencies per minute. SINCGARS also has another built-in feature (frequency offset) which assists in maintaining communication during single channel operation. The operator is capable of offsetting his operating frequency by +/- 5 or 10 KHz.

f. Self- Test. The VRC- 12 series has no means of self-test. SINCGARS was designed with a built-in self-test switch allows for low level fault analysis without the requirement of additional test equipment.

g. Nucular Survivability. The technology used in the VRC- 12 series consists of transistors and tubes. SINCGARS is designed with microchip technology. In the event of a nuclear blast. The VRC- 12 series would be rendered useless. SINCGARS would remain operational depending on its proximity to the blast.

5. **SINCGARS Configyrations**

a. R T -I 523/U .The R T -1523 (C)/ U provides the foundation for all SINCGARS configurations. The RT is capable of being powered by either battery pack (manpack configuration) or vehicle battery (vehicular configurations).



b. RT- 119A. The AN/PRC- 119A is the SINCGARS replacement for the AN/PRC-77/68. This configuration is referred to as the manpack configuration. The AN/PRC-119A is capable of secure voice communications up to 5 miles. See Figure 4. It is comprised of:

(1) AS-3683 (manpack antenna)
(2) RT-1523 (C)/U
(3) H-250 (handset)
(4) CY -8523A (battery box)
(5) BA-5590 (battery/not a component of end item)
(6) ALICE pack

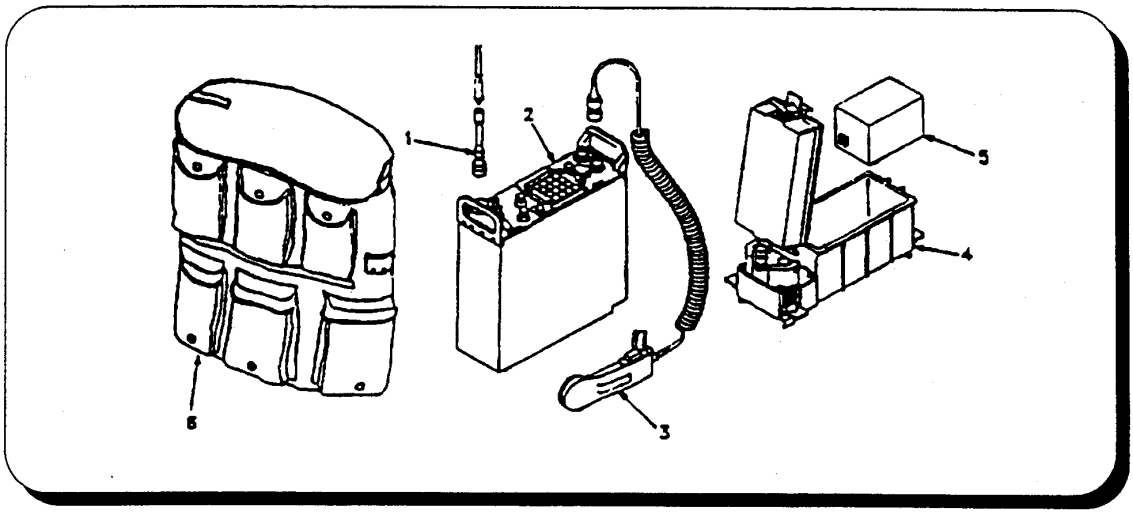


Figure 4. RT-119A .

c. ANNRC-87 Al88A- The ANNRC-87 A is the vehicular mounted. short range, secure voice. VHF communications configuration. See figure 5. It is comprised of:

(1) AS-3900 (vehicular antenna)

(2) AM- 7239/VRC (amplifier adapter)

(3) H-250

(4) C- 11291A/VRC (control-monitor)

(5) CVC Helmet

(6) LS-671/U (mount)

(7) MT-6352 (mount)

(8) RT-1523(C)/U

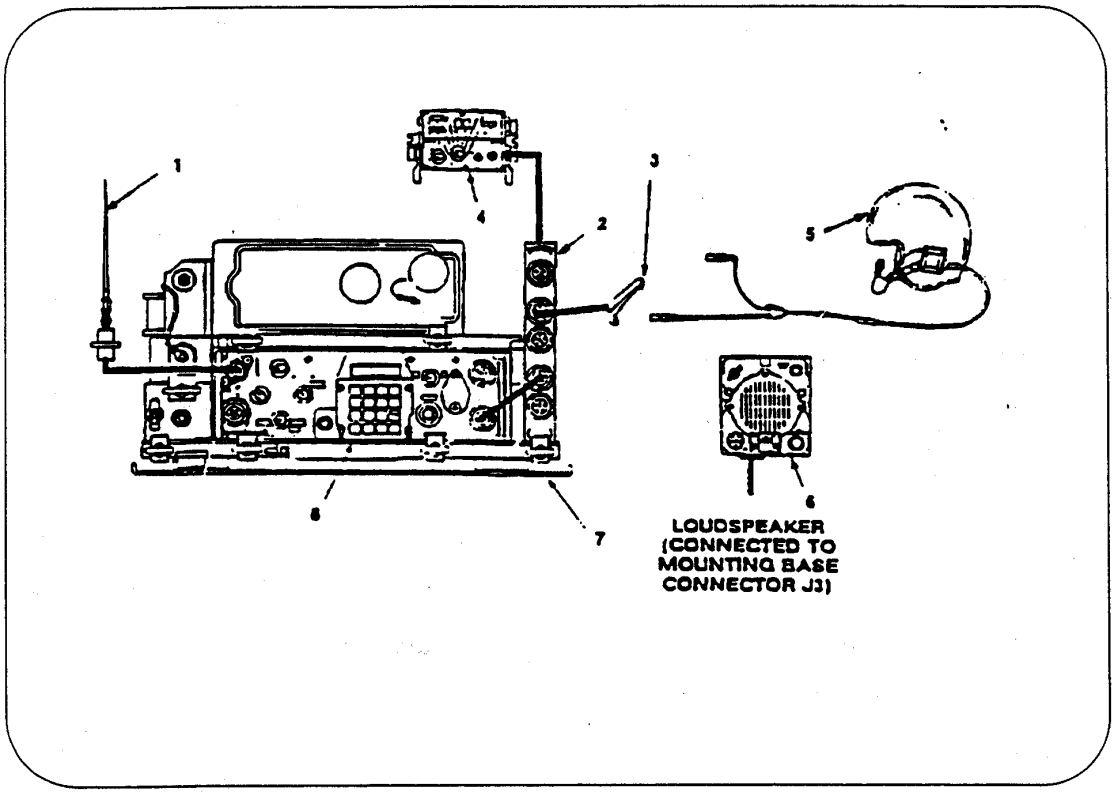


Figure 5

d. AN/VRC-89A. The ANNRC-89A is the vehicular mounted. long, range/short range. secure voice. VHF communications configuration. See Figure 6. It is comprised of:

(1) AS-3900 (2)
(2) AM- 7238/VRC (power amplifier)
(3) N/A
(4) CVC Helmet
(5) C-11291A/VRC
(6) H-250 (2)
(7) AM-7239/VRC
(8) LS-671 /U
(9) MT-6352
(10) RT-1523(C)/U (2)

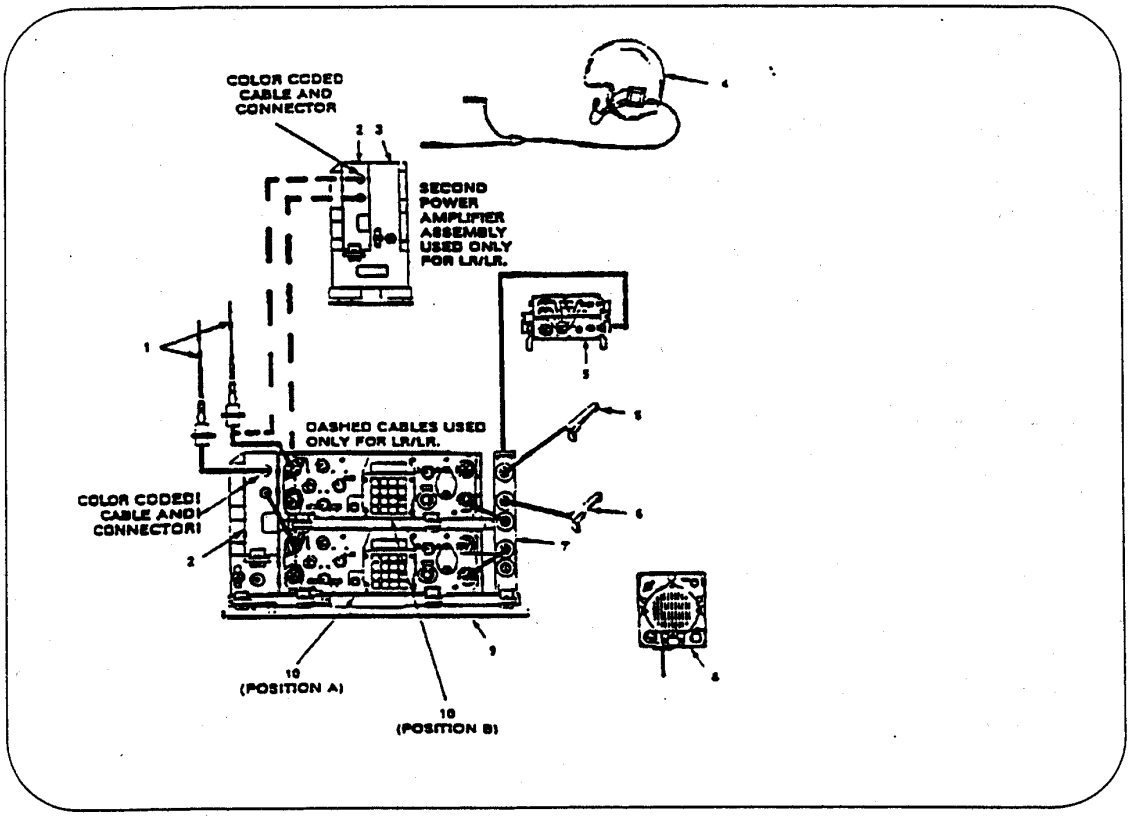


Figure 6 AN/VRC-89A .

e. AN/VRC-90A. The AN/VRC-90A is similar to the ANNRC-87 A. But a power amplifier has been added to make the AN/VRC-90A capable of long range communications. The AN/VRC-90A is the vehicular mounted. long range, secure voice. VHF communications configuration. See Figure 7. It is comprised of:

(1) AS-3900
(2) AM-7238/VRC
(3) RT-1523(C)/U
(4) C-11291A/VRC
(5) LS-671 /U
(6) AM-7239/VRC
(7) H-250
(8) CVC Helmet
(9) MT-6352

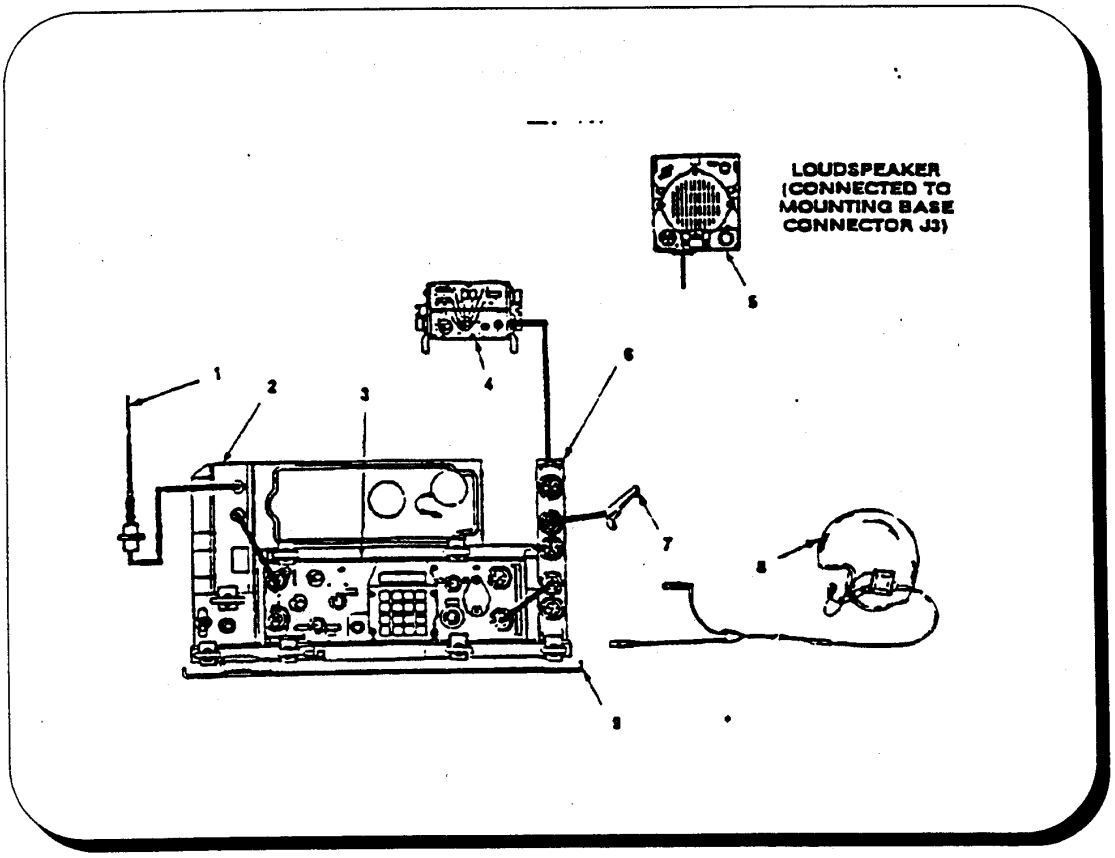


Figure 7. AN/VRC-90A

f. AN/VRC-92A. The AN/VRC-92A is the vehicular mounted. long range/long range. secure voice. VHF communications configuration. See Figure 8. It consists of:

(1) AS-3900

(2) AM-7238/VRC (PA) (2)

(3) MK-2312/VRC (auxiliary elec kit)

(4) CVC Helmet

(5) C- 11291A/VRC*

(6) H-250 (2)

(7) AM-7239/VRC

(8) LS-671 /U

(9) MT-6352

(10) RT-1523(C)/U (2)

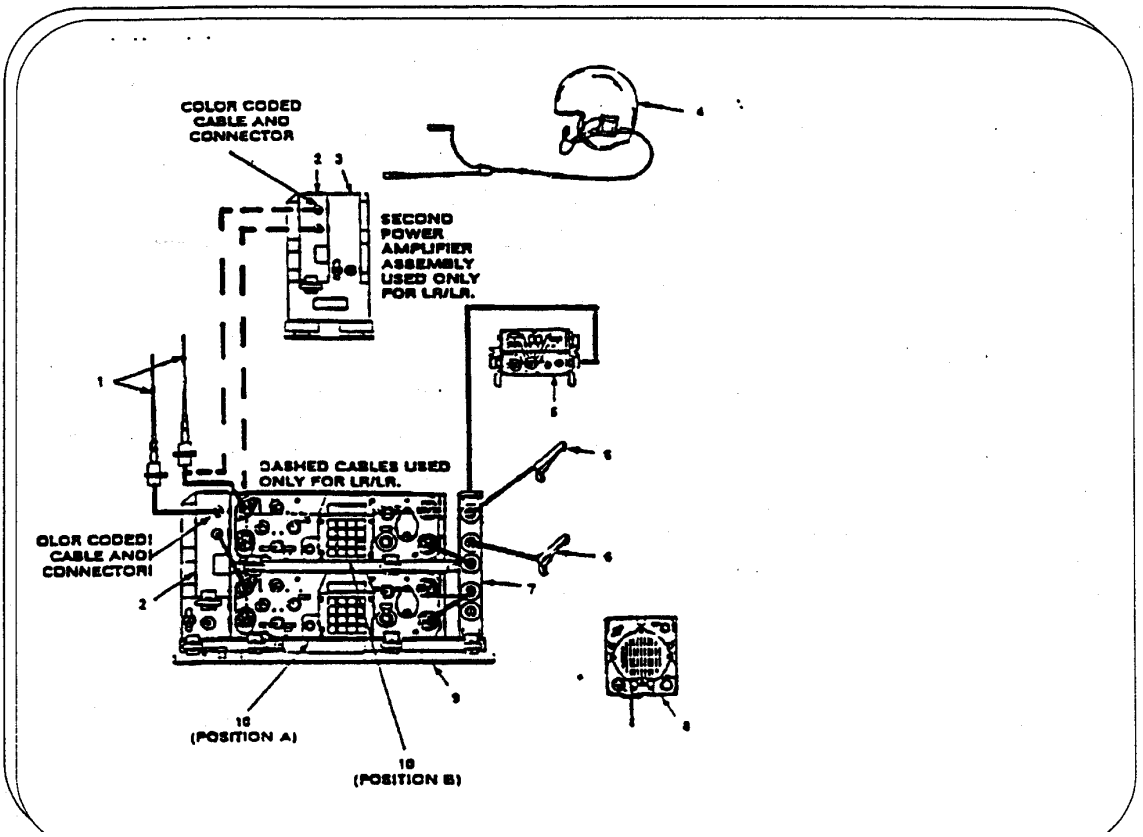


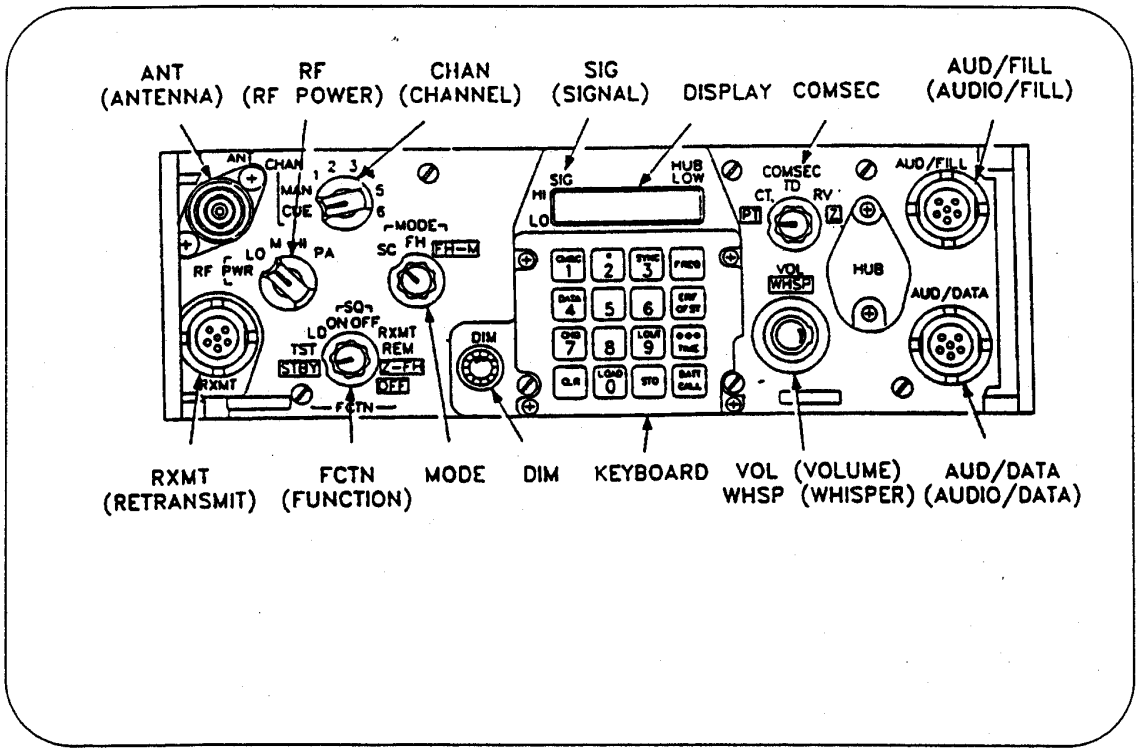
Figure 8 AN/VRC- 92A .

Equipment Note: When the AN/VRC-92A is installed in a vehicle. the nomenclature is AN/MRC-145A.

Equipment Note: The three systems that the Marine Corps will use primarily are the AN/PRC-119A, AN/VRC-88A and the AN/VRC-92A.

6. **Operation In Single Channel**

You must load your R T with one or more SC frequencies.



RT Front Panel

7. **Loading SC Frequencies**. The procedure for loading SC frequencies requires setting the proper switches, pressing the correct number keys for the frequency you wish to load, and staring the load in RT permanent memory by pressing STO button.

a. Obtain authorized operating frequency from SOI or NCS.

b. Refer to the illustration of RT front panel above; then set FCTN to LD.

c. Set MODE to SC.

d. Set CHAN to MAN, CUE, or desired channel (1 - 6) where frequency is to be stored.

e. Press FREQ (display will show "00000", or to frequency RT is currently tuned).

f. Press CLR (display will show five lines).

g. Enter the numbers of the new frequency (using keyboard buttons).

If you make a mistake while entering a frequency, press CLR (this action will delete the last digit entered).

Equipment Note

It is important that you enter another number. or store the frequency within 7 seconds. Otherwise, the display will go blank, and you will have to re-enter the numbers. If you require more than 7 seconds to perform a step, continue to press the last button, and the 7 second clock will be stopped.

h. Press STO (display will blink and show the frequency you just stored).

i. Repeat steps a through h for additional frequencies that you wish to load.

j. Set FCTN to SO ON (or normal operating position).

8. **Clearing Frequencies** Clearing Sc Frequencies. If you wish to clear a frequency from the RT, you must perform the following procedure using the correct switch settings and pressing FREQ., CLARA, LOAD, and STO. When no frequency is desired, pressing STO stores no frequency in the R T permanent memory .

a. Set MODE to SC.

b. Set CHAN to MAN, CUE, or desired channel where frequency is to be cleared.

c. Press FREQ.

d. Press CLR.

e. Press LOAD; then press STO.

f. Set FCTN to SO ON (or normal operating position).

9 **. Loading Offset Frequencies** Loading Offset Frequencies. It may be necessary to offset an SC frequency that is loaded in your RT. Your NCS will direct you to offset your SC frequency when it is necessary. This procedure allows you to change the SC frequency by plus or minus 5 KHz or plus or minus 10 KHz.

a. Set FCTN to SQ ON.

b. Set CHAN to MAN, CUE, or desired channel (1- 6) to be loaded with offset.

c. Press FREQ, OFST, and CHG.

d. Continue to press CHG until desired offset is displayed.

10. **Clearing Offset Frequencies** Clearing Offset Frequencies. When you wish to clear the SC frequency of the offset, simply continue to press CHG until '00' is displayed. The SC frequency will return to the original frequency before the offset was loaded.

a. If no offset is desired, press CHG until "00' is displayed.

11. **Pre-Mission Check**

If you do not perform the following steps, you may risk radio failure during a mission.

a. Make sure your radio is assembled correctly.

b. Make sure you've done the PMCS and the routine checks.

c. PMCS:

(1) Battery physical condition

(2) Battery electrical condition

(3) HUB electrical condition

(4) Receiver-transmitter self-test

(5) Transmitter

(6) Mounting adapter and mounting base

(7) Remote operation

(8) Control-monitor self-test

(9) Control-monitor RT function control

d. Routine checks: Antennas, cables and cable and switches, mounting and assembly hardware

e. Check battery life condition

(1) If FCTN is at QFF, move it to STBY; then move it to SQ ON.

(2) Check required load (do you have the correct FH data, COMSEC keys and MAN frequency?).

(3) Stand by for net opening (NCS will contact you). Make sure you can establish communication on each net you will be operating in. If you cannot communicate, perform the communication troubleshooting procedures.

12. **Operator's Troubleshooting Checklist**

If you have difficulty communicating, take the time to perform the following checks before you decide that there is something wrong with your radio.

a. Make sure you have all switches set properly.

b. Check all cable connections to ensure that they are tight.

c. Make sure your antenna is properly connected and positioned.

d. Try to verify that you have LOS with other stations.

e. Change position to see if communications improve.

f. If you have not heard traffic in some time, perform passive late net entry.

g. Make sure your radio has adequate power (especially manpack).

h. Look and see if another net station is co-located in your area (called co-site interference).

i. Determine if you are being jammed by the enemy. If so, take appropriate action.

j. Should your radio give you a strange, unexplained message which does not automatically clear:

(1) Set FCTN to STBY , then return to SQ ON. This action may clear your problem.

(2) If it does not, and the situation permits, set FCTN to Z-FH-and wait for GOOD, then to OFF and wait 10 seconds, then back to Z-FH-and again wait for GOOD. Now run self-test. If GOOD results, reload radio and reenter net. If problem still exists, contact unit maintenance.

(3) If you still cannot communicate, there may be something wrong with your radio. However, anyone of the above operator troubleshooting actions may put you back into communications. They are well worth trying.

(4) Operators: Two Important rules to follow are:

a. Never use the "TIME" control

b. Never set MODE to FH-M

c. Violating either of these rules can take you out of the net, and possibly stop your entire net from communicating. .

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 526
MAR 99

STUDENT OUTLINE

AN/PRC 113

LEARNING OBJECTIVES:

TERMINAL LEARNING OBJECTIVES:

(1) Without the aid of references, operate the PRC-113 in accordance with the references.

(2) With the aid of references, perform remedial actions for RAC communications in accordance with the reference.

ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, place the PRC-113 into operation in accordance with the reference.

(2) Without the aid of references, utilize the direction finding mode in accordance with the reference.

(3) Without the aid of references, utilize the guard receiver mode in accordance with the reference.

(4) Without the aid of references, transmit in the unsecure mode in accordance with the reference.

OUTLINE:

1. Operational Characteristics Of The Radio Set AN/PRC-113

a. The Radio Set, AN/PRC-113 is a portable two-band very high frequency (VHF) and ultra high frequency (UHF) receiver-transmitter (RT). It is used for forward air control and ground-to-air communications.

b. This radio set can be used with the TSEC/KY -57 cryptographic equipment for secure voice communications

c. The Radio Set, AN/PRC- 113 can be mounted in a vehicle. This configuration, the AN/VRC-83, provides a mobile means of UHF radio communications for the commander.

d. The Radio Set, AN/PRC- 113 can be used under severe operational and environmental conditions which may be encountered during tactical operations involving ground units. The reliability and flexibility needed for this type of operation are insured by using the Radio Set, AN/PRC-113.

e. This radio provides the operator with many UHF frequencies. It also has a guard frequency, direction finding (DF) mode, and the ability to store preset frequencies.

f. Technical Characteristics of the Radio Set- AN/PRC- 113

Frequency Range:	116.000 MHz to 149.975 MHz (VHF mode)
Frequency Range:	225.000 MHz to 399.975 MHz (UHF mode) .
Guard Receiver:	Receives distress signals on 243.000
Modulation:	Amplitude Modulation (AM)
Channels of Operation:	1360 VHF made
Channels of Operation:	7000 UHF mode
Operating Range:	Line of sight (LOS)
Preset Channels:	Eight
Memory:	Retains preset channels when radio is turned off
Power Output	2 or 10 Watts
Power Source	Two BA-5590's or two BB-590's
Crypto:	TSEC/KY-57

2. **Components And Accessories Of The Radio Set- AN/PRC-113**

a. Operators Manual. Provides detailed operating instructions, equipment characteristics and descriptions of the components of the Radio Set, AN/PRC- 113.

b. Supplemental Operator's Manual. Provides supplemental operating instructions for Radio Set, AN/PRC-1l3 for operation in the jam-resistant, Have Quick, electronic counter-countermeasures (ECCM) mode.

c. Radio Set AN/PRC-113.

(1) Receiver-Transmitter. RT-1319B,URC

(2) Battery Case. Use care when installing batteries into the case and when mating batteries to the connectors of the radio. Shorting the connectors of lithium batteries could cause an explosion.

(3) VHF Antenna. Can be used when operating in the VHF mode.

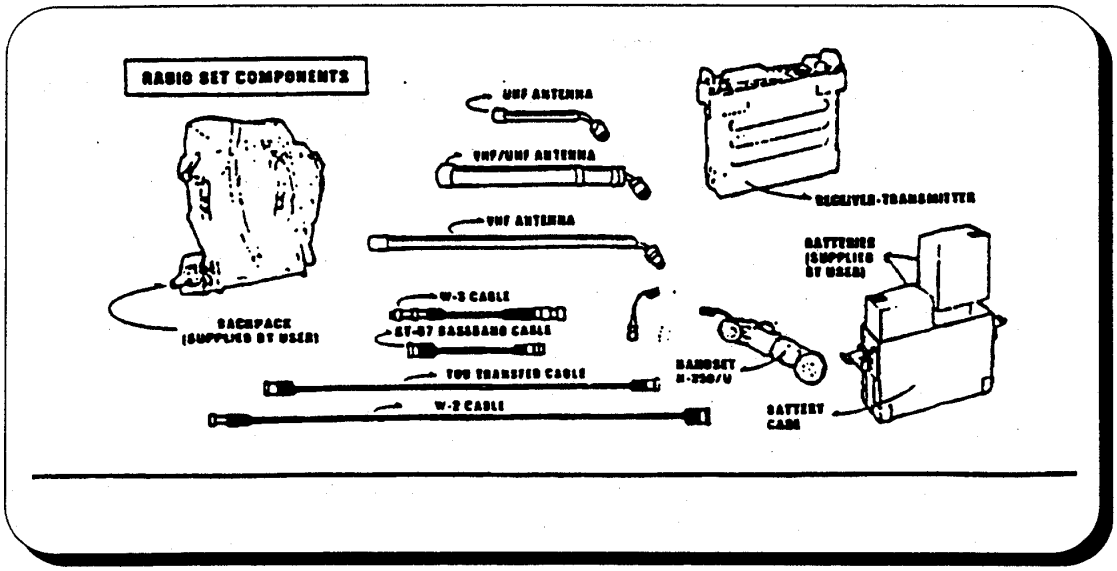
(4) UHF Antenna. Can be used when operating in the UHF mode.

(5) UHF/VHF Antenna. The dual purpose antenna can be used in either the UHF or VHF mode. This dual purpose antenna will be replacing the UHF and the VHF antenna.

(6) Handset H-250/U or H-189/U. Connects to the audio connector of the radio set.

(7) TSEC/KY -57 Baseband Cable. Connects the radio set and TSEC/KY -57 communications security equipment together allowing secure voice operation.

(8) W-3 Cable. Connects radio set and external timing equipment together for use in the frequency hopping mode



(Figure 1) Radio Set AN/PRC- 113 Components .

3. **<u>Controls And Their Functions.</u>**

a. <u>Dim Switch</u>. Used to control the intensity of light on the display.

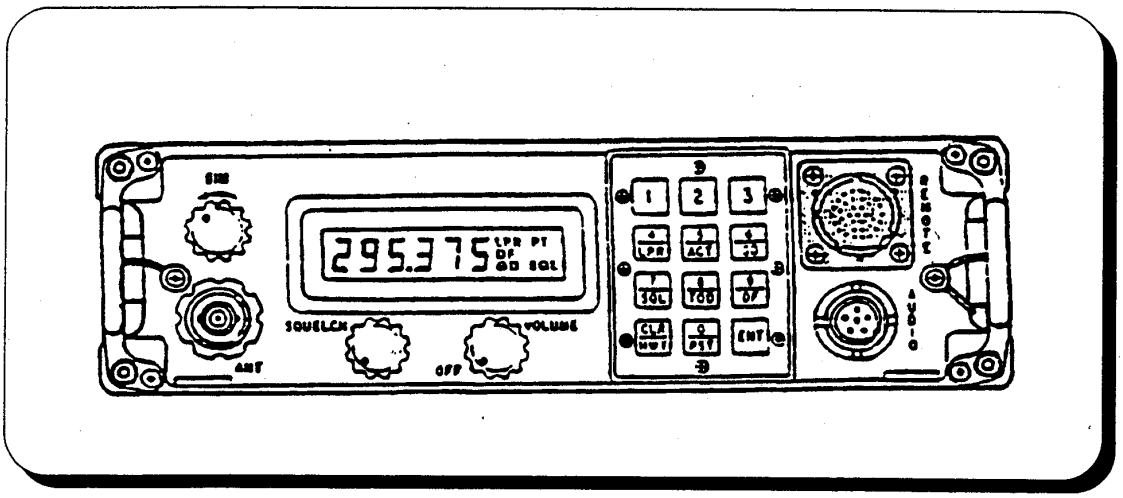
b. <u>Antenna Connector</u>. Provides for connection of either the VHF , UHF or the dual purpose antenna.

c. <u>Squelch Switch.</u> Used to adjust the amount of squelch applied to the incoming transmission.

d. <u>Volume Control/ON/OFF Switch</u>. A two function switch used to turn the radio on and off, and raise or lower the sound heard in the handset.

e. <u>Remote Connector</u>. Used to connect the radio set to the AM-7176 during mobile ECCM operations.

f. <u>Audio Connector</u>. Used for connecting the handset or the TSEC/KY -57 communications security equipment to the radio.



(Figure 2) Radio Set AN/PRC- 113 -Radio Controls

4. **Controls And Functions Of The Keyboard**.

a. 1, 2 and 3- Signal function switches used in setting a frequency. (Frequencies used by the AN/PRC- 113 begin with 1,2, or 3.)

b. 4/LPR- Two function switch. The number 4 is used for frequency selection. If the 4/LPR switch is pushed first, the radio switches between low and high power. When in low power, LPR is lit on the display.

c. 5/ ACT - Two function switch. The number 5 is used for frequency selection, and the ACT function enables and disables the Have Quick mode of operation.

d. 6/GD - Two function switch. The number 6 is used for frequency selection, and the GD function allows monitoring of the international guard distress frequency (243.000 MHz) while communicating on another frequency.

e. 7/S0 L- Two function switch. The number 7 is used for frequency selection, and selection of the squelch mode. When the squelch is turned on, S.QL will appear on the display.

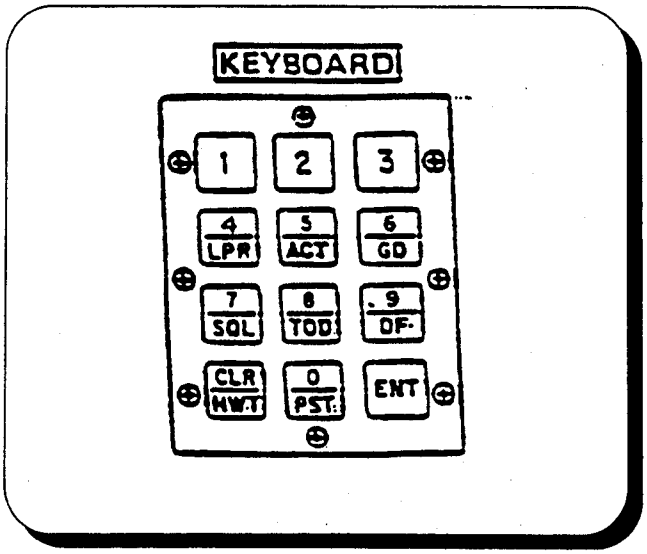
f. 8/TOD- Two function switch. The number 8 is used for frequency selection. Time of day (TOD) is used in the Have Quick operation mode.

g. 2/DF - Two function switch. The number 9 is used for frequency selection and "DF'. When in the DF mode, a continuous 1000 Hz tone is emitted. When the DF mode is being used, DE will appear on the display and the tone will be heard in the handset.

h. CLR/HWT - Used to clear any error made while changing the operation mode or frequency. The HWT function is used to send the TOD by a hardwire connection without energizing the transmitter.

i. 0/PST - Sets the number 0 for a frequency; it also allows selection or entering of preset frequencies. The radio operator can preset up to eight frequencies.

j. ENT Used at the beginning and the completion of operating procedures. It is also used to stop the blinking display, relight the battery saver, enter a new frequency into the RT, and display a frequency stored in memory.



(Figure 3) Radio Set AN/PRC- 113 -Keyboard

5. **Set Up And Operating Procedures.**

a. Install the batteries into the battery case. Be sure to use caution when connecting the batteries.

b. Connect the required accessories to the radio. .

c. Turn an the radio.

(1) First, turn the Volume Control/ON/OFF switch clockwise. The display will show six 8's for approximately four seconds.

(2) After four seconds, the last frequency set into the radio will appear on the display along with any special operation modes (e.g., guard, squelch, or low power)

(3) Now we are ready to manually select a frequency and enter it into the radio for operation.

d. To load the frequency, perform the following:

(1) Press the **ENT** key on the keyboard. Next press either the 1,2, or 3 on the keyboard, remembering that all frequencies start with 1, 2, or 3. After making this selection, the number will appear on the display and the remaining numbers will go blank, indicating a need for more entries. The display shows: 3

(2) Pressthe second, third, fourth and fifth number of the frequency. They will appear on the display. The display shows: 302.0

(3) After the fifth number has been entered, the sixth number is automatically entered. The display will blink on and off for approximately thirty seconds. If the numbers blinking are correct, press the ENT key to set the new frequency. The display shows: 302.05

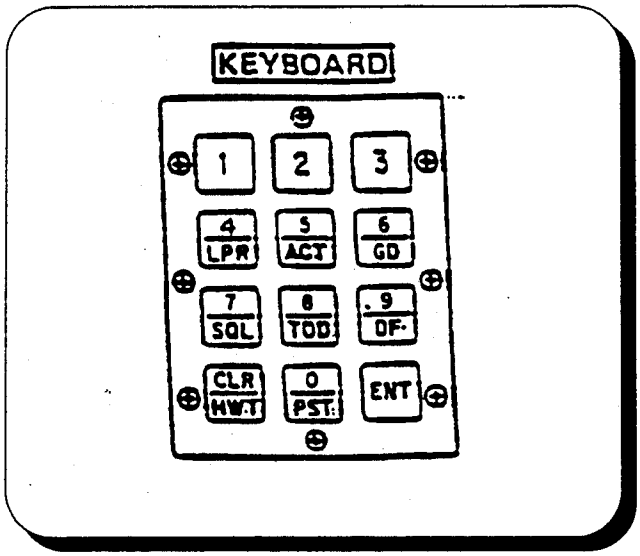
e. Loading the Preset Channels

(1) The AN/PRC-113 will accept eight preset frequencies.

(2) To use a preset channel, each frequency must be loaded into the radio's memory . To load a preset frequency you must perform the steps performed earlier for loading the frequency.

(3) After all numbers have been entered and the display is blinking, press the O/PST key and then press the number 1-8 corresponding to the desired preset position.

(4) Example: Frequency 225.750 has been manually entered into the display. The display is blinking. Press the O/PST key. The display shows: LP ss the key marked 3 and then press **ENT.** The display shows: LP-3 Frequency 225.750 is in preset position three.



(Figure 4) Radio Set AN/PRC- 113 -Keyboard

f. Selecting Preset Channels. After all desired frequencies are loaded to preset positions, the following procedures will allows use of any of them.

(1) Press the 0/PST key and the desired number. For example: Press the 0/PST key then positions 1 followed by **ENT**.

(2) To recall or check other preset frequencies, push the 0/PST key and enter the desired preset position number, press the ENT key. The display will show the frequency in that preset position.

g. Selecting Mode of Operation.

(1) Select any operating mode. (For this example the power mode will be used.)

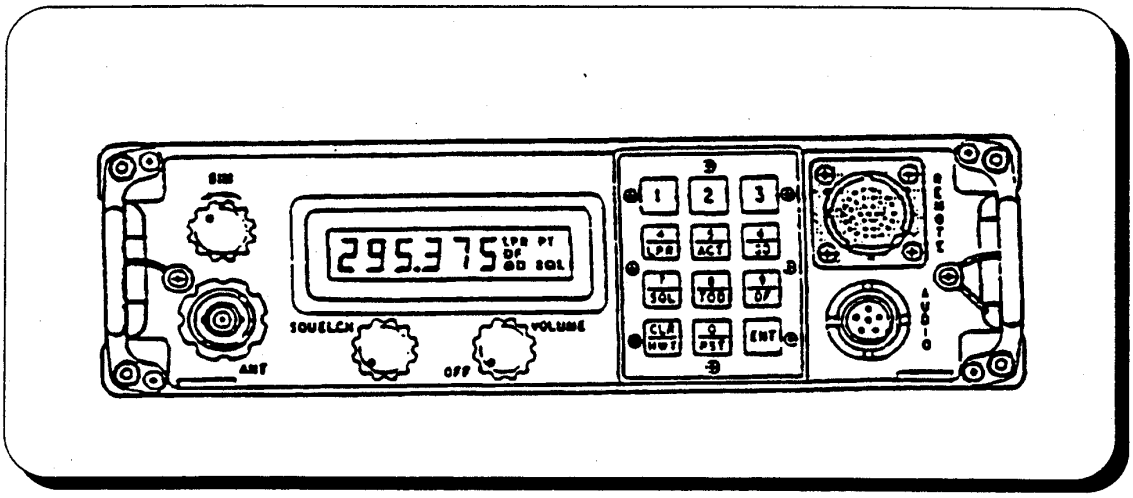
(2) To select the power mode: Look at the display. If LPR is lit, the radio is in the low power mode (2 Watts). If LPR is not lit, the radio is in the high power mode (10 Watts).

(3) To change to low power, press the LPR switch.

(4) Use the same procedures for all other modes of operation.

(5) Whenever any number but 1,2, or 3 is the first button pushed, mode selection is occurring.

h. Turn Off Procedures. After operation, turn the Volume Control/On/Off switch counterclockwise to the OFF position. If desired, remove the accessories. If the radio is not to be used again in the immediate future, remove the batteries.



(Figure 5) Radio Set AN/PRC- 113 in the LPR Mode

6. **Have Quick Operation**

a. Radio Set Prime Features. This operation is used for operating the radio set in the jam-resistant, electronic counter-countermeasures (ECCM) mode. Some of the prime features are as follows:

(1) Active (ACT) Mode. This special mode is the ECCM feature that provides resistance to jamming. It is the result of fast, pseudo-random shifting of the transmit frequency to prevent interference.

(2) Time of Day (TOD). TOD permits the radio set to systematically frequency hop and maintain continuous communications, (e.g., the receiving station shifts the receiving frequency at the same time that the transmitting station shifts.)

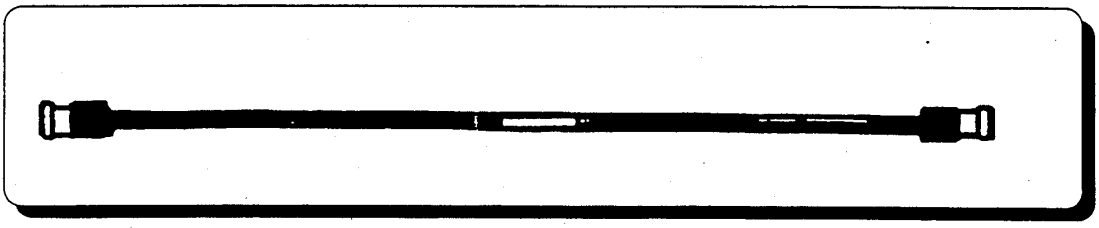
(3) Word of Day (WOD). WOD provides the hop rate and the hopping frequencies used during ECCM operation.

(4) Hardwire Transfer (HWT). HWT permits the transfer of the TOD between a stored TOD source or another radio set without energizing the transmitter.

(5) Direction Finding Tone (DF). The ECCM equipped radio set will first send any stored TOD" and then send a 1000 Hz tone.

(6) Preset Channels. The ECCM equipped radio set has six additional preset channels (15 through 20) which are used to store the WOD data. Visual indications for presets 15 through 20 cannot be recalled after they have been entered into the radio set.

b. Radio Set Components. In addition to the other components, the radio set contains a TOD transfer cable assembly for the connection between the radio set remote connector and the external timing equipment.



(Figure 6) TOD Transfer Cable

c. Controls and Indicators. In addition to the control and indicators listed for the Radio Set, AN/PRC-II3. The radio set contains the following controls and indicators for Have Quick operation.

(1) Position Switch 5/ACT. ACT activates the ECCM capability.

(2) Position Switch 8/TOD. TOD enables the radio set to receive time of day (either by radio frequency (RF) link or hardwire link).

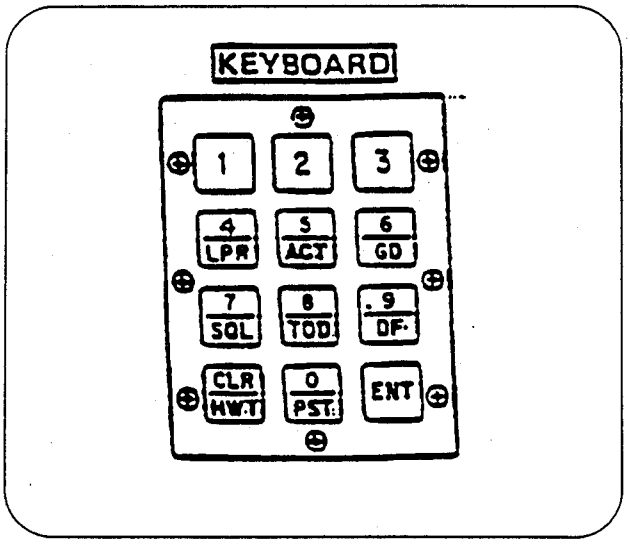
(3) Position Switch CLR/HWT. HWT enables the radio set to send TOD by hardwire without energizing the transmitter.

(4) Position Switch 9/DF. Used to send the TOD by means of the transmitter.

(5) Position Switch 0/PST. In addition to selecting the normal eight preset channels, this key is used during loading of the word of day (WOD) (channels 15 through 20).

d. ECCM Operation for the. Radio Set. The radio set will not operate properly in the active mode (ACT) until the correct word of day (WOD), time of day (TOD), and net have been entered into the radio.

(1) WOD Entry



(Figure 7) Radio Set AN/PRC-113 -Keyboard

(a) The radio set will not communicate with other radio sets if the wrong WOD is entered.

(b) Ensure that preset channels 15 through 20 are correctly entered. Presets for the WOD cannot be recalled for verification of correct entry.

(c) Before your mission, you will be given the WOD. The WOD is entered into the radio set through channels 15 through 20, starting with channel 20 and working backward to channel 15. The WOD may vary in length between one and six channels. Enter the WOD as follows:

1 Load the first frequency of the WOD into preset channel 20 of the radio set. The display shows: I.P-

2 Repeat step one for all remaining elements of the WOD. Preset each frequency to a preset channel (19-15) in sequence until the entire WOD is entered into the radio set.

(2) TOD Entry.

(a) When the radio set is turned on, it receives the first TOD transmitted and the TQD key does not have to be pressed.

(b) When the TOD is lost, perform the following steps to enter the TOD into the radio set.

1 Request the TOD from another radio set operator.

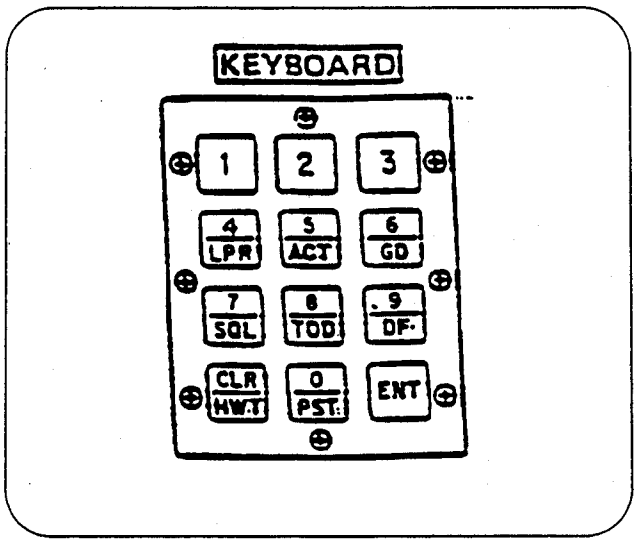
2 Press the 8/TOD key.

a The display shows: 2t

Note: The first digit on the display will always be 2 or 3. The t will be displayed until the TOD is received or until the **ENT** key is pressed.

b When the TOD is received, the display shows: 2tod

3. Press the **ENT** key.



(Figure 8) Radio Set AN/PRC- 113 –Keyboard

(3) Net Entry. The net number allows users to operate in the active mode. Selecting the active mode (ACT) on the radio set puts it in active mode. It also programs the radio to use the net entered into the radio set. Enter a net as follows:

(a) Enter a frequency containing the net number into the radio set.

(b) The display shows, for example: A95.300

Note: The second, third, and fourth numbers indicate the net number.

(4) Active (ACT) Mode Selection. With the WOD, TOD, and net entered into the radio set, perform the following step.

(a) Press the 5/ACT key. The display shows, for example: A95.300

Note: If the A on the display is blinking and a tone is heard in the handset, the TOD is not entered into the radio set. In that case, enter the TOD.

(b) The radio set is now ready to operate in the active mode.

(5) Changing the Net during Active Operation. To change the net during active operation, perform the net entry operation. Enter the frequency containing the new net number. The display shows, for example: A96.500

Note: If A overrides the first number entered. The second, third, and fourth numbers show the new net number.

(6) Send TOD. To send the TOD during the active or passive mode of operation, perform the following:

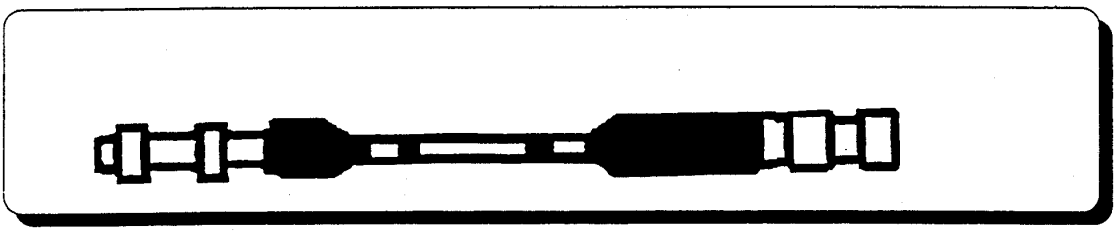
(a) Press the 9/DF key. A tone will be heard in the handset.

(b) Press the 9/DF key again to stop the TOD transmission.

(7) Hardwire Transfer (HWT) Operation

(a) Connect cable W3 (566083-808) between the radio set and the external timing equipment.

(b) To transfer TOD from the radio set, press the CLR/HWT key. The display blinks once.



(Figure 9) W3 Cable (566083-808)

(8) Emergency State of Internal Clock.

(a) If unable to receive the TOD, the internal clock of the radio set may be started by net control by performing the following:

1 Press the CLR/HWT key.

2 Press the number 3 key, then press the **ENT** key.

3 Verify the start of the internal clock by pressing the 5/ACT key. The display shows a letter A. If a flashing letter A appears, the clock has not started (go back to the beginning).

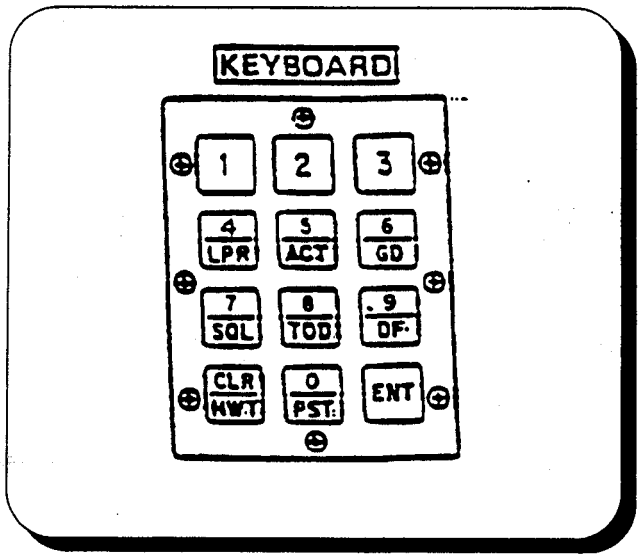
4 Out stations are to wait on the primary frequency. When instructed by net control, press the number 8/TOD key, and standby to receive the TOD.

5 Either 2t or 3t will appear in the display. The t will be displayed until the TOD is received. At this time, press the **ENT** key to save the TOD.

6 Net control will press the DF key and leave it on for three to five seconds. Once the TOD is received the display will show the TOD. Example: 3 tod

7 Press enter to save the TOD.

(b) Now the operator has the choice to either be in the frequency hopping or single channel modes of operation. The ACT key turns this feature on or off.



(Figure 10) Radio Set, AN/PRC- 113 – Keyboard

Note: ECCM operation with other stations is not possible with internal timing, unless it is transmitted and received by others. A valid, common TOD must be entered into all radio sets operating in the ECCM mode.

7 **Troubleshooting**. This is a systematic approach to correcting minor problems which may be encountered during operational use of the radio. Check the:

a. Batteries for proper charge. Ensure that they are properly connected in the case.

b. Handset and antenna for a tight connections.

c. Frequency and call signs, to ensure the correct ones are being used.

d. Volume setting, to ensure the last operator did not turn it down or the radio off.

e. Squelch mode. It may be necessary to place the radio in the squelch mode. If you cannot hear the distant station, turn the squelch mode off.

8. **Preventive Maintenance**. Preventive maintenance is a continuous process which consists of measures taken to maintain the continued serviceability of equipment and to prevent breakdown due to neglect. Check the:

a. Antenna for loose or broken connections.

b. Control knobs to ensure they are not missing or binding.

c. Audio connectors for cleanliness. If needed, clean with an eraser/brush.

d. Handset for frays in the cord. Wipe the handset down with silicone grease. If more attention is needed, turn the handset into the communications-electronics maintenance facility .

e. RT -1319 and accessories for general brushing. If needed, clean with a brush or clean damp cloth.

f. Inside of the battery case for corrosion or obstruction. If corrosion is noted, clean with a cleaner call trichlorotrifluoroethane.

WARNING

The fumes of trichlorotrifluoroethane are poisonous. Provide adequate ventilation whenever you use trichlorotrifluoroethane.

REFERENCES:

1. TO 31R2-22PRCI13-1 RADIO SET, AN/PRC 113 (V) 1
2. TO 31R2-22PRCI13-1 RADIO SET, AN/PRC 113 (V) 3

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 527
MAR 99

STUDENT OUTLINE

RACAL INTERCOM

LEARNING OBJECTIVES:

A. TERMINAL **LEARNING OBJECTIVES:**

(1) Without the aid of references, operate the RACAL intercom in accordance with the references.

(2) With the aid of references, perform remedial actions for RAC communications in accordance with the reference.

B. **ENABLING LEARNING OBJECTIVES**:

(1) Without the aid of references, place the RACAL intercom into operation in accordance with the reference.

(2) Without the aid of references, communicate from position to position in accordance with the reference.

(3) Without the aid of references, communicate from station to station in accordance with the reference.

OUTLINE:

1. The Riverine Assault Craft (RAC) Communications Suite (CS) general descriptions contained in these paragraphs address the RAC CS at the subsystem level. This outline provides the individual operator with the basic nomenclature, functions and maintenance.

2. **Communications Suite Components:**

a. AN/PRC 119A Tactical VHF Radio Subsystem.

b. GRC 231 Tactical HP Receiver/Transmitter with the ANDVT Minterm Encryption Device.

c. AN/PRC 113 Tactical VHF/UHF Receiver/Transmitter with the KY -57 Encryption Device No.2.

d. PSC-3 UHF SATCOM Receiver/Transmitter with the KY -57 Encryption Device.
T
3. RACAL Intercom Subs):stems:

a. Radio Interface Box (RIB) BCC 602: The radio interface box (RIB) when used in the craft as part of the BCC 600 Series radio control and intercom system, provides the interface between the control systems, craft power supply and craft radio. The RIB will accept up to three radios, with or without radio communications security (COMMSEC) fitted. A facility is incorporated to stop transmission automatically on any unsecured radio while a secure message is being transmitted. This function can be overridden by switching to the "NOT SECURE" position if required. The RIB provides an automatic rebroadcast between radios with squelch output. The radios are connected to the RIB via multi-way connectors. The supply, control and audio signals to and from the other boxes in the system are connected via a single coaxial ring. The craft d. c. supply is connected to the RIB via a two-pin connector.

b. Six radio control Box, BCC 608: When used in the craft as part of the BCC 600 Series Radio Control and Intercom System, provides optional split headset working, monitoring and intercom facilities, together with a hands-off live microphone intercom facility. The operator has access to and control of up to six radios. The BCC 608 operates from two independent harness rings, each ring may have up to three radios and an intercom channel. The intercom signal on both rings are combined by the BCC 608 allowing communication between the two rings. The supply, control and audio signals for radios A, B, and C from each harness ring, together with the earth returns, enter and leave the unit via a single coaxial connector for each ring. The pressel lead assembly and headset are connected via a multi-way connector and a remote handset is connected via multi-way connectors.

c. Crewman's Box BCC 605: When used in the craft as part of the BCC 600 Series Radio Control and Intercom System, provides optional split-headset working, monitoring and Intercom facilities, together with a hands-off live microphone intercom facility. The operator has access to and control of up to three radios. The unit may be used with either a Personal unit BCC 610 or with a pressel lead assembly headset. The supply, control and audio signals, together with the earth returns, enter and leave the unit via a single coaxial ring. The Personal Unit or alternative pressel headset lead assembly are connected via multi-way connectors.

4. **Operation of the RACAL Intercom Subsystems:**

a. BCC 602 (RIB):

(1) RIB #1:

a. power switch to off
b. automatic rebroadcast switch to off

(2) RIB #2:

a. power switch to off
b. automatic rebroadcast switch to off

b. BCC 608 (RCB):

a. Selector switch to I
b. MON/OFF/LIVE IC switch to off
c. MON/SELECT switch to Lamps On
d. WORKING (VOLUME) switch to counterclockwise (ccw)
e. MON/LIVE IC (volume) switch to (ccw)

c. BCC 605 Crewman's Box:

a. Selector switch to I
b. MON/OFF/LIVE IC switch to off
c. WORKING (volume) switch to (ccw)
d. MON/LIVE IC (volume) switch to (ccw)

d. Turn the power supply on the RAC CS to the on position

e. Turn on the MAIN circuit breaker located in the RAC CS

f. Turn the Intercom BCC 602 # 1 circuit breaker to the on position

g. Turn the Intercom BCC 602 #2 circuit breaker to the on position

h. Connect the CVC helmets to the intercom.

5. **Intercom Operation:**

a. On the BCC 605 crewman Bbox and both BCC 608 (RCBs) set the rotary switch labeled (MON/OFF/LIVE IC) to the live IC position.

b. Set the working radio switch, labeled (A/B/C/I/CALL) on the BCC 605 and labeled (C2/B2/A2/Cl/Bl/Al/I/CALL) on the BCC 608 to the I position.

c. Set the volume levels at both the BCC 605 and BCC 608s to mid-range.

d. Voice communications spoken into any of the headsets can be heard throughout the other crew stations.

e. In this mode, the intercom communications should be enabled without the push to talk buttons depressed.

6. **Radio Control Operation:**

a. Insure that all Radio and Crypto equipment is powered and ready for operation.

b. Perform the setup for intercom operation.

c. Set the volume controls to midrange.

d. Set the radio switch labeled (C2/B2/A2/Cl/Bl/Al/I/CALL) on the BCC 608s to Al.

e. Communications via AN/PSC-3 are now available through the BCC 608 boxes.

f. Communications via other radios can be established by selecting them with the radio switch by setting the switch according to the information plates located below the BCC 608 boxes.

g. The BCC 605 is used in the same way however it can only control radios A2/B2/C2.

h. While receiving a signal from another transmitting station audio is heard in the left earpiece and the intercom is heard in the right.

7. **Radio Control/Monitor Function:**

a. Perform setup for radio control operation.

b. Set the radio switch labeled (C2/B2/A2/Cl/Bl/Al/I/Call) on the BCC608 to Al.

c. Set the rotary switch labeled (Clear/On/Off/On/Load) To Load (Clear And Load Positions Are Spring Loaded And Will Return To One Of The On Positions), the red light on the bottom right side of the BCC608 labeled Al will illuminate-

d. Set the rotary switch labeled (Mon/Off/Live IC) to the MON position. When the BCC605 is set to MON, it will transmit and receive on the radio selected and monitor the other two positions.

e. Set the radio switch labeled (C2/B2/A2/Cl/Bl/Al/I/Call) to B2, A2, Cl, Bl.

f. Communications can now be established on the radio selected by the radio switch and Al (UHF SATCOM) receiver audio can be monitored simultaneously.

g. All or some radios can be loaded and monitored by repeating steps 12.b. and 12.c. for the appropriate radio switch position.

h. In monitor mode the only radio that has transmit capability is the radio selected by the radio switch.

8. **Clearing a radio being monitored:**

a. Set radio switch to radio position to be cleared.

b. Set the rotary switch labeled (Clear/On/Off/On/Load) to Clear (Clear And Load Positions Are Spring Loaded And Will Return To One Of The Positions), the red light on the bottom right side of the BCC 608 will go out indicating the monitor function for the selected radio is cleared and the radio is no longer being monitored.

9. **Call function:**

a. The call function in the BCC system is an intercom function used to broadcast from one crew station to all other crew stations regardless of the switch settings on the crew stations being called.

b. Set the A/B/C/I/CALL switch on the BCC605 to CALL, or set the radio switch labeled (C2/B2/A2/Cl/Bl/Al/I/CALL) on the BCC608 to CALL, internal voice communications can be transmitted from the crew stations with CALL selected.

c. The CALL position on the BCC 605 and the BCC 608 boxes is spring loaded and must be held during transmission.

d. When the CALL function is selected, operators at all other crew stations should hear not only the CALL transmission but any signal received over the transceiver(s) they have selected.

SO-527-5

REFERENCE:

1. TM 09557A-12&P/11 RAC Communications Suite Manual

NOTES:

ATT ACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolma 28542

TAB 530
MAR 99

STUDENT OUTLINE

R40XX RADAR

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVES:**

(1) With the aid of references, operate the R40XX RADAR in accordance with the references.

(2) Without the aid of references, pilot using RAC electronics in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) With the aid of references, place the R40XX into operation in accordance with the reference.

(2) With the aid of references, determine range and bearing to an object in accordance with the reference.

(3) With the aid of references, determine range and bearing to a selected waypoint in accordance with the reference.

(4) With the aid of references, set an alarm zone in accordance with the references.

(5) With the aid of references, operate in the time mode in accordance with the references.

(6) With the aid of references, operate in the off center mode in accordance with the references.

(7) With the aid of references, operate in the zoom mode in accordance with the references.

(8) With the aid of references, determine the range and bearing between two objects in accordance with the reference.

(9) Without the aid of references, identify navigation aids with the R 40XX Radar in accordance with the references.

(10) Without the aid of references, identify riverine characteristics with the R40XX Radar in accordance with the references.

OUTLINE:

1. **Radar Characteristics**

a. Radar is the electronic equivalent of a bat's sonar. The radar transmitter located in the dome on the forward arch sends out an electronic pulse. The radar receiver, also in the dome, collects the reflected pulses and displays them on the screen located by the coxswain.

b. Radar is line of sight only, so even though the range of the R40X is 32 miles, the height of the dome and the height of the target limit the range because of the curvature of the earth.

c. Since radar pulses are electronic they are not affected by fog, smoke or light rain. This does not limit the visibility to the first object in the path of the pulse. For instance, a column of boats directly approaching your position would appear as only one boat. That same column at an angle would show all of the boats.

d. The radar does not put out enough power to be a safety hazard.

2. **Placing The Radar Into Operation:**

a. Power: To turn the radar on press the ST-BY/OFF key then turn the Tune, Gain and Sea Clutter knobs to the midway position and the Rain Clutter counterclockwise all the way if the weather is clear before transmitting. The radar will go into a standby mode for up to 90 seconds. Once the standby mode is complete, to transmit you would press the X-MIT/OFF key. To turn the radar off press the ST-BY/OFF and X-MIT/OFF keys at the same time.

b. Range: Press the RANGE + to increase the range of the radar and the RANGE - to decrease the range. Consider the most likely engagement range and type of target when choosing a range.

c. Gain: Clockwise increases and counterclockwise decreases the gain. Increasing gain will increase the return from the target.

d. Tune: Clockwise maximizes target echoes. Increasing the tune sharpens the image, to a certain point but too much clutters the screen.

e. Sea Clutter: Clockwise increases and counterclockwise decreases the amount of clutter.

You will adjust for the current sea state. Too high and you lose small targets, while to low and the screen is full of returns.

f. Rain Clutter: Clockwise increases and counterclockwise decrease the amount of clutter. Too high and you lose small targets, too low and the screen is full of returns.

3. **Determining Range To A Target:**

Press the VRM button to turn on or off. Hold the VRM button down to change from VRM #1 to VRM #2. Increase and decrease using the button. The VRM is a circle that will contract or expand depending on the button used. This is used to determine range to an object or to set up an alarm.

4. **Determining Bearing To A Target:**

Turn on or off by pressing the EBL button. Hold down to change from EBL#1 to EBL#2. Rotate the EBL using the buttons. To rotate faster hold down the EBL button at the same time. This is used to determine bearing to an object or to set up an alarm.

5. **Special Function:**

a. Mode: Each press on the button changes the bearing readout from RELATIVE -TRUE - MAGNETIC -RELATIVE.

b. LL/TD: Each press changes readout from OFF -L/L -TD - OFF. Loran readout is in latitude and longitude or time difference for manual navigation.

c. Waypoint: Press the WPT button and the waypoint mark, bearing, distance and the time-to-go to the waypoint are displayed. Press the LL/TD and WPT button together and the ships current latitude and longitude are displayed. This only displays the waypoint currently in the GPS.

d. EXP: The EXP button turns on and off the expansion function. To much target expansion will fill the screen and too little will lose targets. It is better to change the range of the radar.

e. IR: Press the button to turn the function on or off. Interference caused by nearby radars operating in the same frequency band or nearby large reflective targets is diminished.

f. SHM: When pressed the Ships Heading Marker will be momentarily removed. Holding will remove the mark until the button is released. Used to acquire small targets located in the path of your vessel. The bearing information displayed at the top center of the screen is taken from the fluxgate compass and is slightly behind what you are currently steering.

g. CRT Brilliance: Press the DIM/BRIL and the Brilliance menu appears. Press the Range increase or decrease key until the display is set at the desired level. This will not turn off so you must make provisions while in a Waterborne Guardpost or Ambush site.

h. Panel Backlighting: Press the DIM/BRIL key twice and the DIM menu will appear. Use the Range increase or decrease keys to adjust the key backlighting.

i. Alarm: Press the ALM key and MAKE ZONE PRESS ALM is displayed. Set the desired alarm zone using the VRM and EBL functions. Press the ALM key again to adjust the audible alarm. Press the ALM key again to set the IN alarm. Hold the key to memorize the zone. Press the Alarm key again to set the OUT alarm. Press the ALM key again to turn alarm off. To recall a memorized alarm press ALM and hold.

j. Time: Press the TIME key then use the RANGE increase or decrease to set the number of scans. Press the time key again then use the RANGE increase or decrease to set the period between scans. To turn this function on or off, hold the key until the buzzer sounds. This allows the boat to limit the electronic signature and limit the possibility of a radar detector spoiling your opportunity of surprise.

k. Off Center: Press OFF CENT key to turn on. The cursor will appear along with SET ORIGIN/PRESS OFF CENT. Use the SHIFT keys to position the cursor. Press OFF CENT again to activate. To turn off, press OFF CENT again. This allows a focus on the primary sector of the boat depending on position in formation or along the river.

l. Zoom: To activate, press ZOOM. The cursor and SET ORIGIN/PRESS ZOOM will appear. Use the SHIFT keys to position the cursor to the area desired. Press the ZOOM key to activate zoom function. Pressing the ZOOM key again deactivates the function. This allows an expansion of a cluttered area without decreasing the range and possibly losing the targets.

m. Floating EBL: EBL#2 is the floating EBL and VRM #2 is to measure range on EBL #2. Press F.EBL to start. The cursor and SET ORIGIN/PRESS F.EBL will appear. Use the shift keys to move the cursor to the desired position and press the F.EBL key again. Regular EBL and VRM functions will be used to determine bearings and ranges between other objects. To deactivate press F.EBL again.

n. Cursor: To activate press CURSOR. Position using the shift keys to obtain range, bearing and time-to-go for any point on the display. This will appear in 8 to 10 seconds.

o. Shift Key: These keys are pressed to move the cursor. Pressing two keys at once will move the cursor at an angle.

p. Range Rings: Pressing the RR key will turn on or off the Range Rings. The distance of the range rings will be displayed in the upper left corner of the screen. .

REFERENCE:

1. TM 09557A-14/5 Instruction Technical Manual for R40X Radar

2. TM 09557A-14/1 System and Operation Manual w/Components List for Riverine Assault Craft

NOTES:

ATTACHMENTS: None.
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UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 531
MAR 99

STUDENT OUTLINE

V850 DEPTH SOUNDER

LEARNING OBJECTIVES :

A. **TERMINAL LEARNING OBJECTIVES**:

(1) With the aid of references, operate the V850 in accordance with the references.

(2) Without the aid of references, pilot using RAC electronics in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) With the aid of references, place the depth finder into operation in accordance with the reference.

(2) With the aid of references, operate in standard mode in accordance with the reference.

(3) With the aid of references, adjust the range in accordance with the reference.

(4) With the aid of references, determine water depth in accordance with the references.

(5) With the aid of references, set shallow water alarm in accordance with the references.

(6) With the aid of references, operate in the split screen mode in accordance with the references.

(7) Without the aid of references, identify navigation aids with the V850 Depth finder in accordance with the references.

(8) Without the aid of references, identify riverine characteristics with the V850 Depth finder in accordance with the references.

OUTLINE:

1. **General Characteristics**:

a. The V850 has the following general characteristics:

(1) 8- inch monitor screen

(2) 256 dot resolution

(3) 8 color display

(4) Range in 5 unit steps (5 to 955 units programmable in feet/meters/fathoms)

(5) 9 display modes possible (standard and navigation for our application)

(6) Chart speed in 9 steps with freeze

(7) Alarms for shallow water 3 feet to maximum depth and deep water maximum depth to 3 feet.

(8) Water temperatures from 32 to 99.9 degrees Fahrenheit.

(9) Speed in units of knots/miles per hour/ kilometers per hour

(10) Speed indicated from 0-70 in tenths

(11) Trip log from 0-999 with reset

(12) 10 levels of brightness available

b. There are several considerations for operation of the V850:

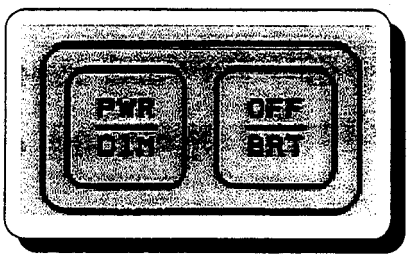
(1) Avoid storing in direct sunlight for prolonged periods or excessive heat of 120 degrees or above.

(2) If subject to water spray, rain or condensation, clean immediately after use and cover for storage.

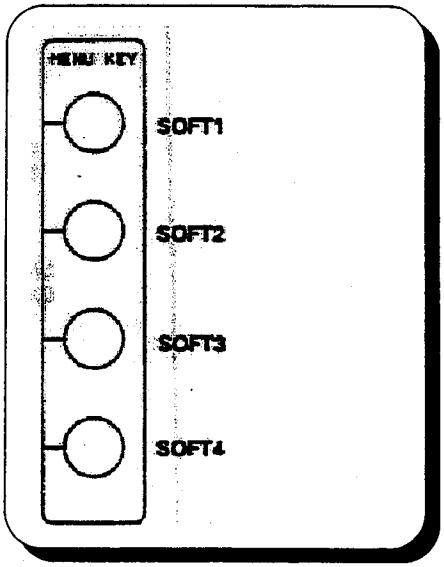
(3) Keep clear of other electronic equipment and magnetic interference as it may effect the unit.

2. **Keypad Layout** :

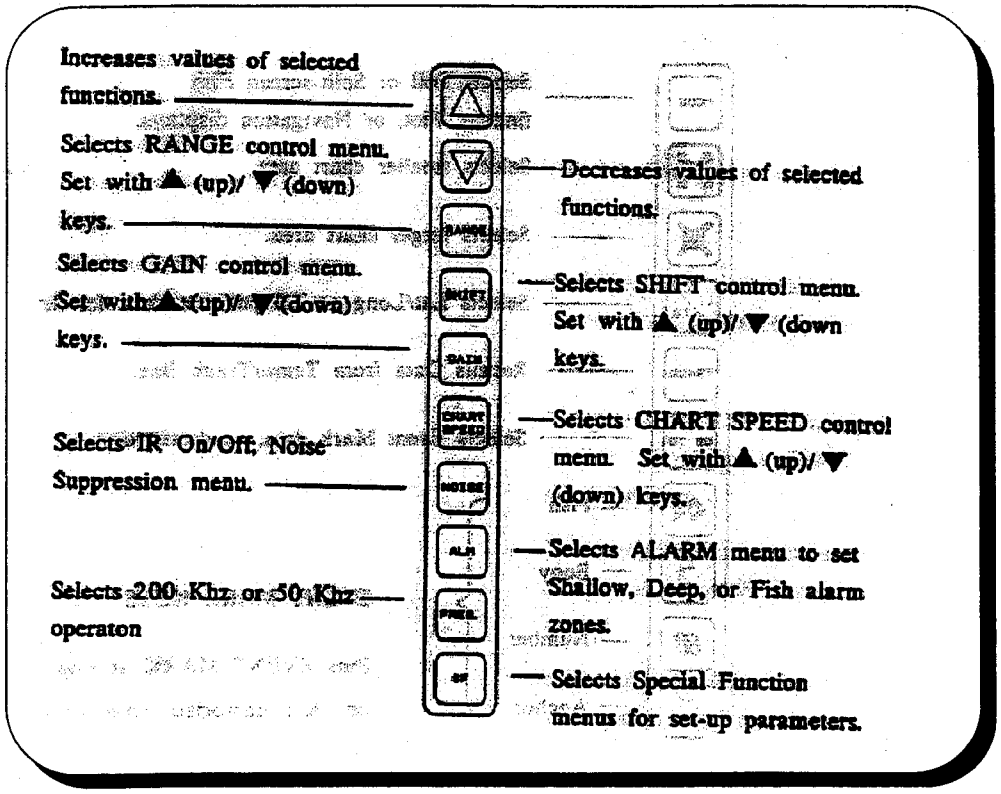
a. The most important keys are the Power Control keys located at the lower right side of the display unit. These keys control unit "ON" or "OFF" operation, CRT brilliance, and panel illumination.



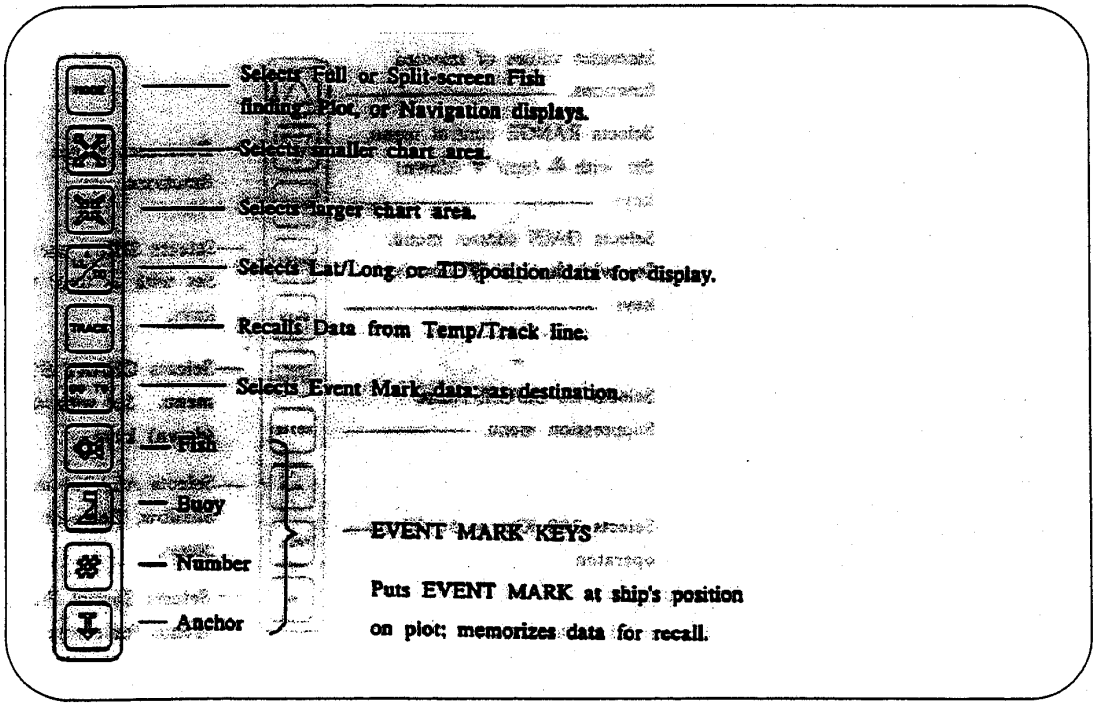
b. The large round keys adjacent to the display right edge are called "soft key" and are used to select items from the "help" menu appearing on the screen.



c. The keypad strip down the right side contains the keys used most often and to perform the most important operations. They are as follows:



d. The keypad a1ong the left side primarily supports the track plotter operation. They are:



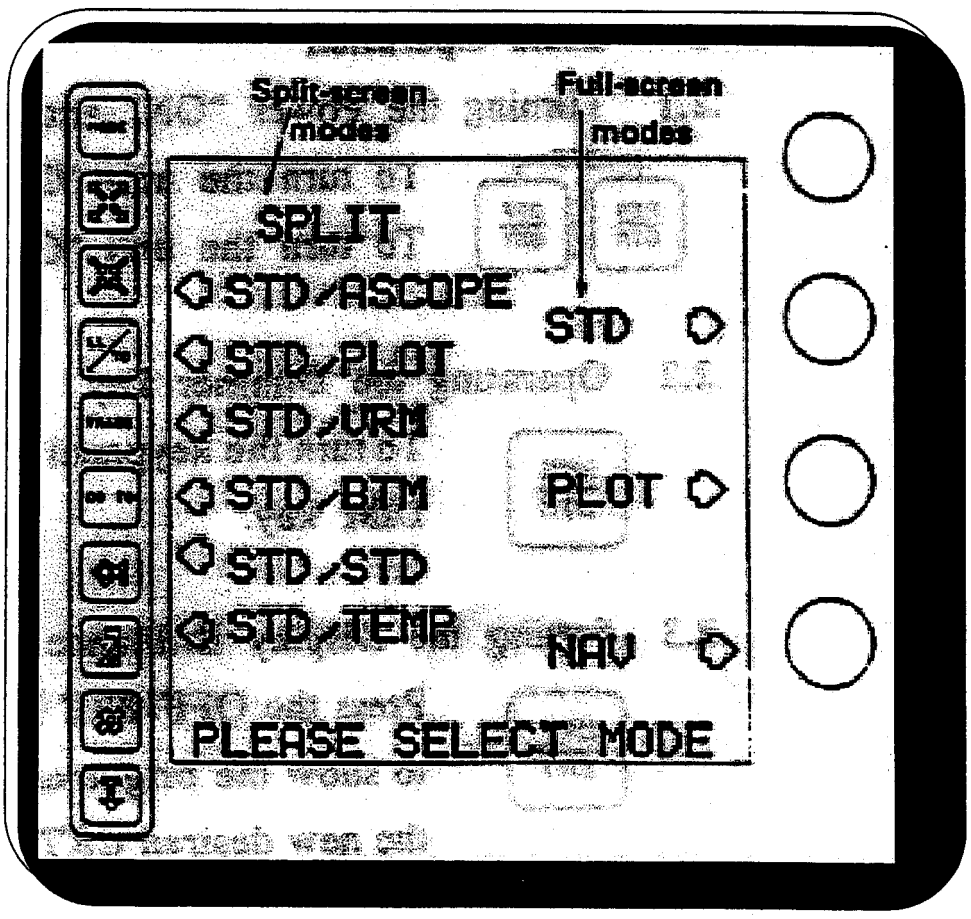
3. **Basic Operation**

a. To turn the unit on you need only push the pwr button. However, to turn the unit off you must push the pwr and off buttons simultaneously.

b. To operate the dimmer key. By using the pwr/dim key, you will turn the key panel backlighting on and off.

c. To set the display brilliance, press the off/brt key. A temporary menu appears on screen to show the brightness less. Use the increase or decrease keys to select the new desired CRT' brightness level. The menu will disappear after 7 seconds.

d. To select any mode just press the mode key. A menu page will appear on the screen. The mode menu is organized so that the split-screen presentations are selected by keys on the left key panel, while the full-screen modes are selected by the "soft keys" at the right side of the screen. Just press the key next to the mode indicator to bring the desired mode to the display.



4. **Using the Display Modes**

a. **The standard mode** - normally presents a full screen view from the surface level to the depth range selected and typically includes the bottom of echo returns. The standard display

mode does not necessarily have to begin at "0", but may be shifted down to begin at any selected .depth using the shift key and the increase or decrease keys.

(1) Frequency Key. The choice between 200KHz or 50KHz transmission mode is made by pressing the frequency key. The transmitted "cone" angle can become either 10 degrees for 200KHz or 40 degrees for 50KHz.

(2) Range Key. Selects the area of water you want to look at on the screen in 5-unit steps. The maximum range setting appears at the scale marks near the bottom right of the screen. Range can be set on manually adjusted or automatic.

(3) Shift Key. Controls the point where the range scale of the picture should begin. In most standard displays, the surface line appears along the top of the display and the shift value is "0".

(4) Gain Key. Often weather conditions, currents, temperature or salinity changes can produce varying levels of acoustical noise in water, making the background level on the display appear noisy. Adjusting the echo sounder sensitivity for a clearer picture is usually required. The sensitivity is adjustable from 0 to 16, with either manual or automatic settings.

(5) Chart Speed Key. Varies the speed with which the unit updates the information presented on the CRT. Speed "0" is freeze and a setting of"5" is normal.

(6) Trip Log Reset. Located at the top center of the screen to show distance traveled in nautical miles, statute miles, or kilometers. To reset press the noise and alarm keys together.

(7) Alarm Key . By pressing this button you will call up the menu to set the shallow and deep water alarms. Press the soft key for the desired function and use the increase and decrease keys to the desired depth.

(8) Noise Suppression/Interference Reduction Key. Controls both interference rejection OFF /On operation and background noise suppression functions. The interference reducer eliminates interference from other depth finders. The noise suppression eliminates clutter from particles such as plankton in the water .

(9) Variable Range Marker Key. This function can measure the depth of objects in the midwater areas accurately.

b. **Standard/VRM Mode**. Upper 60% displays standard screen, while lower 40% displays variable range returns in midwater .

c. **Standard/ A-Scone Mode**. Left side of screen is a standard display, while the right side is a instantaneous display of the bottom.

d. Standard/Bottom Mode. This displays at the selected frequency a standard screen on .the upper 60%, while the lower 40% gives a closer look at objects on or near the bottom.

e. Standard/Standard Mode. Allows you to view the screen with both frequencies being used for a better representation of the bottom.

f. Standard/Temperature Mode. Provides a record of surface temperature changes in a graphical form on the bottom 20%, while the top 80% of the display shows a standard presentation.

g. Plot Mode. To record and retrace your vessels track. Can also remember and display up to 80 event markers. These could be your home channel buoy, best anchorage, or waypoints.

h. Navigation Mode. This uses the entire display as a giant digital depth, speed, and surface temperature display. The display is very useful when you are traveling from point to point in open waters. For best depth indications and tracking the unit should be on auto range, auto gain, and 200KHz. When the bottom echo is temporarily lost the system will show "ERR".

REFERENCE:

1. TM 09557A-14/8 Instruction Technical Manual for V850 Depthfmder

2. TM 09557A-14/1 System and Operation Manual w/Components List for Riverine Assault Craft

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 532
MAR 99

STUDENT OUTLINE

RAYTHEON 202 MARINE BAND RADIO

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE:** Without the aid of references, operate the RAY 202 in accordance with the references.

B. **ENABLING LEARNING OBJECTIVE**:

(1) Without the aid of references, place the RAY 202 into operation in accordance with the reference.

(2) Without the aid of references, transmit a message in the clear mode in accordance with the reference.

(3) Without the aid of references, operate the hailer in accordance with the references.

(4) Without the of references, operate the fog horn in accordance with the references.

OUTLINE:

1. **The Raytheon 202**: The Raytheon 202 is programmed for two way communications on all international, US and Canadian channels plus reception on local weather channels and the international safety channel (Channel 16). The ray 202 is also capable of transmitting on 53 channels and receiving on 92. The Raytheon 202 is also capable of two types of frequency communications , ship to ship, ship to shore and it is also our main source of communications here at the school. You need to become familiar with this radio and its capabilities.

2. **Place Radio Into Operation:**

a. **Turn Power On** by pushing the ON/OFF volume knob (The radio automatically selects channel 16). The ON/OFF knob also controls the volume. To increase volume turn the knob clockwise, to decrease the volume turn knob counter clock wise. When you first turn on the radio you should place the ON/OFF knob to the mid-point position.

b. Select Proper Channels by turning the channel selector control clockwise to increase the channel number. To decrease the channel number turn the channel selector control knob counter clockwise.

c. Adjust Squelch by turning the squelch control knob clockwise to reduce the speaker noise and counter clockwise to increase speaker noise. The squelch should be set so that incoming radio signals can be heard.

d. Adjust Wattage by pressing the [func] function key and then push the [1/25] key to set wattage output (1-25) as appropriate. An example would be 1 watt for areas such as a harbor and would increase as your distance from the harbor increased.

2. **Transmit A Message**

a. To TRANSMIT A MESSAGE, pick up the handset, and press the push-to -talk (PTT) switch with your thumb. When talking, talk in clear voice just as if you were talking to another person standing in front of you.

3. Operate Hailer .

a. T o Operate The Hailer press the [HAIL] key, this will put the radio into the hailer mode and hail will show up on the screen. Press the PTT switch and speak directly into the microphone. When the PTT switch is released, the audio signals at the hailing horn are amplified and applied to the RAY 202 internal speaker. When the [HAIL] key is pressed again the radio returns to the previous operating mode.

4. **Operate Fog Horn**

a. To Operate The Fog Horn press the [func] key and the [fog] key. Pressing the PTT switch will cause the manual foghorn to blast. To return to normal function press the [fog] key.

b. The Raytheon 202 is also capable of an auto fog mode as well. To activate, place in the manual foghorn mode then press the [func] key and then the [fog] key. The auto fog will appear on the screen and a series of timed blast will occur for 5 seconds every 115 seconds.

5. **Identify Channels:**

a. Channel -WX weather. To use weather channel press [WX] key and rotate channel selector knob to desired channel (1,2, or 3). While on weather channel the transmitter is disabled. Press WX key and return to previous operating channel. .

b. Channel - 82 SOTG operating net. Rotate channel selector knob to 82.

c. Channel - 26 Operator. Rotate channel selector knob to channel 26 and request operator to patch you to desired number. If operator is busy, try again after a few minutes.

d. Channel - 16 International Distress. When radio is turned on it automatically goes to channel 16. If on another channel rotate channel selector knob to 16.

6. **Take Radio Out Of Operation:**

a. To turn the radio off, turn the volume control counter clockwise and press ON/OFF/VOLUME control until radio is off.

REFERENCE:

1. TM 09557 A-14/9 Operation Manual, RAY 202 VHF Radiotelephone/Hailer

2. TM 09557A-14/l System and Operation Manual w/Components List for Riverine Assault Craft

NOTES:

ATTACHMENT8: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 533
MAR 99

STUDENT OUTLINE RAYTHEON 398 GPS

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVES**: Without the aid of references, operate the RAYTHEON 398 in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references, place the RAYTHEON 398 into operation in accordance with the reference. .

(2) Without the aid of references, setup RAYTHEON 398 in accordance with the reference.

(3) Without the aid of references, determine bearing and range to a waypoint in accordance with the references.

(4) Without the aid of references, set up an automatic route sequence in accordance with the references.

(5) Without the aid of references, determine craft velocity/cross track error in accordance with the references.

(6) Without the aid of references, set alarms in accordance with the references.

OUTLINE:

1. **GPS Characteristics:**

a. The GPS system is a satellite based radio navigation system designed - to provide global, continuous 24 hour-per-day, all weather, accurate position data for navigators worldwide. The GPS is based on a receiver ability to accurately measure the propagation time of signals transmitted from geo-synchronized satellites in your receiver unit.

b. The satellites transmit accurately timed signals along with a navigation message which includes the satellite's position, precise time and bearing to the satellite from the time delay and uses triangulation to determine your position.

c. Three satellites are necessary to determine a two dimensional fix and four are needed for a three dimensional fix (position and elevation). Since the RAYTHEON 398 is a receiver only, your position cannot be located by Radio Direction Finding. The satellite transmissions are extremely difficult to jam or destroy.

2. **GPS Orientation**:

a. PWR: To turn the GPS on press the PWR Key.

b. OFF: To turn off the GPS press the PWR and OFF Keys simultaneously.

c. MODE SWITCH: Selects the desired mode for display:

1. SA T for satellite information. .
2. WPT for waypoint information.
3. L/L for position display.
4. RTE for route information.
5. INIT for initializing the system.

d. SLP: Turns off display and backlighting for saving power .

e. NUMBERS KEYS: Used to enter numerical information.

f. ENT: Enter input data

g. #: Designates waypoint, Route Sequence numbers and so on.

h. SAVE: Saves current position up to 10 (not backed by internal battery)

i. +MEM: + selects North or West, used to increase backlighting. MEM memorizes current
position to 99 (backed up by internal battery).

j. -RCL: -selects South or East. RCL recalls memorized position data.

k. CLR: Clears erroneous entries.

l. AIM: Changes mode from Auto to Manual.

m. SF: Activates LCD display test and special function. Reentry of this key returns screen to normal.

n. CHG: Changes display page from first through third.

o. NEXT: Changes to the next route leg when route sequence is activated. Changes time display in R TE. Set Magnetic compass Correction Value in L/L.

3. **Operating Modes**

a. Initializing

(1) Turn on the GPS with the PWR button. Adjust the backlighting by pressing the SF button and adjust with + or - keys.

(2) Enter your estimated position by turning the mode switch to INIT, punching the latitude in the numeral keys and use the + or - to select North or South then press enter. Repeat this step for the longitude.

(3) Enter Coordinated Universal Time (UTC) by entering the year, month and day with the numeral keys then press enter. Next enter, within 15 minutes accuracy, the hour then minutes by the 24 hour clock and press enter. Next enter the time difference between local and UTC with the numeral keys and press enter.

(4) Enter the antenna height above sea level in meters with the numeral keys and press enter.

(5) There is no Gyro or speed input so these steps will not be completed. The initialization is complete and the mode switch can be turned to another function.

b. Lat/Long Display Mode. To operate effectively the averaging function should be set at fast acting. Press SF then # then 21 then enter. Press the next key until 3 is displayed then press SF to return to normal screen.

(1) Page 1

a. Top line is the course deviation indicator.

b. Lines 2 and 3 are current Latitude and Longitude.

c. Line 4 has the speed over ground in knots and the course over ground in degrees.

d. Line 5 has the waypoint number and the bearing and distance to that waypoint.

(2) Page two is accessed by pressing CHG button.

a. Top line is the Cross Track Error bar graph. The more bars displayed the further off track.

b. Lines 2 and 3 are current Latitude and Longitude.

c. Line 4 has the velocity toward destination and the cross track error in nautical miles.

d. Line 5 has the waypoint, the velocity along route in knots and the course made good in degrees.

(3) Page three is accessed by pressing the CHG button. .

a. Top line allows manual entry of the Latitude and Longitude offset to correct the GPS with the chart if needed. To enter manual corrections press the CHG key twice then enter the Latitude correction value (e.g. seconds + or -) then press enter. Repeat for Longitude. To turn off manual correction enter 0 for Lat/Long in the same procedure.

b. Line 3 shows height of antenna above sea level and time to go to reach the selected waypoint.

c. Line 4 shows the current calculated drift, the set and the magnetic correction value. To set the magnetic correction press the CHG key twice then press the next key then AIM key then enter. This is the automatic correction. To enter manual corrections repeat the step except enter a numerical value in place of the A/M key. To change the magnetic correction to true repeat the step but enter O instead of the A/M key.

c. Waypoint Display Mode. Ensure the GPS is set to Rhumb Line. Set the knob to WPT, press NEXT to select between the R for Rhumb Line and Great Circle.

1. Page 1

a. Lines I and 2 allow the entry of Latitude and Longitude. To enter waypoint press the 3 button, enter waypoint number and press enter. Next enter the Latitude with the numeral keys and use the + or - select North or South then press enter. Repeat the same steps for Longitude using the + or - to select West or East then press enter.

b. Line three will display the waypoint number and the bearing and range to the waypoint.

(2) Page 2 is accessed by pressing the CHG button.

a. Lines 1 and 2 display current position Latitude and Longitude.

b. To enter a waypoint using range and bearing from current position press the 3 key, enter waypoint with numeral keys then press enter. Then press the CHG key and enter the bearing 3 digit degrees with the numeral keys then press enter. Enter range in nautical miles to the nearest 1/100 then press enter. The waypoint is now entered with the Lat/Long of the designated position.

c. To enter present position as a waypoint, enter the waypoint number as before except before pressing enter press the MEM key.

d. To erase waypoints individually enter the waypoint number then press 0 then enter to erase the waypoint number then repeat for the Lat/Long. To erase all waypoints press the SF key then the # key then enter 90 and press enter. All waypoints are erased, press the SF key to return to the normal screen.

d. Route Display Mode. To operate effectively the Dynamic mode must be set to high speed. Press the SF key then # then 7 then ENT. Press next until 0 is displayed in the lower right comer of the screen then press the SF key to return to the normal screen. To navigate without the route sequence, enter the waypoint number you wish to approach.

1. Page I

a. Top Line is the leg of the route. Without the route sequencing it will read 00-25.

b. Line 2 is the current route sequence.

c. Line 3 displays the bearing and distance of the route.

d. Line 4 displays the auto sequence and the trip distance from your present position to the final waypoint of the route.

(2) Page 2 is accessed by pressing the CHG key.

a. The top line has the arrival alarm and distance.

b. Line 2 has the Off course alarm and the distance.

c. Lines 4 and 5 have the total distance of the route and the total distance traveled in the route.

d. To engage the automatic route sequence you must first have waypoints in numerical order as detailed in the waypoint section. Set to RTE then press ENT. Next press # then the number of the first then the last waypoints (02,13 etc...). Then press ENT then AIM then ENT again. Next set the Auto Route Mode by pressing CHG then enter a 2 digit distance and press enter. This sets the distance from the waypoint the GPS switches to the next in the route. To abandon the automatic route function select RTE page 1, press ENT then -then ENT.

(3) Press CHG to get page 3.

a. Line 1 has the UTC time display. .

b. Line 2 display local time.

c. Line 3 display the time to go for the waypoint in hours and minutes.

d. Line 4 displays the difference between UTC and local and the time to go for the trip in hours and minutes.

e. Satellite Status Display

(1) Page 1

a. Line 1 displays the satellite number, the signal reception status and the received signal level.

b. Line 2 displays the azimuth angle and elevation angle.

c. Line 3 and 4 include the number of normal satellites the DOP value, the number of visible satellites and which are selected for position fix information. The DOP level should be set at # 1. To change the DOP press SF then # then 12 then enter. Press the NEXT key until appears then press SF to return to the normal screen. .

d. Press # and enter the satellite number to display the signal status etc... of any other available satellite.

(2) Press CHG to access page 2. This page allows you to deselect unreliable satellites.

a. Lines 1 and 2 display deselected satellites.

b. Lines 3 and 4 display the start and end time for the availability of 3 or more satellites to indicate position fix ability .

(3) Press CHG to access page 3. Page three indicates times during which 2 or more satellites are available in cases where an atomic clock is available for input.

4. **Setting The Alarms**

a. Arrival alarm.

(1) Set mode switch to RTE and press CHG. Press + MEM until D is displayed in the upper left corner of the screen then enter the distance in nautical miles to the nearest 1/l00 and press ENT.

(2) This is necessary to set the route sequence function. To clear this function select RTE page 2 and press 0 then enter.

b. Anchor watch alarm.

(1) Enter your present position as a waypoint and display it under the WPT. Set the mode switch to RTE then press -RECL. The display should have this][. Enter the limit and press enter.

(2) This alarm will sound if the boat moves more than the limit from the current position. to silence press CLR. To clear, go to RTE page 2 and press 0 then ENT.

c. Off Course Alarm.

(1) Go to RTE page 2, press ENT then -.Press -until][appears then enter the desired distance then ENT .

(2) If the vessel strays more than the desired distance the alarm will sound. Press CLR to .silence the alarm. To clear the alarm go to RTE page 2 then press 2 then press ENT then 0 then ENT.

d. Boundary Alarm.

(1) Select the two waypoints to place the boundary between by selecting RTE then press # , then key in the two waypoints and press ENT.

(2) To set the alarm go to RTE page 2, press ENT then + MEM until][appears. Enter the distance from the boundary you wish the alarm to sound and press ENT.

(3) To silence the alarm press CLR. To clear the alarm go to RTE page 2, press ENT, then 0 then ENT.

5. **Status Indicators**

a. Under certain conditions status indicators may appear on the screen. These alarms indicate that the received signals are of questionable quality at that moment and you should use caution in utilizing navigation calculations. When an alarm condition is detected these symbols will appear on the display regardless of the function your unit is on. When the various symbols are lighted the meaning of the indicators are as follows.

(1) ANC - This indicates that the anchor watch alarm has been triggered.

(2) MAG - This indicates that a magnetic compass correction is being applied and that all bearing information is magnetic instead of true.

(3) XTE - This indicates that the cross track error alarm has been triggered.

(4) ARV - This indicates that the arrival alarm has been triggered.

(5) SOL - This warning means that the unit cannot calculate your Lat/Long position. This will light when the unit is energized but should go out after couple of minutes.

(6) 2D - Two dimensional fix using three satellites.

(7) 2SV - two-dimensional fix with two satellites and the atomic clock.

(8) DR - Dead reckoning using the speed and course displayed on the navigator using the Gyrocompass and the Speed Log.

(9) Triangle L/L - This indicates that the Lat/Long correction is applied to the L/L mode.

REFERENCE:

1. TM 09557A-14/6 Instruction Technical Manual for GPS Navigator Model 920

2. TM 09557 A-14/1 System and Operation Manual w/Components List for Riverine Assault Craft

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
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TAB 534
MAR 99

STUDENT OUTLINE

MSG H60 GUN MOUNT

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE**: With the aid of references maintain the M240G in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references, mount the MSG H60 to the amidships weapons mount in accordance with the reference.

(2) With the aid of references, adjust the safety stops on the MSG H60 in accordance with the reference.

(3) Without the aid of references, mount the M240G in the MSG H60 in accordance with the reference.

OUTLINE:

1. **Description Of The Msg H60 Gun Mount**.

a. The H60 Gun Mount provides a light, yet serviceable mount for the M240G machine-gun on aircraft, naval craft, and land vehicles. The mount is equip with a small or large pintle, allowing it to be used with a variety of stands. Based on the firing position required, the H60 can be used in a seated, kneeling, or standing position. The ammunition can holder, suitable for securing a 200 round can of ammo, is provided but can be removed if necessary .

b. The H60 gun mount sets upon the SVM-l stand which is mounted to the RAC. The stand provides a means of mounting the H60 mount to the rail of a naval craft or the sides and/or dashboard of a vehicle.

2. **Nomenclature.**

a. The mount has a carriage (1) which supports the cradle (2) and attaches to the stand, with the use of a pintle (3). The cradle has a front mounting slot (4) and a rear latch (5) that is used to

secure the machine-gun on to the mount. A latch lock assembly and quick release pin (6) and the weapon safety lanyard (7) are used to prevent any unintentional disengagement of the weapon from the mount. The ammunition can holder (8) is provided with an elastic ammo can retaining strap (9) with hooked ends to secure the can of ammo to the holder. The mount also has a 2 position elevation lock and elevation lock pin (10), a train lock and train lock pin (11), and a depression stop bolt (12). (See Figure 1)

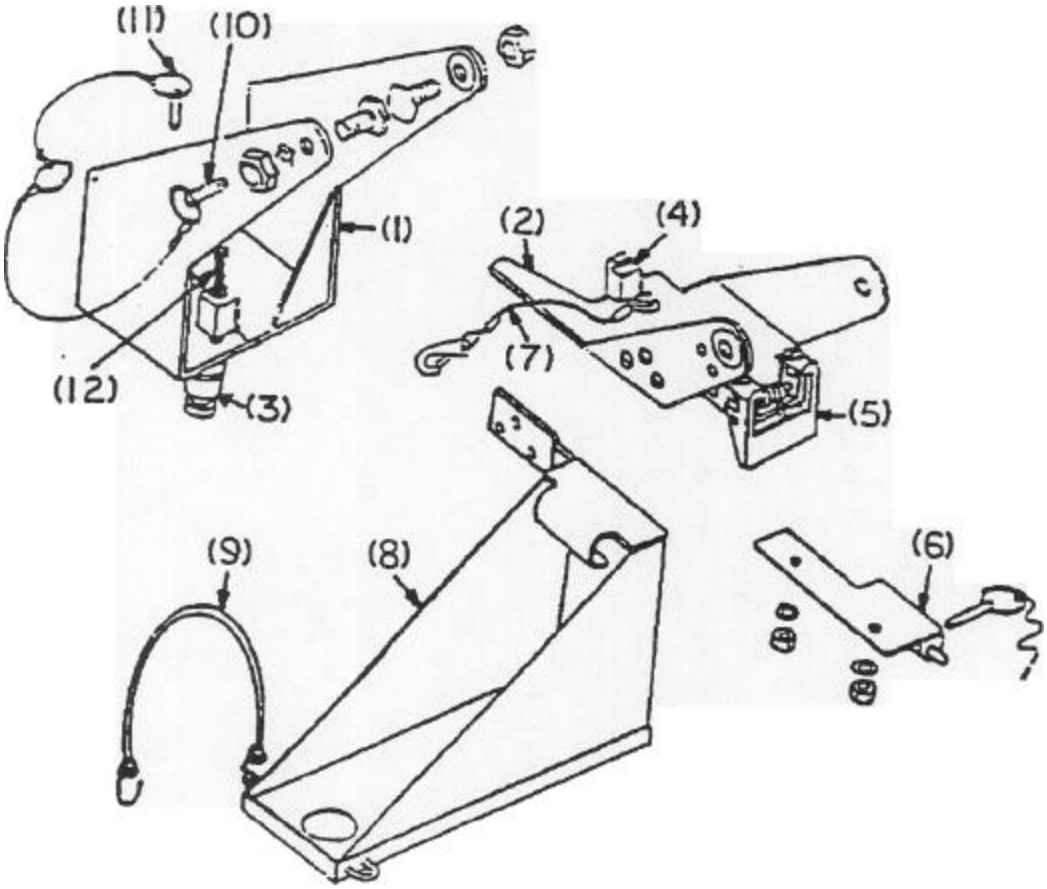

Figure 1, H60 GUN MOUNT (Exploded View)

b. The SVM-l stand (1) is equipped with a pintle bushing (2). The train lock pin hole (3) and train stop (4) are located on top of the pintle bushing. The H60 mount is secured to the stand by using a pintle retaining pin (5). A gasket (6) is provided for shock absorption between the stand and surface to which it is mounted. (See Figure 2)

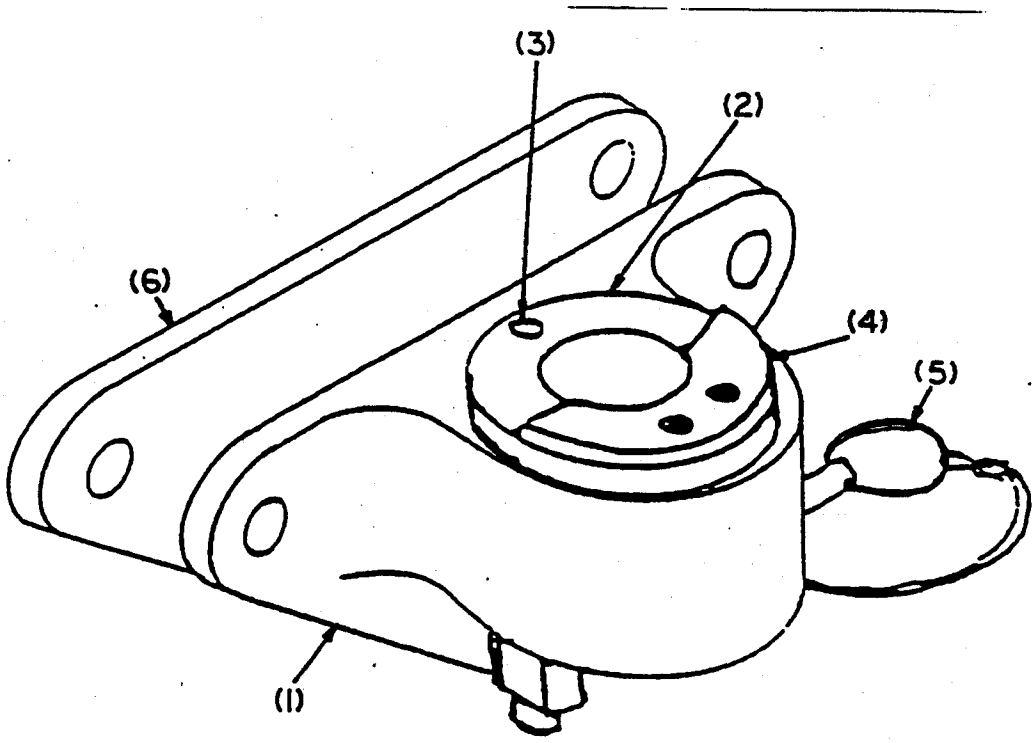

Figure 2-2, SVM-l STAND

c. Specifications:

(1) Maximum …….Elevation +40degrees

(2) Maximum Depression. …….27 degrees

(3) Maximum Train limited by fixed stops.

Safety Note: Train Stops must prevent the weapon from firing rounds no closer than 5 inches from surrounding structures or 15 inches from any manned station within the craft.

(4) Rear Area Working Circle: ……40 inches

(5) Weight. ……..15.5 lbs

(6) Length ……12.5inches

(7) Width ……17inches

3. **Installation**

a. Mount to Stand. Prior to installing the H60 mount to the SVM-l stand, ensure that the pintle bushing is generously greased inside the pintle bushing and on the pintle retaining pin.
The procedure for installation and removal is as follows;

(1) Pull quick release pin from the stand.

(2) Insert the pintle from the gun mount into the pintle bushing, ensuring that it is fully seated.

(3) Install the quick release pin and check for freedom of movement. Additionally check that the mount stops movement upon contact with the fixed train stop.

b. Weapon to Mount. Before installing the machine onto the H60 mount ensure that the weapon is on safe, the barrel is locked in to the receiver.

(1) Procedures for mounting the machine to the mount is as follows;

(a) Attach the snap hook of the safety lanyard to the front sling swivel.

(b) Remove quick release pin from the latch lock.

(c) Position the machine-guns carrying handle straight up and lock the bipod legs to the rear folded position.

(d) Place weapon onto the mount so that the front mount slot is aligned with the front mounting pin on the mount. Slide the machine-gun down and forward until the front mounting pin is engaged into the front mounting slot.

(e) Open the latch mechanism and lower the weapon so that the receiver lugs rest fully into the latch. Release latch.

(f) Insert the latch lock pin into the latch lock. Push again on the latch mechanism and test to ensure that the receiver lugs remain within the latch.

(g) Rotate carrying handle to left.

(h) If the weapon and stand are to be made for transport, ensure that the train lock pin is inserted into the train lock pin hole. Also ensure the elevation lock pin is inserted into the elevation lock pin hole. Prior to firing these pins should be removed.

c. **Ammunition Can Installation**

(1) Remove lid from can

(2) Hold ammo can at an angle toward the mount and slide the one end of the can under the ramp of the can holder. Ensure that the rounds are facing forward.

(3) Lower can into the bottom of the tray till fully seated.

(4) Pull the ammo can retaining strap over the can and hook to the eye on the ammo can holder.

Safety Note: Ensure the ammo can is fully seated into the holder and the retaining strap is in place before firing weapon.

4. Depression Stop. Upon installation of the machine-gun and mount at a firing station, the depression stop should be checked. The depression stop should allow for the arc of fire of the weapon to be 5 inches above and away from the tallest structure on the craft and 15 inches away from the nearest manned station. The weapon should never be fired before the depression stop is checked and adjusted if needed.

a. Checking the Depression Stop

(1) With mount on stand and weapon on the mount, ensure the machine-gun is clear of ammunition.

(2) With the weapon fully depressed, traverse from the left train stop to the right train stop. Observe for the tallest structure that is with the machine-guns arc of fire.

(3) No structure should be observed within a 5 inch limit of the arc off1Ie of the machine-gun.

(4) If no structures are seen with the limit, continue to make ready the weapon. If there are structures within the limits, adjustment to the depression stop must be done.

b. Making Depression Stop Adjustments.

(1) With the weapon mounted to the H60, elevation lock and train stop pins inserted, loosen the depression stop nut on the mount with a 9/16 inch wrench.

(2) Remove the elevation lock pin and the train stop pin to allow the gun to move freely.

(3) Traverse the machine-gun so that the weapon arc of fire is directed towards the tallest structure.

(4) Insert the depression stop adjustment guide into the barrel of the machine-gun the bottom edge of the guide should make contact with the structure being observed.

(5) Holding the weapon and mount in place, attach a "C" clamp to the mount between the cradle and the carriage.

(6) Raise the depression stop bolt till it makes full contact with the bottom of the cradle. Tighten the depression stop nut.

(7) Re-check depression stop adjustment guide, ensuring that the minimum limits are being maintained. Adjust as necessary.

(8) Remove "C" clamp.

5. Removal. Removing the weapon and components are basically conducted in reverse order of installation.

a. Removing the Ammunition Can

(1) Remove ammo can retaining strap from over the can and reattach the hook to the eye from under the ammo can holder.

(2) Holding can at an angle, slide the end of the can from underneath the ramp of the can holder.

(3) Lift and remove can from the bottom of the tray.

b. Removing Weapon from Mount. Prior to removing the weapon from the mount, ensure the weapon has been cleared of ammunition and the selector placed on SAFE.

(1) If not already installed, insert the train lock pin into the train lock pin hole, and the elevation lock pin into the elevation lock pin hole.

SO-534-6

(2) Pull quick release pin from latch lock.

(3) Push in on the latch mechanism to release the receiver lugs from the latch lock. Raise the weapon till the receiver lugs are clear of the latch lock.

(4) Pull weapon rearward, releasing the front mounting slot of the weapon from the front mounting slot on the mount. Then raise the weapon up and off of the mount.

(5) Detach lanyard snap hook from carrying handle and place carrying handle straight up.

Equipment Note: Care must be taken when removing the weapon from the front mounting pin. The front mounting slot must be fully clear of the pin before lifting the weapon. Should the pin still be engaged into the slot, the damage to the slot or the pin could happen, resulting in the cradle having to be replaced.

c. Mount from the Stand.

(1) Pull quick release pin from the stand.

(2) Lift and remove pintle of the gun mount from the pintle bushing of the stand.

(3) Reinstall the quick release pin to the stand.

6. **Maintenance.** The H60 gun mount and the SVM-l stand require regular maintenance just as any other piece of equipment. Maintenance should be performed after the completion of any live firing and on a weakly basis to maintain serviceability .

a. Before U se.

(1) Inspect to ensure gun mount and stand are clean and lightly lubricated. Pintle and pintle bushing should be lightly greased.

(2) Inspect all pins, ensuring lanyards, pin rings, and ball bearing tops are present and serviceable.

(3) Inspect to ensure the shoulder bolts, cap screws, and locking nuts are intact.

(4) Inspect the latch and latch spring for freedom of movement and serviceability.

(5) Inspect for any damage or defects in the cradle, carriage, ammo can holder, and latch lock assembly.

(6) Inspect serviceability of weapon retaining lanyard.

(7) Inspect train stop, ensure mount stops when contact is made.

b. During Use

(1) Frequently inspect to ensure all retaining pins remain intact with pin holes when inserted.

(2) Inspect latch lock assembly, ensuring weapon remains locked into position.

(3) Inspect depression stop bolt and nut. Ensure that the nut does not become loose on the bolt. Should this happen, immediately cease firing and readjust the depression stop.

c. After Use

(1) Clean dirt, mud, and salt water spay from the mount and stand using warm soapy, fresh water. Dry thoroughly!

(2) Apply a thin film of lubricant to all surfaces of the mount and stand.

(3) Apply a film of grease to the pintle, pintle bushing, and retaining pins.

(4) Check tightness of all bolts and lock nuts.

REFERENCE:

1 MSG H60 Operations, Maintenance and General Reference Manual

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
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TAB 535
MAR **99**

STUDENT OUTLINE

MK 93 MOUNT

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE:** Without the aid of references, when given a scenario, field firing range and target, engage a target as directed in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references and given the necessary materials, mount the MK 93 MOD 0 to the MK-16 MOD 8 and the SRS.

(2) Without the aid of references and given the necessary materials, properly check the depression stop adjustments.

(3) Without the aid of references and given the necessary materials, properly Mount and Dismount the M2 .50 caliber Machineguns to MK 93.

4) Without the aid of references and given the necessary materials, properly Mount and Dismount the MK 19 to the MK 93.

(5) Without the aid of references and given the necessary materials, Select the proper cleaning gear to PM the MK 93 MOD O

OUTLINE:

1 **Seat Rotating Stand (SRS).**

a. The Seated Rotating Stand (SRS) provides a platform for a weapons mount. (Figure 1-1) Bolt holes are provided at the front of the SRS for mounting of the **MK-16 MOD 8 Stand Assembly**. (Figurel-2)

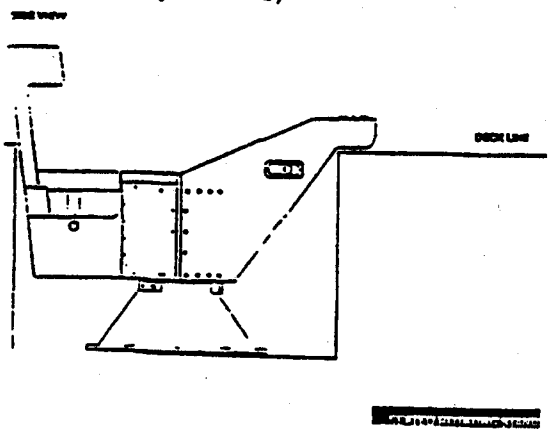
b. The advantages of the SRS are: A low profile, half the working circle of a standing gunner, more armor protection and less operator fatigue.

c. The SRS is equipped with a mechanical brake as well as a train lock pin to prevent unwanted rotation and has fixed train stops which may be set according to user requirements. The MK-16 stands are also equipped with train stops. This combination gives the user his total required train stop setting.

2. **Description Of The Mk 93 Mod 0 Gun Mount.**

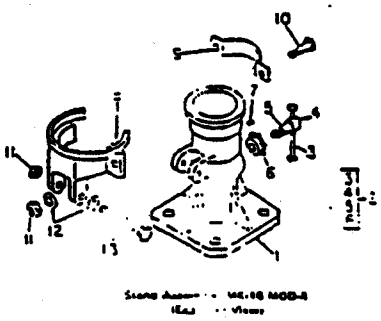
a. General Description. The Gun Mount MK 93 MOD 0 is made of stainless steel and will interface with either a M2-HB .50 caliber Machinegun or a MK 19 MOD 3 40mm Machinegun (Grenade Launcher). The .50 caliber is installed utilizing shock absorbers to reduce the recoil load. The shock absorbers rotate under the mount which allows a MK 19 MOD 3 to be hard mounted. (Figure 1-3)

(Figure 1-1)

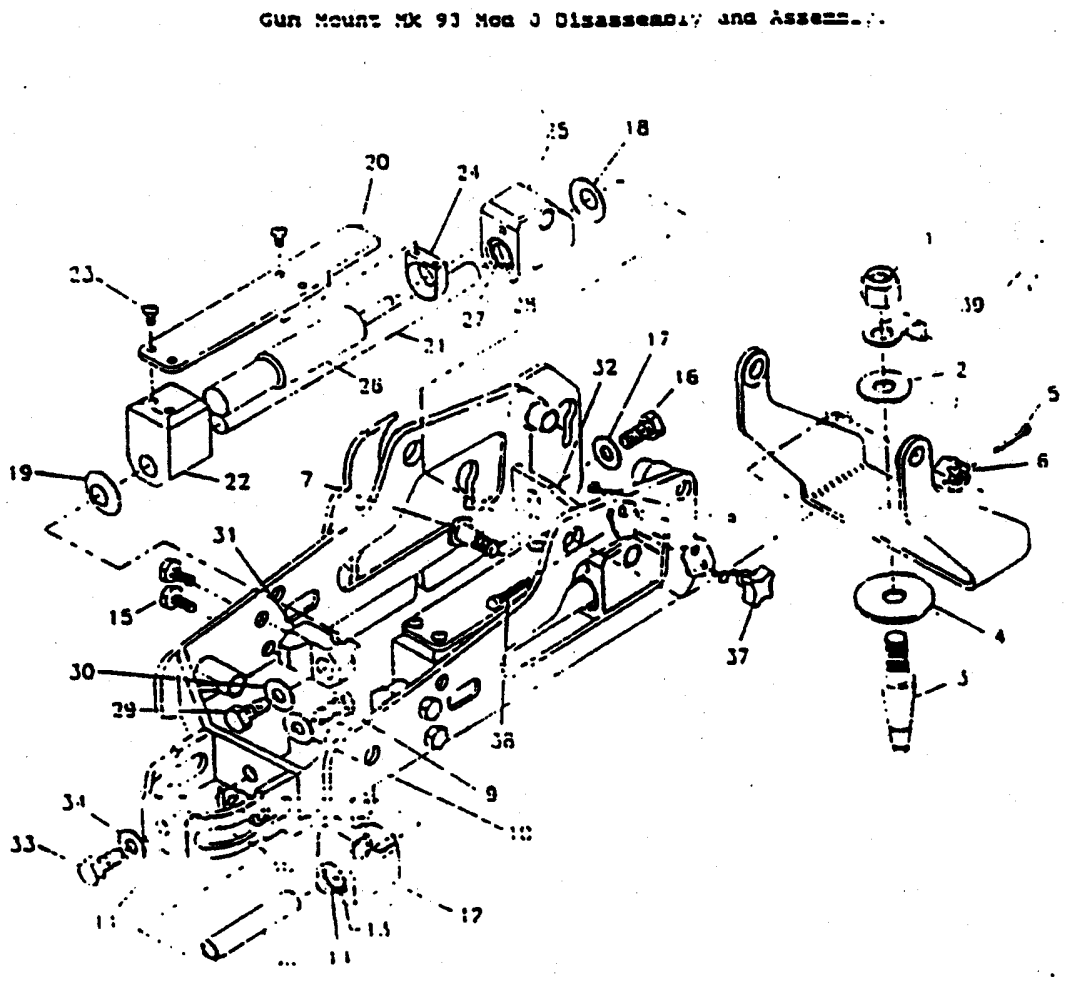


(Figure 1-2)

Item	Description	Part Number	Qty
1	Stand, MK-16 MOD-3	[illegible]	[illegible]
2	Clamp Assembly, Prime	[illegible]	[illegible]
3	Handle	[illegible]	[illegible]
4	Collar	[illegible]	[illegible]
5	Screw	[illegible]	[illegible]
6	Nut	[illegible]	[illegible]
7	Setscrew, Self Locking	[illegible]	[illegible]
8	Stop, Train	[illegible]	[illegible]
9	Clamp	[illegible]	[illegible]
10	Screw	[illegible]	[illegible]
11	Nut	[illegible]	[illegible]
12	Washer	[illegible]	[illegible]
13	Screw	[illegible]	[illegible]
14	Nut (not shown)	[illegible]	[illegible]
15	Cap Screw (not shown)	[illegible]	[illegible]
16	Gasket, Shock Absorbing (not shown)	[illegible]	[illegible]



b. Physical Description.



(1) Carriage Assembly .Is a yoke-shaped weldment and will accept either of two bolt-in pintle assemblies which mount through the drilled hole.

(2) Cradle Assembly. Provides features which facilitate mounting of the MK 19 or the M2 .50 caliber Machineguns.

(3) Train Sto12 Bracket. Is bolted to the carriage assembly and it replaces the top washer in the assembly. In Conjunction with the train stop brackets assembled to the MK 16 stand assembly which limits the degree of train allowed.

(4) Ammunition Can Holder. Attaches to the side of the cradle assembly ammunition can bracket, is for use with the .50 caliber. It holds a 100 round ammunition can. (figure 1-4)

(5) Bracket Mounting Assembly Attaches to the cradle assembly ammunition can bracket, and is for use with the MK 19. It holds a 48 round ammunition can. (figure 1-5)

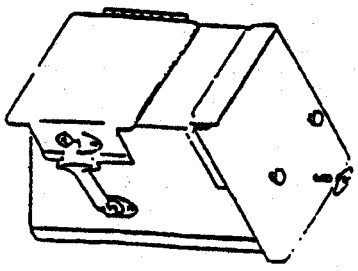
(6) Small Pintle. Is a threaded pintle which is inserted through a hole in the bottom plate of the carriage assembly and is bolted into place.

(7) Large Pintle. Is a threaded pintle which is inserted through a hole in the bottom plate of the carriage assembly, the train stop bracket replaces the top washer and the assembly is bolted in place.

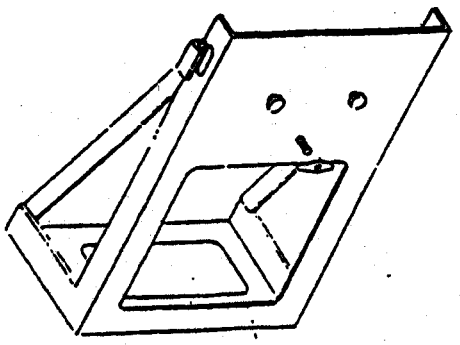
(8) Stowage Bar Assembly .Is an optional bar which attaches to the rear T &E Brackets of the carriage assembly. It is used in lieu of the train and elevation assembly to secure the rear of the mount in a stowage position for travel.

(figure 1-4)

(figure 1-4)



(figure 1-5)



(9) Armor Shield. Is optional, the MK 93 MOD 0 comes with or with or without, and can be mounted either in the front gun tub or rear gun tub of the RAC.

(10) Catch Bag Assembly Consist of a frame bag, and pin. The frame is installed into a slot in the front cross member of the cradle assembly. The bag is installed and held in place by Velcro strips after the frame is secured.

3. **General Data**

a. Weight: ……32.0 lbs

Height: ……10.0 in.

Radius of Front Working Circle:…….72.0 in.

Radius of Rear Working Circle:……..…60.0 in.

b. Operating Characteristics

Elevation Limits for M2-HB ……...Lower Degrees 27.0

…….Upper Degrees 67.0

Elevation Limits for MK 19……Adjustably
……Upper Degrees 67.0

4. **Mounting M2-HB**

a. Remove front .50 caliber pin assembly from the front slider assemblies.

b. Rotate front slider assemblies to the "UP" position.

c. Remove rear.50 caliber pin assembly from the rear slider assembly.

d. Rotate rear slider assembly to "UP" position.

e. Place M2-HB in mount and align front mounting hole with the bushings in the front slider assemblies. Insert front .50 caliber pin assembly through front slider assemblies and the weapon until the pin dent balls are secure and clearly visible.

f. Align rear mounting hole of the M2-HB with bushing in the rear slider assembly and insert rear .50 caliber pin assembly through the rear slider assembly and the weapon, until the mount pin detent balls are secure and clearly visible.

5. **Dismounting.** Reverse the procedures.

6. **Mounting MK 19 MOD 0.**

a. Ensure that the front slider assemblies are in the "DOWN" position and the front .50 caliber pin assembly is inserted through the bushings until the pin detent balls are secure and clearly visible.

b. Ensure rear slider assembly is in the "DOWN" position, the rear .50 caliber pin assembly is inserted through the bushing and the stowage bracket, and that the detent balls are secure and clearly visible.

c. Place the MK 19 MOD 3 in the mount and align two locking channel pins receiver with forward mounting pins on cradle.

d. Slide the MK 19 forward on mounting pins until mount holes in weapon sear assembly align with the upper rear holes in the cradle assembly.

e. Insert the rear MK 19 pin assembly through the cradle assembly and sear until the detent balls are secure and visible.

7. **Depression Stop**. Upon installation of the weapons and mounts depression stop should be checked. The depression stop should allow for the arc of fire of the weapon to be 5 inches above and away from the tallest structure on the craft and 15 inches away from the away from the nearest manned station. The weapon should never be fired before the depression stop is checked and adjusted if needed.

a. Checking the Depression Stop.

(1) With mount on stand and weapon on the mount, ensure the weapon is clear of ammunition.

(2) With the weapon fully depressed, traverse from the left train stop to the right train stop. Observe for the tallest structure that is with the weapon's arc of fire.

(3) No structure should be observed within a 5 inch limit of the structure and the arc of fire of the weapon.

(4) If no structures are seen within the limit, continue to make ready the weapon. If there are structures within the limits, adjustment to the depression stop must be made.

b. Making Depression Stop Adjustments.

(1) Install mount on stand.

(2) Check weapon to make sure that it is clear of ammo.

(3) Remove all internal parts and back plate or butt stock from weapon and install barrel.

(4) Install weapon to mount.

(5) Traverse SRS and mount to their respective train stops. As you traverse the weapon and mount from the left train stop to right train stop, observe the tallest structure in the arc of fire. Determine how far above that point you want the maximum depression to be **5 inches/127 millimeters is the minimum height above structure considered to be safe.**

(6) Tools needed: 9/16 inch open end wrench, Cardboard, Marker and C Clamp.

8. **PM Of The Mk 93 Mod 0**.

a. If exposed to salt water, rinse with fresh water first then lube with Cleaner Lubricant Preservative (CLP).

b. Clean immediately after use for 2 consecutive days thereafter. Remove all carbon, dirt, and rust which may be present on the mounts. Use the SL3 gear with the weapons being used.

REFERENCES:

1. TM 09557 A-14/11 Seated Rotating Stand (SRS) For the Riverine Assault Craft (RAC)

2. SW36l-AO-MMO-OlO Small Arms Machine Gun Mounts.

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB **536**
MAR **99**

STUDENT OUTLINE

M240G MACHINEGUN

LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVES:

(1) With the aid of references and given the necessary materials, maintain the M240G in accordance with the references.

(2) Without the aid of references, perform immediate actions on the M240G in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, list in writing, the characteristics of the M240G in accordance with the reference.

(2) Without the aid of references and when given a diagran1, identify in writing the nomenclature of the M240G in accordance with the reference.

(3) Without the aid of references, clear the M240G in accordance with the references.

(4) Without the aid of references, disassemble the M240G within 2 minutes in accordance with the reference.

(5) With the aid of references, clean the M240G in accordance with the references.

(6) Without the aid of references, assemble the M240G within 2 minutes in accordance with the references.

(7) Without the aid of references, perform a function check in accordance with the references.

(8) Without the aid of references and given a list of an1nlunition uses, match the ammunition markings to the appropriate uses in accordance with the references.

(9) Without the aid of references and given a belt of dummy ammunition, load the M240G in accordance with the references.

(10) Without the aid of references and a belt of dummy ammunition, unload the M240G in accordance with the references.

(11) Without the aid of references, describe in writing the proper cycle of functioning in accordance with the references.

(12) Without the aid of references, describe in writing the definition of stoppage in accordance with the references.

(13) Without the aid of references and given a list, select the definition of malfunction in accordance with the references.

(14) Without the aid of references, perform immediate action on the M240G in accordance with the references.

(15) Without the aid of references, perform remedial action on the M240G in accordance with the references.

OUTLINE:

1. **Characteristics**

a. The M240G machinegun is a belt fed, air cooled, gas operated, fully automatic machine gun that fires a 7.62mm round and is fired from the open bolt position.

b. Dimensions

(1) Weight -24.2 pounds

(2) Weight of barrel -6.61bs

(3) Length -49 inches

c. Range and Velocity

(1) Maximum effective range -1,800 meters

(2) Maximum range -3,725 meters

(3) Muzzle Velocity -2800 feet per second

d. Rates of Fire

(1) Sustained- 100 rounds per minute. (6 to 8 round burst with a 4. to 5 second pause, change barrels every 10 min).

(2) Rapid -200 rounds per minute. (6 to 8 round burst with a 2 to 3 second pause, change barrel every 2 minutes).

(3) Cyclic -650 to 950 rounds per minute. (Trigger pulled to the rear with no pause, change barrel every min).

2. **Nomenclature.** The M240G has eight main groups. They are the barrel assembly, trigger housing assembly, butt stock and buffer assembly, receiver assembly, drive spring rod assembly, bolt and operating rod assembly, cover assembly, and feed tray.

3. **Clearing The Gun.** Just like with any weapon safety, is the main concern. So, before we can begin disassembly we must first know how to clear the gun.

a. Place the safety switch on fire. Pull the cocking handle to the rear with right hand, palm up.

b. Place the safety switch on safe. The safety will be on "SAFE" every time the cover is opened. Return the cocking handle to he forward position.

c. Squeeze the cover latch to open the cover and raise the cover to the vertical position.

d. Raise the feed tray and visually inspect the chamber.

(1) If there is a round in the chamber, remove it by inserting a cleaning rod from the muzzle end, and continue with the procedure.

(2) The gunner will yell "CLEAR",

e. Pull the cocking handle to the rear.

f. Use your left hand to pull the trigger while holding the cocking handle to the rear.

g. Ride the bolt forward until it locks fully forward and the cocking lever is fully locked in its forward position.

h. At this time the gun is considered to be clear.

4. General Disassembly. There are 8 main assemblies to the M240G machine gun. Detail disassembly begins with the bolt forward, cover raised.

a. Remove the Butt stock and Buffer Assembly:

(1) Press the Back plate Latch

(2) Slide the Butt stock upward and remove from the receiver.

b. Remove the Drive Spring Rod Assembly

(1) To remove the drive spring rod assembly, first push in against its base.

(2) Lift up and outward so that it clears its retaining studs inside the receiver .

(3) Remove it from the rear of the receiver.

c. Removing the Bolt and Operating Rod Assembly

(1) Pull the cocking handle to the rear to start the rearward movement of the bolt and operating assembly inside the receiver.

(2) With the index finger, reach inside the top of the receiver and push rearward on the face of the bolt until the bolt and operating rod assembly is exposed at the rear of the receiver.

(3) Grasp the bolt and operating rod assembly and remove it from the rear of the receiver.

(4) To separate the operating rod and bolt remove the spring-loaded pin that holds them together.

(5) Then, pull the bolt forward until it is clear of the firing pin, thus disengaging the bolt from the operating rod.

d. Removing the Trigger Housing Assembly

(1) Remove the trigger housing assembly spring pin.

(2) Rotate the rear of the trigger housing assembly down, disengage the holding notch at the front of the assembly from its recess on the bottom of the receiver and remove the assembly from the receiver.

(3) The trigger housing group consists of the trigger housing assembly and the trigger housing assembly spring pin.

e. Removing the Barrel Assembly

(1) Press the barrel locking lever.

(2) Rotate charging handle to upright position.

(3) Push forward separating the barrel from the receiver.

(4) Grasp and rotate gas collar clockwise until it releases from the gas plug.

(5) Slide gas regulator plug to the rear out of gas regulator.

f. Removing the Cover Assembly

(1) Remove Hinge Pin Spring

(2) Remove Cover Assembly

g. Removing the Feed Tray:

(1) Lift off the receiver assembly.

h. This will leave the receiver assembly as the eighth assembly.

5. **Operational Maintenance Check And Service**. These are checks that the gunner must perform before he can safely fire the weapon. They are divided into three groups; before, during and after firing checks.

a. Before firing checks include the following

(1) Visually check for any missing or damaged tools and equipment.

(2) Run a dry swab through the bore to remove excess CLP or obstructions.

(3) Disassemble the gun into its major groups or assemblies.

(4) Clean all metal parts thoroughly and apply a light coat of oil to all metal parts.

(5) Moving parts: generously lube and test for worn or broken parts. They should function without excessive friction.

(6) Gas plug is on setting one and completely assembled,

b. During firing checks

(1) While firing maintain a light coat of lubrication on the gun and a generous amount of lube on friction producing parts.

(2) Change barrels as necessary

c. After firing check. (Consists of a detailed inspection and cleaning of the gun and equipment)

d. Cleaning the machine gun

(1) After firing, clean the gun with CLP, RBC, or dry cleaning solvent.

(2) The gun must be cleaned for 3 consecutive days after firing.

(a) After each day of cleaning, wipe all cleaning materials from the gun and apply a light coat of CLP on all metal parts.

(3) If dry cleaning solvent is used special care should be made to keep it off all plastic and rubber surfaces, as well as the butt stock buffer assembly.

e. Inspecting the machinegun. Always check for cleanliness but also inspect for:

(1) Broken parts

(2) Missing parts

(3) Burred parts

(4) Rust

(5) Operation of moving parts

f. Lubricating the machinegun

(1) In general, lightly lubricated all metal parts of the gun to guard against rust.

(2) Generously lubricate all metal parts of the gun that cause friction.

(3) Do not lubricate the gas piston, rubberized portions, or plastic portions of the gun.

g. Types of lubricants. The kind of lubricants you will use on the M240G will depend primarily on the ambient temperature.

(1) CLP is used under all but the coldest arctic conditions.

(2) Lubricating oil, weapon (LAW) is used when the temperature drops below 0 degrees F.

(3) LSA can be used above 0 degrees F.

h. Special maintenance

(1) In cold climates, the gun must be kept free of excess oil and moisture. If the gun is brought indoors, allow the weapon to come to room temperature, then wipe it completely dry and apply a light coat of oil.

(2) In hot humid climates, the gun must be inspected frequently for rust and moisture. A light coat of oil should be maintained at all times.

(3) In a hot dry climate, the gun should be cleaned daily and the oil wiped off. Enough oil will remain in the pores of the metal to lubricate the gun. Excess oil will attract dust and sand to the weapon.

i. Cleaning material:

(1) Spare barrel case

(2) 2-bore brushes

(3) l-receiver brush

(4) l-chamber brush

(5) 5 section cleaning rod with head assembly and swab holder to be carried in a small arms cleaning rod case

(6) Ruptured cartridge extractor

(7) 5/32 hex wrench

(8) Reamer cleaner

(9) Scraper combination reamer

(10) Tool combination front sight adjustment

(11) Tool combination scraper and extractor

6. **Detail Assembly**. Assembly is done in reverse order of disassembly. The receiver will be the base so start with the Feed Tray.

a. Replace the Feed Tray: Place the cover onto the receiver, aligning its guides with the receiver bracket.

b. Replace the Cover Assembly

(1) Place cover on receiver aligning its holes with the mounting bracket.

(2) Close cover.

(3) Insert Spring Hinge Pin.

(4) Open Cover

c. Replace Barrel Assembly

(1) Insert gas regulator plug, set number 1.

(2) Place collar over forward end of gas regulator plug. Rotate counter-clockwise until it locks into place. (Ensure locked in position).

(3) Place barrel in receiver.

(4) Rotate changing handle down.

(5) Count clicks.

d. Replace Trigger Housing Assembly:

(1) Insert forward notch of trigger housing into recess of receiver.

(2) Rotate the trigger housing up to rear mounting lug.

(3) Insert trigger housing spring pin.

e. Replace Bolt and Operating Rod Assembly

(1) Slide bolt over firing pin.

(2) Insert Spring Loaded Pin.

(3) Replace Bolt and Operating Rod Assembly back into receiver.

f. Replace Drive Spring Rod Assembly

(1) Insert in the back of receiver.

(2) Push in and down.

(3) Align the retaining stud up with the receiver bottom.

g. Replace Butt stock and Buffer Assembly

(1) Align the Butt stock with the receiver.

(2) Press on back plate latch.

(3) Push down to seat on receiver.

7. **Function Check.** To perform a functions check, do the following:

a. Pull bolt to the rear .

b. Put weapon on safe.

c. Close the cover.

d. Return cocking handle forward.

e. Attempt to fire.

f. Place weapon on fire.

g. Pull cocking handle to rear and ride bolt home.

h. Half cock weapon.

i. Put weapon on safe.

8. **Five Types Of Machinegun Ammunition**

a. The tracer cartridge is used for observation of fire, incendiary effect, signaling, marking targets and during training. For easy identification, the tip of the tracer round is painted orange.

b. The ball cartridge is used for marksmanship training, and against personnel and lightly armored material targets. The tip of the ball cartridge is not painted.

c. The armor piercing round is used against lightly armored targets and is for combat use only. The tip of the armor piercing round is black.

d. The blank cartridge is used for training when simulated firing is desired. The blank round is identified by the crimped end and lack of projectile.

e. The dummy round is used for crew drill and practice in loading the gun. The dummy round has three holes drilled through the cartridge case and no markings on the round.

9. Operation Of The M240G Machinegun: Operation of the M240G machinegun is broken into four parts. Loading, unloading, changing the barrel, and clearing the gun. There are two methods of loading the M240G machinegun, the cover raised method and the closed cover method.

a. Raised Cover Method.

(1) The gunner ensures that the bolt is to the rear and the safety lever is on safe.

(2) Raise the cover

(3) Take a belt of ammunition and place the first round directly over the feed aperture with the open side of the link down.

(4) Now close the cover and place the safety lever on fire.

(5) The gun is now loaded and ready to fire.

b. Cover Closed Method. The cover closed method is the alternate method:

(1) Ensure that the bolt is forward, the safety lever is on fire and the cover remains closed.

(2) Take a belt of ammunition, ensure that the open end of the link is down, and force the first round into the feed tray until a distinct click is heard. The click indicates that the first round has passed to the right and the holding pawls has engaged it.

(3) Then pull the cocking handle to the rear and return it to the forward position.

(4) The gun is now fully loaded.

10. **Unloading**

a. To unload the machinegun, ensure that the bolt is to the rear and the safety lever is on safe.

b. Raises the cover.

c. Remove the ammunition and links from the feed tray.

d. Raise the feed tray and visually inspect the receiver and chamber to ensure no rounds remain in them.

e. Once the feed tray, receiver and chamber have been cleared of all ammunition and links, the gun is considered to be unloaded.

11. **Changing Of The Barrel.** When firing the gun, either in practice or .in combat, the barrel should be changed:

a. After firing the cyclic rate for one minute.

b. After firing the rapid rate for two minutes.

c. After firing the sustained rate for ten minutes.

d. Ensure the bolt is to the rear and the safety lever is on safe, cover raised and gun unloaded.

e. Push in on the barrel locking latch with the left hand.

f. Grasp the barrel by the changing handle and remove it from the gun, then place the barrel to the left in such a way that the barrel socket is not resting in the dirt or on the spare barrel bag.

g. Now grasp the spare barrel by the changing handle and insert it into the gun.

h. Lower the changing handle, insuring proper headspace, which is 2 to 7 clicks.

i. Changing of the barrel is now complete.

12. **Clearing The Machinegun After Firing**

a. Ensure that the bolt is to the rear and the safety lever is on safe.

b. Then raise the cover and remove all ammunition and links from the feed tray.

c. Next run a cleaning rod down the barrel.

e. When you are able to see the tip of the cleaning rod, will sound off " all clear",

f. The gun is now considered to be clear.

13. **The Cycle Of Functioning**. The cycle of functioning is broken down into eight steps. It begins by loading a round in the feed tray groove and then pulling the trigger. It ends when the trigger is released.

a. Feeding. This step is completed when the round is positioned in the feed tray groove either by hand or by the action of the cover parts.

b. Chambering

(1) This is accomplished when the bolt moves forward, strips the round from the links and pushes it forward into the chamber.

(2) The round is forced down by the chambering ramp as the bolt travels forward.

(3) As the round is fully chambered the extractor snaps over the base of the cartridge and the ejector is depressed.

c. Locking. Actually takes the same time as chambering

(1) The bolt enters the barrel socket by the swinging of the locking lever locking it into the barrel socket.

(2) The bolt and barrel do not actually lock. That is why you can remove the barrel with the bolt forward.

d. Firing.

(1) After the bolt is locked, the operating rod moves freely carrying the firing pin through the firing pin aperture, striking the prime, firing the round.

e. Unlocking

(1) Unlocking is accomplished by the action of the gas, on the gas piston, which forces the operating rod to the rear.

f. Extracting. The extractor grips the rim of the cartridge as the bolt and operating rod pull the case from the chamber.

g. Ejecting. Ejecting is accomplished by the push of the ejector on the top of the casing.

(1) The casing is ejected as soon as it is in line with the cartridge ejection port.

h. Cocking. This process of placing the parts to fire the next round.

(1) Firing pin removed from the face of the bolt.

(2) Bolt has moved far enough back to pick up the next round.

i. This completes one cycle of functioning of the machinegun. If the trigger is compressed again the cycle will begin again.

14. **Malfunctions.** A malfunction is a failure of the machinegun to function properly. The two most common types on malfunctions are sluggish operation and a runaway gun.

a. Sluggish operation, nom1ally caused by excessive friction or excessive lose of gas.

(1) Check gas setting

(2) Clean, inspect and re-lube

b. A Runaway gun is when the gun continues to fire after the trigger is released usually caused by a worn, broken or burred sear.

(1) If parts are worn they need to be replaced.

(2) The action taken for a runaway gun, bipod or tripod mounted, is to twist and break the belt of ammunition.

(3) If firing in the assault, hold gun on target.

15. **Stoppages.** A stoppage is an interruption in the cycle of function cause by a faulty gun or ammunition. In short the gun stops firing.

a. Stoppage must be cleared quickly.

b. Apply immediate action

c. Definitions of stoppages:

(1) A hang fire is a round that goes off some time after the firing pin strikes the primer and is a rare occurrence.

(2) A spent cartridge is a casing that does not fully eject from the gun. It is cleared by pulling the cocking handle to the rear just far enough to release pressure on the cartridge. Remove the cartridge and let go of the cocking lever.

(3) A cook off is a round that goes off due to the heat of the barrel, igniting the powder in the round.

16. **Immediate Action**. The prompt action taken by the gunner to reduce a stoppage of the machinegun without investigating the cause is immediate action.

a. If the gun stops firing, the gunner will perform immediate action.

(1) The first step in immediate action is wait five seconds (Hang fire) pull the bolt to the rear return cocking handle forward.

b. Round or casing ejected attempt to fire. If the weapons fires continue mission. Fails to fire place the safety on safe, assume there is a live round in chamber decide whether barrel is hot or cold.

c. Bolt cannot be pulled to the rear assume live round in chamber place safety on safe and wait until barrel reaches air temperature.

d. Round or casing not ejected safety on safe assume a live round is in. the chamber. Decide whether you have a hot or cold barrel.

e. Hot barrel. A hot barrel is when you fire 150 rds or more in a 2 min time period. When you have a hot barrel, you will wait until the barrel has reached air temperature, proceed with cold barrel procedures. Put safety on safe.

f. Cold barrel. A cold barrel is less than 150 rds in 2 minutes. The first thing you do in a cold barrel situation is raise feed tray cover remove the ammo belt and links, inspect chamber, and clear the gun and inspect it. Wait 5 seconds for a hang fire.

REFERENCES:

1. TM 08670A-10/1A Operator's Manual, Machinegun, 7.62rnm M240
2. TM 086708-10/1 Supplement 1 M240G
3. FMFRP 6-15 Machineguns and Machinegun Gunnery

NOTES:

ATTACHMENTS: None

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 537
MAR 99

STUDENT OUTLINE

THE BROWNING .50 CALIBER HB, M2 MACHINE GUN

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE(S):**

(1) With the aid of references and given the necessary materials, maintain the M2 in accordance with the references.

(2) Without the aid of references, set headspace and timing on the M2 in accordance with the references.

(3) Without the aid of references, perform immediate actions on the M2 in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) Without the aid of references, when given a list, select the characteristics of the M2 in accordance with the references.

(2) Without the aid of references when given a diagram, identify the nomenclature of the M2 in accordance with the references.

(3) Without the aid of references, clear the M2 in accordance with the references.

(4) Without the aid of references, disassemble the M2 within 3 minutes in accordance with the references.

(5) Without the aid of references, assemble the M2 within 3 minutes in accordance with the references.

(6) Without the aid of references perform, a function check in accordance with the references.

(7) Without the aid of references when given a list, select the authorized cleaning material in accordance with the references.

(8) Without the aid of references, set headspace on the M2 in accordance with the references.

(9) Without the aid of references set timing on the M2 in accordance with the references.

(10) Without the aid of references and given a list of ammunition uses, match the ammunition marking to the appropriate uses in accordance with the references.

(11) Without the aid of references and a belt of ammunition, load the M2 in accordance with the references.

(12) Without the aid of references and a belt of ammunition, unload the M2 in accordance with the references.

(13) Without the aid of references and given a list, select the proper cycle of functioning in accordance with the references.

(14) Without the aid of references and given a list, select the definition of stoppages in accordance with the references.

(15) Without the aid of references and given a list, select the definition of malfunction in accordance with the references.

(16) Without the aid of references perform immediate action on the M2 in accordance with the references.

(17) Without the aid of references, perform remedial action on the M2 in accordance with the references.

OUTLINE:

A versatile weapon used on the Riverine Assault Craft is the Browning .50 caliber HB M2 machinegun. The M2 serves the same role on the RAC as it does when ground fired. Offensive and/or defensive combat! As a gunner, you must understand how the weapon works, fires and is employed to be effective. This class will give you basic knowledge on the weapon and its operation.

1. Description: The Browning machinegun, caliber .50 HB, M2 is a belt-fed, recoil- operated, air-cooled, crew-served machinegun. The gun is capable of single-shot fire as well as automatic.

a. The machinegun has two different roles:

(1) It can provide a volume of close accurate, heavy fire for accomplishment of the mission in the attack.

(2) It can also deliver long range, close defensive, and final protective fires (FPF) as part of a units defense.

b. The machinegun can also provide the following:

(1) Protective fires for vehicular movements and convoys.

(2) Defense against low flying aircraft and small boats.

(3) Destroy light armored vehicles.

(4) Conduct reconnaissance by fire on suspected enemy positions.

2. **Characteristics Of The M2**

a. Weight:

(1) Receiver group ……..60 Lbs

(2) Barrel …….24LBS

b. Length:

(1) Barrel …….45 in.

(2) Overall …….……..65 in.

c. Range:

(1) Maximum ……..6,800 meters

(2) Maximum Effective ……..1,830 meters

d. Rate of Fire:

(1) Single Shot

(2) Sustained …….40 rds or less per Min.
(6-9 round bursts of automatic fire, fired in 10-15 second intervals)

(3) Rapid ……..40 rds or more per Min.
(6-9 round bursts of automatic fire, fired in 5-10 second intervals)

(4) Cyclic……450-550 rds per Min. (fired without a break in firing)

3. **Nomenclature:**

a. The Browning Machinegun cal .50 consists of 12 major groups and assemblies. (Fig 1)

(1) Barrel Group

(a) Barrel Carrier Assembly

(b) Barrel Assembly

(c) Flash Hider

(2) Bolt Group and Rod Assembly

(a) Bolt Group

1 Bolt .

2. Barrel Buffer Group

3. Barrel Extension Group

(b) Drive Spring Rod Assembly

(3) Cover and Receiver Group

(a) Back plate Assembly

(b) Shoulder Headless Pin (Bolt Stud)

(c) Cover Group

(d) Retracting Slide Handle

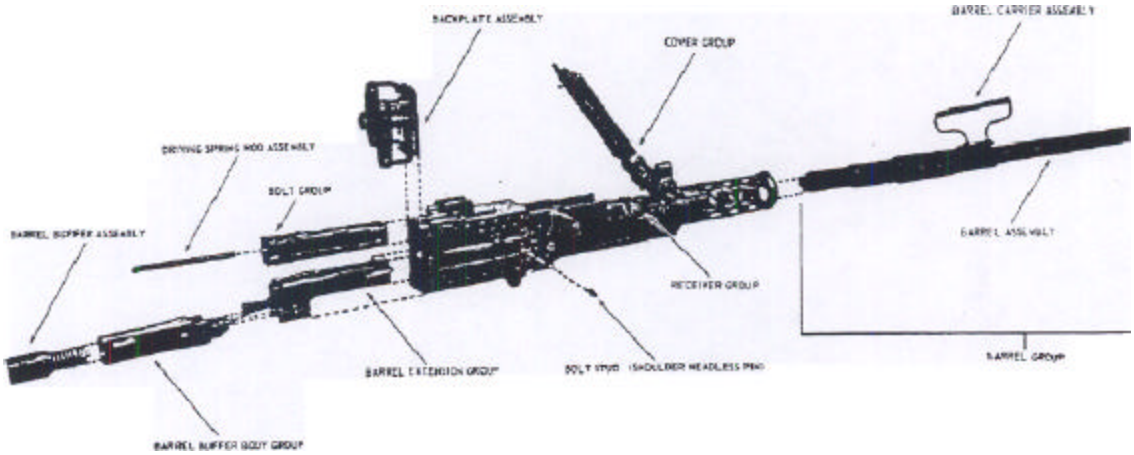


Figure 1, MAJOR GROUPS

4. <u>Disassembly And Assembly Of The M2</u>

a. There are two (2) classifications of disassembly and assembly. These are:

(1) General disassembly and assembly. The removal and/or replacing of major groups and assemblies of the gun.

(2) Detail disassembly and assembly. Removing and/or replacing of all component parts of each major group and assembly.

b. Prior to disassembling the machinegun, it should be cleared to insure the weapon is unloaded and in a safe condition.

(1) Unlock the bolt-latch release (if applicable) and raise the cover.

(2) Lift extractor and remove ammunition, if loaded.

(3) Pull bolt to rear.

(4) Inspect the chamber and T -slot for rounds.

(5) Press the bolt-latch release and "ride" the bolt forward.

(6) Close cover.

c. <u>General Disassembly:</u>

(1) *Remove Barrel Group*. First raise the cover. Grasp the retracting slide handle and pull the bolt to the rear, aligning the barrel locking lug spring with the 3/8 in hole on the right side plate of the gun. Being careful not to damage the threads or the barrel-locking notches, unscrew the barrel. Allow the bolt to go forward slowly. Do not let the bolt slam forward while the barrels removed.

(2) *Remove Back plate Assembly*. Insure bolt latch release is up. Bolt must be forward before the back plate assembly can be removed. Located below the buffer tube sleeve is the back plate latch and the back plate latch lock. Pull ***OUT*** on the latch lock an *UP* on the latch. Lift straight up on the back plate assembly to remove from receiver. (Fig 2)

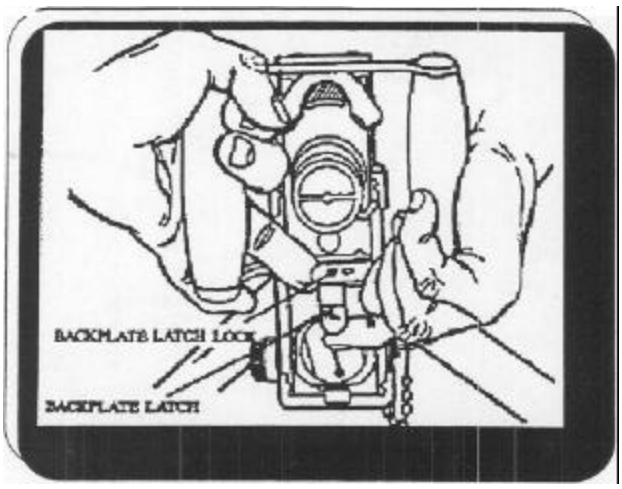


Figure 2, REMOVING THE BACK PLATE ASSEMBLY

(3) *Remove Drive-Spring Rod Assembly*. Located next to the right side plate inside the receiver is the drive-spring rod assembly. Push in and to the left on the head of the head of the drive-spring rod. Once released from the side plate, pull the entire assembly out of the rear of the receiver.

(4) *Remove the Shoulder Headless Pin {Bolt Stud)*. Grasping the retracting slide handle, jerk the bolt half-way to the rear. The collar of the bolt stud must be aligned with the 3/8 inch hole (bolt slot) in the right side plate. Remove by pulling the bolt stud to the right and out of the receiver..

(5) *Remove the Bolt Group*. Push up on the bolt latch to free the bolt group and slide it from the rear of the receiver. Place the bolt down on its right side so that the extractor will not fall from the bolt. (Fig 3)

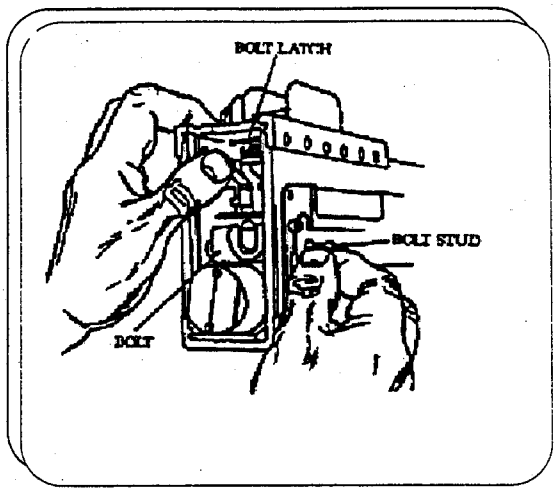


Figure 3, REMOVE THE BOLT GROUP

(a) Detail disassembly. For purposes of cleaning and maintenance, the bolt is disassembled in detail. (Fig 4)

1 *Extractor*. Rotate the extractor upward and remove it from the bolt, freeing the bolt switch.

2. *Bolt switch and bolt switch stud*. Lift out the bolt switch and pullout the bolt switch stud. On some models of machineguns, the bolt switch stud is stacked so that it can not be removed.

1 *Cocking lever pin and cocking lever*. Rotate the top of the cocking lever toward the rear of the bolt. Remove the cocking lever pin. Lift out the cocking lever, note that the rounded nose of the lever is down and to the rear of the bolt).

4. *Sear stop pin.* Using the thin end of the cocking lever, pry the sear stop out of its groove in the bolt, and into the center recess. Turn the bolt over and drift the sear stop pin free from engagement with the firing pin spring. Turn the bolt back over and lift the sear stop and pin from the bolt.

5. *Sear, sear slide, sear spring* Press down on the sear and remove the sear slide. Lift the sear of the bolt. Using the thin end of the cocking lever, insert between the coils of the spring and remove spring from bolt.

6 *Firing pin extension assembly and firing pin* . Raise the front of the bolt, allowing the firing pin extension assembly to slide out of the rear of the bolt into the hand. Separate the firing pin from the extension.

(b) Assembly of the bolt group is conducted in reverse order of disassembly

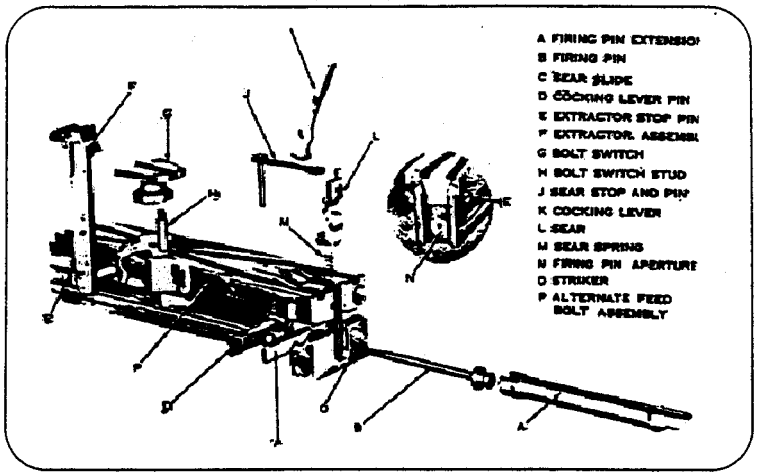


Figure 4, DETAIL DISASSEMBLY, BOLT GROUP

(6) *Remove the Barrel Buffer Group and the Barrel Extension Group*. Insert a punch through the hole in the receiver located on the lower back comer of the right side plate. Push in on the barrel buffer body lock spring, while at the same time pushing the barrel extension group and the barrel buffer body group out of the rear of the receiver. Once clear of the receiver, the two groups can be separated by pushing forward on the accelerator tips. (Fig 5)

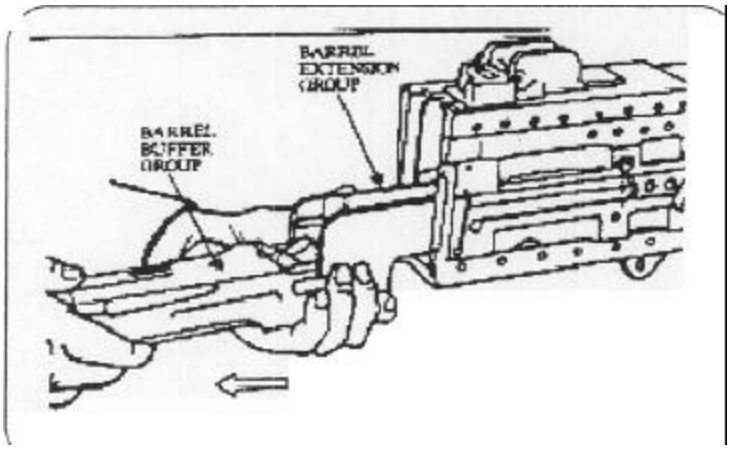


Figure 5, REMOVING THE BARREL BUFFER & BARREL EXTENSION GROUP

(7) *Remove the Barrel Buffer Assembly*. The barrel buffer assembly is removed from the barrel buffer body group by pulling out to the rear. The barrel buffer body assembly is not disassembled (Fig 6)

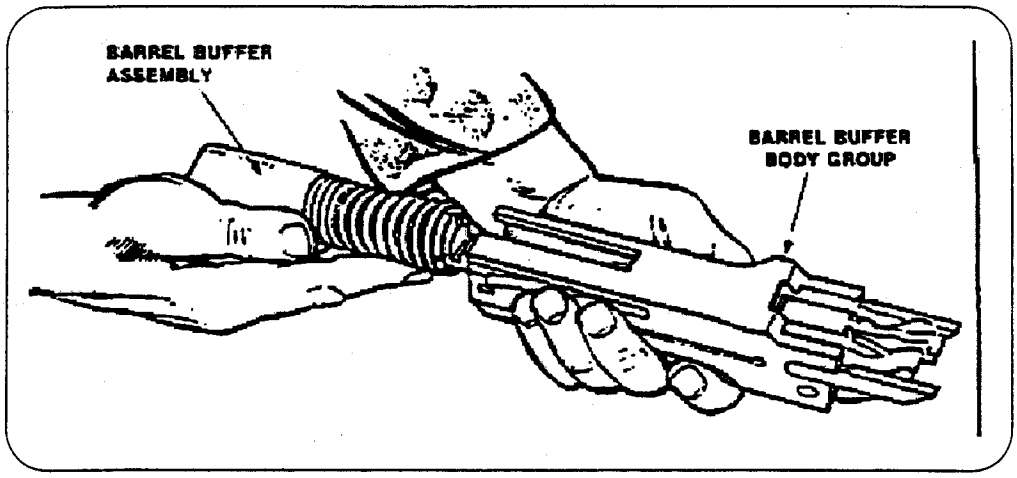


Figure 6, SEPARATING THE BARREL BUFFER ASSEMBLY

(8) With disassembly complete, preventive maintenance and cleaning can be conducted

d. Care and Cleaning. Complete and thorough knowledge of how to properly care, clean, and maintaining the machinegun cannot be over emphasized enough. These actions will determine whether or not the weapon will function properly.

(1) For proper cleaning of the machinegun, a systematic method of maintenance should be developed. Most importantly though, is that the weapon must be cleaned as soon as possible after firing or exposure to field or training environments. Keep in mind that under extreme climatic and combat conditions, the machinegun should be cleaned and oiled daily.

(2) Cleaning material authorized for the M2 .50 cal are listed as follows:

(a) Cleaner, Lubricant, and Protectant (CLP). A thin oil made of a special cleaning solution and lubricant containing teflon. Used for cleaning and lubricating during normal and for the prevention of rust. CLP is the preferred material for cleaning and lubricating the gun.

(b) Rifle Bore Cleaner (RBC). Used to clean the bore of the gun after having been fired. After cleaning with RBC, immediately dry the bore and any other parts exposed to the cleaner; then apply a thin coat of CLP .

(c) Lubricating Oil Arctic Weapons (LAW). Used in the same manner as CLP , except that it is only used in temperature below 0 degrees Fahrenheit.

(d) Warm soapy water.

Equipment Note: When using any other agent other than CLP to clean the weapon, it should be thoroughly dried and a thin coat of CLP applied.

(3) Care and Cleaning Under Unusual Condition. Weather, especially inclement weather has an adverse effect on the machine guns operation and functioning. Care should be taken to reduce these effects and must be cleaned daily with the prescribed lubricants. In addition, the weapon should be covered and protected from the elements as much as possible when not in use.

(a) Cold Climates. Keep the gun covered as much as possible. Lubricate with CLP. Under conditions when the temperature is sustained under 0 degrees Fahrenheit, use LAW . During times of cleaning, the weapon should be removed from the elements and taken inside. Allow the gun to warm to room temperature and then clean. It is important that all moisture is removed from the machinegun and CLP, (or LAW if required), be applied.

(b) Hot, Humid Climates. The gun should be inspected more often for any signs of rust. Maintain moisture free as much as possible and keep lightly lubricated with CLP .

(c) Hot, Dry Climates. This type of weather is usua11y associated with the desert. Care should be taken to prevent sand and other debris from entering into the inside of the gun. When cleaning and lubing, only an extreme light coat of oil is needed.

(d) Nuclear, Biological, and Chemical (NBC) Conditions. In the event that contamination is expected, apply lubricant to all outside surfaces. Keep covered as much as possible. Should the gun become exposed, decontaminate as prescribed in FM 21-40, Chemical, Biological, Radiological, and Nuclear Defense.

e. Assembly. Assembly of the machinegun is conducted in the reverse order that disassembly occurred. Once assembly has been completed, Timing and Headspace must be checked.

5. **Setting Timing And Headspace**

a. Proper timing and headspace is essential to the operation of the caliber .50, M2 machine gun, and to the safety of the machinegun crew. Should incorrect adjustments be placed on the weapon improper functioning, damage to parts, and/or personal injury may occur.

b. Timing and headspace can be explained as follows:

(1) Headspace is the distance between the face of the bolt and the base of the cartridge case, (cartridge fully seated in the chamber .

(2) Timing is the adjustment of the gun so that firing takes place when the recoiling parts are in the correct position for firing.

c. Timing and headspace should be checked and set prior to firing, when gun has been disassembled and reassembled, whenever the barrel or any major group within the receiver has been replaced, or whenever there is any doubt that correct adjustments are set.

d. Setting and adjusting timing and/or headspace is set with the headspace and timing gage and is done as follows:

(1) Headspace

(a) Raise the cover up all the way. Grasp the retracting slide handle and retract the bolt until the barrel-locking-spring lug is centered in the 3/8-inch hole, located on the right side of the receiver. (Fig. 7)

(b) Hold the bolt in this position and screw the barrel fully into the barrel extension. (Fig.8)

(c) Still holding the bolt retracted, unscrew the barrel two notched, (clicks). Now release the retracting slide handle and allow bolt to go forward.

Equipment Note: With the bolt forward, check the barrel rotation. Grasping the barrel, attempt to turn the barrel in either direction. The barrel should not turn. If the barrel does turn, return weapon to armory for possible damage.

(d) Cock the gun; Pull the retracting slide handle all the way to the rear, (Fig. 9) then return it to the forward position. Press the bolt release latch and allow the bolt to go forward. DO NOT PRESS THE TRIGGER!

(e) Pull the retracting slide handle back until the barrel extension is approximately 1/16-inch from trunnion block. (Fig. 10) This insures the locking surfaces of the breech lock and the bolt are in proper contact.

(f) Insert the **GO** end of the headspace gage into the T -slot, between the face of the bolt and the rear end of the barrel. (Fig. 11) If **GO** end of gage enters freely down to the center ring of the gage, then attempt to insert the **NO GO** end of the gage. (Fig. 12) If the **GO** enters and the **NO GO** does not, then correct headspace is set.

(g) If the **GO** end of the gage does not enter, headspace is to tight. Adjust by pulling the retracting slide handle back so that the barrel-Locking-lug spring is aligned with the hole on the right side. Then unscrew the barrel one notch (click) from the barrel extension. Check headspace till correct.

(h) If the **NO GO** end of the gage enters the T-slot, headspace is to loose. Adjustments are made the same as above except, the barrel must be screwed into the barrel extension, again one notch at a time. Ensure to check the headspace distance after each click until the **GO** enters and the **NO GO** does not.

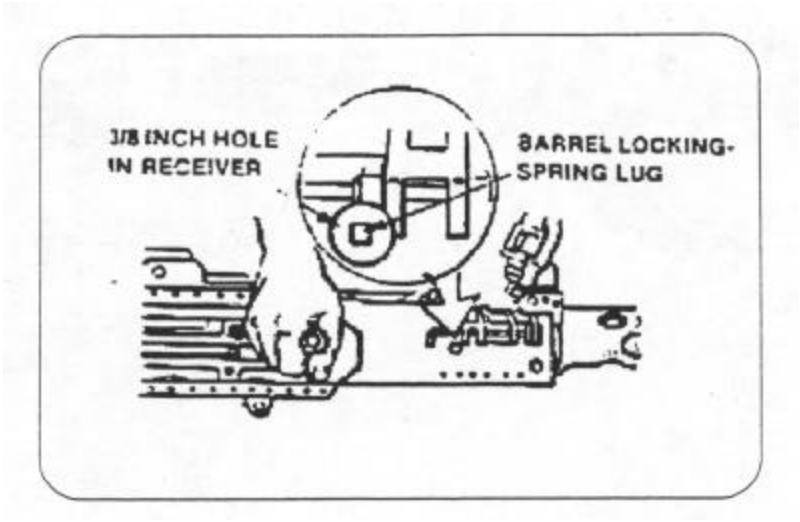


Figure 7, BARREL LOCKING SPRING CENTERED IN 3/8 HOLE

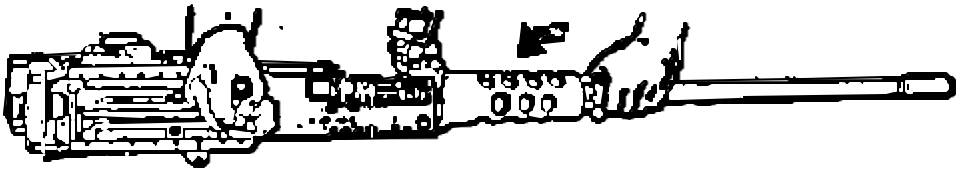


Figure 8, BARREL SCREWED INTO BARREL EXTENSION

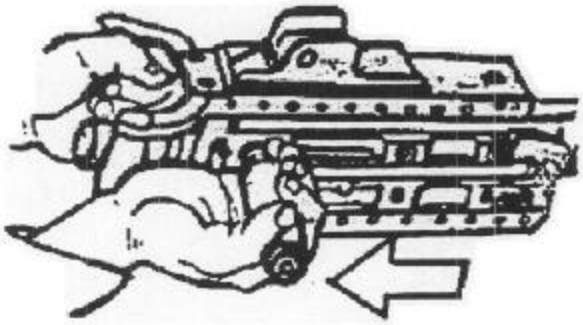


Figure 9, COCK THE GUN

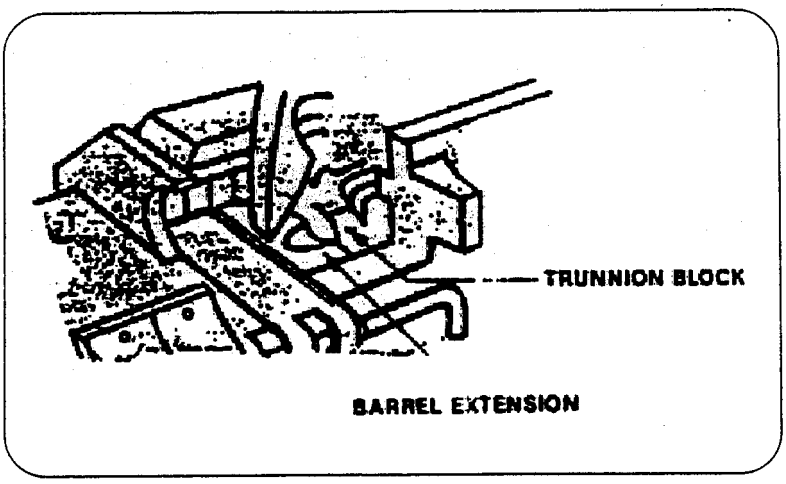


Figure 10, BARREL EXTENSION 1/16" FROM TRUNNION BLOCK

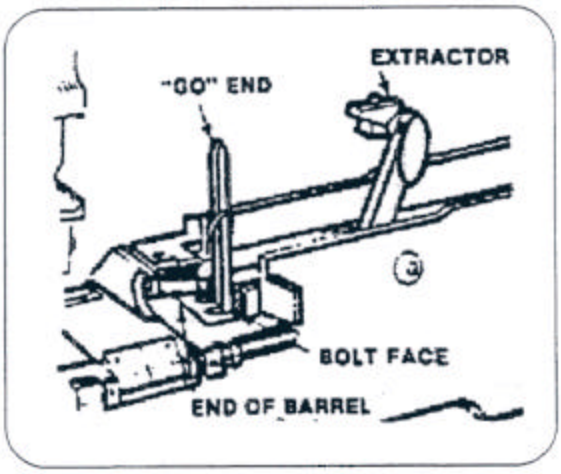


Figure 11, INSERT "GO"

SO-537-13

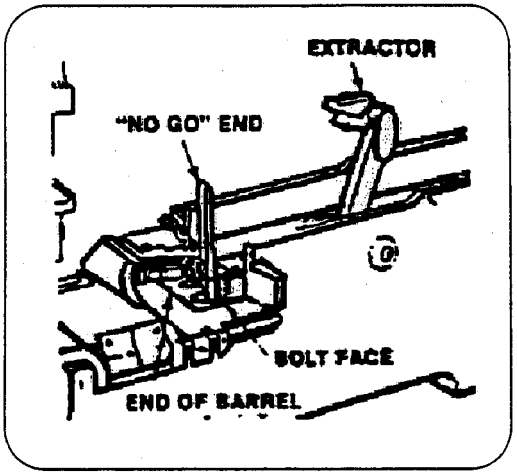


Figure 12, INSERT "NO GO"

(2) Timing:

(a) Headspace must be checked prior to checking timing.

(b) Cock the gun; Pull the retracting slide handle all the way to the rear, then return it to the forward most position. Press the bolt release latch and allow the bolt to go forward. DO NOT DEPRESS THE TRIGGER!

(c) Raise the extractor and pull the retracting slide handle back until the front of the barrel extension is approximatelyl/4 inch from the trunnion block.

(d) Insert the **NO FIRE** timing gage between the barrel extension and the trunnion block. (Fig. 13) The beveled edge of the gage should be placed on the barrel notches. Allow the barrel to close slowly onto the gage.

(e) Depress the trigger. The firing pin should not release. If the firing pin does release, the weapon is not timed, and the gun will fire too early.

(f) To correct, pull the retracting slide handle to rear, remove **NO FIRE** gage and insert FIRE gage (Fig. 14), allow bolt to go forward.

(g) Remove back plate and screw the timing adjustment nut to the *left* until it rest on the trigger bar, (Fig. 15). Press up on the trigger lever attempting to fire. Rotate the timing adjustment nut to the *right* one notch at a time, pressing up on the trigger lever each time, attempting to fire. Continue process till firing pin is released.

(h) When the firing pin has been released, turn the timing adjustment nut to the *right* two additional times. Replace back plate.

(i) Recock the weapon. Insert the **NO FIRE** gage and attempt to fire the weapon by depressing the trigger. The weapon should not fire. (If weapon does fire, a defect is present and the weapon should be returned to the armory and maintenance personnel notified).

(j) Replace the **NO FIRE** gage with the FIRE gage and attempt to fire. The weapon should fire and the gun is correctly timed.

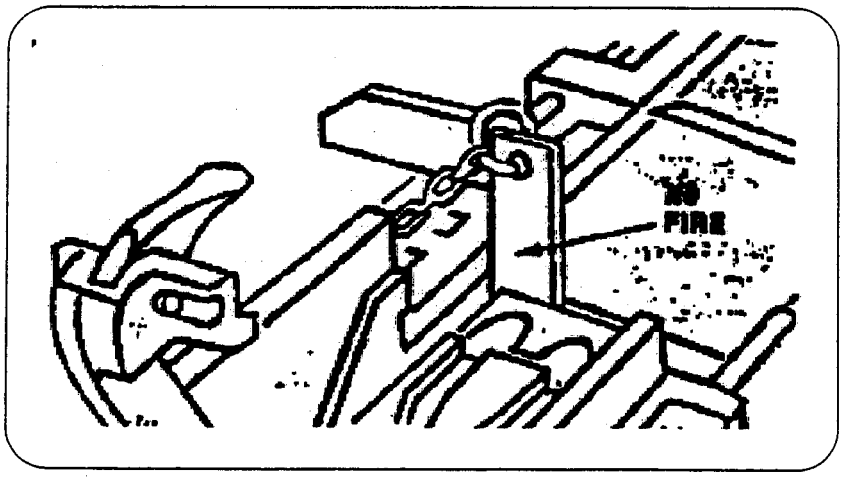


Figure 13, INSERT "NO FIRE"

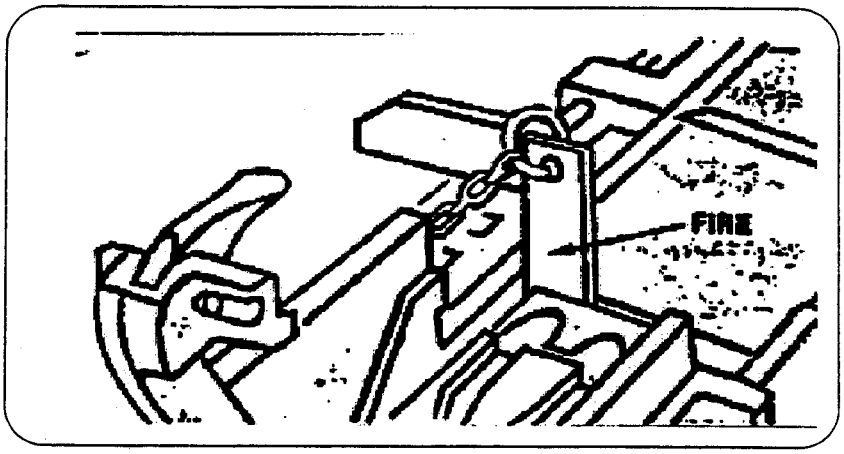


Figure 14, INSERT "FIRE"

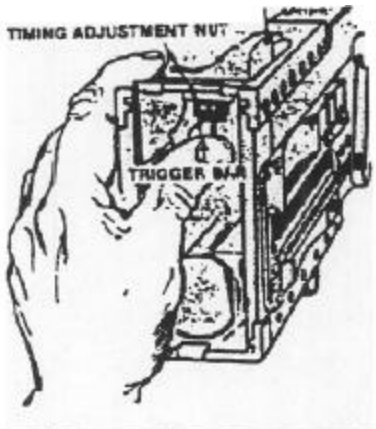


Figure 15, MAKING TIMING ADJUSTMENTS

6. **Ammunition:**

a. The caliber .50 ammunition for the M2 is issued as complete rounds in a metal split-linked disintegrating belt. Each gunner must be able to identify the types of ammunition and what each type is used for.

b. Classifications: There are eight of these and are as follows;

(1) Ba1l: No markings of any kind. Used against targets of light material and personnel. Also used during marksmanship training

(2) Tracer: Marked with a red, maroon, or an orange tip. Used for observation of fire, incendiary effect, signaling and the marking of targets.

(3) Armor Piercing: Marked by a black tip. Used against light armored targets where armor piercing effects are desired.

(4) Incendiary: Marked with a blue tip and mayor may not have a light blue ring. Produces incendiary effects, especially against aircraft.

(5) Armor Piercing Incendiary: Marked with an aluminum colored tip, or an aluminum ring with a blue tip. Used for armor-piercing, combined with fire producing (incendiary) effects.

(6) Armor Piercing Incendiary Tracer: Has an aluminum ring with a red tip. Produces the same effect as the armor piercing incendiary, but has the additional tracer feature.

(7) Dummy: Easily identified by the holes in the side of the cartridge body. Used for classroom training. It is completely inert, but serves to provide training of loading service ammunition.

(8) Blank: Easily identified by that it has no bullet. Used during training evolution's when simulated firing of service ammunition is desired. The blank firing adapter (BFA) must be attached.

7. **Loading**

a. There are two methods in which the machine gun is loaded. This begins with the half-load followed by the load method.

(1) To half-load the machinegun, the gunner will ensure that the bolt is forward and the cover closed.

(2) The assistant gunner then inserts the double loop end of the ammunition belt into the feedway until the first round is engaged by the belt-holding pawl.

(3) The gunner then grasps the retracting slide handle, palm facing up, and jerks it to the rear; and then releases the handle.

(a) If the bolt latch release lock is engaging the bolt latch release, the bolt and retracting slide handle will move forward, half loading the gun.

(b) If the bolt latch release is up and free of the bolt latch release lock, the bolt latch will hold the bolt and the retracting slide handle to the rear. If this is the case, the retracting slide handle must be manually returned to the forward position before releasing the bolt.

(4) To complete the half-load procedure, press the bolt latch release, allowing the bolt to go forward.

(5) To fully load the weapon, the procedure above is conducted, except that the gunner is required to pull and release the bolt twice. This action will chamber a round.

Equipment Note: The Browning Caliber .50 HB, M2 machinegun is capable of being loaded from either right of left side. The gun is commonly loaded from the left. To load from the right, the bolt switch and bolt switch stud (located inside the bolt group), must be turned to accept right side loading.

8. Unloading

a. To unload the gun, the gunner must unlock the bolt release latch, if engaged, and raise the cover.

b. The assistant gunner then removes the ammunition from the feedway.

c. The gunner then pulls the bolt to the rear and inspects the chamber and the T -slot. The

best method for inspecting is to (1) visually look inside the receiver, and (2) physically inspect by feeling the chamber and T -slot.

9. **Clearing**. Clearing the machinegun should be accomplished after every completion of firing. It requires the unloading procedures to be performed and:

a. Place a wooden block inside the receiver between the bolt and the rear of the barrel. The block should extend at least 1 inch above and below the receiver.

b. Using a cleaning rod, insert into the barrel, from the muzzle end, and push through till it can be seen in the receiver.

c. During periods when firing is at a lull and unloading the weapon is unnecessary , the bolt should be latched to the rear.

10. **Cycle Of Operation**. The cycle of operation of the machine gun has eight basic steps, Keep in mind that more than one step can occur at the same time.

a. Feeding. The action of placing a cartridge into the receiver, approximately behind the barrel, ready to be chambered.

b. Chamber. The placement of the round into the chamber.

c. Locking. The bolt is fully forward .and locked to the barrel and

the barrel extension.

d. Firing. Release of the firing pin, igniting the primer of the cartridge once the trigger is pulled.

e. Unlocking. Bolt is unlocked from the barrel and the barrel extension.

f. Extracting. The cartridge being pulled from the chamber as the bolt moves rearward.

g. Ejecting. The empty cartridge being ejected from the receiver through the ejection port.

h. Cocking. The firing pin is withdrawn into the cocked position when the bolt completes its full rearward movement.

Equipment Note: The cycle of operation for the machinegun begins with the belt of ammunition positioned over the belt holding pawl. The weapon must be manually operated to place the first round into the chamber.

11. **Malfunctions**. A malfunction is any failure of the gun to function properly. Defective ammo or unsatisfactory operation by the crew member is not considered a malfunction. The two most common malfunction of the M2 .50 caliber are:

a. Sluggish Operation. This is when the weapon fails to function freely. Usual caused by the buildup of carbon, dirt, lack of lubrication, or incorrect setting of timing and headspace. To correct this problem the weapon should be cleaned, inspected for burred parts, lubricated adequately, and correct timing and headspace set.

b. Uncontrolled Automatic Fire: Or, "runaway gun", as it is mostly referred to. This is when the machinegun continues to fire after the trigger has been released. This can be caused by a bent trigger lever, jammed or broken sideplate trigger, worn surfaces between the trigger lever and sear. Action to correct this will be covered in immediate action.

12. **Stoppages**: A stoppage is an interruption in the cycle of operation that is caused by faulty actions of the gun or by faulty ammunition. Some stoppages and their corrective actions are:

a. Failure to Feed

(1) Caused by: Defective parts in firing mechanism. Defective ammunition. Incorrect timing.

(2) Corrective action: Replace defective parts. Replace, exchange ammunition. Reset timing.

b. Failure to Chamber

(1) Caused by: Broken part or obstruction in T -slot or chamber. Ruptured cartridge.

(2) Corrective action: Clear T -slot or chamber of obstruction. Replace Broken part. Remove cartridge.

c. Failure to lock

(1) Caused by: Incorrect headspace or broken parts.

(2) Corrective action: Replace worn parts. Reset headspace.

d. Failure

(1) Caused by: Faulty ammo, broken or worn parts, incorrect timing.

(2) Corrective action: Replace ammo. Replace broken parts. Reset timing.

e. Failure to extract

(1) Caused by: Dirty chamber.

(2) Corrective action: Clean weapon

f. Failure to cock

(1) Caused by: Broken or worn sear. Worn sear notch. Weak sear spring. Worn hooked notch on firing pin extension. Broken cocking lever.

(2) Corrective action: Replace parts

g. Failure to feed

(1) Caused by: Defective ammunition. Defective feed mechanism. Defective Extractor. Improperly loaded ammunition belt.

(2) Corrective action: Replace defective parts. Replace ammunition. Correctly load ammunition.

h. Failure -to unlock

(1) Caused by: Broken parts in receiver.

(2) Corrective action: Replace parts.

i. Failure to extract

(1) Caused by: Dirty chamber. Ruptured cartridge.

(2) Corrective action: Clean weapon. Remove ruptured cartridge.

13. Immediate Action. Immediate action is that action taken to reduce a malfunction or stoppage without investigating the cause. Immediate action must be taken in the event of a the gun failing to fire or a misfire.

a. If the gun fails to fire.

(1) Keep weapon pointed in a safe direction. Wait 5 seconds, a hang fire may be causing the misfire. Next, pull bolt to rear, checking for ejection and feeding of the belt of ammo. Release bolt, relay gun back on target and attempt to fire.

(2) If the gun fails to fire again, wait another 5 seconds, pull bolt to rear and engage the bolt latch. Return retracting slide handle to forward position. Open cover, remove ammunition, and inspect the weapon to determine the cause of the stoppage.

(3) In the event of a misfire.

(a) Maintain the weapon pointed in a safe direction. Keep the round locked in the

chamber for the first 5 seconds after a misfire occurs. This will prevent an explosion outside of the gun in the event of a hang fire.

(b) If the barrel is hot, the round must be extracted within the next 5 seconds to prevent a cook off. The barrel is hot enough to cause a cook off if more than 150 rounds have been fired in a 2 minute period.

(c) When the barrel is hot and the round cannot be extracted with the 10 second time, the round must remain in the chamber for at least 5 minute. This is a safety precaution to guard against a cook off.

(d) The covered is to remain ***closed*** during all waiting periods.

(e) Remove round with the ruptured cartridge extractor .

(4) Uncontrolled automatic fire:

(a) KEEP THE COVER CLOSED! !

(b) Keep the machinegun laid on the target or in a safe direction.

(c) Twist the belt of ammunition, causing the gun to jam. The belt will not separate.

(d) This action may damage the feeding mechanism on the machinegun. Inspect and replace any worn, broken, or burred parts on the gun before placing back into action.

14. **Remedial Action**. Remedial action is that action taken to reduce or correct a stoppage. Most generally, the quickest way to resume firing is to replace the defective part.

a. Removing A Cartridge from the T -Slots. If the expended casing fails to fall from the receiver, use a cleaning rod and push the cartridge out the bottom.

b. Removing a Ruptured Cartridge. When an expended cartridge becomes lodged into the chamber, it is considered a ruptured cartridge. The quickest way to clear a ruptured cartridge is to use a cleaning rod and push it through the barrel bore from the muzzle end. Ensure that the bolt is locked to the rear. Another way is to use the ruptured cartridge extractor.

(1) To remove a ruptured cartridge the ruptured cartridge extractor must be used by following these steps:

(a) Raise cover and pull bolt to rear.

(b) Place the ruptured cartridge extractor in the T -slot of the bolt. It should be in the same position as if it were a round in the T -slot.

(c) Ensuring that the ruptured cartridge extractor is finally in place, allow the bolt to go forward into battery. This action forces the extractor through the ruptured casing.

(d) Pull bolt to the rear and remove the ruptured casing and extractor from the bolt.

(2) Anytime that a ruptured cartridge occurs the timing and headspace must be check and reset if required.

REFERENCE:

1. TM 9-1005-213-10, Operators Manual, Machinegun, Cal.50, M2
2. FMFRP 6-15, Machineguns and Machinegun Gunnery

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 538
MAR 99

STUDENT OUTLINE

MK19

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVES**:

(1) With the aid of references and given the necessary materials, maintain the MK19 in accordance with the reference.

(2) Without the aid of references, perform immediate actions on the MK19 in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references, describe in writing the characteristics of the MKI9 in accordance with the reference.

(2) Without the aid of references and when given a diagram, identify the nomenclature of the MK19 in accordance with the reference.

(3) Without the aid of references, clear the MK19 in accordance with the references.

(4) Without the aid of references, disassemble the MK 19 within 3 minutes in accordance with the reference.

(5) Without the aid of references when given cleaning materials in accordance with the references.

(6) Without the aid of references, assemble the MK19 within 3 minutes in accordance with the references.

(7) Without the aid of references, perform a function check in accordance with the references.

(8) Without the aid of references and given a list of ammunition uses, match the ammunition markings to the appropriate uses in accordance with the references.

(9) Without the aid of references and a belt of ammunition, load the MK 19 in accordance with the references.

(10) Without the aid of references and a belt of ammunition, unload the MK19 in accordance with the references.

(11) Without the aid of references describe in writing the proper cycle of functioning in accordance with the references.

(12) Without the aid of references describe in writing the definition of stoppage in accordance with the references.

(13) Without the aid of references describe in writing the definition of malfunction in accordance with the references.

(14) Without the aid of references, perform immediate action on the MK19 in accordance with the references.

(15) Without the aid of references, perform remedial action on the MK.19 in accordance with the references.

1. **Characteristics**

The MK 19 MOD 3 40mm machinegun, is a Blowback-operated, air-cooled, fully automatic weapon. The ammunition is fed into the gun by a disintegrating metallic link belt. The weapon features a barrel which prevents cook off even after prolonged firing.

2. General Data:

a. Weight: ……75.61bs

Length:……..43.1 in.

Width: ……..13.4 in.

Height:…….8.8 in.

b. Maximum Range: ……..2120 meters

Maximum Effective: ……...1500 meters

c. Rate of Fire: (fired in 3-5 round bursts when firing the MK 19 MOD 3 40MM Machinegun).

Sustained ……40 rounds/min

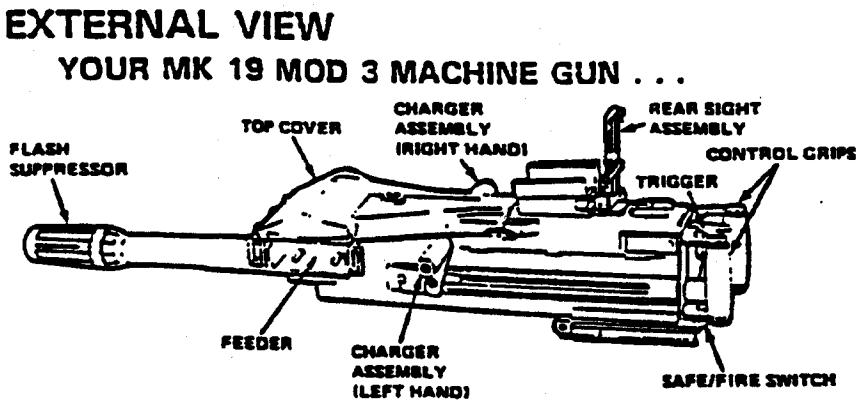
Rapid……60 rounds/min

Cyclic……..325-375 rounds/min

d. Muzzle Velocity……790 feet per second

3. **Nomenclature External**

a. Control Grip Assembly -located on the backplate.



(Figure 1)

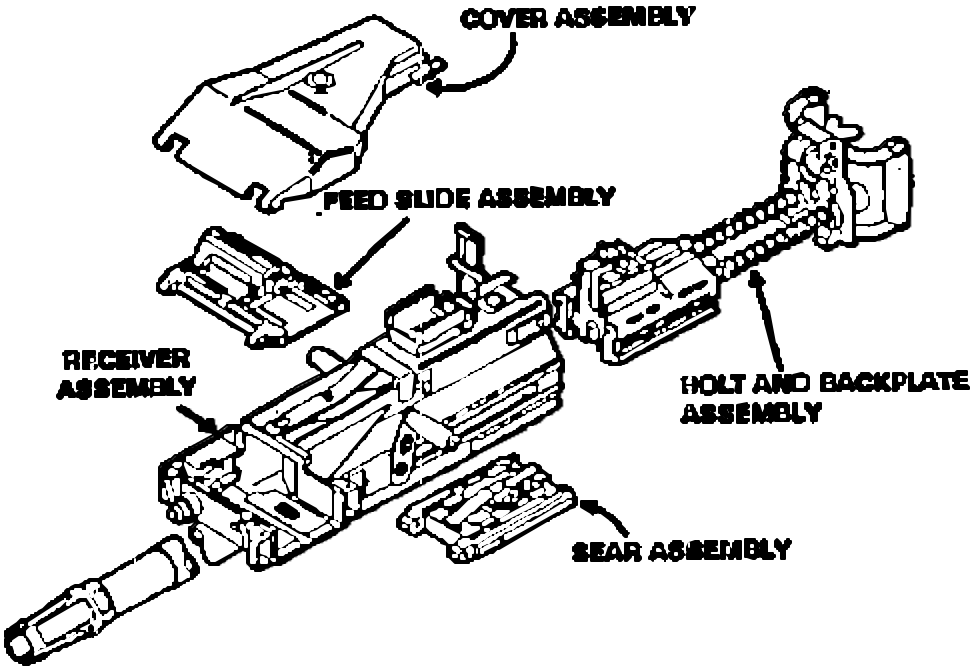
b. **Trigger** - located between the control grips. The trigger is a "butterfly" type.

c. **Thumb Safe** - located on the bottom rear of the gun.

d. **Rear Sight Assembly** - The base of the rear sight is designed to hold AN/TVS-5 Night Vision Sight. The elevation and windage Sight scale is graduated from 300 to 1500 meters. With the sight aperture fully lowered, the weapon's elevation is at 200 meters.

Charging Assemblies - MK 19 MOD 3 has a right-hand and left-hand assembly. Their Function is to pull the bolt to the rear into position for firing. Either charger can be used; it is best to pull both.

(Figure 2)



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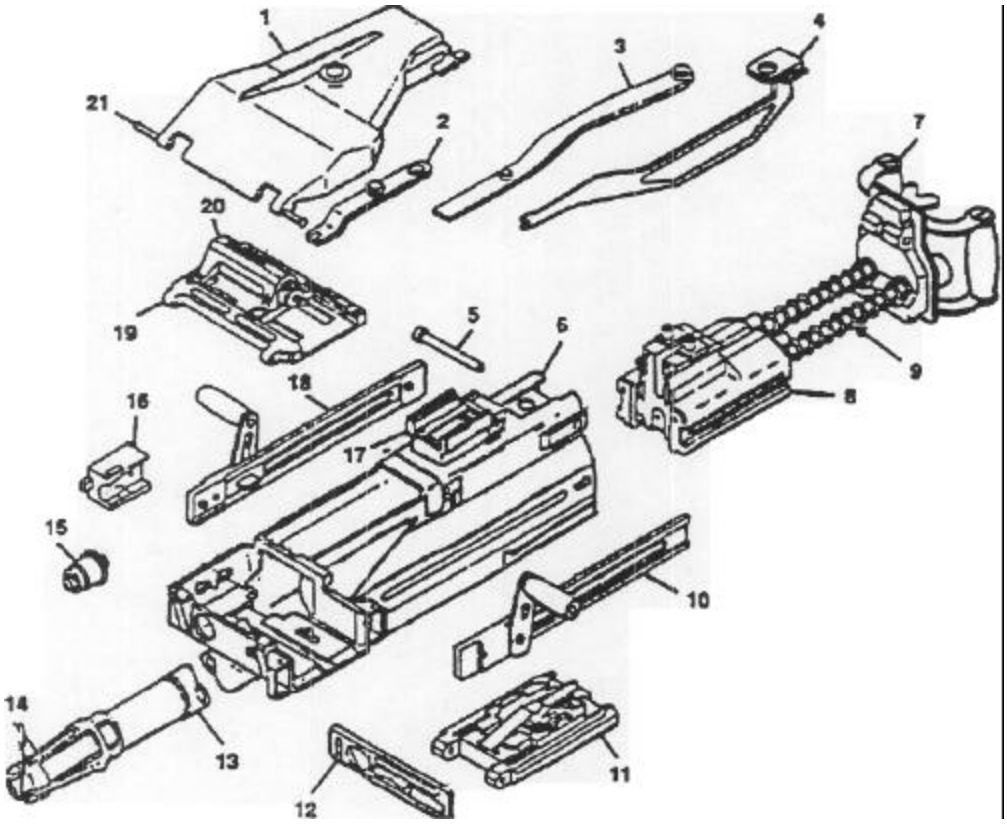
5. **Nomenclature Internal**

1. TOP COVER ASSEMBLY.
2. SECONDARY DRIVE LEVER ASSEMBLY.
3. PRIMARY DRIVE LEVER.
4. VERTICAL CAM ASSEMBLY.
5. BACKPLATE PIN ASSEMBLY.
6. RECEIVER ASSEMBLY.
7. CONTROL GRIP ASSEMBLY.
8. BOLT AND BACKPLATE ASSEMBLY.
9. GUIDE ROD AND SPRING.
10. CHARGER ASSEMBLY: LEFT.
11. SEAR ASSEMBLY.
12. ALIGNMENT GUIDE ASSEMBLY.
13. BARREL.
14. FLASH-SUPPRESSOR.
15. ROUND POSITIONING BLOCK.
15. OGIVE PLUNGER ASSEMBLY.
16. ROUND POSITIONING BLOCK.
17. REAR SIGHT ASSEMBLY.
18. CHARGER ASSEMBLY, RIGHT.
19. FEED TRAY.
20. FEED SLIDE ASSEMBLY.
21. COVER PINS.



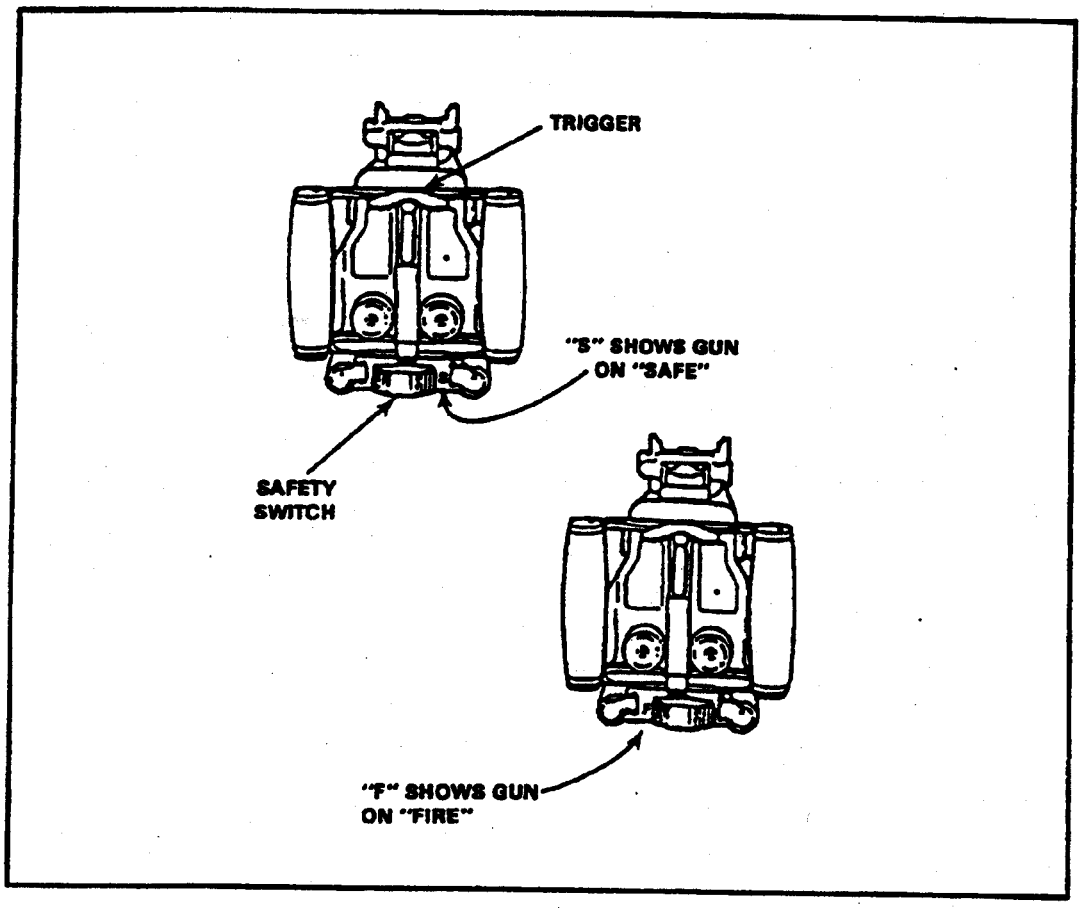
Top Cover Assembly- Opens by a latch mechanism on the left-hand side.

g. **Feeder**- located on the left-hand side. used for loading belts of rounds.

h. **Flash Suppressor**- located at the end of the barrel.

4. Nomenclature Five Major Assemblies

(figure 4)



SAFE ("S") position.

MK 19 Mod 3 40mm Machinegun consists of 5 major groups and assemblies.

(1) Receiver Assembly - with chargers, sight, barrel and flash suppressor holds the other four assemblies. Ammo is fed into the feeder (left side of receiver).

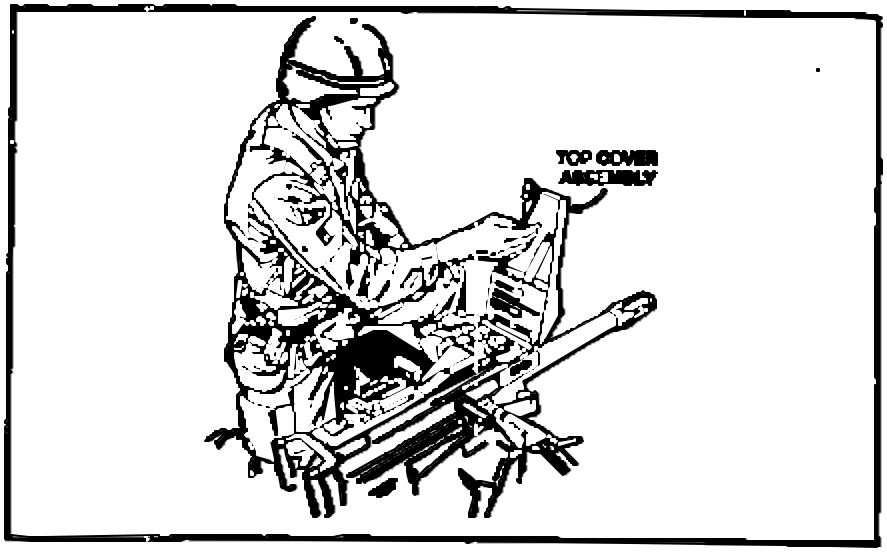
(2) Feed Slide Assembly and Tray -holds the rounds in the feeder and indexes the ammo into position for firing.

(3) Top Cover Assembly - holds the feed slide assembly and tray. It is opened by a latch (left side) for loading or to clean and inspect feeder area.

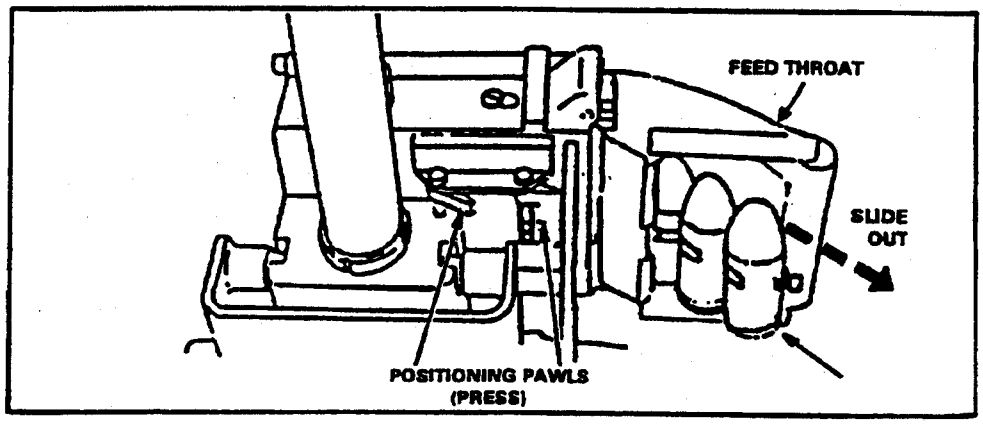
(4) Sear Assembly - holds the receiver sear. Trigger action releases the sear and allows the bolt to go forward. The safety is attached to the sear assembly.

(5) Bolt and Backplate Assembly -the bolt fires the round when the sear is depressed by trigger action. The recoil springs drive the bolt forward on the receiver rails. The guide rods hold the springs in position. Trigger and hand grips are located on the backplate assembly.

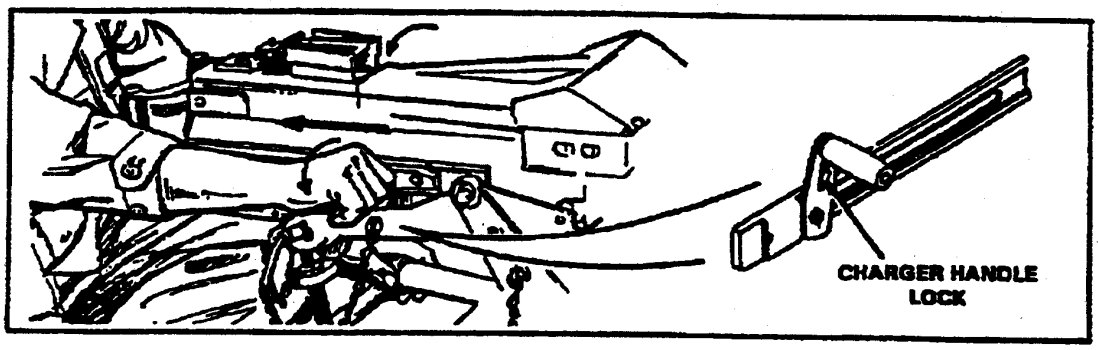
(figure 5/6)



Top cover assembly



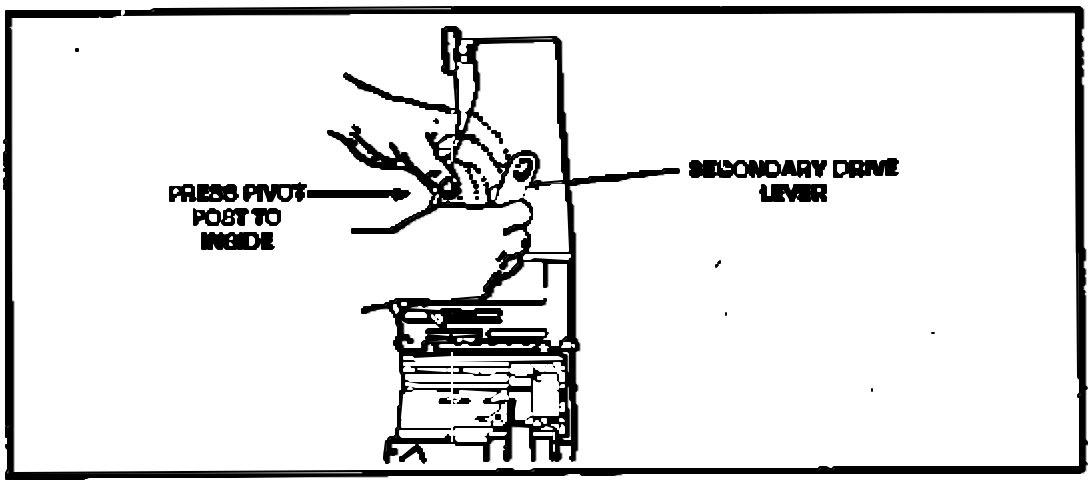
Removal of linked rounds from feeder



6. Clearing Procedure The MK 19 is clear differently in a firing situation than in a non firing situation:

a. Firing situation. In a firing situation, use the following procedures to clear the MK 19.

(1) Move the safety switch to SAFE ("S"). If all the ammunition has not been fired, the bolt is to the rear and around is on the bolt face.



Secondary drive lever removal

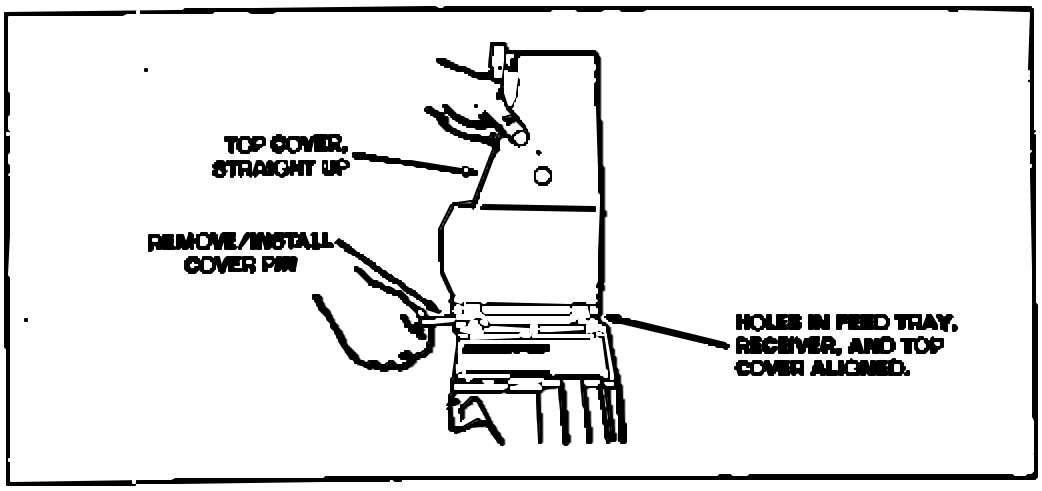
The MK 19 is clear differently in a firing situation than in a non firing situation:

6. **Clearing Procedure**

a. **Firing situation**. In a firing situation, use the following procedures to clear the MK 19.

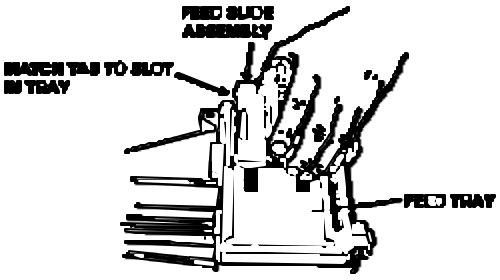
(1) Move the safety switch to SAFE (" S "). If all the ammunition has not been fired, the bolt is to the rear and around is on the bolt face.

(figure 9)



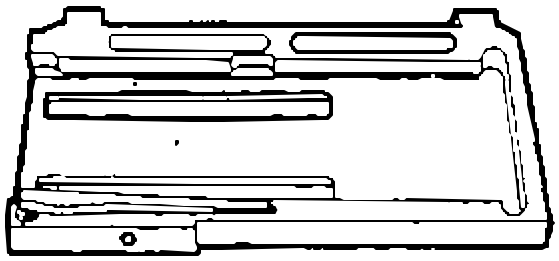
Top cover assembly

(figure 10)



Feed slide assembly

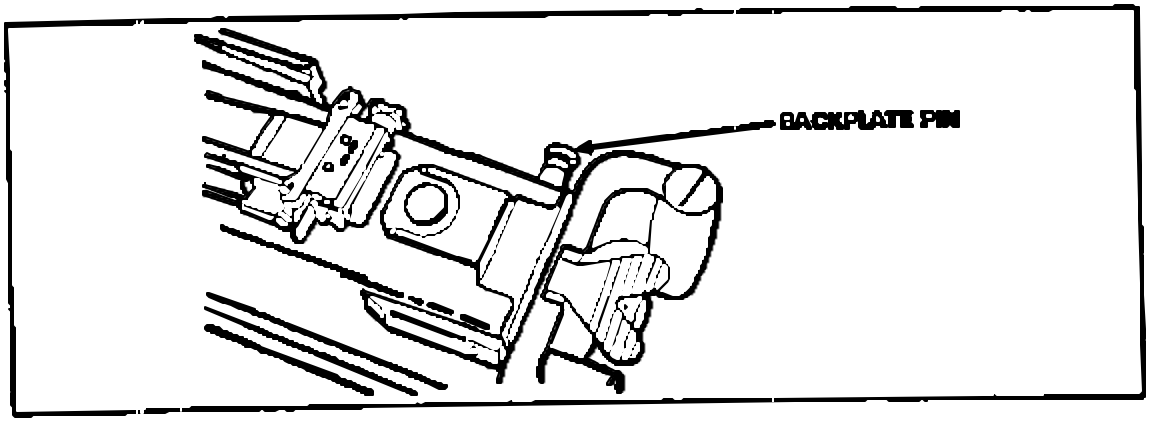
(figure 11)



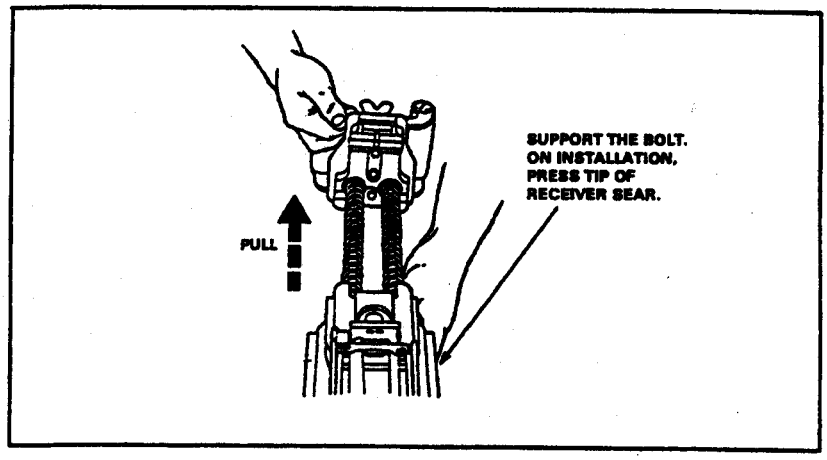
Feed tray

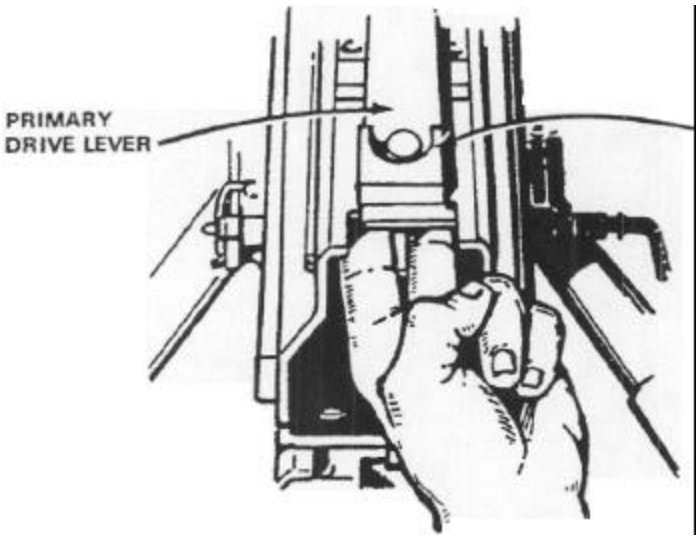
(2) Open the top cover assembly.

(figure 12)



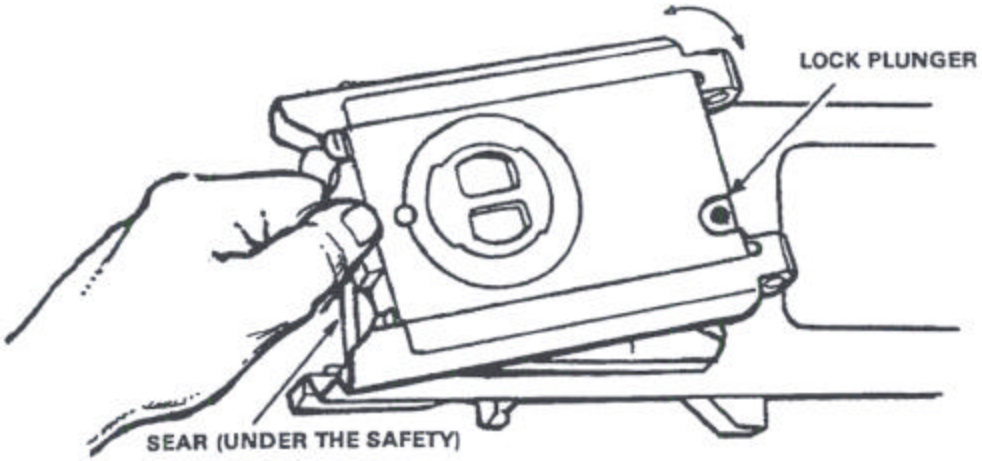
Backplate pin

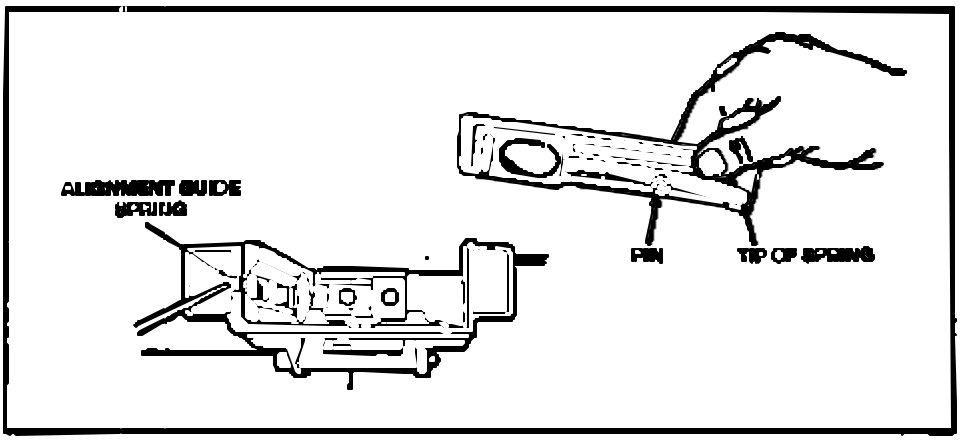


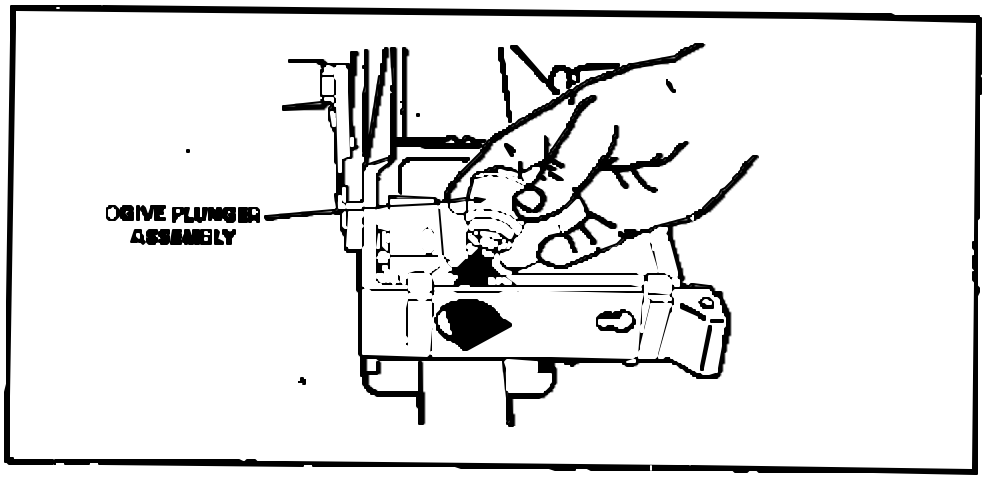


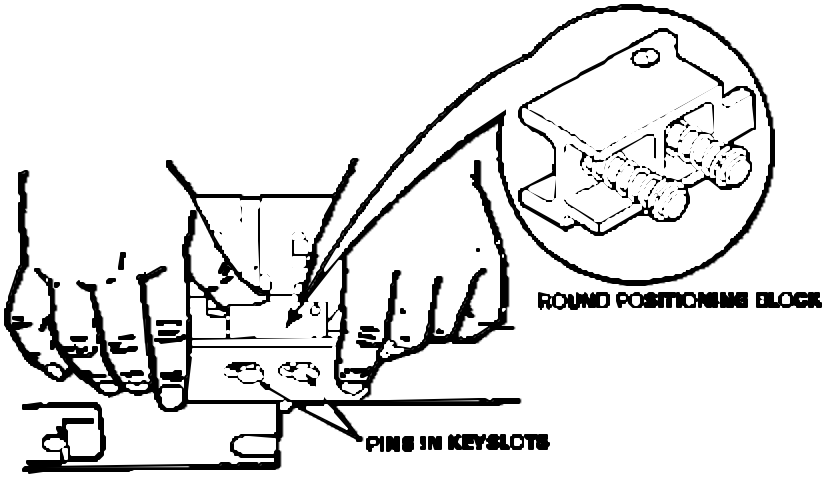
VERTICAL CAM

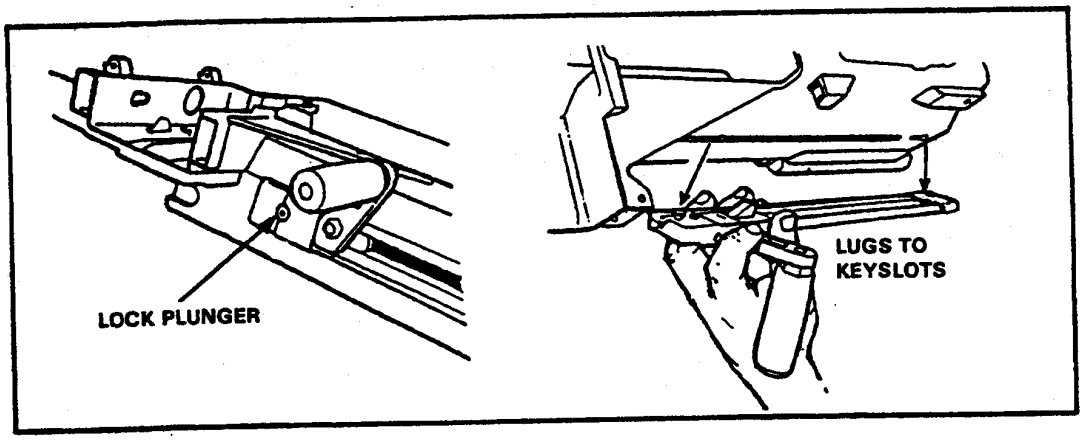
(3) Take the ammunition from the feed tray by reaching beneath the feed tray and pressing the primary and secondary positioning pawls. At the same time, slide the linked rounds out of the MK 19 through the feed throat.


LOCK PLUNGER
SEAR (UNDER THE SAFETY)


ALIGNMENT GUIDE
SPRING
PIN
TIP OF SPRING


OGIVE PLUNGER
ASSEMBLY


ROUND POSITIONING BLOCK
PINS IN KEYSLOTS

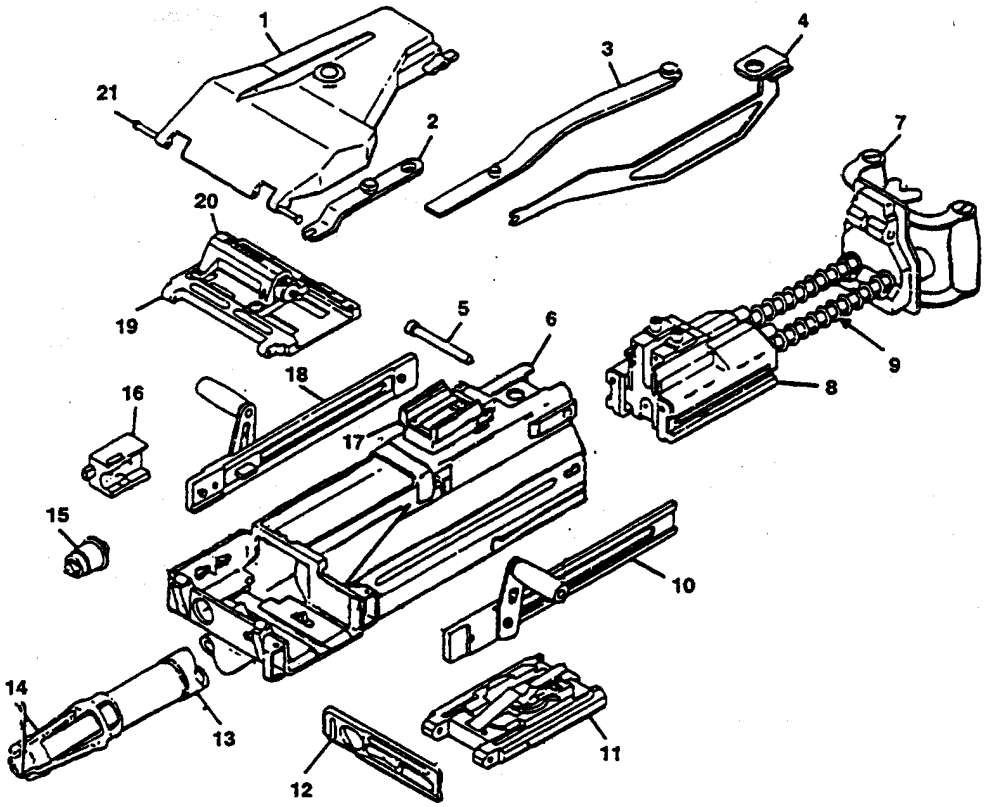


(4) Insert a section of the cleaning rod or bayonet through either side of the receiver rail. Place it on top of the live round or cartridge case, as close to the bolt face as possible, and push down. This action forces the round out of the MK 19.

WARNING
USE EXTREME CARE WHEN TAKING OUT A LIVE RI ONCE THE ROUND WITH A BAYONET. ONCE THE ROUND IS FREE, CATCH IT IN ONE--DO NOT ALLOW IT TO HIT THE GROUND.

(5) Lower and pull both charger handles to the rear.

(figure7)



1. TOP COVER ASSEMBLY.
2. SECONDARY DRIVE LEVER ASSEMBLY.
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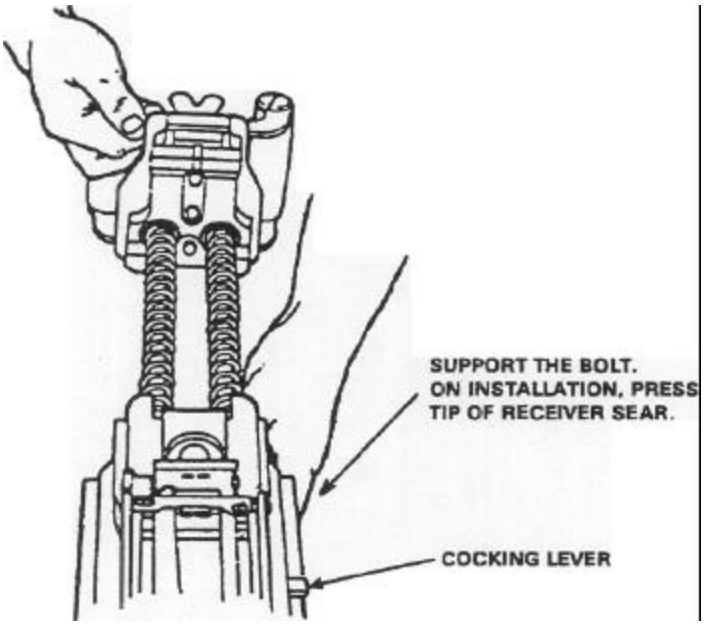
4. VERTICAL CAM ASSEMBLY.
5. BACKPLATE PIN ASSEMBLY.
6. RECEIVER ASSEMBLY.
7. CONTROL GRIP ASSEMBLY.
8. BOLT AND BACKPLATE ASSEMBLY.
9. GUIDE ROD AND SPRING.
10. CHARGER ASSEMBLY, LEFT.
11. SEAR ASSEMBLY.
12. ALIGNMENT GUIDE ASSEMBLY.
13. BARREL.
14. FLASH SUPPRESSOR.
15. OGIVE PLUNGER ASSEMBLY.
16. ROUND POSITIONING BLOCK.
17. REAR SIGHT ASSEMBLY.
18. CHARGER ASSEMBLY, RIGHT.
19. FEED TRAY.
20. FEED SLIDE ASSEMBLY.
21. COVER PINS.



(6) Inspect the chamber and bolt face again to ensure that no live rounds are in the weapon.

(7) Place the safety switch on **FIRE ("F").**

(8) While maintaining rearward pressure on the charging handle, press the trigger and ease the bolt forward.

(9) Place the safety switch on **SAFE ("S).**

b. **Nonfiring Situation**. In nonflring situation, use the following procedures to clear the MK19.

(1) Place the safety switch on **SAFE ("S").**

(2) Open the top cover assembly.

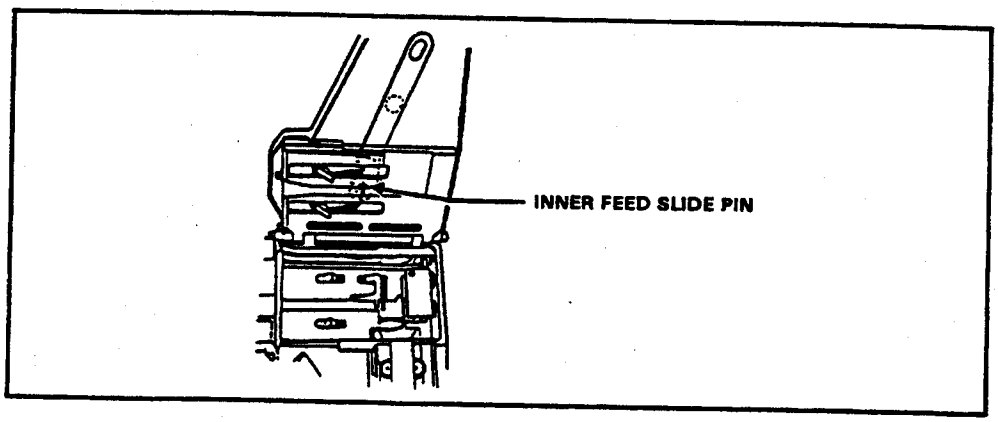
(3) Lower one charger handle.

(4) Pull the charger handle slightly to the rear, allowing sufficient space between the face of the bolt and the chamber to see both. Check for live ammunition.

(5) Ride the bolt forward.

(6) Return the charger handle to its original upright position.

7**. Disassembly**: Disassembly includes removal of parts to the extent to ensure that parts are not lost and are replaced properly, place the (in the order in which they are taken off) on a clean



flat surface.

a. To disassemble:

1. Clear the weapon.

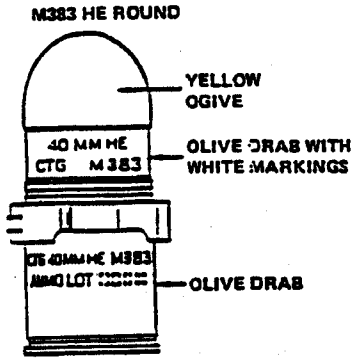
2. Take out the secondary drive lever:

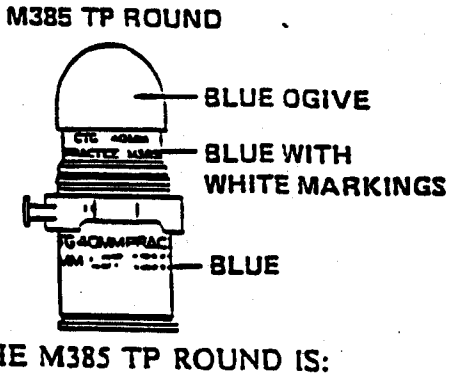
(figure 8)

TAB 538

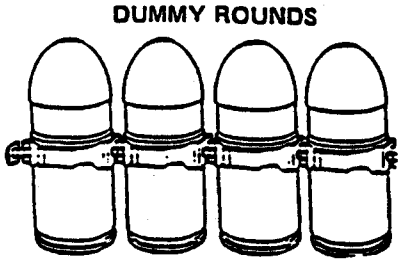
(a) Raise the top cover assembly and push the secondary drive lever pivot post from the outside of the top cover assembly. Separate the secondary drive lever from the top cover assembly.

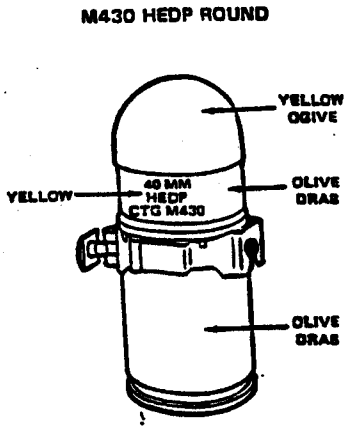
(b) Take the secondary drive lever from the slide assembly, and allow the feed slide and tray assembly to close.





THE M385 TP ROUND IS:





3. **Take off the ton cover assembly**. Hold it straight up with one hand and pull the top cover pins from both sides. Lift the top cover assembly straight up and off.

4. **Take out the feed slide assembly and feed tray:**

(a) Align the tabs on the feed slide assembly with the slots in the feed tray and lift them straight up.

(b) Take out the feed tray by lifting it straight up.

5. **Take out the bolt and backplate assembly.**

(a) Place the safety switch in the **FIRE** position.

(b) Take out the backplate pin using the rim of a spent cartridge case or meta1link. Pry outward on the pin lip and remove the pin with the fingers.

CAUTION
PRYOR TO TAKING OUT THE BACKPLATE PIN, INSURE THAT THE BOLT IS IN THE FORWARD POSITION

(c) Grasp the control grips with both hands and lift up slightly to disengage the backplate from the backplate assembly to the rear. Once the bolt clears the sear, catch the bolt in one to prevent damage to the backplate assembly.

(figure 13)

Removal of bolt and backplate assembly

6. **Take off the primary drive lever and vertical cam.**

(a) Reach under the top of the receiver and locate the drive lever lock. Slide the lock a quarter inch to the rear .

(b) Press down on the primary drive lever pivot post, which releases both the primary drive and vertical cam.

(c) Pull the primary drive lever from the front of the weapon and the vertical cam from the back.

(figure 14)

Primary drive lever and vertical cam

7. **Take off the sear assembly.**

(a) Turn the MK 19 on its side or upside down and use the rim of a spent cartridge case to lift up the sear lock plunger. At the same time, squeeze the sear and rotate the assembly 90 degrees to the right or left. Take off the sear assembly by pulling it away from the weapon. Keep pressure on the sear until the assembly comes off.

(b) Place the safety switch in the **SAFE** position.

(figure 15)

Sear assembly

8. **Take off the alignment guide.**

(a) Depress the tip of the alignment guide spring with finger.

(b) Slide the alignment guide out of the receiver, pulling the assembly slightly rearward.

(figure 16)

Alignment guide.

9. **Take out the ogive plunger**. by pulling the ogive plunger assembly out through the inside wall of the receiver.

(figure 17)

Ogive Plunger

10. **Take off the round-positioning block**. by pushing it into the side of the gun, sliding it forward, and releasing it from the key slots in the receiver wall

(figure 18)

Round-positioning block

11. **Take out the charger assemblies from both sides**. Place the charger assemblies in the upright position. Using a metal link or spent cartridge case, retract the lock plunger at the base of the charger arm. Slide the charger housing rearward to disengage the lugs from the key slots in the receiver. Lift the charger assembly away from the receiver.

(figure 19)

Charger assemblies.

Note: Further disassembly must be done by qualified ordnance personnel.

12. **Assembly**. To assemble the gun, replace the groups in the reverse order from the order in which they were taken off.

(figure 20)

MK 19 Disassembled.

(a) Replace the charger assemblies.

(b) Replace the round-positioning block

(c) Replace the ogive plunger .

(d) Replace the alignment guide.

(e) Replace the primary drive lever and vertical cam.

(f) Attach the sear assembly: depress the sear spring and turn the assembly 90 degrees toward the barrel's center line until the assembly locks into position.

(g) Insert the bolt and backplate assembly.

(h) Ensure that the cocking lever is forward and insert the bolt and backplate assembly into the receiver.

(figure 21)

Insertion of bolt and backplate assembly

NOTE: Before inserting the assembly, place the cocking lever in the forward position. Ensure that the safety switch is in **FIRE ("F")** position so the sear can easily be depressed.

(i) Press the receiver sear and slide the bolt assembly forward until the retainer pin holes in the backplate and receiver are aligned.

j) Insert the backplate retainer pin to lock the assembly into position.

(k) Place the feed tray assembly on the receiver, place the feed slide assembly into the cut out slots on the feed tray.

(l) Attach the top cover assembly, align the pinholes in the top cover assembly with the pinholes in the feed tray. Hold the cover straight up and insert the pins into both sides of the cover.

CAUTION
INSERT THE TOP COVER PINS USING ONLY THE HAND. FORCING THE PIN WILL BREAK THE WELDED CROSSPIN

(m) Replace the secondary drive lever

(n) Lift the feed slide assembly and feed tray.

(o) Place the forked end of the secondary drive lever on the inner feed slide pin

(figure 22)

Replacement of secondary drive lever.

CAUTION
IF THE SECONDARY DRIVE LEVER IS NOT PROPERLY ENGAGED WITH THE INNER FEED SLIDE PIN, THE WEAPON WILL NOT FIRE PROPERLY AND WEAPON DAMAGE MAY RESULT.

(p) Press the raised pivot post through the hole in the top cover assembly. Press the secondary drive lever firmly against the top cover assembly.

13. **FUNCTION CHECK**

a. Open feed tray cover and inspect the feed tray assembly and the chamber to ensure the gun is clear.

b. With the cover closed and the bolt to rear, check the safety by:

(1) Placing safety on **S** (SAFE)

(2) Pull trigger. The bolt should not go forward

(3) Place the safety on **F** (FIRE)

(4) Pull the trigger. The bolt should spring forward

c. With he bolt forward, open the feed tray cover:

(1) Inspect the firing pin and bolt face for signs of worn or damaged parts.

(2) Move the secondary drive lever back and forth to ensure it moves freely.

(3) Press the feed pawls to check for spring pressure.

d. Ensure the secondary drive lever is to the right and engaged under the feed tray. Slide the feed slide to the left and ensure the bolt is forward before closing the cover.

14. **Cleaning**

(a) Cleaning immediately after firing and for 3 consecutive days thereafter, thoroughly clean each of the five main groups of the gun. Detail disassembly each group to the extent permitted and remove all carbon, dirt, and rust which may be present. On the third day after firing, wipe dry and apply a light coat of lubricating oil semi-fluid weapons Teflon (LSAT). At no time should the bolt and backplate assembly be immersed in the cleaning solvent as it dilutes the grease in the packed bearings.

(b) Weekly thereafter, when the gun is not fired, clean the bore and chamber and wipe down the parts with a light coat of LSAT.

15**.** **Lubricating**

(a) Lubricate the weapon with LSAT in temperatures between O degrees Fahrenheit. Lubricate the weapon with LAW temperatures below O degrees Fahrenheit (-18 degrees Celsius).

(b) If exposed to salt air, high humidity , or water, the gun should be wiped down and lubricated more frequently to ensure contaminated lubricant does not cause a malfunction or stoppage.

16. **TYPES OF AMMUNITION**

a. **M383 HE Round**

(1) Yellow ogive (Tip) Olive drab body with white marking.

(2) A high-explosive (HE) grenade.

(3) Designed to inflict personnel casualties.

(4) Packed in a linked, 50-round belt.

(5) Arming Distance 18 to 36 meters.

(6) Blast radius 15 meters.

b. **M385 TP (Training)**

(1) Blue ogive (Tip) Blue body with white marking.

(2) Non-explosive projectile.

(3) Has propelling charge.

(4) Used in training and practice, not in combat.

c. **Dummy Round (Inert)**

(1) Olive drab, no markings.

(2) Totally inert.

(3) Used to check gun functioning and for gun crew training.

d. **M430 HEDP**

(1) Yellow ogive (Tip) olive drab body with yellow marking.

(2) High-explosive, dual purpose grenade pack 48 rounds a belt.

(3) Designed to penetrate 2-inch armor at 0 degree obliquity and inflict personnel casualties.

(4) Arming distance 18 to 36 meters.

(5) Blast radius 15 meters.

17 **.CLEARING PROCEDURES**

a. Point weapon in safe direction.

b. Ensure the bolt is locked to the rear.

c. Grasp charger handles (palms down).

d. Press charger handle locks.

e. Rotate charger handles down.

f. Pull bolt to rear until it clicks.

g. Push charger handles forward.

h. Rotate charger handles up.

i. Ensure the safety is on S (SAFE).

j. Clear the bolt face of round or case.

k. Insert tip of cleaning rod through the right.

l. Tip of cleaning rod should be on tip of the round or case, close to the bolt face.

m. Push down on round or case.

n. Catch a live round.

o. Clear all ammo from feeder.

p. Open top cover.

q. Press primary pawl and secondary pawl.

r. Slide rounds *out* of feeder.

18. **LOADING PROCEDURES**

a. Feeding

(1) Attach feed throat to the feeder. Squeeze the spring-loaded pins on feed. insert into slots on both sides of the feeder.

(2) Bolt should be forward. Take off Safe and ease charger handles forward. Don't let top cover slam shut from open position!

(3) With cover open, insert first round through feed

throat

(4) Insert first round into feeder, female link first.

(5) Push-slide round across the first pawl. Don't roll the round.

(6) Insure the rounds are straight and firmly seated between first and second pawl.

(7) Move feed slide assembly to the left. Then close top cover.

b. **Charging**

(1) Point weapon down-range.

(2) Close top cover before charging.

(3) Grasp charger handles. The preferred method is pa1m-down, as shown. press charger handle locks and rotate the handles down. Pull chargers sharply to the rear. Push the chargers forward again. Rotate handles up.

(4) Load first round. Place safety in fire position press the trigger. The bolt will spring forward. The first round is now loaded on the bolt face.

(5) Pull the chargers sharply to the rear. This pulls the bolt with the loaded round into position for firing.

(6) Push the charger handles back to forward position. Rotate charger handles up. (Place on safe until ready to fire).

19**. UNLOADING MK 19**

a. After Firing

(1) Put on safe and keep weapon pointed down range.

(2) Insure that bolt is to the rear.

(3) Insert the tip of your .50 cat. cleaning rod through the right-hand receiver rail, as close to the bolt face as possible.

(4) Push down on live round or case. Force it off bolt face and out bottom of gun.

(5) Open top cover. If link rounds in feeder?

(6) With one hand, reach beneath the feeder. Press the primary and secondary positioning pawls.

(7) At the same time, slide the linked rounds out of the feeder, and out the feed throat.

(8) Return linked rounds to the ammo can.

20. **CYCLE OF FUNCTIONING**. It is broken down into eight basic steps.

a. Feeding. Is the action of placing the round into position the face of the bolt.

b. Chambering. Is when bolt is ready to chamber the round into the chamber.

c. Locking. Is accomplished when the bolt reaches the forward end of the rail and the round is momentarily held.

d. Firing. As locking occurs, the cocking lever is indexed to the rear. This allows the firing pin to be driven forward to strike the primer .

e. Unlocking. As the round fires the pressure of the burning powder overcomes the tension of the recoil spring and the bolt moves to the rear.

f. Extraction. The initial rearward movement of the bolt along the rails pulls the casing out of contact with the receiver and extraction of the spent casing is accomplished.

g. Ejection. The vertical cam forces a new round into position on the face of the bolt and ejects the spent casing out through the ejection port.

h. Cocking. Simultaneously with ejection, the cocking lever is crammed forward by the rail, cocking the firing pin.

21. **MALFUNCTION**. It is a failure of the gun to function satisfactorily. Defective ammunition or improper operation of the gun by a crewmember is not considered a malfunction of the gun. The two most common malfunctions of the MK 19 are sluggish operation and runaway gun.

a. Sluggish Operation. It is usually due to excessive friction caused by dirt, carbon buildup, lack of proper lubrication, or burred parts. To correct the problems you should inspect the gun for worn and damaged parts and keep gun lube with CLP .

b. Runaway Gun. It is a gun that continues to fire after the trigger has been released. It may be caused by worn parts or short recoil of the bolt assembly. Hold the fire on the target until feeding is stopped or the ammunition is expended. The best method of stopping the depends on several factors such as the amount of ammunition remaining on the belt and how the gun is mounted. If ammunition is not a factor keep gun on target. If gun is mounted on the MK 93 MOD 0 keeping one hand on grip and with other hand press the charger handle locks and lowers one charger handle. This interrupts the cycle of function and the weapon ceases to fire.

22. **STOPPAGES**. It is any interruption in the cycle off operation cause by faulty action of the gun or ammunition.

23. **IMMEDIATE ACTION**. It is the action taken to reduce the stoppage without investigating the cause. In the event of a stoppage in the MK 19, recharge the gun and attempt to fire one time.

24. **REMEDIAL ACTION**. It is the action taken to identify the problem and reduce the stoppage, when your gun does not fire.

25. **MISFIRE.** Use the following instructions for immediate action:

a. Clear the area of personnel by shouting Misfire.

b. Wait 10 seconds.

c. Pull bolt to the rear.

d. Catch live round as it is ejected.

e. Push charging handles forward and up.

f. Attempt to fire.

g. If nothing happens put gun on **SAFE** wait 10 seconds Pull bolt to the rear (Catch live round as it is ejected.) Open the cover and clear the ammo.

26. **BAD AMMUNITION**

a. Primer indented but round didn't fire? Dispose of round as authorized.

b. Primer not indented? Bad firing pin

c. Check for round on the bolt face: If round is on bolt face take of safety, re-lay and fire the round. If round is not on the bolt face, leave bolt in rear position gun on **SAFE.**

27. **BORE OBSTRUCTION**

a. Put gun on **SAFE.**

b. Call Range safety officer (during training).

c. When obstruction is removed check these areas.

d. Carbon buildup in chamber.

e. Receiver rails dry or obstructed.

f. Gun dirty .

g. Feeder or feed slide assembly parts loose, broken or burred.

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STUDENT REFERENCES:

1. *TM 08521A-10/lA Operators Manual and Components List, Machinegun, 40mm, MK19 mod3*

2. *FMFRP 6-15 Machineguns and Machinegun Gunnery*

STUDENT RESOURCES: Student Handout B548-1 (4-96)

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 539
MAR 99

STUDENT OUTLINE

AN/TVS-5

LEARNING OBJECTIVES:

A. TERMINAL LEARNING OBJECTIVES:

(1) With the aid of references and given the proper materials, maintain the AN/TVS-5 in accordance with the references.

(2) Without the aid of references and given a scenario, field firing range and target, engage a target as directed in accordance with the references.

B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, place the AN/TVS-5 into operation in accordance with the reference.

(2) Without the aid of references, troubleshoot the AN/TVS-5 as required in accordance with the references.

(3) With the aid of references, perform preventative maintenance on the AN/TVS-5 in accordance with the reference.

(4) Without the aid of references, mount the AN/TVS-5 in accordance with the references.

(5) Without the aid of references, switch reticles on the AN/TVS-5 for the M2 in accordance with the references.

OUTLINE:

1. Description Of The An/Tvs-5:

a. The AN/TVS-5 is a portable, battery operated, electro-optical instrument. It is used for observation and aimed fire for weapons during periods of low light visibility or at night.

b. The sight amplifies reflected light, such as moonlight, starlight, and/or sky glow so that the viewed scene becomes clearly visible.

c. Since the sight emits no inferred or visible light, (except when the eye-piece is depressed), detection by the enemy is greatly reduced to near zero.

d. The AN/TVS-5 Night Vision Sight can be used on the M2 and the M85 machineguns. Also, it can be mounted onto the M40 recoilless rifle and the M139 20-mm cannon. A mounting bracket for each weapon can be provided.

e. The sight, when mounted onto a tripod, can be used as an observation device, such as for a Forward Observer (FO).

2. **GENERAL CHARACTERISTICS:**

a. Magnification…… 5.6X

b. Field of View……9 degrees

c. Eyepiece Focus…….+3 to-6.0 diopters

d. Objective Lens Focus……25.0 meters to infinity

e. Range…….l000-l200 meters for vehicle targets in starlight and moonlight.

f. Reticle adjustment……..+ -2.5degrees(in 1/4mil increments)

g. Operating conditions……. 65 to + 125 degrees F (-54 to +52 degrees C)

h. Battery type:

(1) BA-1567/U (2 each required)

(a) Voltage ……3.0 volts DC

(b) Shelf Life……..l year at 70degrees F

(c) Operating Life……..50 hours approximately when used at nominal temperatures

(2) BA-3058/U (2 each required)

(a) Voltage ……1.5voltsDC

(b) Shelf Life…….9months

(c) Operating Life……..50 hours approximately when used at normal temperatures

3. **<u>Installation Of Batteries And Battery Housing Adapter:</u>**

a. To install the BA-1567/U lithium batteries, remove the battery caps located on the top and right side of the sight and place the batteries in with the positive (+) side towards the sight. Ensure the caps are tightened firmly back onto the sight.

b. To install the BA-3058/U batteries, an adapter housing must first be put onto the sight. To attach the adapter housing:

(1) Remove battery caps, (and batteries, if any), from the sight.

(2) Replace the battery cap on the right side of the sight. (No battery should be inside)

(3) Install the adapter into the space originally for the top battery cap. Tighten the adapter using the notched side of the retaining screw from the adapter housing.

(4) Install two (2) BA-3058/U batteries in the adapter housing

(a) Lift off the adapter housing cover.

(b) Insert the batteries into the housing observing the terminal polarities marked inside the housing.

(c) Replace cover on the adapter housing.

(5) Position the adapter housing onto the adapter.

(6) Insert the retaining screw into the top of the housing and turn clockwise to tighten.

<u>WARNING:</u> The batteries should be removed when the sight is not in use to prevent accidental operation! Never reinstall install BA-1567/U batteries when the adapter housing assembly is being used, damage to the sight could result.

4. **Controls And Indicators**

a. ON-OFF/TUBE BRIGHTNESS: Applies power to the sight and allows the ON/OFF RETICLE BRIGHTNESS control to function. Also controls the brightness of the image intensifier tube.

b. ON-OFF/RETICLE BRIGHTNESS: Applies power to the reticle and controls the brightness of the reticle.

c. OBJECTIVE FOCUS RING: Adjusts system focus from 25 meters to infinity.

d. DIOPTER FOCUS RING: Adjust focus of the eyepiece.

e. DIOPTER INDICATOR: Indicates the direction of rotation of the diopter focus ring for + (plus) or -(minus) diopter.

f. RETICLE ELEVATION ADJUSTMENT ACTUATOR: Controls up or down reticle adjustments. Each click of adjustment moves the strike of the round 1.0 inch at 100 meters.

g. RECTCILE AZIMUTH ADJUSTMENT ACTUATOR: Controls left or right reticle adjustment. Each click of adjustment moves the strike of the round 1.0 inch at 100 meters.

h. RETICLE PATTERNS, located inside the sight indicate aiming points and provide ranging information for various weapons.

WARNING: The daylight cover must be installed whenever operating the sight during daylight to protect the image intensifier tube from being damaged.

5. **Mounting The Sight To The M2**

a. Mounting bracket assemblies are provided for each type of weapon the AN/TVS-5 can be mounted to. Before mounting the sight to the weapon a visual inspection for obvious damage or missing parts should be conducted. Pay particular attention to the threads on the lever screw assembly and for missing nuts and washers where applicable.

b. Attach the mounting bracket assembly as follows:

(1) Release the catch at the left side of the cartridge cover and raise to the UP position.

(2) Position the M2 mounting bracket assembly over the breach of the machinegun and slide it to the rear until it stops.

(3) Swing the three (3) locking cams to the rear to secure the bracket to the weapon. Insure that the side cam is swung first, followed by the two top cams).

(4) Close and latch the cartridge cover.

(5) Attach the sight to the mounting bracket assembly by positioning it into the groove at the top rear of the bracket so that the scribe line on the bracket is aligned with the scribe line on the sight mounting adapter.

(6) Tighten the lever screw on the bracket to secure the sight to the mounting bracket assembly.

6. **Operation Of The AN/TVS-5**

a. Turn on the ON-OFF/TUBE BRIGHTNESS control clock-wise to power the sight.

b. Adjust the ON-OFF/TUBE BRIGHTNESS control to the lowest setting that will provide good target-to-background contrast.

c. Turn on the ON-OFF/RETICLE BRIGHTNESS control clockwise to turn on the light emitting diode. Adjust the light intensity so that the reticle is visible against the background.

d. Turn the diopter focus ring until you get the clearest image of the reticle pattern.

e. Turn the focus ring until the target in the field of view is sharply defined.

f. Turn the Reticle Brightness/tube brightness controls to OFF when the sight is not in use. and remove the batteries.

7. **Sighting And Zeroing**

a. Sighting: The ANrrvS-5 is normally equipped with one reticle that is used for the M2 and M85 machineguns. To use a different weapon with the sight, it has to be returned to the armory and have the reticle needed installed. Reticle cell for the M2;

(1) Vertical lines at the top of the reticle indicate range (in hundreds of meters) of a 6-foot tall standing person. Measurement is made from the horizontal line to the top (or bottom) of the vertical line for the range indicated.

(2) The horizontal line of the range scale indicates the range (in hundreds of meters) of a 20- foot target, such as tank or truck, viewed from the side.

SO-539-5

(a) Place the left side of the horizontal line on the left edge of the vehicle.

(b) The range to the vehicle is read from the scale where the right edge of the vehicle stops.

(c) The width of most vehicle is approximately half of its length, so when reading range from the scale the distance is one half of the value shown on the scale.

(3) Aiming points for ranges of 0 to 1200 meters are shown as small dots in a vertical row down the center of the reticle. The aiming point for 250 meters are the two horizontal line directly above the aiming dots.

(4) When engaging a target, locate the target and place the range scale of the reticle onto the target. Estimate the range and adjust the machineguns position to place the corresponding aiming points (of range) on the target.

b. Zeroing Procedures: The sight can be zeroed during daylight or darkness. When zeroing during daylight, the daylight cover must be on the sight. Recommended distance for zeroing is 50 meters for machineguns. To zero:

(1) Select a suitable firing position for the weapon.

(2) Select a target at a range of approximately 5O-meters.

(3) With the sight on the weapon and in operation, adjust the azimuth and elevation controls so that the reticle pattern is approximately in the center of the field of view.

(4) Fire a round or two from the weapon to settle the sight on the weapon and tighten the sight and mounting bracket.

(5) Looking through the sight, place the zeroing range aiming point of the reticle pattern (250 meter lines) on the target aiming point. Fire enough rounds to obtain a good shot group.

(6) Next adjust the reticle to move the center of the shot group 9.8cm, (or 3 7/8 inches), directly below the directly below the target aiming point. Reticle adjustment actuators are marked to indicate direction of round impact. F or example, if the shot group is high and to the left, move the elevation adjustment in the DN direction and the azimuth adjustment in the RT direction. Remember 1 click on the elevation and azimuth adjustment actuators moves the strike of the round 1 inch at 100 meters, so a half value will need be used when zeroing at 50 meters.

(7) Move the weapon to reacquire the target on the zero aiming point and repeat steps (5) and (6) until the center of the shot group is 9.8cm (3 7/8in) below the target aiming point.

(8) When zeroing is complete, the zero aiming point will be used to acquire targets at 250 meters.

8. **Operating Conditions**

a. Daylight Operation: A daylight cover is provided with the sight to be used during hours of sun light. Slide the cover onto the end of the sight. Turn the external knob in the center of the cover so that the filters are place in the front of the objective lens. The degree of filtering is adjustable so as to provide the best view of the target view and the reticle. It will also be necessary to adjust the tube brightness, the reticle brightness, and objective focus to obtain the best sight picture. If the objective focus is not correct, three images or a blurred image will be seen.

b. Extreme Cold: Under condition of extreme cold, use of the low temperature adapter is necessary to keep the battery warm. The adapter is equipped with a 5-foot extension cable to permit operation with any weapon. The lens may fog over or frost up during cold rainy weather. Under those conditions, the eye guard is removed, the lens cleaned, and an antifogging compound is applied.

c. Dusty or Sandy Areas: Avoid operation of the sight in these conditions if possible. Should the sight have to be used *avoid:*

(1) Pointing sight into the wind

(2) Keep sight covered as much as possible

(3) Keep carrying case and bag closed except when removing or replacing the sight.

(4) Clean the eyepiece and the objective lens frequently with a lens brush and lens tissue.

d. **Rainy or Humid Conditions:**

(1) Use antifogging compound

(2) Dry all parts thoroughly after expose.

(3) Keep carrying case and bag closed except when removing or replacing the sight.

(4) Do not store sight in a damp carrying case.

e. Salt Water Areas:

(1) Avoid as much expose to the outside are as possible.

(2) After exposure, clean as much as possible with fresh water.

(3) Dry all parts thoroughly after removing traces of salt water.

(4) Keep carrying case and bag closed except when removing or replacing the sight.

9. **Preventive Maintenance Checks And Service (Pmcs):** Preventive maintenance checks and service is performed on a daily basis to keep the sight in operation and ready for use at all times. Procedures for PMCS are a systematic inspection of the sight to enable the operator to detect and identify defects that may cause the sight to fail.

a. The frequency of performing PMCS areas follows:

(1) Daily unless in protective storage (standby condition).

(2) When sight is installed on the weapon.

(3) When the sight is reinstalled after removal for any reason.

(4) Weekly when in a standby condition.

b. Preventive maintenance and service checks shall be performed following the sequence and inspection procedures indicated by the following table.

Interval and Sequence No.			
B	D	A	Item to be inspected and Procedure
X			AN/TVS-5 Check for completeness, including accessories. Check for dirt and moisture on external surfaces and parts. Clean and dry with lint free cloth.
X			SHIPPING AND CARRYING CASE Check for dirt, moisture, and mildew. Clean and dry with lint-free cloth
X			CARRYING BAG Check for dirt, moisture, and mildew. Clean and dry with lint-free cloth

X			BATTERIES Remove batteries. Check for corrosion on terminals and dirt or moisture in battery cap. Clean battery cap with dry cloth. Replace batteries if corroded.
X			LOW TEMPERATURE ADAPTER (IF PRESENT) Check for cracks in cable and for corroded connectors. Report deficiencies to higher category maintenance.
X			DAYLIGHT COVER Check for dirt or cracks in cover or broken lens. Rotate holder to be sure that all apertures can be used.
X			CONTROLS Check each knob, switch and control for smooth mechanical action. If control binds or sticks. Report deficiency to higher category maintenance.
	X		ON-OFF/TUBE BRIGHTNESS Install batteries. Turn switch and control to ON position. Intensifier tube should glow green. Color intensity should change as switch is rotated. Report deficiency to higher category maintenance.
	X		ON-OFF/RETICLE BRIGHTNESS Turn switch to on position. Rotate control and check for change in reticle intensity. If reticle cannot be seen, report deficiency to higher category maintenance.
	X		DIOPTER FOCUS RING Check for smooth movement and adjust for sharp image of reticle. Report deficiency to higher category maintenance.
	X		OBJECTIVE FOCUS RING Check for smooth movement and adjust for sharp image. Report deficiency to higher category maintenance.
	X		RETICLE AZIMUTH ADJUSTMENT KNOB Rotate knob and check that reticle moves in azimuth. Return knob to original position. Report deficiency to higher category maintenance.
	X		RETICLE ELEVATION ADJUSTMENT KNOB Rotate knob and check that reticle moves in elevation. Return knob to original position. Report deficiency to higher category maintenance.
		X	REMOVE BATTERIES Remove battery caps and remove batteries after operation. Replace battery caps

B-Before Operation D-During Operation A-After Operation

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c. Cleaning: The operator is responsible for keeping the sight and accessories clean and serviceable. Cleaning procedures are as follows:

(1) Lenses. Clean the objective lens, eyepiece lens, daylight cover lenses, and right angle relay lenses by removing all loose dirt with a lens brush. Clean the glass surfaces with lens tissue.

(2) Metal Surfaces: Clean all exposed metal surfaces with a lint-free cloth. A dampened cloth may be used to remove stubborn areas. Allow to dry thoroughly before storing.

(3) Eye guard: Clean the rubber eye guard with a damp cloth.

(4) Carrying Bag: Shake out loose dirt and foreign matter. Wipe the inside and outside with a damp cloth. Allow to dry thoroughly.

(5) Carrying and Storage Case: Shake out loose dirt and foreign matter. Clean the exterior with a clean, damp cloth. The interior should be cleaned with a dry cloth. Should a damp cloth be necessary, allow to dry thoroughly before storing the sight and closing the case.

10. Troubleshooting Procedures: Troubleshooting a defective area of the AN/TVS-5 is as intense in nature as is PMCS. The operator must be able to diagnose and correct if able.

a. *Weak or No Illumination Qf Image Intensifier Tube:*

Step 1.	Check to see if ON-OFF TUBE BRIGHTNESS control is turned of or down.
Corrective Action:	If control is turned off, turn on. If control is turned down, adjust until tube is illuminated
Step 2.	Check to see if batteries are weak.
Corrective Action:	Replace batteries and recheck illumination of tube.

b. *Blurred Image:*

Step 1.	Check to see if eyepiece lens is out of focus.
Corrective Action:	Adjust diopter focus ring until reticle pattern is sharply defined.
Step 2.	Check to see if objective lens is out of focus.
Corrective Action:	Adjust objective focus ring until image is sharply defined.

c. *No Visible Reticle Pattern or Intensity to Low:*

Step 1.	Check to see if reticle intensity is turned down or off.
Corrective Action:	If control is turned off, turn on. If control is turned down, adjust until reticle is clearly visible.
Step 2.	Check to see if batteries are weak.
Corrective Action:	Replace batteries and recheck illumination of tube.

d. *Image Intensifier Tube Illuminates But No Image Reticle Pattern:*

TUBE FAILURE: No action can be taken by the operator. Report deficiency to higher category maintenance.

REFERENCE:

1. TM 11-5855-214-10, Operator's Manual, Night Vision Sight, Crew Served Weapon An/Tvs-5

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
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TAB
540 MAR 99

STUDENT OUTLINE

INTRODUCTION TO THE AN/PVS- 7B

LEARNING OBJECTIVE:

A. **TERMINAL LEARNING OBJECTIVES:**

(1) With the aid of references and given proper supplies, maintain the AN/PVS- 7B in accordance with the references.

(2) With the aid of references and given proper supplies, operate the AN/PVS- 7B in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) With the aid of references, perform preventative maintenance on the AN/PVS- 7B in accordance with the references.

(2) With the aid of references, place the AN/PVS- 7B into operation in accordance with the references.

(3) With the aid of references, troubleshoot the AN/PVS- 7B as required in accordance with the references.

OUTLINE:

1. Characteristics and features of the AN PVS- 7B: The PVS- 7B is a self contained, hand held, head mounted, or helmet mounted night vision system. It enables walking, driving, weapons firing, short range surveillance, map reading in both moonlight and starlight. (Using ambient light from the night sky moon, stars, sky glow.)

a. Data

(1) Magnification -1.0X
(2) Field View -40@
(3) Eyepiece Focus -+2.0 to -6.0 Diopters
(4) Objective Lens Focus 25.0 CM to Infinity

(5) Operating Conditions -60F to + 113F
(6) Battery - BA-1567/u (1 required) / AA Alkaline (2 required)

BATTERY LIFE:

Battery Type:	Negligible IR Usage	IR usage 10% of the time
BA-5567 (lithium)	47-85 hrs.	36-65 hrs.
AA Alkaline	89-160 hrs.	68-123 hrs.

(7) Weight- 1.5 Lbs. goggles /storage case 6.7 lbs.

CAUTION: The AN/PVS-7 is a precision electro-optical instrument and must be handled carefully at all times. Put on-off switch to the off position before installing batteries.

WARNING: Extreme care should be taken to see that no stray light is visible from goggles when in operation. Have observer check carefully for stray light visible at edges of eye covers. This is done to prevent detection by the enemy.

b. Description and Use of Operator's Controls

(1) The rotary switch turns goggles and IR illuminators on and off. Turn it on when you are ready to use the goggles. Be sure it is turned off when the goggles are not being used. The IR position is used for close reading.

(a) OFF -Equipment Off.

(b) ON -Goggles On.

(c) IR -Goggles and IR illuminator on. The IR (Infrared), illuminator is a trouble light for conditions of extreme darkness.

(2) Objective Focus: Focuses objective lens. adjust for sharpest image of viewed object.

(3) Latch: Latch used for separation of goggles assembly from head mount/helmet mount assembly.

(4) Diopter adjustment Ring: Focuses eyepiece lens for each eye without the need for glasses. Adjust for sharpest image of intensifier screen.

(5) Interpupillary adjustment: Adjust for distance between eyes by sliding the eyepieces either together or apart so each eye can observe the entire field at the same time.

a. Eye Relief adjust the distance between your eyes and the goggles.

(6) IR spot flood lens: Focuses the IR light for a narrow beam (spot) or wide angle (flood) beam illumination.

(7) Compass illuminator button: Pressing this button activates the compass illuminator LED which make the compass reading visible in the goggles viewing area.

c. Features:

1. Low battery indicator; when illuminated in right eyepiece, it indicates a low battery condition with less than 30 minutes of battery life remaining.

2. LED on indicator: When illuminated (left eyepiece) it indicates that the IR illumination is on.

3. Automatic shutoff: When goggles are removed form the head mount or the helmet mount while in operation, they will automatically shut off.

4. High light cutoff: The goggles will automatically shut off after 70(+30) seconds of operation in daylight or bright room light. Individual bright lights (headlights, flashlights, or other concentrated light sources) will not actuate the high light cutoff function.

5. Demisting Shield: If the eyepiece lens fog up during operation, install the demisting shields over the eyepiece lens.

6. Sacrificial window: If operating in adverse conditions (dust or sand) attach the sacrificial window to protect the objective lens.

7. Compass assembly: Used to obtain compass reading visible through the nvg.

2. Assembly and Preparation for Use.

a. Unpack the goggles.

CAUTION: Relieve air pressure inside carrying case by depressing core of relief valve located near carrying handle before releasing latches.

(1) Release the four latches securing top of carrying case and remove top.

(2) Check contents of case for completeness.

(3) Remove carrying bag from carrying case. Open bag and remove goggles.

(4) Examine the goggles for obvious evidence of damage (cracks, chips, abrasions) and check to see that decals are readable. Report deficiencies.

b. Installation of Batteries: The PVS- 7B is powered by replaceable batteries either a 3.0 volt lithium battery (BA- 5567) or two AA 1.5- volt a1kaline batteries.

(1) Remove battery caps by turning counter clockwise.

(2) Insert battery in battery cap the battery used is (1) BA-I567/u or (2) AA batteries.

(3) Replace battery cap by pushing and turning it clockwise. Tighten it firmly to ensure a watertight seal.

c. Installation of the eyecups.

(1) Carefully press each eyecup over the diopter cell retainer.

(2) Rotate each eyecup into proper viewing position. Adjust for the best fit. The eyecups must seal around your eyes and prevent the green glow from escaping.

d. Installation of the demist shields.

(1) Carefully remove the eyecups.

(2) Carefully press a demist shield onto each eye-piece. Be careful not to smudge the eye-pieces or demist shields.

(3) Replace the eyecups.

e. Installation and adjustment of the head mount assembly.

(1) Prior to donning the head mount, loosen the four chin straps so the ends of each strap are approximately two inches from the sliding bar buckles.

(2) Snap the front and rear snaps in place.

(3) With both hands grasp the neck pad assembly and pull the harness over your head and the neck pad down to the back of your neck.

(4) Holding the chin cup in position for the chin cup and remove any slack from the from and rear chin straps.

(5) Maintain the position of the chin cup and remove any slack from the front and

rear chin straps,

(6) Ensure that the cross-strap assembly is not twisted and remove slack by adjusting the vertical adjustment strap at the neck pad.

(7) Adjust chin straps and vertical adjustment until the chin cup and headband assembly are in a comfortable but firm position.

3. **Place the AN/PVS-7B into operation**:

a. Ensure that batteries are installed.

b. Don the head mount.

c. Align the goggles latch to the head mount socket. Press and hold down the latch lever while installing the goggles into the head mount socket. Release the latch when the goggles fully engage the socket.

d. Set Your eye relief. By depressing the socket release button and move the goggles back toward your eyes until the eyecups comfortably seal around the eyes.

e. *Turn the reset/off-on-ir/pull switch on.*

(1) To activate the IR function, Pull the reset /OFF-ON- IR/pull switch knob out and rotate clockwise to the IR position. With the goggles held to the eyes, observe that a red light appears in the left eyepiece. This indicates that the IR illuminator is operating.

f. Adjust the interpupillary distance. By sliding the eyepieces together or apart so each eye can observe the entire field of view at the same time. The eyepieces adjust independently.

g. Readjust the vertical strap assembly. For vertical adjustment of the head mount until the goggles are properly aligned with your eyes.

NOTE: The sharpest image will be observed only when the objective lens and both eyepieces are properly focused. The objective lens focus adjustment is used to focus on objects at varying distances. The diopter adjustment rings are used to focus your eyes (without glasses) on the image intensifier screen. These adjustments operate independently and must be made separately.

h. Fold the right eye cup. Fold the right eyecup over the eyepiece with your right thumb or forefinger to obstruct view through the right eyepiece. Rotate the left diopter adjustment ring for the clearest view of the image intensifier screen.

i. Fold the left e~ecup. Fold the left eyecup over the eyepiece with your left thumb or forefinger to obstruct view through the left eyepiece. Rotate the right diopter adjustment ring for the clearest view on the image intensifier screen.

j. Adjust the eye relief distance. By pressing the socket release button and sliding goggles fore or aft to obtain a full field of view of the image. Readjust the diopter ring for best Image.

1. Distant View Operation

(a) Turn focus knob fully counterclockwise on objective lens for distance viewing, adjust for clearest view.

(b) Adjust the diopter adjustment ring for clearest view.

(c) Have observer check carefully for stray light visible from the edges of the face cushion assembly.

(d) Check that the IR illuminator has not been turned on by passing your hand directly in front of the goggles. If your hand appears extra bright, turn rotary switch to the on position.

2. Reading Use Operation

(a) Turn focus knob on objective lens fully clockwise to obtain sharp focus at a distance of about 10 inches. At this lens setting, distant objects will not be in sharp focus. The lens may be adjusted to obtain sharp focus on objects at any distance between 25 centimeters to infinity.

(b) Focus objective lens. Adjust for sharpest view of scene.
(c) Focus eyepiece lens. Adjust for clearest image.

4. **Shut Down Procedure**

a. Replace objective lens caps.

b. Make sure rotary switch is set to off.

c. Unscrew battery cap.

d. Remove battery

e. Replace battery cap.

f. Loosen clamp knobs.

g. Place goggles and battery in carrying case and secure latch.

h. Place carrying case in fitted portion of storage case.

i. Latch storage case.

5. **Preventive Maintenance Check and Services** In order to ensure that the equipment is always ready for use, you must do a before, during, and after PREVENTATIVE MAINTENANCE CHECKS AND SERVICE (PMCS) Always keep in mind the CAUTIONS and WARNINGS that appear in the manual.

a. Inspect the AN-PVS 7B for:

(1) Inventory Of All Components
(2) Dirt, Dust
(3) Cracks, Chips, Torn, Frayed, Or Cuts On The Components
(4) Scratches, Or Gouges
(5) Corrosion
(6) Proper Fitting Of Components

6. Cleaning the PVS-7B: To clean the goggles be careful not to scratch the external lens.

a. Brush exterior surfaces with a brush.

b. clean all lens with lens paper.
c. If necessary to clean goggles with water, ensure to dry thoroughly
d. Use a dry clean cloth or rag to wipe down the device.

Table 3-1. Operator's Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Goggles fails to activate.	Visual	Turn switch to RESET/OFF position and then ON.
	Check for defective, missing, or improperly installed battery(ies).	Replace battery(ies) or install correctly. If goggles still fail to activate, refer to higher level of maintenance.
2. IR indicator fails to activate.	Visual.	Refer to higher level of maintenance.
3. Poor image quality.	Check objective lens or eyepiece focus.	Refocus.
	Check for fogging or dirt on lens.	Clean lens surfaces.

NOTE: NO LUBRICATION IS REQUIRED .

7. **TROUBLESHOOTING PROCEDURES**: There is always a chance of a malfunction with your night sight, if a problem occurs, systematically narrow the list of problems that might be causing the malfunction. The best way to correct a malfunction is to follow the **TM.**

Table 3-1. Operator's Troubleshooting (Cont.)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
3. Poor image Quality (cont'd)		If image quality is still poor, refer to higher level of maintenance.
4. Light visible around eyecup.	Check eye-relief distance.	Re-adjust for proper eye-relief distance.
	Check eyecup for resiliency.	If eyecups defective, refer to higher level of maintenance.
5. Diopter adjustment cannot be made.	Check to see if the diopter adjustment ring is bent or broken.	If damaged, refer to higher level of maintenance.
6. Interpupillary adjustment cannot be made (left and right eye).	Defective eyepiece assembly.	Refer to higher level of maintenance.

Table 3-1. Operator's Troubleshooting (Cont.)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
7. Battery cap difficult to turn.	Check for dirt or grit in threads.	Clean.
	Visually inspect for the presence of an o-ring (Figure 2-8).	If o-ring is missing, refer to higher level of maintenance.
	Check for damaged battery cap or threads on battery compartment.	If damaged, refer to higher level of maintenance.
8. Goggles do not shut off when removed from headmount during operation.	Visual.	Return both the goggles and headmount to higher level of maintenance.
9. Head straps cannot be tightened.	Check for defective buckles, fasteners or straps.	If damaged, refer to higher level of maintenance.
10. Headmount or helmet mount socket and goggles latch do not catch.	Check socket or latch for dirt.	Clean socket and latch.
	Check socket or latch for damage.	If damaged, return both headmount or helmet mount and goggles to higher level of maintenance.

Table 3-1. Operator's Troubleshooting (Cont.)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
11. Helmet Mount will not tighten to helmet.	Visual.	If damaged, refer to higher level of maintenance.
12. LIF will not thread in or obstructs view.	Check for dirt in threads.	Clean threads.
	Check for damaged assembly.	If damaged, refer to higher level of maintenance.
13. IR spot/flood lens will not adjust.	Visual.	Refer to higher level of maintenance.
14. Compass does not illuminate.	Visual.	Refer to higher level of maintenance.
15. Compass will not stay on the goggles.	Visual.	Possibly missing an o-ring. Refer to higher level of maintenance.

Table 3-1. Operator's Troubleshooting (Cont.)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
16. Compass display is not clear	Visual.	Make sure the goggles are focused for infinity. If so, and compass display is still not clear, refer to higher level of maintenance.
17. Goggles do not shut off when exposed to high light.	Perform the following test under daylight or bright room light.	
	Place the lens cap on the objective lens. Turn goggles on and observe that they shut off within 70(±30) seconds after energized.	
	Turn goggles off and then on to re-energize goggles.	If damaged, refer to higher level of maintenance.

REFERENCE:

1. *TM OPERATOR .MANUAL AN/PVS- 7B*

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 541
MAR 98

STUDENT HANDOUT

ROCKWELL AN/PSN-ll (PLGR) RECISION

LIGHTWEIGHT GPS RECEIVER

LEARNING OBJECTIVES:

LESSON PURPOSE: The purpose of this lesson is to provide the student with a working knowledge of the PLGR as it applies to the navigational requirements of USMC small boat operations.

OUTLINE

1. Introduction to the Global Positioning: System (GPS). The tremendous technological advances of the 2Oth century revolutionized numerous scientific fields, and maritime navigation has been no exception. The ability now exists for a navigator to electronically determine his position 24 hours a day, seven days a week, anywhere in the world, under the most adverse weather conditions. This universal navigation capability is known as the Global Positioning System (GPS). It has made all other forms of navigation virtually obsolete and is, without a doubt, the most revolutionary advancement in the field of navigation since the invention of the compass. The GPS System consists of three components: the satellite constellation, ground control system, and receiver modules.

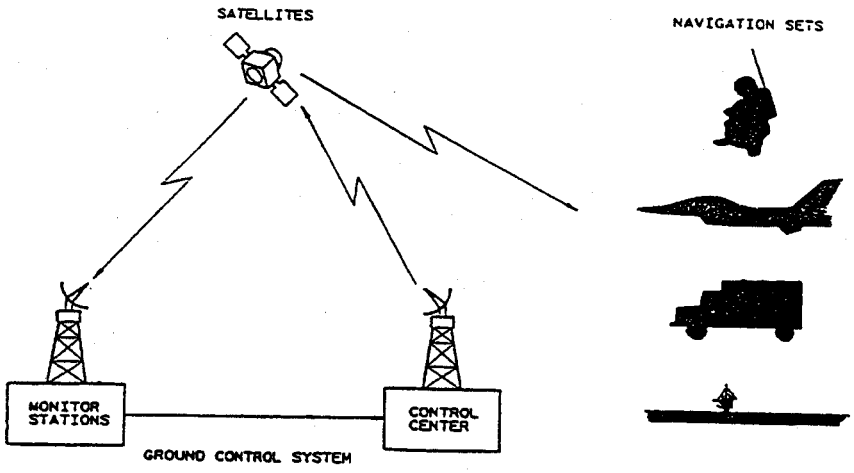


Figure 1 -Components of the GPS

a. **<u>Satellite Constellation</u>**

(1) Constellation consists of 24 satellites (21 operational and 3 spares) to provide 24-hour worldwide coverage.

(2) Satellites orbit the earth at an altitude of 10,900 NM.

(3) Three satellites must be "visible" to acquire a two dimensional fix (latitude/longitude only). Four or more satellites are required for a three dimensional fix (latitude/longitude and altitude) .

(4) Satellites repeatedly broadcast two bits of information:

(a) "This is where I am located "

(b) "The time is…".

(5) GPS simply employs the time, speed, distance formula.

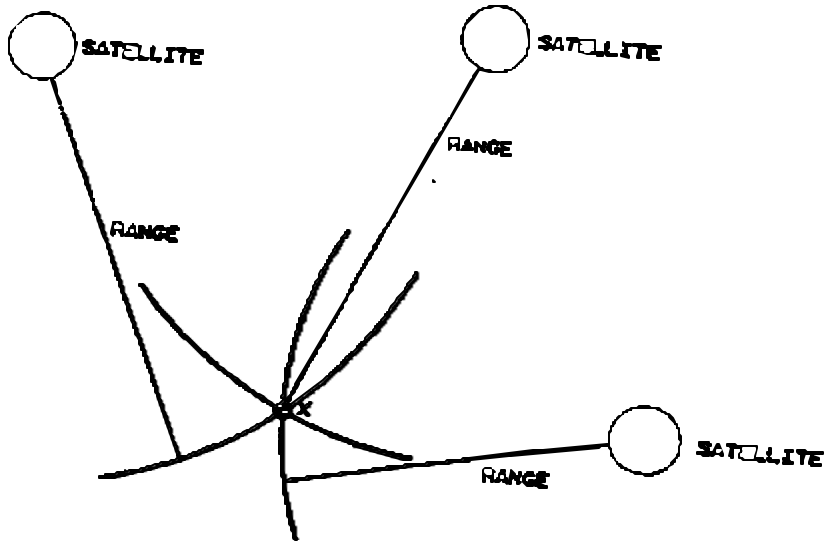
(a) The position of the satellite is known.

(b) The speed of radio waves is known (161,875 NM/sec).

(c) A super-accurate clock in the receiver measures the transmission time.

(d) The receiver computes the D = S X T formula.

(e) With three or more satellites, a series of LOPs are created resulting in a f1X.



b. Ground Control System

(1) "Supervises" Entire GPS System

(a) Tracks satellites.

(b) Checks and controls satellite orbits.

(c) Updates satellite navigation data message.

(2) Control Center

(a) Located at Falcon Air Force Base in Colorado.

(b) "Brains" of the GPS system.

(3) Monitor Stations

(a) Special unmanned GPS receivers located throughout the world.

(b) Collects data to be interpreted by the Control Center

c. Receiver Modules

(1) Many different receiver designs are available, but all have similar components:

(a) Radio receiver.

(b) Antenna.

(c) Computer.

(d) Visual display,

(e) Control unit.

(2) Main difference in receivers is the number of channels.

(a) Single channel receivers can only "listen" to one satellite at a time (position update once every 10-15 seconds).

(b) Multiple channel receivers "listen" to several satellites at once (position update about every second).

(3) Signal reception is line of sight only.

(a) Operation may degraded by terrain, structures, vegetation, etc.

(b) Receiver can only use satellites that it can " see”.

d. GPS Security. The GPS System was designed with the Soviet threat in mind. As a result, it has several features incorporated to ensure system survivability during a full scale conflict.

(1) Selective Availability. Since GPS receivers are being sold on the civilian market, steps have been taken to ensure that enemy forces cannot take advantage of the system ‘s capabilities for missile targeting, bombings, etc.

(a) Selective availability distorts the GPS signal so that only specially modified military receivers provide accurate information.

(b) Civilian receivers can only interpret the Course Acquisition (C/ A) Signal. This capability is called Standard Positioning Service (SPS).

(c) By national policy, the Department of Defense is presently distorting the *CIA* signal. Civilian GPS receiver accuracy is stated to be "within 100 meters, 95 % of the time. “

(d) Military receivers can interpret a more accurate satellite transmission called a Precise Signal or P-code. This capability is called Precise Positioning Service (PPS). PPS accuracy approaches 10-15 meters.

NOTE. reception of the P-code requires a "fill."

(2) Anti-Spoofing. The P-code can be encrypted if the threat requires. The encrypted code is known as a Y -code. Military receivers can read the signal only if they are properly "filled" by a KYK-13.

3 .Rockwell-Collins AN/PSN-11 PLGR. After extensive legal action by competing bidders, the Department of Defense (USMC) Precision Lightweight GPS Receiver (PLGR) contract was given to Rockwell-Collins in the summer of 1993. Although this contract will provide the vast majority of GPS handheld receivers ill the U .S. Military, various civilian models were rapidly procured for use during the Persian Gulf War and will remain in use for the duration of their service life.

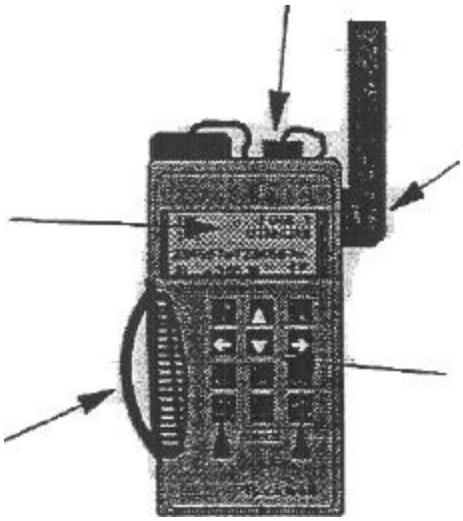


Figure 3 --AN/PSN-11 PLGR

a. **General**

(1) The PLGR was specifically designed for military use and therefore can interpret P-code (providing Precise Positioning Service) and Y -code if necessary .

(2) PLGR is designed for single handed operation (left hand) .

(3) Physical characteristics

(a) Dimensions: 8" by 4" by 2.5"

(b) Weight: 2.7 pounds

(c) Antenna

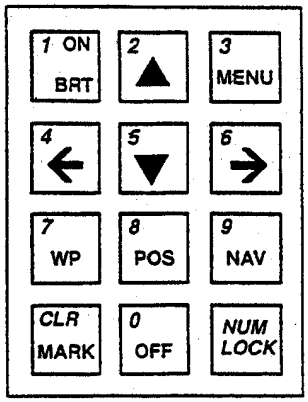
(d) Display

(e) Keypad (Figure 4)

(f) Battery Pack

(g) External Connector Ports

(h) Receiver: 5 channels



(4) Power Source

(a) Power Battery

1. Lithium - BA5800/U (>10 hrs).

2. Nickel/Cadmium (NiCad) - rechargeable (>1.5 hrs).

3. AA Battery Adapter - 8 AA alkaline batteries (>4 hrs).

(b) Memory Battery - LS6 BA (1 yr).

(5) Features

(a) No output signals.

(b) Internal/external battery.

(c) Floats.

(d) Compatible with Night Vision Goggles (NVGs).

(e) Sealed against dust and water.

(f) Works with other electronic systems.

(g) Stores up to 99 waypoints.

(6) Accessory equipment

(a) Remote antenna (for vehicle) and vehicle mounting kit.

(b) Helmet antenna.

(c) Connector cables.

(7) Cost. $ 2,250

b. Operation

(1) ON FUNCTION

Press the "ON" button.
A series of four (4) screens will appear automatically.

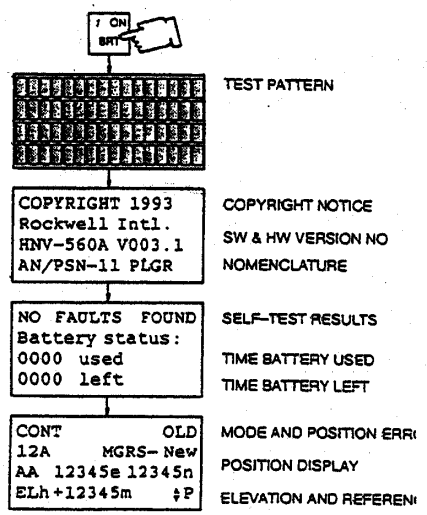


Figure 5

(2) After the initial series of "ON" screens disappears, the PLGR will display the **POSITION FUNCTION**. The position function can also be displayed by pressing the "POS" key.

(a) "POS" Screen 1. The first screen of the position function gives the user information on his location, mode of operation, and position error.

CONT ±100ft	OP MODE & POSITION ERROR
N 12°34.567'	LATITUDE
W 012°34.567'	LONGITUDE
ELh+12345ftD ↕P	ELEVATION & REFERENCE

Figure 6

(press the Down Page arrow to scroll to the next screen)

(b) "POS" Screen 2. The second screen of the position function give the user the time, date, ground track and speed.

1234:56L ± 100ns	TIME & TIME ERROR
31-01-93 THU	DATE, DAY OF WEEK
TRK 123° M	GROUND TRACK
GS 123kph ↕P	GROUND SPEED

Figure 7

(c) "POS" Screen 3. The third screen of the position function provides a satellite summary.

```
TRACK    /   SEARCH
02  04  06  08  /  10
#VIS:    4  #GOOD:  4
ALM   AGE:  <1day▲▼ P
```

SVs TRACKED/SVs SEARCHED
SVs VISIBLE & SVs HEALTHY
ALMANAC AGE

Figure 8

NOTE. Almanac Age indicates the age of the Almanac data. The Almanac Data is automatically updated each time the receiver is turned on. Almanac data greater than 1 day old will result in an increased error.

(3) OFF FUNCTION

(a) Press the "OFF" key . . . a countdown screen appears.

(b) Abort the countdown by pressing any other function key.

(c) "Quick off" by pressing the "OFF" key a second time.

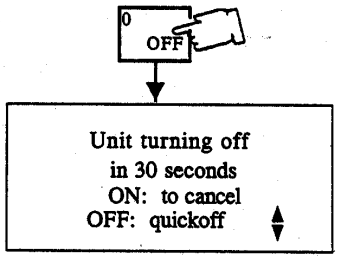


Figure 9

(4) **Keypad Functions**

(a) **CONTROL MODE vs NUMERIC MODE**

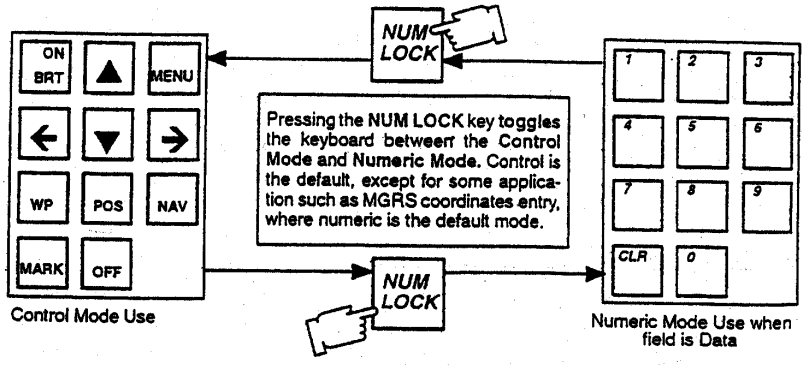


Figure 10

(b) The **PAGING FIELD** at the bottom right hand of the screen indicates whether the keypad is in numeric or control mode. The presence of the up/down arrow indicates the presence of additional pages.

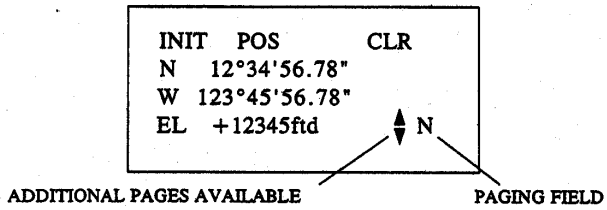


Figure 11

(c) To view the **KEYPAD DISPLAY** press the "ON/BRT" and "MENU" keys simultaneously.

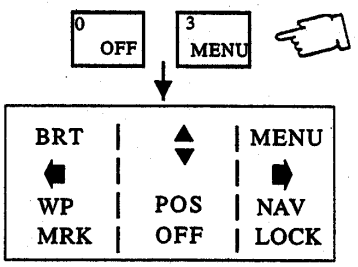


Figure 12

(5) The **SETUP FUNCTION.** Allows the user to select specific operating parameters, i.e., type of units, time zone, datum, etc. A series of seven (7) screens will present the setup options as described below.

(a) To access the setup function,

1. Press the "MENU" key.
2. Highlight "SETUP" using cursor arrows
3. Press Pg Down arrow

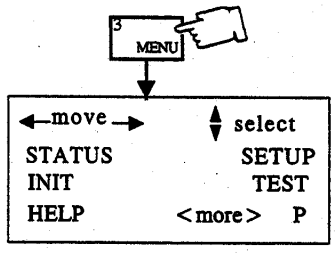


Figure 13

(b) **MODE** (Screen 1, Figure 14).

1. "FIX" (Quick Fix): Tracks satellites long enough to provide an immediate fix and enters STBY mode. This is the default mode when you turn the PLGR on.

2. "STBY" (Standby): No tracking, low power, data manipulation

3. "CONT" (Continuous): Continuously tracks satellites to provide an updated fix on your location. Used for Navigation.

(c) **SV-TYPE** (Screen 1, Figure 14)

1. "Mixed": allows tracking of any type of satellite signal

2. "All-Y": tracks only Y-code signals

SETUP MODE: CONT
Continuous POS
and VEL update
SV-TYPE: mixed P

Figure 14

(c) **UNITS** (Screen 2, Figure 15)

SETUP UNITS
MGRS - New Metric
Elev: feet MSL
ANGL: Deg True P

Figure 15

(d) **MVAR** "Magnetic Variation Source" (Screen 3, below). Select "Calc" to have the variation calculated by the system, as opposed to entering it manually.

Figure 16

SETUP MVAR
TYPE: Calc
P

(e) **ELHOLD** "elevation hold mode" (Screen 4, Figure 17). Select "automatic."

Figure 17

```
SETUP
Elhold: automatic
TIME: Loc = Z - 05:00
ERR: FOM          ▲▼ P
```

(f) **TIME** (Screen 4, Figure 17). Set the time zone (local or Zulu).

(g) **ERR** "error display format" (Screen 4, Figure 17). Select one of the following options:

1. "FOM" (Figure of Merit). This is a number from 1 to 10 based upon an accuracy rating table.

2. "Distance." This will display the degree of error in terms of units of distance (feet, meters, nautical miles).

(h) **DTM** "datum" (Screen 5, Figure 18). Select the datum which matches the chart or map you are using.

Figure 18

```
SETUP    DTM: WGD
WGS - 84
AUTOMATIC     OFF
TIMER: 5 min     ▲▼P
```

(i) **AUTOMATIC OFF TIMER** (Screen 5, Figure 18). Select the desired time delay for the automatic off timer, or turn the timer off.

(j) **SETUP I/O** (Screen 6, Figure 19). This screen is necessary only when using the PLGR's data ports for input/output functions.

Figure 19

```
SETUP  I/O
SERIAL: Standard
HAVEQUICK:  OFF
1PPS: Off        ▲▼P
```

(k) **AUTOMARK MODE** (Screen 7, Figure 20). This function allows the user to program the PLGR to take a fix at a predesignated time or at regularly scheduled intervals.

1. If automark is not enabled, the screen will look like this.

Figure 20

```
SETUP  AUTOMARK
MODE: off        WP : 01
31 - 01 - 93     1200L
REPEAT  0200       ▲▼ P
```

2. To enable automark:

   a. On line 2, choose the mode option (once or rpt) and the starting waypoint number.

   b. On line 3, enter the time to begin getting automatic marks.

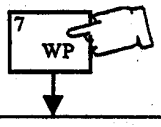
   c. On line 4, enter the desired time interval (*hhmm*) between automarks (if *rpt* was selected on line 2).

3. If automark is already enabled, then "off" is the only selectable field

```
SETUP  AUTOMARK
MODE:  once      WP : 02
NEXT MARK:  0000
TOTAL:       0  OFF ↕ P
```

Figure 21

(6) **The WAYPOINT FUNCTIONS:** Allow the user to enter and manipulate waypoints. In order to display the waypoint menu, press the "WP" key.




```
WP  ←move→  ↕sel
ENTER EDIT        COPY
SR - CALC   RNG - CALC
DIST  CLEAR  ROUTE
```

Figure 22

(a) **CLEAR:** This allows the user to clear (zero/erase) waypoint storage values.

```
CLEAR  from  WP : 0     STARTING WAYPOINT
             to  WP : 0 ENDING WAYPOINT

ACTIVATE   QUIT         ACTIVATE TO CLEAR WP.
                        QUIT TO RETURN TO WP MENU
```

Figure 23

(b) **ENTER.** This allows the user to assign a value to an unused waypoint.

```
WP : 01   WPT001                WAYPOINT NUMBER & LABEL
12A          MGRS - New
AA   12345e   12345n            POSITION
+00000m          CLR ↕ N        ELEVATION AND REFERENCE.
                                RESET
```

Figure 24

(c) **EDIT**. This allows the user to change or view the value <u>already assigned</u> to an <u>existing</u> waypoint.

Figure 25

```
WP : 01   WPT001          WAYPOINT NUMBER & LABEL
12A          MGRS - New   POSITION
AA   12345e   12345n      ELEVATION AND REFERENCE.
+00000m        CLR ↕ N    RESET
                          *
```

(d) **COPY**. This allows the user to copy the value stored in one waypoint into another waypoint.

Figure 26

```
COPY WP :  01  to  02     ORIGIN AND DESTINATION
                          OF COPY DATA

ACTIVATE      QUIT        ACTIVATE COPY, QUIT TO WP
                          MENU
```

(e) **DIST** (Distance). This allows the user to calculate the distance and azimuth between two waypoints.

Figure 27

```
DIST   frm 01  to  02     FROM WAYPOINT, TO WAYPOINT
RNG        0 . 0m         RANGE BETWEEN WAYPOINT
AZ      000 . 0° M        AZIMUTH BETWEEN WAYPOINT
ELA  +  000.0°            ELEVATION ANGLE BETWEEN WP
```

(f) **ROUTE**. This allows the user to enter a navigation route using up to nine (9) legs.

Figure 28

```
ROUTE   for   LEG   1     LEG NUMBER
WP   01   WPT001          ORIGIN WAYPOINT
TO   02   WPT002          DESTINATION WAYPOINT
SAVE                ↕ P   SAVE DEFINITION OR QUIT
                          *
```

(7) The <u>**MARK FUNCTION:**</u> Stores the user's current position (fix) in a designated waypoint field (indicated on the screen, below). To access the mark function, press the "MARK" key.

Figure 29

```
MARK   position to
WP : 01     MARK01
MARK :      saves
   ON :     cancels
```

<u>NOTE</u>. Press the "MARK" key again to execute a the mark function. Otherwise, press the "ON" key to cancel out of the mark function.

(8) **The NAVIGATION FUNCTION:** Provides the user with detailed navigational information when traveling to a waypoint. To access the navigation function, press the "NAV" key.

(a) "NAV" Screen 1 prompts the user to determine the following:

1. Choose Display Mode (SLOW, 2-D FAST, or 3D FAST)

2. Choose Navigation Mode (Direct, Course To, Course From, and Route).

3. Enter the destination waypoint.

Figure 30

```
SLOW          DIRECT
WP : 01   TARGET

                    P
```

OR 2D FAST, 3D FAST

(b) "NAV" Screens 2, 3 and 4 provide navigational information according to the format chosen above. The recommended setting for an open water transit is "2-D FAST/DIRECT.

(c) Navigation Screen Abbreviations:

1. TRK: TRACK (course) you are moving along.

2. AZ: AZIMUTH to destination/waypoint/target.

3. STR: STEER right or left the indicated number of degrees in order to maintain the desired azimuth.

4. RNG: RANGE to destination/waypoint/target.

5. TTG: TIME to destination/waypoint/target.

6. ELD: ELEVATION DIFFERENCE of destination/ waypoint/target.

7. MMD: MINIMUM MISS DISTANCE while moving along the current track.

8. SR: SLANT RANGE to destination/waypoint/target.

9. ELA: ELEVATION ANGLE to destination/waypoint/target.

REFERENCES

1. *American Practical Navigator*

2. *Dutton* ' s *Navigation and Piloting*

3. TM 11-5825-291-13, AN/PSN-11, Technical Manual

NOTES

ATTACHMENTS. None

UNITED STATES MARINE CORPS
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Special Operations Training Group, II Marine Expeditionary Force
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TAB 542
MAR 99

STUDENT OUTLINE

FIRE COMMANDS

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE:** Without the aid of references when given a scenario, field firing range and target, engage a target as directed in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references, determine range to a target in accordance with the references.

(2) Without the aid of references, apply leads in accordance with the references.

(3) Without the aid of references, select the proper rate of fire for engaging a target in accordance with the references.

(4) Without the aid of references, engage a point target in accordance with the references.

(5) Without the aid of references, engage a linear target in accordance with the references.

(6) Without the aid of references, engage a wide target in accordance with the references.

(7) Without the aid of references, engage a deep target in accordance with the references.

(8) Without the aid of references, engage an oblique target in accordance with the references.

OUTLINE:

1. **Fire Commands**: Fire commands are the means by which fire control is exercised. Fire commands are the instructions issued to the gunner that enable them to properly engage the desired targets. There are two types of fire commands - initial and subsequent.

2. **Initial Fire** commands are issued to engage targets and to shift fire to new targets.

3. **Subsequent Fire** commands are issued to adjust fire, change the rate of fire, and cease fire.

a. Initial Fire commands. The elements contained in the initial fire command are identical to those utilized for the infantry unit leader. The acronym **ADDRAC** can be utilized to remember the elements.

(1) **A**LERT: Is the first element of the initial fire command. Fire Mission is announced for all targets.

(2) **D**IRECTION: (only when not obvious) Gunner must be told to look in a particular direction to see it. Direction is given as **Front, Right, Left, Rear (1 front, r front etc).**

(3) **D**ESCRIPTION: (only when not obvious) A target description is a word or two used to inform the gunner of the nature of his target.

(4) **R**ANGE: This is announced in meters. The range is announced in even digits, hundreds, or thousands. **(FOUR FIVE ZERO, THREE HUNDRED, ONE HUNDRED, ONE THOUSAND).**

(5) **A**SSIGNMENT/METHOD: This element is utilized only when specific assignments are required to divide the target, designate rate of fIfe.

(6) **C**ONTROL: Command to open fire for immediate engagement of the target, the command fire or the arm-and-hand signal to fire is given without a pause (At my command or On my signal).

4. **Methods Of Range Determination**: There are many methods for determining range. Some of these are estimating by eye, firing the gun, measuring range from a map or aerial photograph, ranges are determined to the nearest 100 meters for machinegun firing. In combat, the most commonly used methods are estimating by eye and firing the gun.

a. Estimating by eye: is the method most often used. There are two methods of estimating by eye--the 100-meter unit of measure method and the appearance of objects method.

(1) l00-Meter unit of measure method. To use this method, the gunner must be able to visualize a 100-meter distance. With this distance in mind, he can mentally determine how many of these 100-meter units there are between his position and the target. Application of the unit of measure beyond 500 meters, is difficult. For this reason, in ranges over 500 meters, it is to the target, apply the 100-meter unit up to that point, and multiply the estimated distance by two.

b. Estimating by appearance: Another satisfactory method of estimating ranges is to memorize, through frequent practice, the appearance of objects. By learning the appearance of a small boat at 300, 500, 700 and 1000 meters, and memorizing the details that can be distinguished on the small boat at those key ranges, a fairly reliable range estimation can be made when a small boat is the target is in the vicinity of the target.

(1) Objects seem nearer when.

a. Object is in a bright light.

b. Color of the object contrasts sharply with the color of the background.

(2) Objects seem more distant when.

a. There is poor light or fog.

b. Only a small part of the object can be seen.

5. **Apply Leads**: The lead requirement demands that the gunner cause the round to intersect the target. Angular tolerance in fulfilling the lead requirement is provided by the horizontal mass of the target. the magnitude of this angle varies directly with the length of the target fuselage and the sine of the angle of approach. It varies inversely with the range to the target.

6. **Rate Of Fire:** Surprise and shock effect may be obtained by firing all weapons at the same time, using the rapid rate for at least the first few bursts. Engage fleeing targets as soon as possible, and with all available fire. Use the rapid rate for the initial delivery of fire to make adjustment of fire easier. Also, whenever the rate of fire is not stated, use the rapid rate in all cases, unless otherwise ordered, fire the first few bursts at the rapid rate; thereafter, use the prescribed rate.

(a) **Sustained**. The sustained rate of fire is measured in rounds per minute and is the rate at which a machine gun may be fired indefinitely without damage from overheating. The sustained rate is directed by announcing **SUSTAINED.**

(b) **Rapid**. The rapid rate of fire is measured in rounds per minute and is the rate at which a machinegun may be fired for a limited period of time without danger of damage from overheating. the rapid rate permits a high volume of fire to be delivered for a fixed and relatively short period of time. Gunners will automatically employ the rapid rate unless another rate is announced

(c) **Cyclic**. This is the rate at which a gun can be fired, for a limited time ONLY, at the fastest rate the gun will fire. This rate may be used when the target or area needs the greatest possible suppression. The cyclic rate is announced CYCLIC.

7 . **Engagement Of A Point Target**: Any target no larger than the beaten zone is a point target, and is engaged by fixed fIfe.

(1) FIRE MISSION.

(2) FRONT .

(3) DINGIE.

(4) SIX HUNDRED.

(5) FIXED.

(6) RAPID.

(7) FIRE.

8. **Engagement Of A Linear Target:** The gun is aim to the outside of either flank or on a reference point within the target area. The gunner traverses back and forth across the entire area until told to cease fire.

(1) FIRE MISSION.

(2) FRONT.

(3) ROWBOAT.

(4) FIVE HUNDRED.

(5) TRAVERSE.

(6) AT MY COMMAND.

(7) FIRE.

9. **Engagement Of A Wide Target**: When the flanks of a target are not easily identifiable to the gunner, the target may be identified by firing a gun or laying the guns, or by using a reference

point which is visible to the gunner and in the vicinity of the target. The first two methods are simple and accurate, and once the flanks of the target are identified, the target is engaged.

(1) FIRE MISSION.

(2) PORT SIDE

(3) WATCH MY BURSTS (OR TRACERS)

(4) ONE HUNDRED.

(5) FIVE RRC TIE TO PIER.

(6) AT MY COMMAND.

(7) FIRE.

10. **Engage A Deep Target**: If the target extends over 200 meters in depth, the range to the near end is announced for gun one and that to the far end for the number two gun. The command for this type of fire is SEARCH.

(1) FIRE MISSION.

(2) PORT SSIDE.

(3) CRRC'S IN A COLUMN

(4) TWO HUNDRED.

(5) SEARCH.

(6) AT MY COMMAND.

(7) FIRE.

11. **Engage A Oblique**: This is fire directed at a target moving at any angle other than directly toward or perpendicular to the gun.

(1) FIRE MISSION.

(2) RIGHT FRONT

(3) MACHINEGUN ON PIER.

(4) ONE HUNDRED.

(5) TRAVERSE.

(6) AT MY COMMAND.

(7) FIRE.

12. **Engage An Air Target**: The gunner fires continuously throughout the engagement. Since the large amount of smoke created by continuous fire tends to restrict visibility, the gunner keeps his head and eyes high above the gun to observe the tracers. When there is doubt as to the gun to observe the tracers. positions, he increases his lead. It is important that the gunner initially opens fire with an adequate lead, and once established his tracking is not reversed. If his initial lead is too great, the tracking rate is slowed and he allows the target to catch up with his tracers.

REFERENCE:

1. FMFRP 6-15 Machineguns and Machinegun Gunnery
2. FM 23-27 MK19 40-MM GRENADE MACHINEGUN MOD 3

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TAB 543
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STUDENT OUTLINE

TECHNIQUES OF FIRE

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVES**: Without the aid of references and provided the necessary materials, engage land and water based targets from both the static and moving position as per the references:

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references, identify in writing the armor defeating capabilities of the MK19 and the M2 in accordance with the references.

(2) Without the aid of references, identify in writing selected terms in accordance with the references.

(3) Without the aid of references, identify in writing the classes of fire of the machine-gun as it pertains to the ground, gun and the target in accordance with the references.

(4) Without the aid of references, state in writing two (2) methods of range determination in accordance with the references.

OUTLINE

1 **General Machine-Gun Techniques And Fundamentals**

a. Technique of fire is the method of delivering and controlling effective fire. Each member of the machine-gun crew must be trained in the standard methods of applying fire, both as a crew member and as a gunner, and he must perform his assigned task automatically and effectively.

b. The simplest and most effective technique of delivering fire with the machine-gun, mounted on its ground or vehicular (boat) mounts, is to align the sights of the gun on the target and properly apply fire. This technique if fire is called direct laying.

c. Before the machine-gun can be employed to the best advantage using any firing technique, certain fundamentals must be understood and applied. These include:

* Characteristics of fire.
* Classes of fire.
* Range determination.
* Fire control and fire commands.
* Target designation.
* Methods of engaging targets.
* Overhead fire.
* Predetermined fire.
* Final protective fires.
* Range cards.
* Firing from position defilade.
* Machine gunner's mathematics.
* firing positions.

d. To be most effective, a machine-gun should be employed from a tripod mount on the ground, using a traversing and elevating mechanism> ...

e. While a machine-gun may be employed from a vehicle/boat on the move, this lessens the accuracy of fire and generally decreases the survivability of the vehicle/boat and crew. When the gun must be employed from a vehicle, the leader seeks a firing position that provides the greatest possible degree of cover for the vehicle/boat and crew.

2. Employment Of The M240G. Mk19, And M2 :

a. The M240G's high rate of fire and low recoil allow for quick, accurate suppressive fire to be delivered on any target encountered by the Riverine Assault Craft.

b. The size and reduced weight of the M240G ammunition allows for a large quantity of ammunition to be carried on board, and also greatly reduces reload time.

c. The M240G's smaller projectile will not defeat armored fighting vehicles, fortifications, or penetrate, with any accuracy, thick vegetation.

d. The MK19 with its dual-purpose M430 round, is a superior weapon against light armor. Its maximum effective range is 1,500 meters while its armor penetration is 2 inches of homogeneous steel out to 2,200 meters.

f. Because of its high trajectory compared to most machine-guns, the MK19 can be effectively employed both against some defilade enemy positions and from defilade firing positions.

g. The dual-purpose MK19 round is also effective against personnel, with an effective casualty radius of fifteen (15) meters.

h. In general the M2 is a more effective weapon against personnel because of its higher volume of fire and 1,000 meters of grazing fire.

i. Although its effectiveness against aircraft is limited, the M2 is a far more effective antiaircraft gun than the MK 19.

j. The M2 can be employed effectively through light vegetation, while the MK19 may detonate prematurely when fired through the same vegetation.

k. The M2 however, cannot penetrate the armor of a BMP past 600 meters.

l. The high angle off fire of the MK19 and the flatter trajectory of the M2 can be employed effectively in tandem in many situations, the characteristics of one complementing the other.

3. **Machine-Gun Characteristics Of Fire**:

a. **Trajectory-** The trajectory, or path of a projectile through the air, is influenced by several factors. The major factors influencing the trajectory are the velocity of the bullet, and the resistance of the air. To overcome the influence of these factors, it is necessary to elevate the bore above a straight line from the muzzle of the gun to the target. (See fig. 7-1)

b. **Burst Of Fire-** The number shots in a burst of fire is limited by several factors, including the size and shape of the target, ground formation, and ammunition supply. For ground targets, the number of rounds in each burst varies from about 6 to 20 for the heavy machine-gun, and from 6 to 12 for the light machine-gun.

c. **Cone Of Fire-** When a burst is fired, the vibrations of the gun and tripod, variations in ammunition, and conditions of the atmosphere give each bullet a trajectory differing slightly from that of the others. The resulting group of trajectories is known as the cone of fire. (See fig. 7-2)

d. **Beaten Zone-** The beaten zone is the area in the ground upon which the cone of fire falls. As the range increases, the beaten zone becomes shorter and wider. The beaten zone remains two mils wide at any range.

e. **Center Of Impact-** The center of the beaten zone is called the center of impact. It has been found that 82 percent of the shots are uniformly grouped around the center of impact. **TRANSITION**: There are many ways to employ the machine-gun and even more variations. On land it is important that the gunner know the many ways to best employ his weapon. On board a Riverine Assault Craft, fighting normally with the numbers against you and from an unstable platform it could mean the difference between life and death.

4. **Classes Of Fire**: Machine-gun fire is classified with respect to, the ground, the target, and the gun.

a. Classes Of Fire With Respect Of The Ground:

(1) Plunging fire: Fire in which the angle of fall of the rounds, with reference to the slope of the ground is such that the danger space is practically confirmed to the beaten zone. Plunging fire is obtained when firing from high ground into low ground, when firing from low ground to high ground or when firing at long ranges.

(2) Grazing fire: Fire approximately parallel to the ground where the center of the cone of fire does not rise above 1 meter from the ground .

b. Classes Of Fire With Respect To The Target

(1) Frontal fire: The long axis of the beaten zone is at a right angle to the long axis of the target.

(2) Flanking fire: Delivered against the flank of a target.

(3) Oblique fire: The long axis of the beaten zone is at an angle, but not a right angle, to the long axis of the target.

(4) Enfilade fire: The long axis of the beaten zone coincides with the long axis of the target. This class of fire is either frontal or flanking and is the most desirable class of fire with respect to the target, because it makes maximum use of the beaten zone.

c. Classes Of Fire With Respect To The Gun:

(1) Fixed fire: Fire delivered on a point target. Little or no manipulation is required.

(2) Traversing fire: Fire distributed against a wide target requiring successive changes in the direction of the gun..

(3) Searching fire: Fire distributed in depth by successive changes in the elevation of the gun.

(4) Traversing and searching fire: Fire delivered both in width and depth by changes in direction an elevation.

(5) Swinging Traverse: Employed against targets which require major changes in direction but little or no change in elevation.

(6) Free gun: Fire delivered against moving targets which must require rapid changes in both direction and elevation.

5. **Range Determination:** There are many methods for determining range. Some of these are estimating by eye, firing the gun, measuring range from a map, stepping off the distance, or asking another unit. In combat estimating by eye is the most common.

a. Methods of range determination:

(1) Estimating by eye - Estimating by eye is the method most often used in the field. There are two methods of estimating by eye -the l00 meter unit of measure method and the appearance of objects method. To use the 100 meter unit of measure method the gunner must be able to visualize a 100- meter distance on the ground. With this distance in mind, he can mentally determine how many of these 100-meter units are between his position and the target. Application of the unit of measure beyond 500 meters, is difficult. Another satisfactory method of estimating ranges is to memorize, though frequent practice, the appearance of objects, vegetation, and the amount of detail that can be distinguished at a few key ranges, and then to estimate between these ranges to determine the desired distance.

b. Conditions Affecting the Appearance of Objects: Conditions of light and terrain have considerable effect upon the appearance of objects, sometimes making them seem much more nearer, and, at other times, much more distant than they really are.

(1) Objects seem nearer when:

* object is in a bright light
* color of the object contrasts sharply with the color of the background.
* looking over water, snow or a uniform surface like a wheat field-
* looking from a height downward.
* in the clear atmosphere of high altitudes.
* looking over a depression most of which is hidden.
* looking down a straight road or railroad track

(2) Objects seem more distant when;

* looking over a depression most of which is visible.
* there is poor light or fog.
* only a small part of the object can be seen.
* looking from low ground toward higher ground.

REFERENCES

1. FM 23-65 BROWNING MACHINE GUN
2. FMFRP 6-15 MACHINE-GUN
3. SCHOOL OF INFANTRY MACHINE-GUN POI
4. FM 23-27 MK19 40MM GRENADE MACHINE-GUN, MOD 3

NOTES:

ATTACHMENTS: None.

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TAB 545
MAR 99

STUDENT OUTLINE

RIVERINE OPERATIONS OVERVIEW

LESSON PURPOSE:

1. This purpose of this lesson is to introduce the student to the structure of the Mobile Riverine Force and the doctrine of Riverine Warfare.

OUTLINE:

1 Concept of Riverine Operations:

a. The Riverine Area is characterized by limited land lines of communication with extensive water surface and or inland waterways that provide natural routes for surface transportation and communications. Where navigable waterways exist and roads do not, or where forces are required to use waterways, an effective program to control the waterways and/or interdict hostile movement becomes a decisive factor.

b. The primary advantage of a Mobile Riverine Force (MRF) is its ability to concentrate a mix of forces effective for operations in the riverine area, including the ability to attack selected targets throughout the riverine area. Riverine operations exploit the advantages of the waterways for movement, capitalizing on mobility, to find, fix and destroy hostile forces. Surface mobility is achieved primarily by specialized riverine craft maintaining control of water lines of communication and providing transportation and combat support to Marine Corps and Naval Special Warfare Forces.

c. Environmental factors which can affect the composition and employment of the MRF may include:

(1) Shallow water: This will limit the type of craft to be used and the range of their movement.

(2) Large tidal range: This could limit riverine craft to operations during only times of high tide and allow the enemy periods of free access.

(3) Currents: The speed of some riverine currents could also limit the type of craft to be used for transport and their range. For instance, an AAV is a capable riverine craft but at only 6-7 knots speed, it may be able to only move a few miles upriver and be to slow to gain any surprise.

(4) Narrow waterways: These areas are ideal for ambushes or obstacles used to limit friendly access. They channelize movement into lanes ideal for mining.

(5) Natural or man made obstacles: Naturally deposited sandbars limit movement. Swampy areas limit the amount of time ground troops can operate. Fishing nets placed on stakes can tangle in propellers or clog intakes.

(6) Bridges: Bridges may not include sufficient clearance for craft to pass underneath during high tides or the pilings may be too close to allow passage of any but the smallest craft.

2. **The Mobile Riverine Force Composition:**

a. The Mobile Riverine Force is task organized to fight in the riverine environment. It consists of five elements:

(1) Command Element: The Command Element is based on the mission and the balance of forces. If the mission is to control the waterway, the majority of forces will be naval and the Commander will be a naval officer. If the mission is to control the riverine area, in addition to the waterway, the majority of forces will be ground troops and the Commander will be a Marine.

(2) Ground Combat Element: The Ground Combat Element (GCE) is usually a Battalion Landing Team, an infantry battalion augmented by artillery, Amtracs. LAVs. and Reconnaissance elements.

(3) Air Combat Element: The Air Combat Element (ACE) is usually a composite squadron made up of attack, medium and heavy transport and command and control helicopters and attack aircraft. This would include naval aircraft.

(4) Combat Service Support Element: The Combat Service Support Element (CSSE) provides maintenance, supply, medical, dental, engineering, salvage, explosive ordnance disposal, and other support functions for the MRF.

(5) Riverine Assault Group: The Riverine Assault Group (RAG) provides landing craft for transportation, mine-sweeping, fire support and escort craft. The Riverine Assault Craft and possibly the AMTRACs would be attached to the RAG for MRF operations.

3. **Mobile Riverine Force Missions:**

a. Assault: Assault missions may be the most fun but they are also the least frequent. Assault missions involve:

(1) Establishing control of water lines of a geographical area which includes water lines of communication.

(2) Establish control of land areas and/or population and resources.

(3) Locate and destroy hostile forces, installations and supplies.

(4) Establish and secure an area for a combat support base as required.

b. Surveillance, Interdiction and Security missions are what most concern Riverine Assault Craft.

(1) Protect friendly lines of communication.

(2) Deny hostile forces the use of waterways.

(3) Collect intelligence information.

(4) Perform security missions.

(5) Enforce population and resources control.

4. **Riverine Assault Craft in Support of an MRF**:

a. The Riverine Assault Craft can support an Assault Operation in several ways.

(1) Escort Operations: The Riverine Assault Craft will escort the GCE on their way to the objective.

(2) Fire Support: The RAC can be positioned on the flanks of the Riverine Landing Site and provide fires ashore in support of the landing.

(3) Command and Control: The RAC radio suite enables the boat to be used by the Commander to control unit operations and coordinate either fire or logistical support. The RAC also has the ability to mount equipment for Electronic Warfare, jamming, direction finding etc...

b. The RAC can support surveillance, interdiction and security missions in additional ways.

(1) Patrolling: The RAC patrols are used the same way a Commander uses land patrols, to collect intelligence, protect lines of communication and provide security for the force.

(2) Waterborne Guard posts/Ambushes: These deny the enemy the use of the waterways.

(3) Board and Searches: This is a means of denying the enemy the use of the waterway and also enforces population and resources control. We want to starve the enemy of food ammunition and other support such as medical.

REFERENCES:

1. *NWP 13A/FMFM* 7 -5 *DOCTRINE FOR NAVY/MARINE CORPS JOINT RIVERINE OPERATIONS*

2. *FMFM7-5A MAGTF RIVERINE OPERATIONS*

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TAB 546
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STUDENT OUTLINE

RIVERINE CHARACTERISTICS/PILOTING

LEARNING OBJECTIVE:

A. **TERMINAL LEARNING OBJECTIVE**: With the aid of references, pilot the RAC using visual means in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) Without the aid of references, select from a list the indicators of shallow water in accordance with the reference.

(2) Without the aid of references, select from a list the indicators of deep water in accordance with the reference.

(3) Without the aid of references, select from a list the indicators of underwater obstacles in accordance with the references.

(4) Without the aid of references, from a diagram select the most likely location of a sandbar formation in accordance with the references.

(5) Without the aid of references, select from a list the location of the swiftest current in accordance with the references.

OUTLINE:

1. **Importance of Waterways.** In many areas of the world, extensive river and canal systems provide the principle means of transportation. People tend to settle along these waterways that frequently provide their only lines of communication. Thus, these waterways become natural highways used extensively by the civil populace and enemy forces. To enemy forces, these waterways represent a natural means for movement and for control of the populace. Heavy civilian water traffic and congested settlements provide natural concealment for clandestine movement. The presence of these waterways as natural highways dictate that their use be denied to the enemy.

2. **Navigable Waterways**:

a. The current is usually strongest in the deeper channels. Rivers are shallower on the inside of curves than the outside.

b. There are usually sandbars or mud flats near the point where tributaries enter rivers that may hazard watercraft movement.

c. Channels usually run deeper near steep banks and shallower near swamps or banks with shallow gradients.

3. **Terminology:**

a. Pilot- A guide who leads others along difficult or unknown courses.

b. Piloting- The determination of the position, speed and direction of the movements of a vessel involving frequent or continuous reference to landmarks, aids to navigation and water depth.

c. Coxswain- A responsible person who has charge of a ship's boat and its crew, and the one who usually steers.

d. Reach- A straight portion of a flowing waterway system.

e. Bend- A turn in a waterway's course also referred to as a curve.

f. Oxbow- A series of bends in a waterway's course. Usually, found in type III riverine environments and/or older type II river systems.

g. Current- The portion of a waterway moving continuously in a predictable direction. The swiftest part of a river system.

h. Sweeper- Trees pulled into the waterway by collapsing banks, or trees rooted to the river bottom.

i. Canal- A man-made waterway used to transport commercial boat traffic and/or for irrigation.

j. De1ta- Triangular shaped, silt formed stretch of land that develops along the mouth of a river system as it empties into a larger body of water.

4. **Physical Characteristics of Major Riverine Systems**: Major drainage areas are divided into four basic sectors or types. Each of which has certain characteristics. These four types are:

a. **Type I** - Upper sector, or Headwaters.

(1) This sector is often a mountainous region drained by numerous small tributaries, many of which merge to form a river system. It is variable and unpredictable. Headwaters are characterized by waterfalls, rapids, high banks, steep gradients, and local variations in depth.

(2) River passage in this area is difficult and usually not navigable by motorized craft except in their lower stretches.

(3) Because of the navigability problem, and the fact that the water is to deep to be forded without difficulty, the type I waterways are primarily obstacles as opposed to lines of communication.

(4) Type I riverine environment is the least significant of the representative types of riverine environments. Operations are conducted in accordance with established procedures with only minor modifications necessary.

b. **Type II** - Middle Sector or Central Valley .

(1) This sector contains one or more major rivers. There also may be numerous smaller streams, canals, and patties. These waterways may present serious obstacles, but should become useful as lines of communications. The waters in this category can usually be navigated by small motorized craft.

(2) This sector is generally a broad river valley into which numerous smaller tributaries feed. The middle sector is wider and slower than the upper sector and is often interspersed with obstacles.

(3) In the upper part of the middle sector, the erosional process is dominant; whereas down stream the depositional process becomes progressively more active. Consequently, in the upper part, navigation is more heavily influenced by river-bedrock formations and often approaches conditions similar to those of the headwaters.

(4) In parts of the middle sector, braiding (multiple channeling) occurs and successful piloting depends heavily on determining the principle/deepest channel. Deep channels are scarce in braided middle sectors; consequently, waterborne movement is often difficult

without experienced river pilots. In addition, braided channels constantly change course; making accurate charting nearly impossible (see figure 1).

BRAIDED CHANNEL

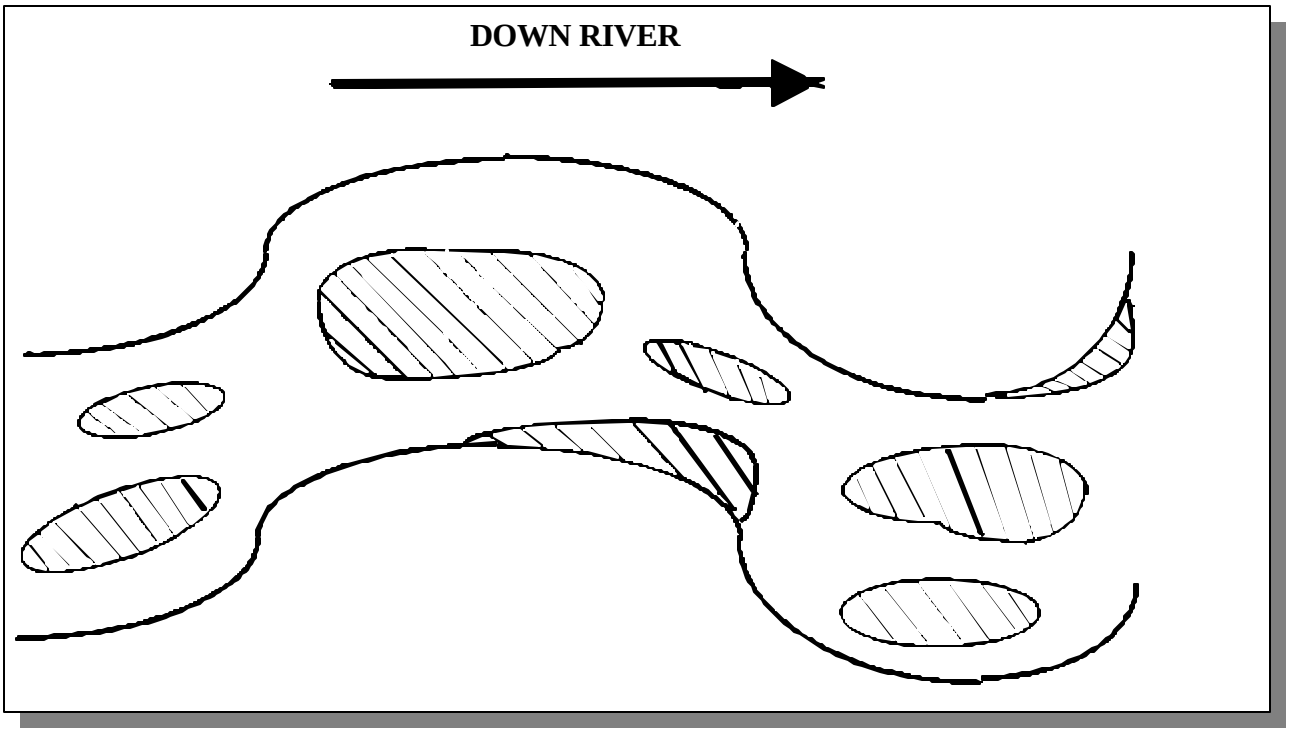


Figure 1

(5) In that part of the middle sector where meandering occurs, navigation problems are greatly simplified by relatively regular and predictable characteristics of the main channel. At low to average river stages, the location of maximum current is predictable and changes occur gradually (see figure 2).

MEANDERING CHANNEL

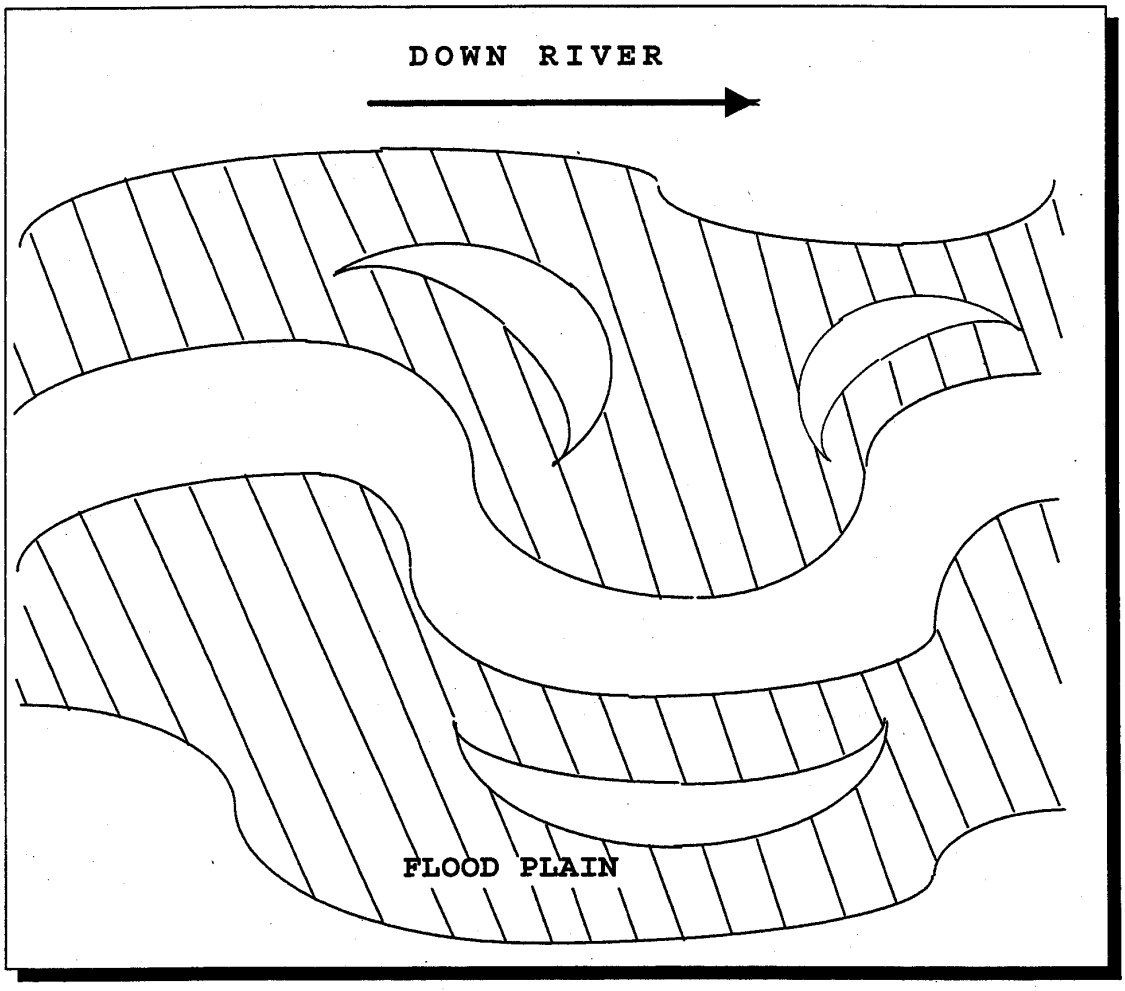


Figure 2

(6) Tactical operations in the riverine environments are conventional in planning and execution, but the waterways must be exploited to ensure success of those operations.

(7) Waterborne operations will augment or support land operations whenever advantageous.

(8) Major waterways permit the use of larger boats and landing craft which can be employed in both tactical and logistical operations.

(9) Sufficient dry land areas exist to pern1it normal sitting of ground force installations

c. **Type III -** Lower Sector of Delta.

(1) When a delta is formed, it is characterized by a flat depositional plain, formed by a number of river tributaries disabusing sediment and water into a gulf, bay, or ocean.

(2) The lower sector is generally the widest of the sectors, and the speed of the current may change or even reverse with the tide.

(3) Water depth throughout the delta area is often predictable at various river and tidal stages.

(4) Tidal activity can influence the velocity and direction of currents radically. Tidal activity frequently results in saline invasion, so that the water in rivers and canals is too brackish for human consumption. This saline invasion may extend inland up to 30 miles or more from the seacoast. When operating in salt or brackish water additional 1st echelon maintenance must be performed on waterborne craft and related equipment, to remain operational.

(5) Channels that are navigable by ships are often found in the lower sector. Numerous low-lying islands and locations where the primary or secondary river channels double back exist in this type of waterway; therefore, this area may require additional attention.

(6) Dominant water courses in the delta are relatively straight tributaries, assisting in the identification of navigable channels. Bottoms of tributaries normally slope up to a crest at all river mouths and form a critical dimension that requires the use of high tides for watercraft with marginal drafts.

(7) The lower sector is usually navigable by ships in natural or man-made channels. This environment will accommodate all sizes of watercraft from canoes to ships the size of LSTs, LSDs, or LPDs. Barges for use as floating helicopter pads, and artillery firing points possess useful potential.

(8) Type III environments are dominated by water. There may be several major waterways in the area in addition to an extensive network of lesser waterways, canals, and irrigation ditches. In tropical and subtropical areas, the banks may be covered with a dense growth that precludes visibility inland from the water. The generally flat terrain and lush

vegetation severely limit ground observation. Waterways are the predominant lines of communication when usable roads are scarce; cross-country mobility is drastically curtailed; and suitable land area for command, control, fire support, logistics, and air installations frequently is not available.

(9) MAGTF operations will be affected significantly by this environment. Waterways must be exploited to exercise control over the area of responsibility. Extensive support by riverine elements will be required. The unavailability of hardstand sites for installations and the possible limitations of wheeled and tracked vehicles are major considerations in planning operations in this environment. When necessary, facilities for command and control, combat support, and combat service and support must be waterborne. Helicopters and medium size waterborne craft will playa major role in the transport of personnel and logistics.

d. **Type IV** -Canals. Canals may be encountered and used in an operation. Since canals are man-made, their characteristics are usually predictable, and they are often navigable by shallow draft boats. Entrances and exits are critical points on canals, and special emphasis should be placed on obtaining information about these areas. It should be noted that enemy tactics include using deceptive mud or wood barricades to open or close man-made canals.

5. **Operational Effects**: No two river areas are the same. Even within a given riverine system, the effect of the environment on operations will vary with seasonal changes in rainfall, temperature, and other climatic conditions. An area trafficable to tracked and wheeled vehicles in the dry season may be nearly impassable to foot troops in the wet season. Tactics to be employed will vary according to the nature, armament and effectiveness of the enemy. Nevertheless, the general principles set forth here remains valid in all riverine areas.

6. **Weather:** Adverse weather conditions can either enhance, or degrade riverine operations. The ability to forecast weather conditions accurately in a given locale, must be included in the intelligence estimate. For example, although the reduced visibility caused by heavy rains or fog can be exploited in the movement of a riverine assault force, the detrimental effects of severe weather on communications, riverine navigation, force integrity and safety may outweigh any potential benefits derived. Further, seasonal or other prolonged periods of extreme weather (i.e. heat, cold, rain, etc.) may have a significant effect on the endurance and alertness of assigned personnel, as well as contribute to the degraded performance of equipment.

7. **Riverine Piloting:**

a. Boat captains, coxswains and other key personnel should be trained in the principles of riverine piloting before a unit begins operating on the waterways within their Tactical Area of

Operational Responsibility (TAOR). Boat operations may appear simple, but certain techniques must be mastered. Training should also include use of certain native watercraft when organic Joint Mobile Riverine Force (JMRF) waterborne craft are not initially available.

b. The greatest current velocities and the steepest gradients are generally found near the upper sectors or headwaters of the river. Velocities may vary at all points of the river within short stretches, or between points across a channel. Flow is swiftest where the channel is constricted, and slowest where the stream spreads out broad and shallow. In a meandering stream, centrifugal force throws the water to the outside of the bends. In spite of this general rule; underwater obstructions remain a hazard to navigation. These obstructions can be present even in the deepest channels, particularly in tidal waterways.

c. Surface Indicators. The surface of the water directly to the front of the boat must be watched closely.

(1) Rippled Water - Lightly rippled water, where no wind is blowing, is an indicator of shallow water.

(2) Undulating Waves - A long undulating wave indicates deep water and fast currents. A smooth surface usually indicates deep water and slightly lessened velocity.

(3) **"Vees"** - A "Vee" on the surface of the water generally indicates an obstruction, lying parallel with the direction of the current. Current velocity, size of the obstruction and closeness of the obstruction to the surface of the water combine to determine the size of the "Vee". The "Vee" is only an indicator of the approximate size, location, and closeness of the obstacle to the surface of the water. It does not indicate the total size of the obstruction.

(4) Rolled Waves - A rolled surface, at a particular point usually indicates an obstruction, such as a log, tree or cable lying perpendicular to the direction of the current.

d. Observation is very important in piloting. The coxswain must place himself so that he can constantly observe the waterway's course and surface. Occupants of the boat should remain seated so they do not obstruct the boat captain and/or coxswain's view, or suddenly shift the balance of the boat. All passengers have the additional duty as observers; watching for obstacles in the water and signs of enemy activity . A void ripples, boils, and other indications of disturbed water and obstructions. These disturbances can force a boat into obstructions that will tear out the boat's bottom. Sweepers are extremely dangerous to boat crews and passengers. A collision with one may cause a boat to overturn and be tom apart. A boat that overturns in sweepers exposes occupants to double dangers. The tree branches can impale personnel and/or catch and hold them under water.

e. Tidal Considerations. In tidal waterways, silt deltas or shoals are found on both ends of mid-channel islands, and on both sides of the mouths of waterways. The tidal flow backing up into tributaries will usually form sandbars and shoals across the mouth of a river entrance. Breaks in the shoals will be near the shore rather than at midstream (see figure 3).

TIDAL CONSIDERATIONS

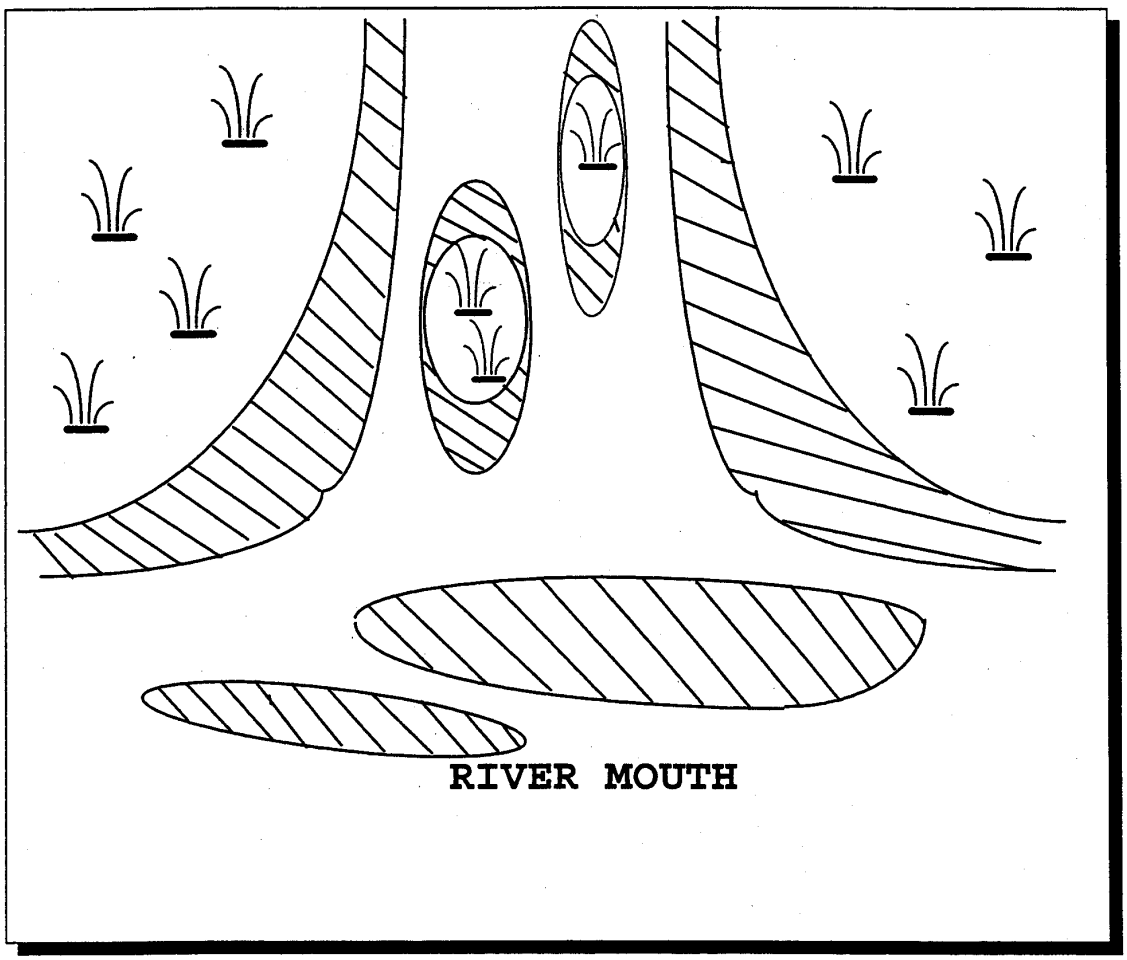


Figure 3

f. River Movement. A river can be read easier when moving upstream, against the current than it can when moving with the current. Also, watercraft are more responsive to helm commands when moving against the current. Waterway channels and river obstacles are

indicated by natural and man-made signs. By learning these indicators and watching for them, boat captains and coxswains can navigate waterways safely without damage to their craft or engines.

(1) Negotiating River/Stream Intersections - When moving from one channel into another which is perpendicular to the first, the coxswain should navigate at right angles to the current into which he is traveling. He should pass on the downstream side of the channel to be entered, proceed upstream a short distance, and then turn back into the flow of the new current. A powered craft should be throttled down to about half speed until the coxswain knows what lies ahead of his craft (see figure 4)

NEGOTIATING RIVER/STREAM INTERSECTIONS

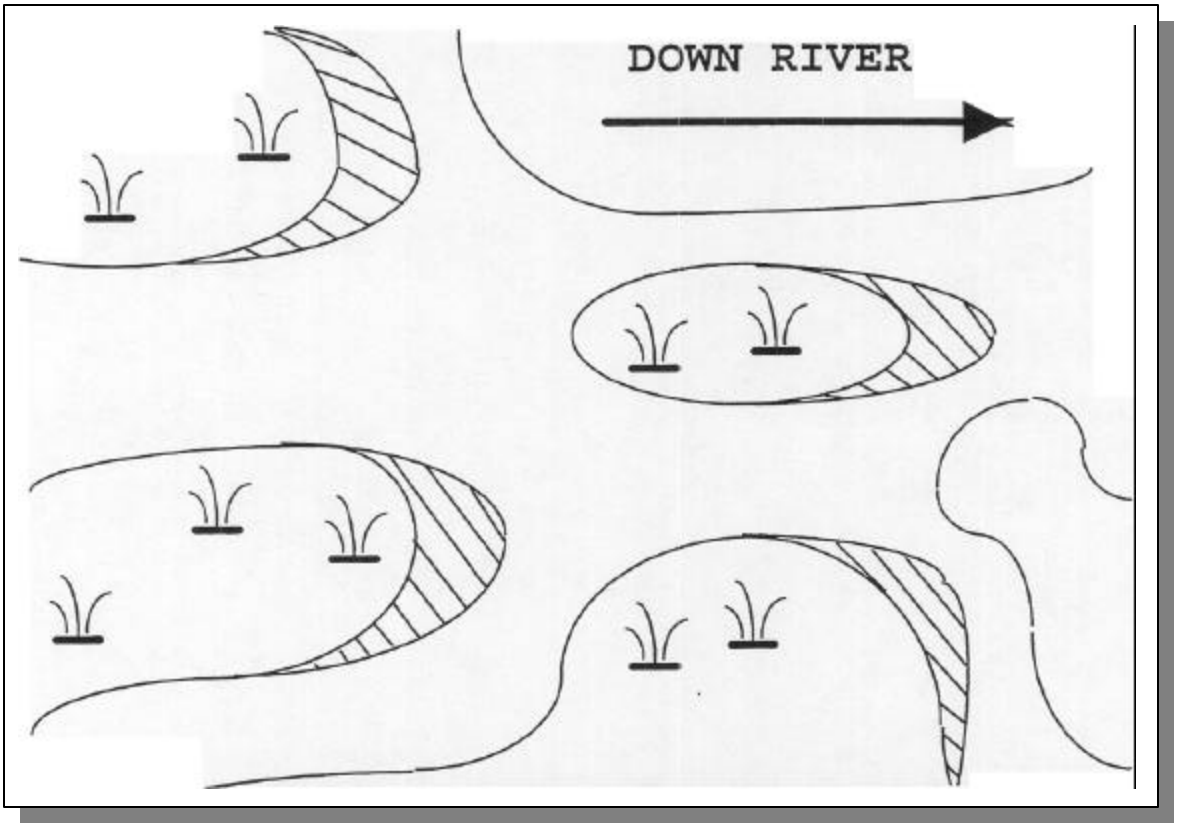


Figure 4

(2) Negotiating River Bends - When moving around a bend whether moving with or against the current the coxswain should normally stay to the outside of the bend. The

centrifugal force of the water moving around the curve will normally leave the deepest channel to the outside of the bend. The prudent riverine coxswain/pilot must be watchful of sweepers and other obstacles, that could be deposited to the outside of these bends (see figure 5).

NEGOTIATING RIVER BENDS

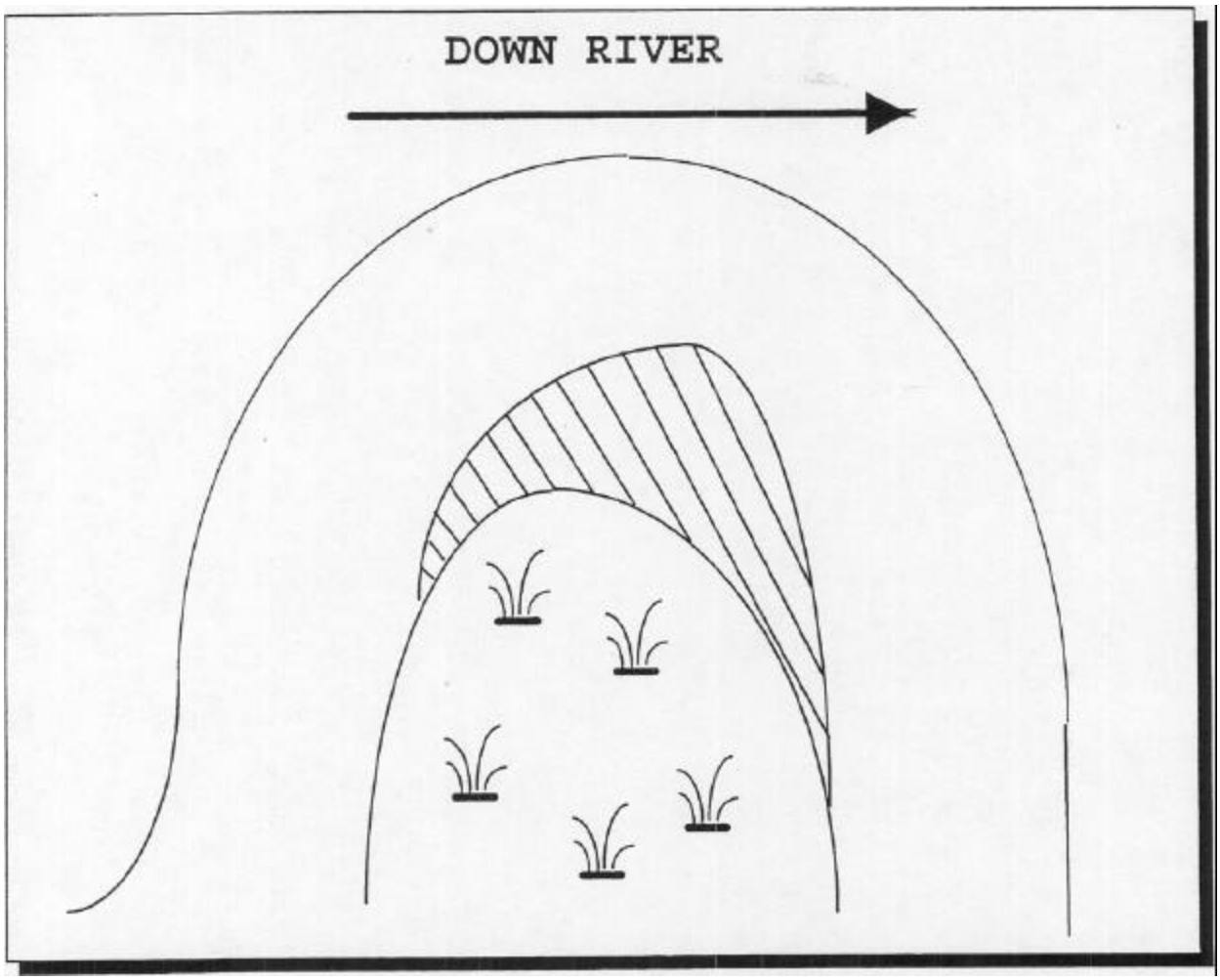


Figure 5

g. **Deep Channel Indicators.**

(1) Man-Made Indicators.

(a) Buoyage systems

(b) Fishing nets

(c) Pilings

(d) Stakes

(e) Boat hulks

(f) Road/Ramps to the waterway

(g) Ferry landings

(h) Mooring stations

(i) Piers, new and old

(2) Natural Indicators.

(a) Birds standing in the water

(b) Ripples/Choppy water

(c) Waves/Wakes

(d) "Vees"

(e) Undulations in smooth/calm water

(f) Animal tracks to the water's edge

(g) Trash piles in the middle of the waterway

(h) Steep banks

(i) Swampy/Shallow banks

(j) Swirling water

(k) Fast flowing water

8. **Riverine Navigation:**

a. The waterway must be sufficiently wide and deep to accommodate the boat or watercraft being used. If a unit is moving only a short distance, or to a well defined debarkation point, hasty route selection may be the only preparation necessary. The length of the move increases the chances of a navigational error. For a short move, a simple plan committed to memory may suffice.

b. The most accurate method of navigation in a riverine environment is by the use of satellite navigation (SATNAV) equipment (e.g. Global Positioning System [GPS], or the Trim Pack). In type II, III and IV environments the ability to use terrain association may be limited because of the lack of identifiable terrain.

c. The use of a navigator and an observer is the best method to locate a position on an inland waterway without the use of SATNAV equipment. Unit personnel must be trained to perform these duties. The persons acting as navigation team are equipped with a map, compass, flashlight and grease pencil. During the hours of darkness, he lies under a poncho on the deck of the craft. The poncho prevents anyone on or near the waterway from seeing the light the navigator would be using. The observer, well forward in the craft, calls the bends, intersections and other landmarks to the navigator. With the aid of his compass the navigator plots this information with his present position and time. The information is recorded for future use. The observer and the navigator must work together to stay abreast of their location in the river and present position on a standard coordinate system (i.e. military grid reference system or latitude/longitude). By using this navigational method, the boat can move to any accessible predestinated landing site. This is particularly important on a patrol mission when waterborne craft are used to infiltrate into hostile areas. During large waterborne movements each element should designate primary and back-up navigation craft.

d. Another aid to navigation is a strip map drawn on a piece of luminous tape showing critical checkpoints. The time-distance method also may be used. The time from the point of origin to the first checkpoint is noted and compared to the entire route to be traveled. This provides an estimate of the time required to complete the movement. If time of arrival at the destination is critical, reverse planning by the "S x T = D" formula should be used, allowing additional time for unforeseen halts, or interruptions in the forces movement.

e. When a MAGTF or Mobile Riverine Force (MFR) initially occupies a TAOR the riverine force may employ native guides to familiarize its river pilots, boat captains and coxswains to the area. Even the most recent editions of maps and charts of the area cannot be relied upon for complete accuracy. This is especially true in type II and III environments where braiding and tidal effects are constantly moving the main channels.

REFERENCES:

1. *FMFM 7-5A, .MAGTF RIVERINE, OPERATIONS*
2. *ST* 21-75-3, *DISMOUNTED PATROLLING*

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 547
MAR 99

STUDENT OUTLINE

RIVERINE MOVEMENT TECHNIQUES

LEARNING OBJECTIVE:

A. **TERMINAL LEARNING OBJECTIVE**:

(1) Without the aid of references, maintain position in formation/movement technique in accordance with the references.

(2) Without the aid of references and given a scenario in a Riverine Environment, cover the assigned sector of fire in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references describe in writing the signal for the appropriate movement technique in accordance with the reference.

(2) Without the aid of references, utilize the traveling movement technique in accordance with the reference.

(3) Without the aid of references, utilize the traveling overwatch movement technique in accordance with the reference.

(4) Without the aid of references, utilize the bounding overwatch movement technique with alternating bounds in accordance with the reference.

(5) Without the aid of references, utilize the bounding overwatch movement technique with successive bounds in accordance with the reference.

(6) Without the aid of references, and given a scenario in a Riverine Environment, adjust the sector of fire as required based on the formation in accordance with the references.

(7) Without the aid of references, and given a scenario in a Riverine Environment, adjust the sector of fire as required based on the movement technique in accordance with the references.

(8) Without the aid of references, and given a scenario in a Riverine Environment, maintain watch for hazards/targets as directed in accordance with the references.

(9) Without the aid of references, and given a scenario in a Riverine Environment, report as directed in accordance with the references.

(10) Without the aid of references, and given a scenario in a Riverine Environment, engage as directed in accordance with the references.

OUTLINE:

1. General. Waterborne movement is essential to the conduct of military operations in a riverine environment. It is similar in nature to ground, vehicular movement. It is also similar to small unit patrol tactics in that awareness/alertness of the individual craft is a key element of overall formation security .

2. **Factors Affecting Waterborne Movement:**

M -Mission E -Enemy
T -Terrain and Weather
T -Troops and Fire Support available

T -Time available
S -Space
L -Logistic Support available

3. **Riverine Movement Techniques**. Riverine forces may employ several different types of movement techniques to maximize security and fire power. A typical movement will entail a combination of movement techniques and formations over its course. The use of proper movement techniques provides the commander with the control necessary to take advantage of the cover and concealment afforded by the terrain. It will cause contact to be made with the enemy by the smallest possible element. There are three basic movement techniques used.

a. Traveling - a movement technique used when speed is necessary and contact with enemy forces is not likely. All elements of the unit move simultaneously with the unit leader located where he can best control. To execute the arm and hand signal for the traveling movement technique extend the arm overhead and swing it in a circle from the shoulder (see figure 1).

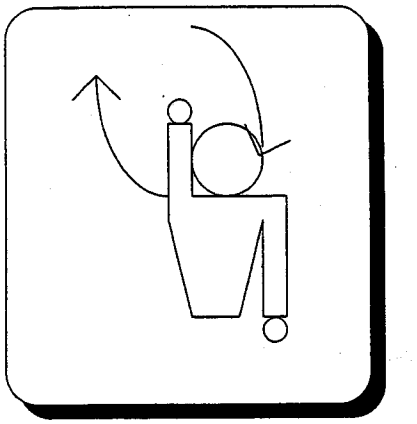


Figure 1

b. Traveling Overwatch- a movement technique used when contact with enemy forces is possible. The lead element and trailing element are separated by a short distance which varies with the terrain. The trailing element moves at variable speeds and may pause for short periods to overwatch the lead element. It keys its movement to terrain and the lead element. The trailing element overwatches at such a distance that should the enemy engage the lead element, it will not prevent the trailing element from firing or moving to support the lead element. To execute the arm and hand signal for the traveling overwatch technique extend both arms and raise them up and down (see figure 2) .

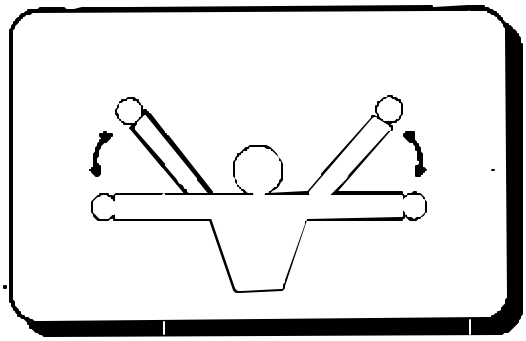


Figure 2

c. Bounding Overwatch - a movement technique used when contact with enemy forces is expected. The unit moves by bounds. One element is always halted to overwatch another element while it moves. The overwatching element is positioned to support the moving unit by fire or fire and movement. To execute the arm and hand signal extend one arm to a 45 degree angle. Bend the arm and tap the helmet. Repeat (see figure 3). There are two basic bounding overwatch methods used in riverine movement.

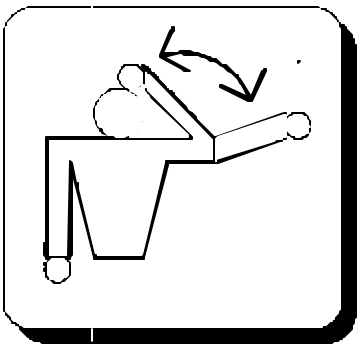


Figure 3

1) Successive Bounds - the overwatch element covers the bounding element to provide for maximum security. The bounding element proceeds an appropriate distance and stops to provide security for the overwatch element which then transits forward to the vicinity of the bounding element. The bounding element then proceeds forward under the cover of the overwatch element. This process is repeated until another movement technique is used or the destination is reached (see figure 4).

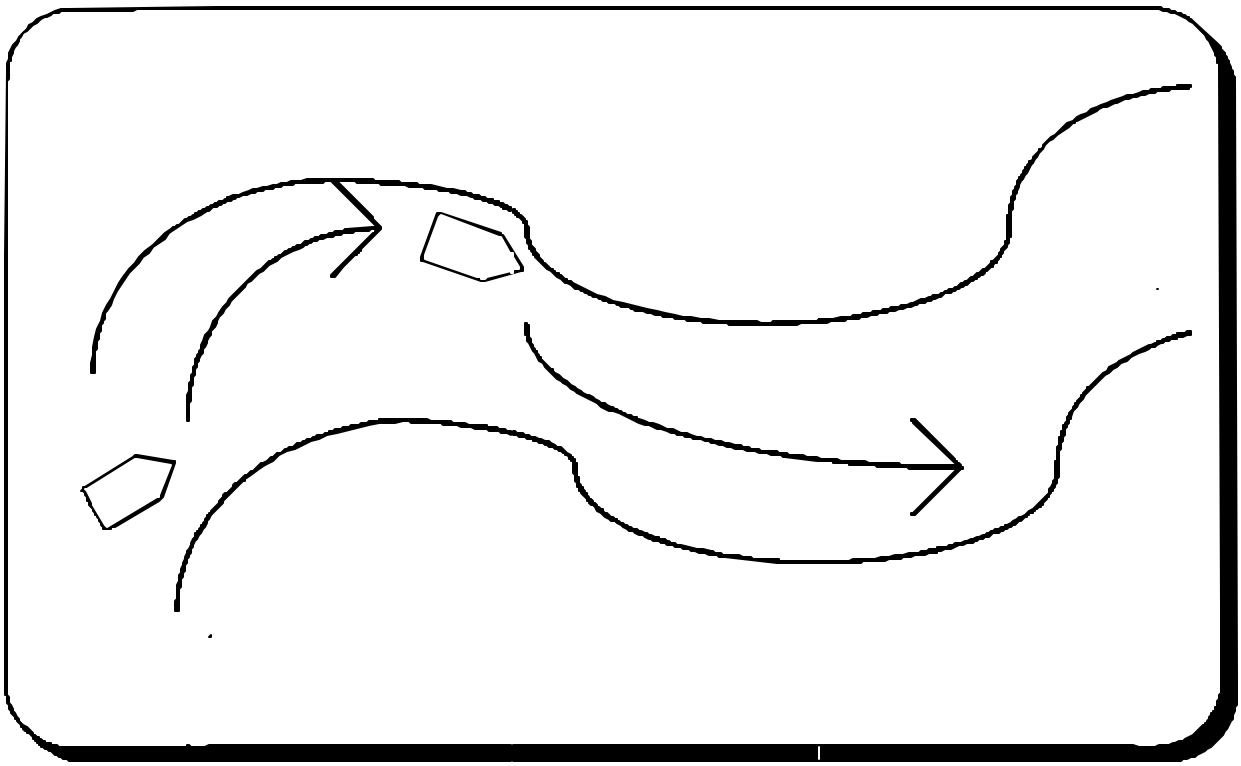


Figure 4

(2) Alternate Bounds - the overwatch element covers the movement of the bounding element. The bounding element proceeds an appropriate distance and stops to provide

security for the overwatch element as in the Successive Bounds method. The overwatch element then proceeds passed the halted bounding element, which is now the overwatch element, and takes up an overwatch position forward. This process is repeated until another movement technique is used or the destination reached. The Alternate Bounds method is faster but less secure (see figure 5).

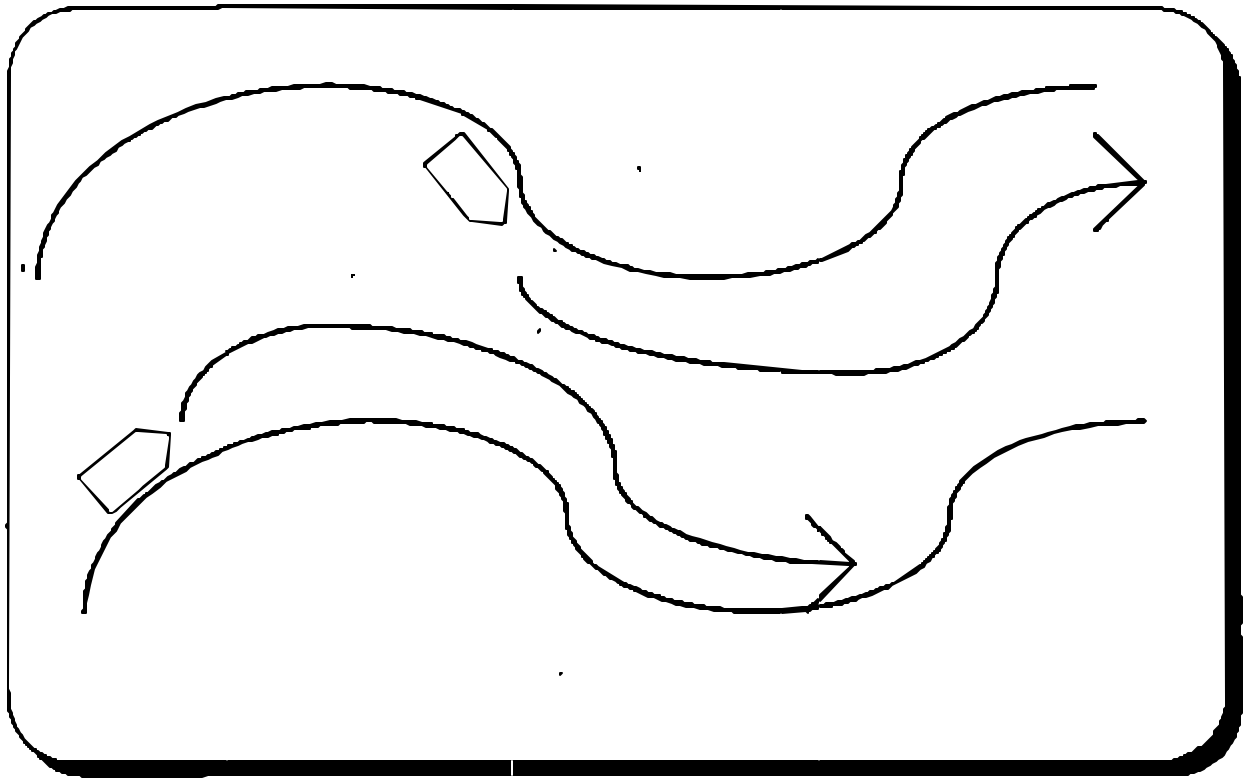


Figure 5

4. **Riverine Tactical Halts**

a. Herringbone - an arrangement of craft at left and right angles to the line of march used to establish security during an unscheduled halt (see figure 6). To execute the arm and hand signal extend the arms parallel to the ground. Bend the arms until the forearms are perpendicular. Repeat (see figure 7).

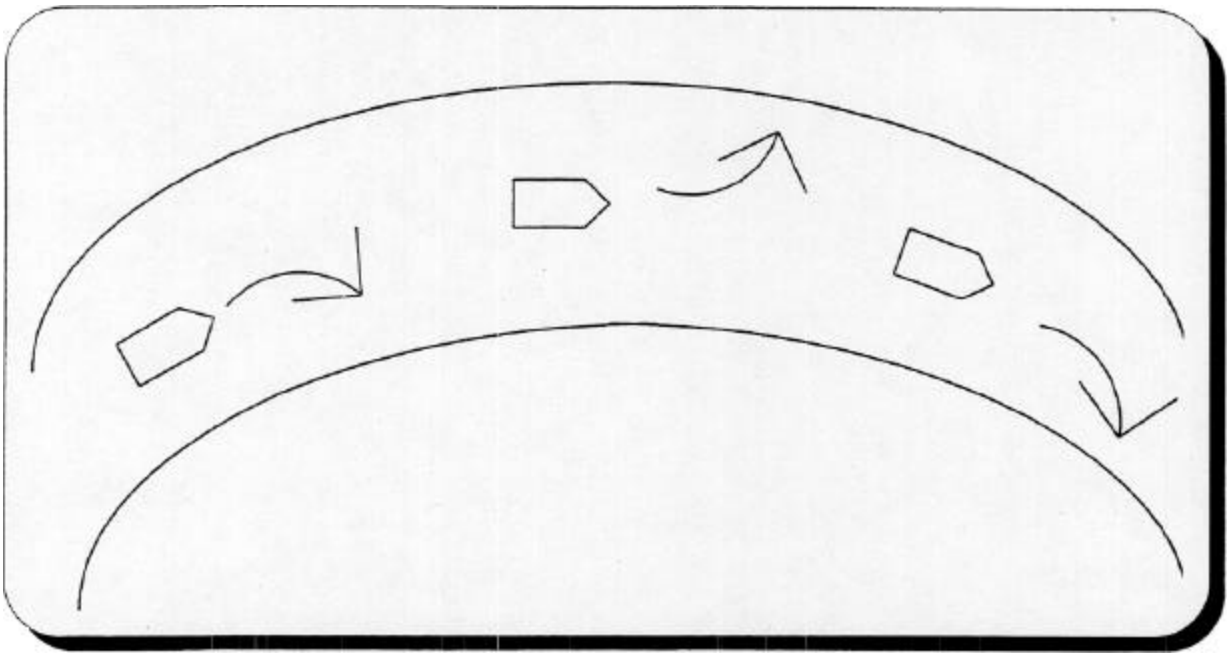


Figure 6

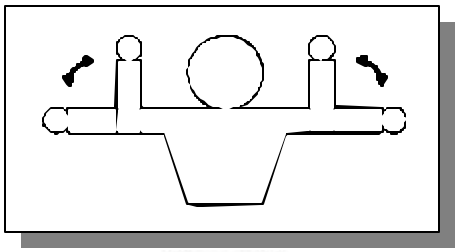


Figure 7

REFERENCE:

1. NSW/USMC Riverine Operations Handbook

2. FMFM 7-5A MAGTF Riverine Operations

3. FMFM 6-5 Marine Rifle Squad

4. FMFM 7-5 Doctrine Navy/Marine Joint Riverine Operations

NOTES:

ATTACHMENTS: None.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 548
MAR 99

STUDENT OUTLINE

INSERT AND EXTRACT

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVES:

(1) Without the aid of references and given a scenario in a Riverine Environment, conduct a landing or withdrawal in accordance with the references.

(2) Without the aid of references and given a scenario in a Riverine Environment, cover the assigned sector of fire in accordance With the references.

B. ENABLING LEARNING OBJECTIVES:

(1) Without the aid of references, act as flank security during a multiple craft/multiple team insert or extract in accordance with the reference.

(2) Without the aid of references, rotate between flank and insert or extract craft during a multiple craft/multiple team insert or extract in accordance with the references.

(3) Without the aid of references, glide into an insert or extract point during a multiple craft/single team insert or extract in accordance with the reference.

(4) Without the aid of references, act as the recovery craft during an emergency extraction in accordance with the reference.

(5) Without the aid of references and given an insert or extract scenario in a Riverine Environment, adjust the sector of fire as required in accordance with the references.

OUTLINE:

1. Insertion/Extraction Types. The size of the supported ground force may vary, ranging from a small team to a reinforced infantry company. Based on METT -TSL the tactical commander will decide if the insertion or extraction will be conducted overtly or clandestinely.

a. Overt. Overt operations are those that are conducted with no intention of concealing their execution.

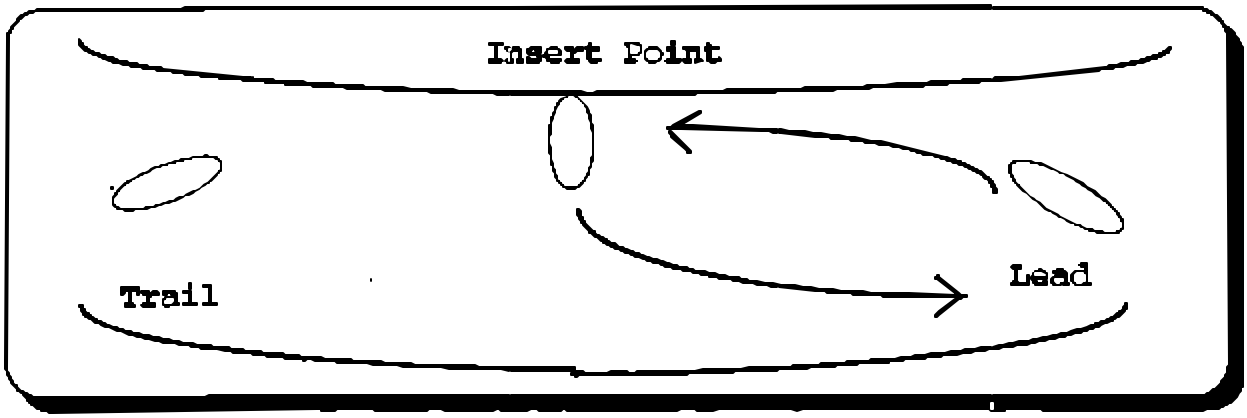
b. Clandestine. Clandestine operations are those that are conducted with the intent to conceal the on-going operation.

(1) A deception plan to confuse the enemy as to the actual insertion/extraction site should consider false insertions/extractions before and/or after the actual insertion/extraction.

2. **Multiple Craft / Multiple Teams Insertion/Extraction.**

a. Once the site has been determined, the lead and trail craft move to a position from which they can cover the near and far banks and up and down the river. They overwatch the craft inserting the team.

b. Once the craft that has inserted their team is finished, it moves to one of the overwatch positions and the craft it relieves moves to insert its team.

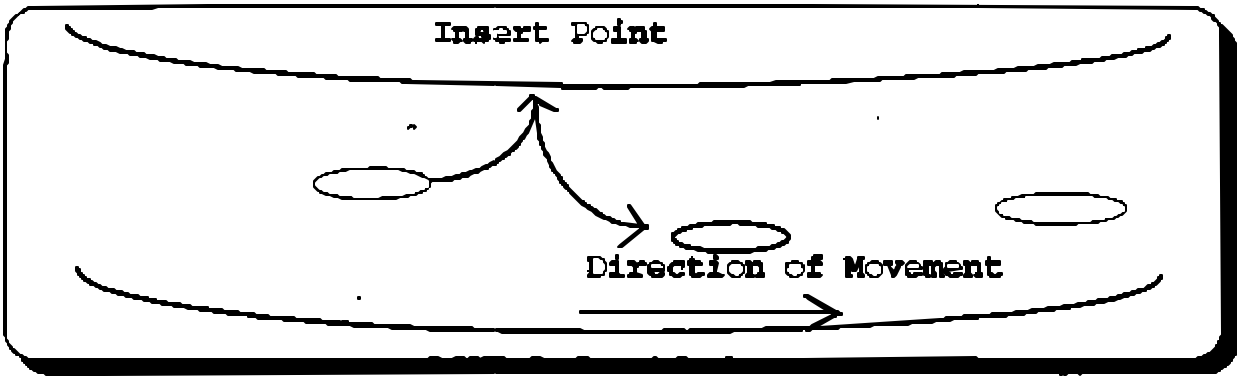


c. The process is repeated until all teams are inserted.

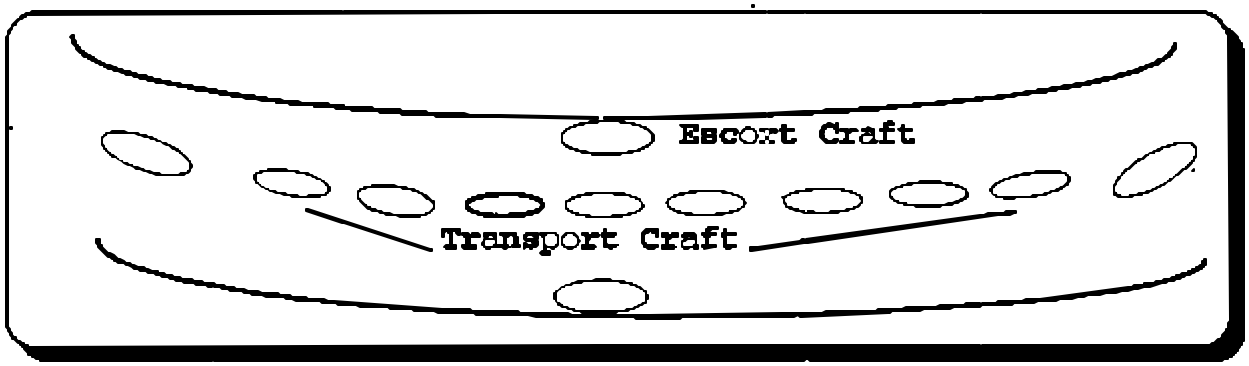
d. Once all teams have been inserted, the signal is given (SOP), and all craft move out in the designated direction.

3. **Multiple Craft/Single Team Insertion/Extraction.**

a. Once the site has been determined, the craft with the team to be inserted peels off to insert while the other craft continue up or down the river with their engine covers open to deceive the enemy.

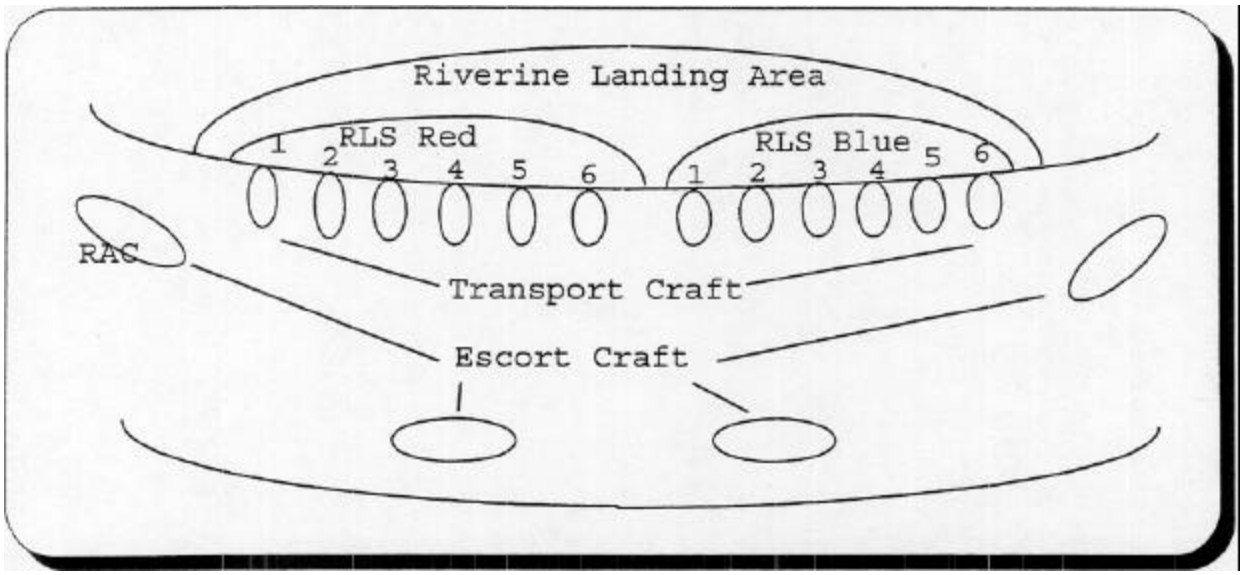


b. Once the team has been inserted the insertion craft withdraws quietly and slowly moves to catch up with the other craft and the other craft close their engine covers.

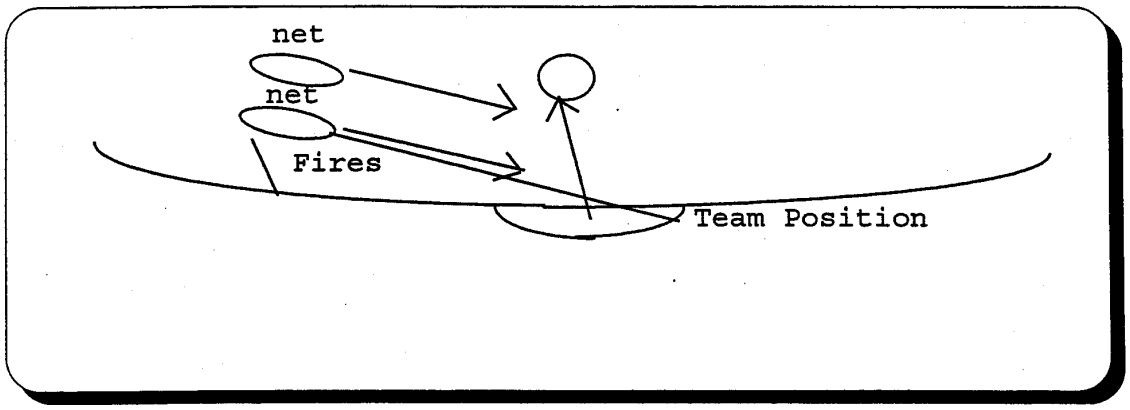


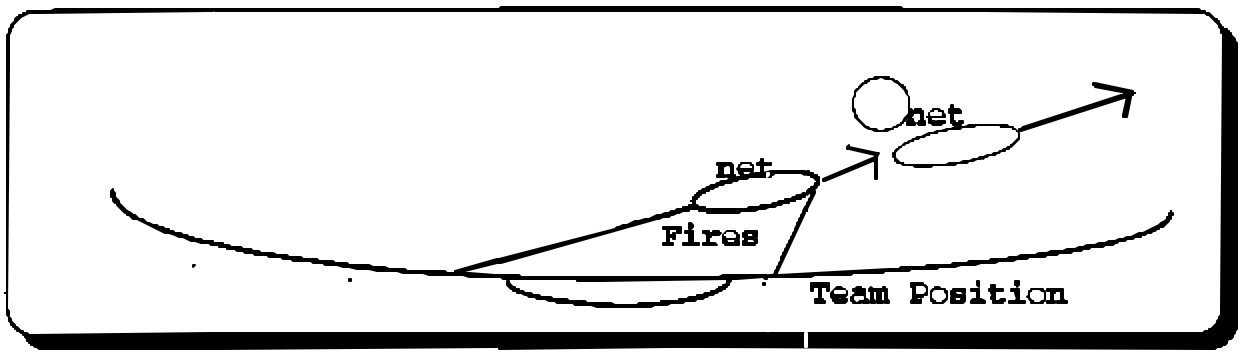
4. **<u>Inserting a Unit from Transport Craft with a RAC Insert</u>**

a. The escort craft form a diamond around the transport craft until arrival at the RLA.



b. At the Riverine Landing Area (Code Name) the escort craft move to cover the flanks and provide fire support as required. The transport craft move to their designated Riverine Landing Site (Color) and their numbered Riverine Landing Points.





5. Emergency Extraction A unit can be extracted under pressure by withdrawing under the covering fire of the RACs while boarding the transport craft at the RLA. Small teams have an additional option

a. The RACs carry cargo net sections for emergency extracts. The RACs will rig the nets on the far side of the craft.

b. Defensive fires provided initially by supporting arms, air, artillery etc... allow the RACs to approach the team.

c. As the RACs approach to within small arms range, the supporting arms shift and the teams enter the water. The enemy position is marked so the RACs can provide accurate cover fire.

d. The outboard RAC recovers the team while the inboard RAC provides suppressive

fire.

f. The lead or outboard craft, with the team, moves out fire. The RACs can drag the team on the nets for short distances if fire superiority cannot be obtained. The trail or inboard craft follows in case a team member falls off the net.

e. Once all team members are recovered the RACs depart and supporting fires resume on the position.

6. **Insertion/Extraction Plans**. The Insertion Plan addresses actions that will take place at the Riverine Landing Point (RLP). Actions at the RLP begin at an Insert/Extract Rally Point (lRP/ERP), outside of small arms range, or at least one terrain feature away from the RLP. This plan must incorporate the latest available intelligence on the enemy as well as terrain and water conditions (i.e. water depth, bottom composition, height of bank etc...).

The insertion/extraction plan should also:

(1) Provide detailed load plans for each craft.

(2) Landing sequences for multiple craft insertions/extractions.

(3) Fire control measure to prevent fraticide

(4) Emergency towing procedures should a craft become grounded, or disabled because of enemy fire or mechanical failure.

(5) Security plan during the landing/withdrawal.

(6) Communications plan (both electronic and visual) between the RCE craft, GCE, Air combat Element (ACE), and/or other supporting elements (i.e. artillery , and other indirect fire weapons).

(7) Alternate insertion/extraction points.

(8) Contingency for enemy contact during the insertion/extraction. This is especially important during landings when only a portion of the GCE is ashore. Should the CE continue to land the rest of the combat troops, should you attempt to withdraw those already ashore, should the RCE attempt to land the rest of the GCE at the alternate insert point, and have them link-up with those already ashore. These are a few of the possible alternatives the RCE commander will have to plan for depending on the situation (METT- TSL), and the priority of the mission being conducted.

(9) Method of identifying the Riverine Landing Site (RLS), and prominent terrain features at the site.

7. **Extraction Contingencies**. As all craft pull their people off the RLS a system has to be established to report head counts to the mission commander. He has to know of any casualties, mission personnel, or lost classified equipments/documents ASAP .

a. Medivac Procedures. Specific craft may be designated as the Medivac RACs with appropriate first aid equipment and corpsmen aboard. This should not be the Primary Control Craft (PCC).

b. Enemy Contact. IADs have to be established and rehearsed for enemy contact to include:

(1) The GCE is still ashore.

(2) Only a portion of the GCE has been extracted.

(3) GCE has to move to alternate extract point.

(4) The RLS is booby trapped and the RCE has to move to the alternate extract point.

(5) Contact from the enemy waterborne craft.

(6) Other contingencies as they arise.

c. No Communication Procedures. Should the RCE lose radio communications with the GCE, a series of far and near recognition signals have to be established to verify each others identity. Additionally, preplanned extract points and times need to be established.

d. Left Behind Procedures. Should personnel be left behind a plan needs to be made as to who, how and where these personnel can be extracted.

e. Other Contingencies. As the situation dictates.

REFERENCES:

1. *NWP-13 (Rev A)/FMFM* 7-5, *Doctrine for Navy/Marine Corps Joint Riverine Operations*

2. *FMFM 7-5A, MAGTF Riverine Operations*

3. *NSW/USMC Riverine Operations Handbook*

NOTES:

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Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 549
MAR 99

STUDENT OUTLINE

PASSIVE MINE COUNTERMEASURES

LEARNING OBJECTIVE:

A. **TERMINAL LEARNING OBJECTIVE**: Without the aid of references and given a scenario in a Riverine Environment, conduct mine counter measures in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES**:

(1) Without the aid of references, identify in writing the types of mines encountered in a Riverine Environment in accordance with the references.

(2) Without the aid of references, describe in writing the mine indicators in accordance with the references. ,

(3) Without the aid of references, describe in writing passive mine countenneasures in accordance with the references.

(4) Without the aid of references, describe in writing the proper response to a mine sighting in accordance with the references.

OUTLINE:

The Riverine environment includes rivers, canals, lakes and coastal areas. It is characterized by limited lines of communication and extensive waterways that provide natural routes for transportation and at the same time riverine areas will impose a variety of limitations on mine warfare operations in area of operations (AOs). These include:

a. Bridges, overpasses pier pilings, and other supports with low overhead clearances.

b. Tidal actions and seasonal climate changes which could make placement and concealment of mine difficult.

c. Floating debris which could affect emplacement of mines

d. Minimal underwater visibility which could limit mine emplacement & detection

1. **TYPES OF MINES** - Riverine forces may encounter anything from technically advanced mines which have been manufactured expressly for specific riverine targets to relatively crude field expedient mines which make use of locally available explosives and detonating systems. Anything that can be made watertight can be used to create an expedient mine. (C-4, unexploded ordnance, TNT, or gasoline) Detonators can consist of a simple primer and battery or the fuse from recovered dud ordnance. Field expedient mines are easily manufactured, lightweight, and are command detonated most of the time. They can be extremely effective. All mines have three factors in common, Container, Detonator and Explosive Charge (Body, Fuse and Filler)

a. Bottom Mines are generally larger than the other types of mines. They can be field expedient (such as a 2000 lb bomb re-configured). Bottom mines are mostly command detonated in a riverine AO but they can be influenced detonated in riverine AO. Bottom mines are generally used against specific targets (Troop transport, Supply ships and Command and Control ships)

b. Moored Mines are generally anchored to the bottom of a river and are buoyant. In some cases they can be suspended on a cable and manually moved or aimed. Currents and tides have a significant effect on moored mines, often causing them to dip below an effective depth, to become visible on the surface, or to break loose from mooring. Location is usually marked by a stake or other inconspicuous object so that operators can tell when victim is over or near the mine. (These mines are contact or influence activated).

c. Drifting Mine are relatively lightweight, small, buoyant and can be launched from craft or land. Usually activated by contact but can be influence-activated. Drifting mines are uncontrollable and are free to move with the tides and currents. Once deployed the imperil all riverine traffic. They can be activated by floating debris and can beach without detonating becoming a hazard to the local civilian populace and friendly forces.

d. Field Expedient Mines are normally light weight and effective. They are enhanced by ease of manufacture, and the ability to plant and move.

(1) Container must be water tight to protect the explosive charge used.

(a) Milk Can
(b) Empty Ammo Can (c) 55 gal Drum
(d) Anything that can be made watertight

(2) Explosive Charge that is use must be effective and easily obtained.

(a) C-4 (plastic explosives)

(b) Unexploded small ordnance
(c) TNT
(d) Gasoline

(3) Detonator must be effective enough to set the explosive charge used off.

(a) Primer and Battery
(b) Spare Generator
(c) Fuse from dud ordnance

2. **Mine Classifications**

a. Magnetic use either a dip needle system or an inductance mechanism to initiate detonation.

(1) Dip needle mechanism uses a needle so balanced that when it lies in normal magnetic field of the earth the mine firing circuit is open. The magnetism of a passing ship cause the needle to dip closing the circuit.

(2) Inductance mechanism uses a search coil to detect a moving magnetic field. When this field passes over the coil a small electrical current is generated activating the mine.

b. Acoustic consists of a passive microphone and associated circuitry for detecting underwater noises coming from ship's machinery. It is similar to an eardrum when sound causes it to vibrate and send impulse to brain.

(1) Usually lay on river bottoms

(2) Activated by the acoustic signature of a passing ship. (Low frequencies from a hull or prop and high frequencies from turbines and other rotating machinery)

c. Pressure The movement of the vessel through the water causes a change in water pressure which, if the mine is set for that pressure change will detonate the mine. The pressure signature of a ship is a function of its speed, displacement, and the water depth.

(1) Usually lay on river bottom

(2) Activated by pressure change by a passing ship

(3) Passing ship causes an area of reduced pressured

(4) Pressure difference increases as ship speed increases

(5) Pressures also change as a result of swells and waves

3. Mine Indicators The riverine force should carefully consider all available intelligence regarding enemy mining capabilities and tactics, ambush threats and waterway hydrogrophy. Mine attacks normally are conducted against river craft in locations where the banks afford protection to the enemy while providing a good ambush site. Mining is frequently used in conjunction with ambushes. Indicators to look for are as follows:

a. Suspicious clumps of vegetation not common to the AO.

b. Movement of an object not consistent with the current.

c. Stakes, rocks, or boards on the bank or in the river.

d. Abnormal activity by the local populace

e. Areas wear craft are forced unnaturally into a given channel (obstruction to normal navigation)

4. Passive Mine Countermeasures are measures taken or conducted with out the use of mechanical methods or devises (mine clearing vessels or various sweeps). This operation is the basic routine of prevention. In order for a mine to be effective it must first be position close enough to a craft to damage it, either by physically placing the mine on the craft or positioning the mine so that the craft and mine come into contact with each other. To make this task more difficult, the following passive countermeasures should be used:

a. Inspect craft prior to patrols

b. Reconnaissance by fire of all floating debris when possible

c. The use of concussion grenades in suspicious areas

d. Destroy enemy mine manufacturing and stowage facilities

e. Interception of mines and personnel in route to suspected target areas

f. Avoid routine time schedules of patrolling operations

g. Waterborne movement should be random with no patrol formation interval or position maintained or fixed.

h. Develop a mine countermeasure system (SOP)

i. Use all means to prevent or reduce the danger

The most effective means of countering a mine threat is to prevent the laying of mines by whatever means appropriate. Strict adherence to the unit SOP and be aware of the daily activities in your area of operation.

5. **Proper Response to Mine Sightings**

a. When dealing with mines in a riverine environment your response could mean the difference of life, death, equipment loss and mission accomplishment. How you react to a sighting should ultimately be determined by your unit SOP's and the mission or missions that have been assigned to your unit. Remember that a mine sighting could also mean that you have just entered a ambush zone. The following are general rules that should be followed:

(1) Your first reaction should be self protection by all means in which you can prevent the hull and other characteristics from causing a mine to detonate.

(2) Contact other craft in the area by COMM or Hand and Arm Signals.

(3) Attempt to depart the area by the same route that you entered.

(4) Contact *BOD* and give appropriate information (Time, Location, Type of Mine if known, How the mine was marked).

(5) Look for alternative route if possible

(6) If the mine is floating Destroy it.

b. Destroying Mines - Riverine mines at no time should be approached by those other than qualified. Therefore your only alternative to destroy a mine will be with direct fire weapons or concussion grenades if appropriate. M60 machine guns have been known to sink more mines than they have detonated. A 50 cal or larger will give you some penetration below the water surface to destroy, contact and/or penetrate the buoyant cover and activate the mine. Your over riding consideration in mine destruction should be to do it at a distance from the craft, which will limit collateral damage to your craft. Your reaction should be to mark the mine location through verbal directions and if possible by firing tracers at the mine.

REFERENCES:

1. *FMFM* 7- 5 *Doctrine Navy / Marine Joint Riverine Operations*

2. *FMFM* 7- *5A MAGTF Riverine Operations*

3. *NSW / USMC Riverine Operations Handbook*

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TAB 550
MAR 99

STUDENT OUTLINE

IMMEDIATE ACTION DRILLS

LEARNING OBJECTIVE:

A. **TERMINAL LEARNING OBJECTIVE**: Without the aid of references and provided the necessary materials, conduct immediate action drills.

B. **ENABLING LEARNING OBJECTIVE**:

(1) Without the aid of references and provided the necessary materials, perform immediate action drills for an air attack.

(2) Without the aid of references and provided the necessary materials, perform immediate action drills for indirect fire.

(3) Without the aid of references and provided the necessary materials, perform immediate action drills for direct rue.

(4) Without the aid of references and provided the necessary materials, perform immediate action drills for mine attack.

OUTLINE:

1. **Respond to an Air Attack**:

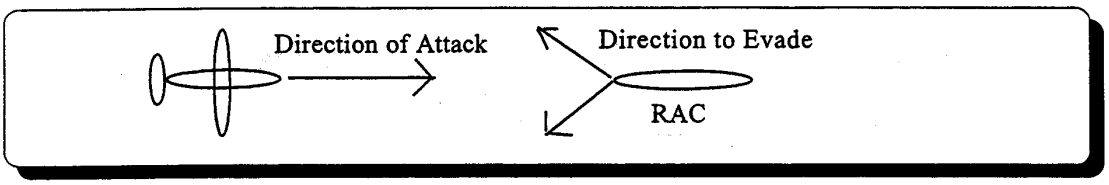
a. Enemy aircraft sighted.

(1) The most obvious part of a RAC on the water is the wake. Seek cover and concealment if possible. If no cover or concealment is readily available, remain motionless as this will reduce the chance of being spotted.

(2) If you are in a covered or concealed position, remain motionless for at least 30 seconds after the first aircraft has passed as they, like you, travel in at least pairs.

b. Enemy aircraft begins engagement.

(1) Turn 45 degrees from the direction of attack if possible and disperse.



(2) If in formation, move at maximum speed while retaining formation integrity. This is to reduce confusion, collisions and target exposure time.

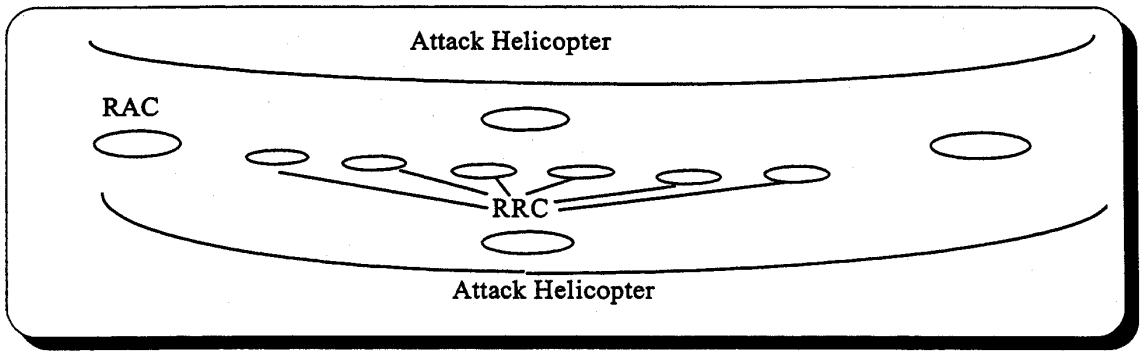
(3) If engaged with bombs or spray, treat as indirect fire.

2. **Respond to Indirect Fire**:

The response to indirect fire is to move rapidly out of or around the impact area. The problem with indirect fire is the amount of time it takes to adjust; a moving target is almost impossible to hit with indirect fire. An additionally concern is who is calling for that fire and how are you being observed. You must move from the observation area not just the impact area.

3. **Respond to Direct Fire:**

a Direct Fire Response to direct fire is dependent on the mission. A unit assigned as escort for an assault mission would force passage and continue the mission. Any movement of this sort should be accompanied by attack helicopters flanking the waterborne movement. These helicopters would provide suppressive fires. Additional fire support should be brought to bear if available.



(1) Return fire with available weapons and attempt to suppress the enemy position.

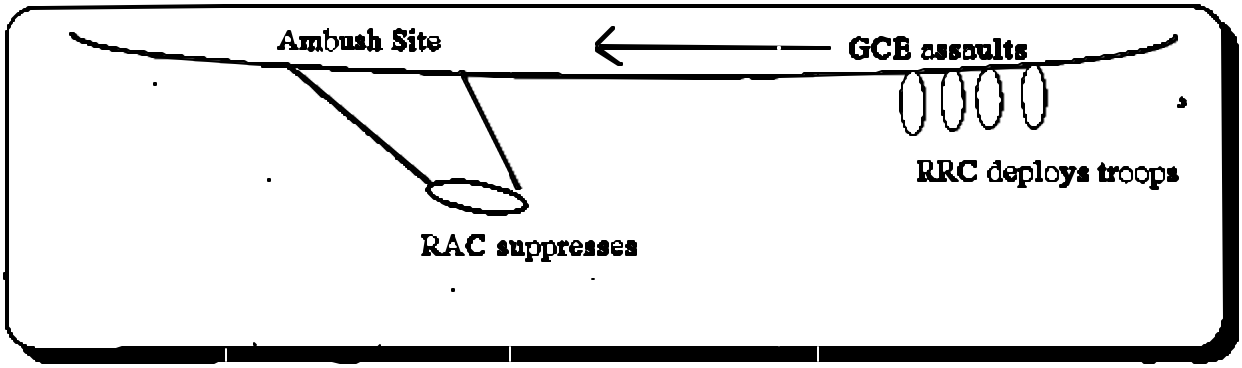
(2) Move at varying speeds in an erratic, angled path if being engaged by ATGMs.

(3) Move to a covered and concealed position, usually further along the route, if return fire does not suppress the enemy position.

b. A unit assigned to patrol an area would attempt to eliminate the threat. Escort helicopters or other fire support assets should be brought to bear if time permits or the situation requires.

(1) Craft in the kill zone would attempt to suppress the enemy fires and exit the zone.

(2) Craft not in the kill zone would attempt to suppress the enemy fires and land embarked Marines, if available, to sweep through the position. These forces would be supported by fire.



4. **<u>Respond to a Mine Attack:</u>**

A mine attack can be identified by a single explosion with no preceding indicators like muzzle blast or the sound of incoming fire.

a. Move to a secure area, usually back along the course. Move out of the main channel in case it was a floating mine.

b. Provide fire support for rescue/salvage operations. The mine attack may have been the signal to initiate an ambush.

REFERENCES:

1. *NWP-I3 (RevA)/FMFM7-5, Doctrine for Navy/Marine Corps Joint Riverine Operations*
2. *FMFM 7-5A, .MAGTF Riverine Operations*
3. *NSW/USMC Riverine Operations Handbook*

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TAB 551
MAR 99

STUDENT OUTLINE

RIVERINE ANNEX

LEARNING OBJECTIVE:

A. TERMINAL LEARNING OBJECTIVES

(1) With the aid of references, given the required information, write a riverine annex in accordance with the references.

(2) With the aid of references, given the required information, prepare a route card in accordance with the references.

B. ENABLING LEARNING OBJECTIVES

(1) Without the aid of references, given the required information, identify in writing the resources needed to complete a riverine annex in accordance with the references.

(2) Without the aid of references, identify in writing items included in a riverine annex in accordance with the references.

(3) Without the aid of references, identify in writing items included in a route card in accordance with the references.

OUTLINE

1. The riverine annex is normally given after the standard operation order which covers the operations ashore. The small boat annex contains information that is not covered in the operations order and covers such items as embarkation, debarkation, movement to the riverine landing site (RLS), and returning to the rendezvous point.

2. Resources. In order to write your Riverine annex, you will need specific information which should be provided by:

a. Embarked Troop Commander. Provides information, direction and guidance concerning the enemy situation, mission, execution, administration, logistics, and command and signal.

b. Embarked Troop Navigator. Provides information, direction and guidance on weather and the navigation plan.

c. Embarked Troop Boat Officer. Provides information, direction and guidance on craft availability .

3. **Format**

The riverine annex is written in the standard five paragraph format (SMEAC).

a. Situation. A general statement that emphasizes information concerning the small boat insert.

(1) Enemy:

(a) Weather. To include general astronomical information if not provided in operation order.

1. Tides. The tide before and after the L-Hour should include the type, time and height.

2. Winds. At sea and onshore or offshore.

3. Current: direction, velocity , at launch and landing.

4. Water temperature.

5. Air temperature. Air and water temperature must be considered to determine possibility of hypothermia..

6. Visibility.

7. Percent of illumination.

(b) Riverine Landing Area Characteristics

1. Width

2. Depth

3. Bottom

4. Slope

5. Height

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TAB 551

6. Terrain

(c) Riverine Transit Characteristics

1. Width
2. Depth
3. Bottom
4. Slope
5. Height
6. Terrain

(d) Natural Obstacles: (Sandbars, Islands, Vegetation, Debris)

1. Description
    a. depth
    b. clearance
2. Lat/Long

(e) Man made Obstacles: (Bridge, Dam, Traps)

1. Description
    a. depth
    b. clearance
2. Lat/Long

(f) Terrain Characteristics

(g) Trafficability of access roads to the river

(h) Significant areas of cover and concealment

(i) Civilian/Military Installations along the route

(g) Populated areas

(k) Ramp and docking areas

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TAB 551

(l) Navigation Aids:

1. Description

2. Lat/Long

(m) Fording Sites

(n) Ferry routes

(2) Enemy Capabilities / Intentions:

(a) Identification. Location, ActivitY and Stren~h.

(b) Detection capabilities:

1. Infrared

2. Acoustic

3. Visual

4. Electronic

5. LP/OP

(c) Patrols:

1. Ground

2. Water

(d) Water mines:

1. Description

2. Location

(e) Bobby Traps:

1. Shoreline

2. In the Water

(3) Friendly Forces. Units furnishing support and/or operating in the area.

(a) Air

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(b) Naval Gun Fire

(c) Artillery / Mortars

(d) Watercraft

(e) Security

(f) Patrols

(g) Advance Forces

(h) Sensors

(i) LP/OP

(j) Attachments and Detachments

(k) Rules of Engagement

b. Mission. Basic mission statement generally including a clandestine delivery to and recovery from a riverine insertion point, of a raid force. This is only the mission for the riverine small boat movement, not of the entire raid.

c. Execution

(1) Concept of Operations: Brief description of the operation including the type of craft, type of launch, general route of passage, type of landing, actions of coxswains during operations ashore, withdrawal, return passage and embarkation .

(2) Scheme of Maneuver

(a) Staging Plan

1. Pickup zone location

2. Pickup zone time

3. Pickup zone security

4. Pickup zone marking and control

5. Landing formation and direction

6. Troop and equipment load

(b) Waterborne Movement Plan

1. Route

2. Latitude

3. Longitude

(c) Legs:

1. Course

2. Speed

3. Distance

4. Top

(d) Formations

(e) Deception Plan

(f) Escort Craft Mission

(g) Escort Helo Mission

(h) Abort Criteria

(3). Landing Plan

(a) RLA Location

(b) RLA Time

(c) Formation

(d) RLS Marking and Control

(e) RLP Marking and Control

(f) Escort craft

(g) Escort helo mission

(h) Abort criteria

(4) Laager Plan

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TAB 551

(a) Laager location

(b) Laager type (shut down/running)

(c) Laager security

(d) Call forward procedure

(5). Extraction Plan

(a) Pickup location

(b) Pickup time

(c) Escort craft mission

(d) Escort helo mission

(e) Supporting plans

(6). Return Movement Plan

(a) Route

(b) Latitude

(c) Longitude

(7). Legs

(a) Course

(b) Speed

(c) Distance

(d) Top

(8). Formations

(9). Deception Plan

(a) Escort craft mission

(b) Escort helo mission

(c) RLA Location

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TAB 551

(d) RLA Time

(e) Formation

(f) RLS Marking and control

(g) RLP Marking and control

10. Coordinating Instructions

(a) Mission abort

(b) Down boat

(c) Crossing obs1tacles/danger areas

(d) Man overboard

(e) Special cargo

(t) Bump plan

11. Actions on Enemy Contact During Transit

(a) Visual

(b) Aircraft

(c) Waterborne

(d) Shore

12. Ineffective Fires

(a) Aircraft

(b) Waterborne

(c) Shore

13. Effective Fires

(a) Aircraft

(b) Waterborne

(c) Shore

14. Fire Support Coordination Measures

(a) Phase lines (reports)

(b) RLS Marking

(c) Weapons status (tight/free)

(d) Manifests

15. Fire Support Plan

(a) Riverine assault craft

(b) Air

(c) Indirect fires

(d) On call target

1. Description

2. Location

3. Designation

d. Admin and Logistics. Accountability of personnel, boat team assignments, handling of casualties, standard and special equipment for boats, uniform, fuel, bullets, first aid and EPWs.

e. Command and Signal

(1) Signal. Signal for landing, recovery etc. Frequencies

(2) Command. Location of raid force commander, GCE Commander

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TAB 551

REFERENCES :

1 ST 21-75-2, *Ranger Handbook*

NOTES:

ATTACHMENTS:

1 Riverine Annex

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TAB 551

Riverine Annex

1. Situation

A. Enemy

(1) Weather/Terrain

		Time	Height
Tide	High	_____	_____
	Low	_____	_____
	High	_____	_____
	Low	_____	_____

Range _____Duration_____

Launch _____Transit _____ Landing _____

Current	Direction	Velocity
Launch _____	_____	_____
Transit _____	_____	_____

Landing_____ _____ _____.

Winds _____ _____

Temp Air _____Water _____

Upstream Weather Effect On Water Level

_____

Riverine Landing Area Characteristics

Width _____Bottom _____

Depth _____Slope _____

Height _____Terrain _____

Riverine Transit Characteristics

Width _____Depth _____

Bottom _____Slope _____

TAB 551

Height_____ Terrain_____

Natural Obstacles (Sandbars, Islands, Veg, Debris)

Desc/Depth/Clearance	Lat	Long
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Man Made Obstacles (Bridge, Dams, Fish Traps)

Description/ Clearance	Lat	Long
_____	_____	_____
_____	_____	_____

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TAB 551

_____	_____	_____
_____	_____	_____
_____	_____	_____

Terrain Characteristics

Trafficability Of Access Roads To The River

_____

Significant Areas Of Cover And Concealment

_____

Civil/Military Installations Along The River

_____

Populated Areas

_____

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TAB 551

Ramping And Docking Facilities

_____

Navigation Aids (Buoys, Lights, River Intersections)

Description	Lat	Long
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Fords

_____

Ferrys

_____

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TAB 551

B. Enemy

Enemy Capabilities/Intentions (Drawd)

_____

_____

Detection Capabilities During Transit

Infrared _____

Acoustic_____

Visual_____

Electronic_____

Lp's/Op's_____

Ground Patrols_____

Waterborne Patrols_____

Water Mines And Attack Swimmer Capabilities

_____

Booby Traps In Or Along Shoreline

_____

C. Friendly

Supporting Units And Times Effective

Air_____

NGF_____

Artillery_____

Mortars_____

Watercraft_____

Attachments_____

Detachments_____

Security_____

Patrols _____

Lp's/Op's_____

Advance Forces_____

Sensors_____

Rules Of Engagement (Allied/Host Nation/Usa/Etc...)

Mission_____

_____

3. Execution

A. Concept Of Operations _____

_____

_____

B. Scheme Of Maneuver _____

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TAB 551

_____

_____

1. Staging Plan -

A. Pickup zone Location_____

B. Pickup Zone Time _____

C. Pickup Zone Security _____

D. Pickup Zone Marking And Control

_____

E. Landing Formation And Direction

_____

F. Troop And Equipment Load

_____

2. Waterborne Movement Plan

A. Route	Latitude	Longitude
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

_____	_____	_____
_____	_____	_____
_____	_____	_____

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TAB 551

_____	_____	_____

Legs	Course	Speed	Distance	Top
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

B. Formations _____

C. Deception Plan _____

D. Escort Craft Mission _____

E. Escort Helo Mission _____

F. Abort Criteria _____

3. Landing Plan

A. Rla Location _____

B. Rla Time _____

C. Formation _____

D. Rls Marking And Control _____

E. Rlp Marking And Control _____

F. Escort Craft Mission _____

G. Escort Helo Mission_____

H. Abort Criteria _____

4. Laager Plan

A. Laager Location _____

B. Laager Type (Shut Down/Running)_____

C. Laager Security _____

D. Call Forward Procedure _____

5. Extraction Plan

A. Pickup Location _____

B. Pickup Time _____

C. Escort Craft Mission _____

D. Escort Helo Mission _____

E. Supporting Plans _____

6. Return Movement Plan

A. Route	Latitude	Longitude
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

TAB 551

_____ _____ _____

_____ _____ _____

Legs	Course	Speed	Distance	Top
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	

_____ _____ _____ _____

B. Formations _____

C. Deception Plan _____

D. Escort Craft Mission _____

E. Escort Helo Mission _____

F. Rla Location _____

G. Rla Time _____

H. Formation _____

I. Rls Marking And Control _____

J. Rlp Marking And Control _____

7. Coordinating Instructions

A. Mission Abort _____

B. Down Boat _____

C. Crossing Obstacles/Danger Areas_____

D. Man Overboard _____

E. Special Cargo _____

F. Bump Plan _____

G. Actions On Enemy Contact During Transit

Visual

Aircraft _____

Waterborne _____

Shore _____

Ineffective Fires

Aircraft _____

Waterborne _____

Shore _____

Effective Fires

Aircraft _____

Waterborne _____

Shore _____

H. Fire Support Coordination Measures

_____ _____

_____ _____

_____ _____

I. Phase Lines (Reports)

_____ _____

_____ _____

_____ _____

_____ _____

J. RLS Latitude Longitude Marking

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

K. Weapons Status (Tight/Free)

L. Manifests _____

C. Fire Support Plan

1. Riverine Assault Craft _____

2. Air _____

3. Indirect Fires _____

4. On Call Targets _____

Description	Location	Designation
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Command And Control

A. Signal

1. Call Signs And Frequencies

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TAB 551

Craft Call Sign	Pri Freq	Alt Freq

Craft Marking

_____ _____ _____

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TAB 551

5. Command

A. Transit Location

GCE Commander_____

Riverine Landing Area _____

Date And Time _____

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TAB 552
MAR 99

STUDENT OUTLINE

RIVERINE AMBUSH

LEARNING OBJECTIVE:

A. **TERMINAL LEARNING OBJECTIVE:** Without the aid of references and given a scenario in a Riverine Environment, conduct a riverine ambush in accordance with the references.

B. **ENABLING LEARNING OBJECTIVE:**

(1) Without the aid of references, describe in writing the purpose of a Riverine Ambush in accordance with the references.

(2) Without the aid of references, describe in writing the factors of a successful ambush in accordance with the references.

(3) Without the aid of references, describe in writing the organization of an ambush patrol in accordance with the references:

(4) Without the aid of references and given a scenario in a Riverine Environment, occupy an ambush position in accordance with the references.

OUTLINE:

DEFINITION:

An ambush is a surprise attack from a concealed position on a moving or temporarily halted target.

1. **Purpose of Ambushes**: When properly employed the ambush is used to destroy enemy forces and to interdict enemy movement of personnel, equipment, and supplies within the riverine areas of operation.

2. **Categories of Ambushes**: There are two categories of ambushes: deliberate and hasty.

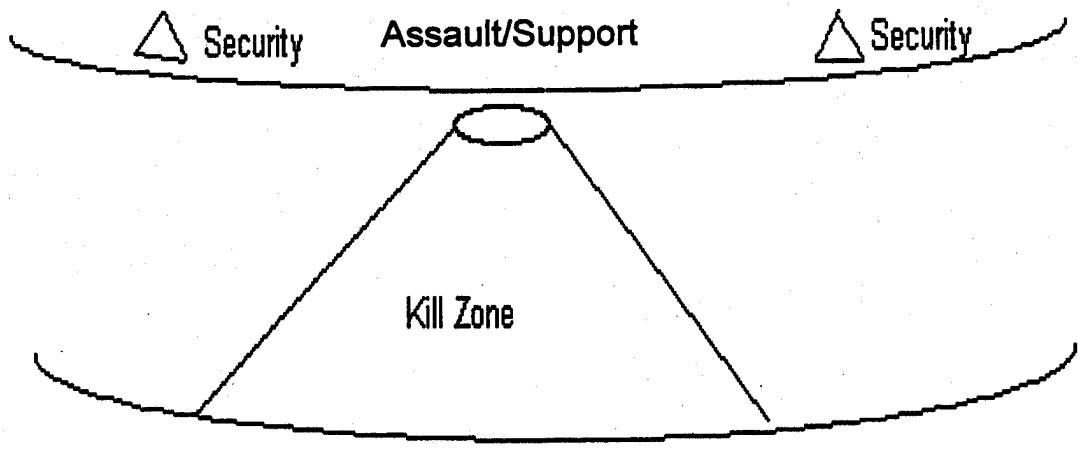
a. Deliberate Ambush: A deliberate ambush is conducted against a specific target at a predetermined location. There are two types of deliberate ambushes:.

(1) POINT: An ambush with a single kill zone.
(2) AREA: An ambush with two or more related point ambushes.

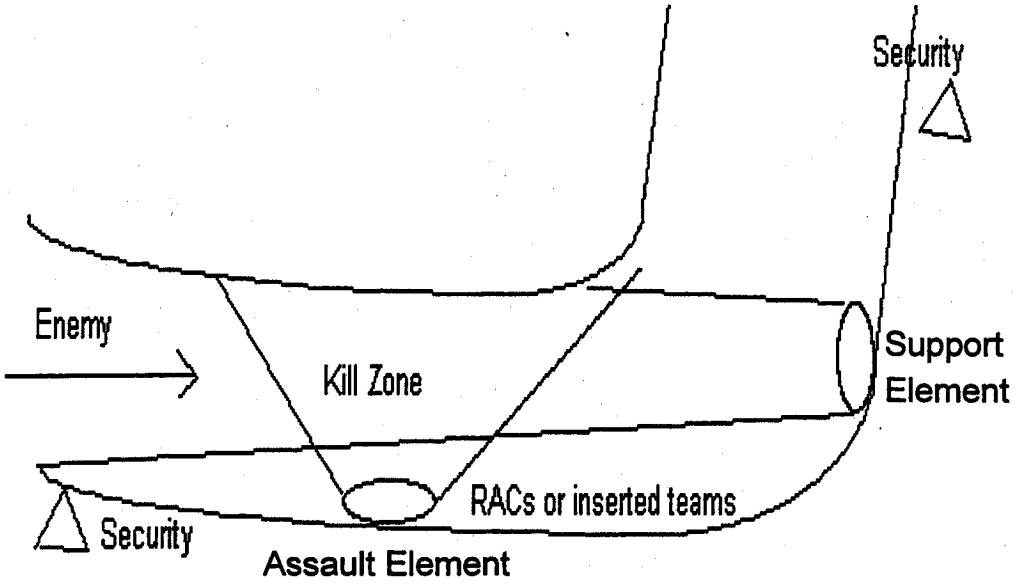
b. Hasty Ambush: The hasty ambush is conducted when an opportunity to ambush the enemy presents itself during riverine operations, it is generally not a preplanned evolution.

3. **Types of Ambush Formations**: Two basic formations used are linear and L- shaped.

a. Linear ambush: When using the linear formation, the assault and support elements deploy parallel to the enemy route. This positions both elements on the long axis of the kill zone and subjects the enemy to flanking fire.



b. L- shaped ambush: In an l-shaped ambush the assault element forms the long leg parallel to the enemy direction of movement along the kill zone. The support element forms the short leg at one of and at right angles to the assault element. This provides both flanking (long leg) and enfilading fires (short leg) against the enemy.



4. **Standards of an Ambush:**

a. Surprise: It is surprise that allows the ambush patrol to seize and retain control of the situation. If complete surprise cannot be achieved, it must be so nearly complete that the target is not aware of the ambush until too late for effective reaction.

b. Coordinated fires: All weapons, indirect fires, mines, and demolition's must be coordinated to achieve:

(1) Isolation of the killing zone to prevent escape or reinforcement.

(2) Surprise delivery of a large volume of highly concentrated fires into the kill zone.

c. Violence of action: The controlled mental and physical aggression directed at the enemy.

d. Speed: Once the ambush is initiated, your presence is now known so quick and deliberate actions on objective area are essential.

e. Withdrawal: This is a controlled and organized movement out of the objective area.

5. **FACTORS OF A SUCCESSFUL AMBUSH**: Listed below are some factors the Plt/Sec Ldr should consider.

a. Reconnaissance - Conduct a reconnaissance to determine:

(1) Type of ambush necessary
(2) Security requirements and positions
(3) Assault positions
(4) Support positions.
(5) Withdrawal route
(6) Enemy routes to the operation area (land or water).

b. Camouflage - Ensure it is adequate and covers 360 degrees. Ensure that camouflage does not restrict the craft ability to withdrawal rapidly.

c. Routes- A route is planned to allow the patrol to enter the ambush site from a direction that will not take them through the planned kill zone. (not always applicable in riverine environment) A covered and concealed withdrawal route is also planned. As with all patrols, you must have alternate routes planned.

d. Ambush site- In conjunction with the map or aerial photo study by the Plt/Sec Ldr during his preparation phase, a physical reconnaissance of the site must be made. The following factors influence the selection of an appropriate ambush site:

(1) Water depths at the ambush site
(2) Obstacles to friendly and enemy movement
(3) Cover and concealment
(4) Tidal considerations and weather
(5) Fields of fire and observation
(6) Illumination data
(7) Avenues of approach.
(8) Withdrawal routes

e. Positions- The security teams move into position first to prevent the patrol from being surprised as it moves into the ambush site. The assault and support elements are positioned so
that they can fire along the entire kill zone, or their sectors of fire must overlap so that the killing

zone is covered completely. The section leader selects a position from which he can best initiate the ambush.

f. Local security- The security unit normally employed in two teams, does not usually participate in the initial attack, but protects the flanks and rear, gives early warning of enemy approach by land or water, and covers the patrol withdrawal at the conclusion of the ambush. Radar alarm zones can be set to give the patrol early warning, but must not take the place of physical security.

g. Control- Close control must be maintained during movement to, occupation of, and withdrawal from the ambush site. This is best achieved through rehearsals and maintenance of good communications. Control is most critical as the enemy approaches the kill zone. Control measures must provide for early warning of enemy approach, fire control, initiation of appropriate action if the ambush is prematurely detected, and timely and orderly withdrawal of the ambush force from the ambush site. To facilitate control an ambush should have at least these four distinct signals, open fire, shift and cease fires, assault or search the kill zone, and withdraw from the site (such as, night vision equipment and pyrotechnics) .

h. Illumination- Illumination of the target at night is beneficial during the execution of the ambush. The section leader must ensure the assault and support elements have a means of engaging the enemy in the kill zone during the periods of limited visibility .

i. Obstacles- They may also be employed to trap riverine craft in the kill zone. Such obstacles may consist of trees explosively dropped or cut down in the waterway, or cables or lines stretched across the water way.

6. **Organization of an Ambush Patrol**: The ambush patrol is broken down into separate elements.

a. Headquarters Element: This element is responsible for the overall conduct of the patrol. It contains the following personnel: corpsman, forward observer, interpreter, enroute recorder, and the Plt/Sec Ldr and Assist Plt/Sec Ldr.

b. Assault Element: The assault element engages the enemy at the objective.

c. Support Element: The support element provides supporting fires for the assault elements attack, and covering fire for its withdrawal.

d. Security Element: The security element isolates the objective and covers the patrols withdrawal from the objective area.

e. Special Teams: Within the mission, there are specific tasks that must be carried out. You must assign special teams to carry out these tasks. We will discuss three special teams and their duties.

(1) POW and Search Teams: These teams are responsible for searching and securing all POW and their equipment.

(2) Aid and litter teams: These teams are responsible for providing basic first aid to casualties and for evacuating casualties out of the objective area.

(3) Demolition team: This team responsible for designating and setting up demolition sites and destroying all enemy equipment.

7. Conducting an Ambush: The Plt/Sec Ldr should consider the following sequence when planning a deliberate ambush.

a. Conducts security halt and establishes an Objective Rally Point (orp) prior to ambush site, usually a major terrain feature away.

b. Plt/Sec Ldr issues five point contingency plan, to assist section leader. This plan

address:

(1) Going- Where the Plt/Sec Ldr going.
(2) Others- Who the Plt/Sec Ldr taking with him
(3) Time- Time he will be gone (establishes a NLT)
(4) What- What If the Plt/Sec Ldr does not return in time.
(5) Actions on enemy contact, you and me

(a) If Plt/Sec Ldr have enemy contact:
1. The Plt/Sec Ldr will
2. The unit (-) will

(b) If the unit (-) have enemy contact:
1. The Plt/Sec Ldr will
2. The unit (-) will

c. Plt/Sec Ldr conducts leaders recon. Plt/Sec Ldr will take:
(1) Left and right side security.
(2) Support team leader.
(3) Assault team leader.

d. Emplace security left and then right side. When emplacing security always emplace on the enemy side first (enemy side being designated on the intended direction the enemy is going

to approach kill zone). Before Plt/Sec Ldr leaves security position he is to issue five point contingency plan. Instructions to security elements must include how to notify Plt/Sec Ldr of enemy approach and the rules of engagement .

e. Section leader Recons ambush site: Plt/Sec Ldr establishes .

(1) Assault line
(2) Support position
(3) Center of kill zone
(4) Withdrawal routes
(5) Location of reinforcing obstacles
(6) After leaders recon is completed, the Plt/Sec Ldr finalizes his plan.

f. Move in assault and support elements. Plt/Sec Ldr can either move back to security halt and move forward the remaining elements or call back to assist Plt/Sec Ldr and have him move remaining element forward into position.

<u>Assault element should:</u>

(1) Identify sector of fires.
(2) Emplace mines or explosives.
(3) Camouflage positions

<u>Support element should:</u>

(1) Identify sectors of fires.

g. The Plt/Sec Ldr initiates the ambush using the most reliable weapon, simultaneously detonating all other demolition's. The assault elements fire until enemy is destroyed or the cease fire signal is observed. The POW and Search Teams and demolition's teams will then perform their duties, once all action are complete the patrol will start its withdrawal.

h. The elements withdraw from the ambush site: Plan an order of withdraw for all elements. The Plt/Sec Ldr should have his elements withdraw in the reverse order they set in.

i. The elements disseminate information. When dissemination of information is conducted, the Plt/SL must ensure:

(1) Patrol is at least one major terrain feature away. If being pursued, move until

safe.

(2) All Patrol members, regardless of rank and position, receive the disseminated information.

(3) Security is maintained during dissemination process.

REFERENCE:

1. *FMFM* 7-5 *Doctrine Navy/Marine Joint Riverine Operations*
2. *FMFM* 7-*5A .MAGTF Riverine Operations*
3. *NSW/USMC Riverine Operations Handbook*
4. *SH-21-76 RangerHandbook*

SO-552-8
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Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 553
MAR 99

STUDENT OUTLINE

ABANDON AND .DESTROY THE RAC

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE**:

(1) Without the aid of references and provided the necessary materials, explain in writing the conditions under which abandonment should be considered in accordance with the references.

(2) Without the aid of references and provided the necessary materials, explain in writing the procedures for destroying a RAC in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of references, state in writing who makes the determination if a RAC should be abandoned in accordance with the references.

(2) Without the aid of references, state in writing the priority of evacuation for items on the RAC during a deliberate abandonment and destruction in accordance with the references.

(3) Without the aid of reference and provided the necessary materials, demonstrate the method of rendering weapons inoperable during a deliberate abandonment and destruction in accordance with the references.

(4) Without the aid of references and provided the necessary materials, indicate in writing the placement of the thermite grenades during a deliberate abandonment and destruction in accordance with the references.

(5) Without the aid of references and provided the necessary materials, describe in writing the rapid method of RAC abandonment and destruction in accordance with the references.

SO-553-1
TAB 553

OUTLINE

1. **Decision To Abandon:**

a. The decision to abandon and destroy the RAC is made by the senior man present.

b. The decision to abandon and destroy the RAC is based on several different criteria:

(1) Extent of the damage: If the damage to the RAC is so serious that it cannot be repaired, it should be abandoned and destroyed in a position that would cause the enemy the most trouble and not interfere with subsequent friendly operations. For example, if there was a small creek that the enemy is using to transport equipment or personnel that is too small for passage by friendly craft, the RAC should be sunk there. Do not sink the RAC in the main channel where it would interfere with your passage.

(2) Possibility of towing the RAC: If the RAC can be towed there is still the possibility that at that slow speed you would be unable to cross a sandbar or other such obstacle that could be passed on step. Another scenario that would render towing impossible would be returning through an enemy stronghold that would expose the craft to greater damage and the crew to more danger due to the slow speed required for towing. Physical damage to the craft that would rule out towing would consist of the RAC taking on enough water to ground the boat.

(3) Suitability of the position for defense until repairs or recovery is accomplished: If the: RAC is taking on enough water to run the risk of grounding or flooding the engine compartment, it should be intentionally grounded at the safest and nearest point. This is done in order to facilitate repairs and ease of recovery. The position chosen should be defendable for the duration of repairs or until a recovery craft can come from the Mobile Riverine Base. If enemy fires prohibit repair or eventual recovery, abandonment and destruction is required.

(4) RAC cannot make sufficient speed to exit a kill zone. If the RAC has sustained engine damage and is unable to quickly exit the kill zone and supporting fires are unavailable or ineffective, rapid abandonment and destruction may be required. Just multiply the number of personnel aboard times $200,000.00 to determine if this is cost effective.

(5) Since this class, like any other plan, cannot take into account the unexpected, the senior man present must weigh the risks and benefits to determine the ideal solution. Unit SOPs will also provide a guideline for this decision.

2. Evacuation Of Essential Material:

The priority of material to be removed is the same as the enemy's priority of material to be captured.

a. Information of extreme intelligence value such as encryption sheets, call signs and frequencies, maps and orders. These can cause the most damage to your operations without ever coming into contact with the enemy. These are the easiest things to evacuate and should either be kept in a sealed container with weight for easy disposal or on your person for easy evacuation.

b. Equipment necessary for immediate survival of the crew, such as individual weapons, should be next in the order of priority to remove from the craft. Most first class swimmers can swim with a map case and their personal weapon, it takes at least a WSQ to swim with a MK-19.

c. Radio encryption devices such as the KY-99 and the fills can cause the compromise of friendly operations for the short term until other units are notified to update communications security information or until the next frequency changes. They are harder to evacuate as they must be physically removed from the mounts.

d. If time allows and there is a craft alongside to take the load, communications equipment should be removed from the racks and transferred to another RAC. The next item to be evacuated would be weapons and ammunition. The communications equipment, as mentioned earlier, will allow the enemy to confound your plans without ever coming into contact. The weapons and ammunition are only effective against engaged units. It would be difficult to explain to someone's mother that you were whipped by your own equipment.

e. The last items to be evacuated, if time and lift are available, would be the RAC electronics, among others. The depth finder, radar and other navigation equipment are time consuming to remove and may have

little immediate or long term impact on operations. Microwave ovens or what ever non-mission essential equipment remaining can be removed if possible at this time.

3. **Destruction Procedures**

a. Deliberate Destruction: If time permits, this is the most thorough method of ensuring the enemy gains no advantage from your misfortune. This method requires five thermite grenades to ensure complete destruction.

(1) Place one grenade on the top of each engine. This will ensure the block is destroyed and the engine is rendered irreparable.

(2) Place the third grenade on the top of the fuel cell in the troop compartment.

(3) Place the fourth grenade on top of the communications suite in front of the boat

captain.

(4) The last thermite grenade is placed on top of the coxswain suite.

(5) Remove bolts and back plates from unrecovered weapons and either throw them away or take them with you.

(6) Place all unrecovered ammunition in the troop compartment on top of the fuel cells.

(7) Ensure all fire extinguishers are discharged prior to ignition of the thermite grenades and leave the engine compartment open for ventilation.

(8) Ignite the thermite grenades, the one above the fuel cell last and quickly remove all valuable flammable objects, including yourself, from the craft as quickly as possible.

b. Rapid Abandonment and Destruction: When the situation dictates an immediate abandonment, other craft should recover personnel and bring all weapons to bear on the dan1aged craft. Particular attention should be placed on the coxswain and boat captain positions and the engine compartment. Fire until required to exit the area or destruction is ensured.

REFERENCE:

1. FMFM 7-5 Doctrine Navy/Marine Joint Riverine Operations

2. FMFM 7-5A MAGTF Riverine Operations

3. NSW/USMC Riverine Operations Handbook

NOTES:

ATTACHMENTS: None.

SO-553-4
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TAB 554
MAR 99

STUDENT OUTLINE

WATERBORNE GUARD POST

LEARNING OBJECTIVES:

A. **TERMINAL LEARNING OBJECTIVE**: Without the aid of and per the reference and given a scenario in a Riverine Environment, occupy a Waterborne Guard Post in accordance with the references.

B. **ENABLING LEARNING OBJECTIVES:**

(1) Without the aid of and per the reference describe in writing the purpose of an Waterborne Guard Post in accordance with the references.

(2) Without the aid of and per the reference describe in writing an appropriate location for a Waterborne Guard Post in accordance with the references.

(3) Without the aid of and per the reference and given a scenario in a Riverine Environment, report or interdict as directed in accordance with the references.

OUTLINE:

1. Definition: A waterborne guard post is a static or dynamic position focused on collecting information and intelligence.

2. Purpose: The waterborne guard post positions can be occupied by ground forces or riverine craft. The purpose of a waterborne guard post is:

a. To gather intelligence on the enemy-

(1) Monitoring enemy positions.

(2) Monitoring enemy riverine traffic on a waterway.

b. Interdiction: Halting or intercepting waterborne craft.

3. **Types Of Waterborne Guard Post Positions**: There are two types of positions used for Waterborne Guard Post:

a. Static- Stationary or motionless set positions

b. Dynamic- Moving / mobile positions.

4. **Factors That Influence The Selection Of A Static Or Dynamic Position:**

The Plt/Sec Ldr must take into account several considerations when directed to conduct riverine surveillance operations.

a. Mission requirements (To include **EEIs** and **ORIs**)

b. Intelligence on enemy capabilities and operational patterns

c. Availability of suitable terrain /vegetation for static positions

d. Friendly force capabilities to include training armament, communications, and available fire support.

e. The extent to which friendly forces can move securely during the day and night in the riverine area of operation.

5. **Waterborne Guard Post Site Selection**.

The site selection of a **WBGP** is critical. **WBGP** for surveillance purposes are optimally made up of two patrol craft (Limited the size of the patrol is to avoid detection but offer mutual support). Based on the intelligence of the enemy riverine capabilities and movement patterns and an analysis of the terrain features present in the riverine area of operations. The Plt/Sec Ldr should consider the following when selecting a **WBGP** site.

a. Water depths at the **WBGP** site.

b. Cover and concealment

c. Tidal considerations and weather

d. Fields of fire and observation

e. Illumination data

f. Avenues of approach.

g. Withdrawal routes,

h. Potential enemy activity

6. **Occupying A Static Waterborne Guard Post:**

The Plt/Sec Ldr must conduct a reconnaissance of potential **WBGP** site prior to occupying (if possible ground forces can be used to sweep the area). The patrol should occupy the site at last light or during the hours of darkness.

a. While enroute to the **WBGP**, the force should vary its speed, make several false landings, or when possible use a drop off system to make it harder for the enemy to pin point your **WBGP** position.

b. Once in position, secure craft. Moor craft to the shore or a tree (ensure when mooring craft that it is done in such a way so as to facilitate immediate departure, should rapid withdrawal be necessary).

c. After securing craft, **FREEZE** and conduct a listening halt to check for enemy

activity.

d. Assign sectors of observation/fires.

e. Emplace security measures, trip flares, mines, and claymores to ensure of 360 degree security.

f. Place or activate monitoring devices: radar, night visions goggles.

g. Camouflage positions. Ensure camouflage can provide 360 degrees concealment.

h. Maintain noise, movement and light discipline. Light discipline is essential. There should be no white lights, no smoking, and all essential equipment should be organized before dark. Noise carries extremely well over water, and especially at night when ambient noise levels are lower. The movement in the craft should be keep to an absolute minimum, as unnecessary wakes and waves might be noticeable.

i. Once patrol is complete, disseminate and report all information.

7. **Dynamic Waterborne Guard Post Positions:**

Dynamic surveillance operations involve mobile information/intelligence collection. The principles that apply to a static position also apply to a dynamic position. The purpose for a dynamic **WBGP** is generally to obscure the collection portion of the mission and not to reveal the to potential targets that they are contacts of interest (coi's)

REFERENCES:

1. FMFM 7-5 Doctrine Navy / Marine Joint Riverine Operations

2. FMFM 7-5A MAGTF Riverine Operations

3. NSW / USMC Riverine Operations Handbook

NOTES:

ATTACHMENTS: None.

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TAB 555
MAR 99

STUDENT OUTLINE

BOARD AND SEARCH

LEARNING OBJECTIVES:

A. **Terminal Learning Objective**: Without the aid and given a scenario in a Riverine Environment, conduct Board and Search operations in accordance with the references.

B. **Enabling Learning Objectives**:

(1) Without the aid of references, identify in writing the purpose of a board and search in accordance with the reference.

(2) Without the aid of references, from a list select the two type of board and searches in accordance with the references.

(3) Without the aid of references, select from a list of indicators of hidden compartments in accordance with the references.

(4) Without the aid of references, from a list select the phases of a board and search in accordance with the references.

(5) Without the aid of references, given a scenario in a Riverine Environment, intercept a Contact of Interest, (COI), as directed in accordance with the references.

(6) Without the aid of references, given a scenario in a Riverine Environment, board a COI as directed in accordance with the reference.

(7) Without the aid of references, given a scenario in a Riverine Environment, cover a COI as directed in accordance with the references.

(8) Without the aid of references, given a scenario in a Riverine Environment, conduct and emergency breakaway as directed in accordance with the references.

OUTLINE

1. **Purpose** Board and Search operations support the Mobile Riverine Force mission of Surveillance, Interdiction and Security by performing the following:

a. Protect Friendly Lines of Communications - This denies the enemy the opportunity to move by water to ambush positions. In a Riverine environment, the river may be the only way to move.

b. Deny Hostile Forces the Use of Waterways - This removes the option of the enemy moving forces or material by water. This limits his mobility while maintaining yours. This also limits his resupply efforts.

c. Collect Intelligence Information - All the satellites in the world cannot replace a Marine searching craft and personnel.

d. Perform Security Missions - This is the same idea as having a metal detector at an airport.

e. Enforce Population and Resources Control - This limits the enemy's ability to gain food and equipment from the noncombatants in the area. It also limits the freedom of movement of couriers and messengers.

2. **Types Of Board And Search Operations**

a. Riverine Board and Search - Performed by Riverine Assault Craft while on patrol. The crews of the RACs perform the search.

b. Fixed Site Board and Search - Performed by a combination of the RACs and the Ground Combat Element located in a Forward Operating Base.

3 .**Riverine Board And Search**

a. Detection and Identification of Contacts of Interest (COI) - The 8-2 should provide guidance as to the profile of COIs in order to keep you from having to search every craft. If this intelligence is lacking, the collection of enough questionnaires, located in the back of the handout should help. Visual, electronic and aerial reconnaissance will assist the craft in selecting COIs.

b. Hailing and Stopping

1. In a three craft patrol, the lead craft would hail and stop the COI while maintaining the smallest profile and maximizing firepower that could be brought to bear and announce to the COI the following in a polite manner:

Identity of the Patrol

Authority which allows the search

2. The craft is then instructed to report to the second craft for instructions. The lead craft then reports that a Board and Search is commencing to higher headquarters.

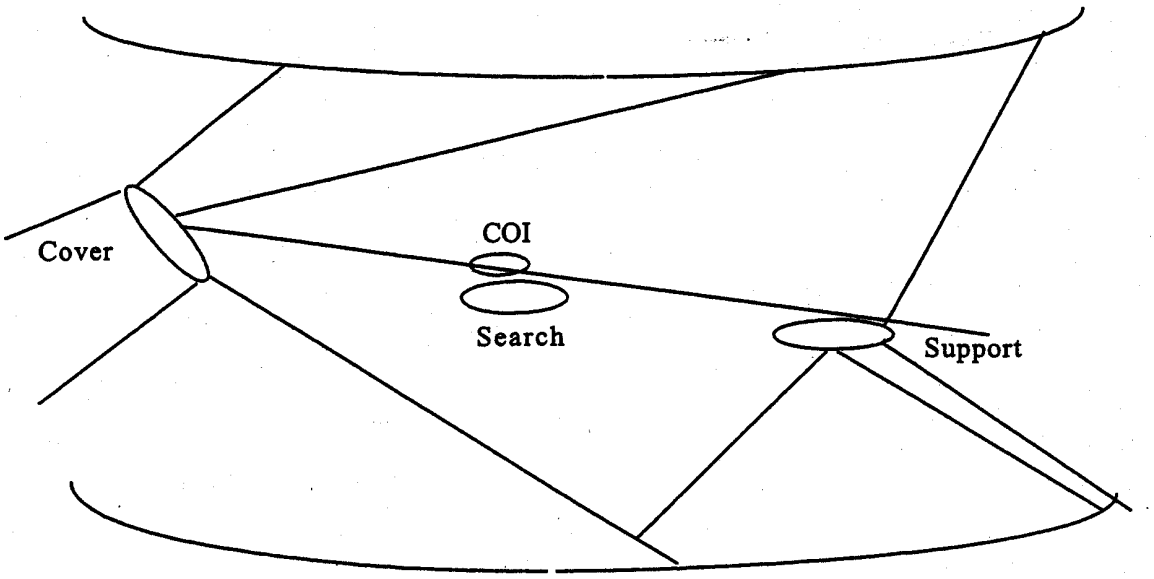
c. Approach

1 1. The COI would now be escorted back along the course. The purpose of this is to ensure that the COI is not bait in an ambush.

2. The lead craft, cover craft, takes up a position to provide security upriver and to cover the COI.

3. The trail craft, support craft, takes up a position to provide security down river and to support the search craft.

4. The second craft, search craft, has the COI perform a 360 degree circle while observing for suspicious items along the hull. The search craft is pointing upstream and orders the COI to come alongside, pointed the same direction. This allows for quicker response on the helm or to chase.



5. The Cover craft from this position can cover the COI by fire without endangering either the Search or Support craft.

6. The Section Leader in the Support craft can observe without being tasked in the search. This craft should never be directly downstream from the COI in order to avoid something from the COI, a mine for instance, from drifting into the RAC.

7. The COI should be placed between the Search craft and the most dangerous bank.

d. Boarding

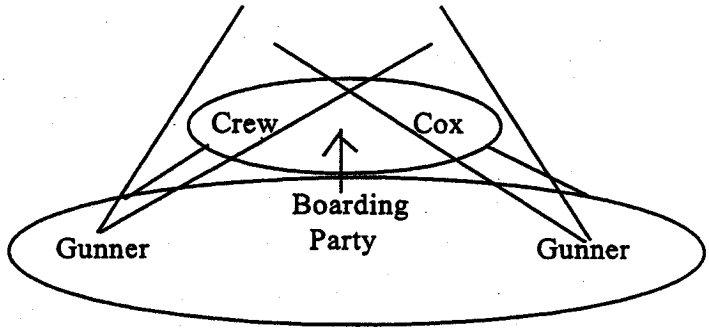
1 Get a head count of all personnel on board.

2. Have all personnel move to one location on the craft except the coxswain.

3. The gunners on the RAC at some point will use their personal weapons as the mounts will not depress enough.

4. As the craft comes along side, toss a line from the RAC to the COI to be looped loosely around a cleat then passed back to the RAC. Nothing should ever pass from the COI to the RAC! The line is then secured by the gunner standing on the line to allow for quick release.

5. The boarding party should board from amidships and ensure to never get in the line of fire of the gunners. Do a quick "pat down" of the crew for weapons. Sweep the craft for hidden personnel before starting the in-depth search.



6. Have the craft master do the searching in order not to set off a booby trap. During the search ensure that all the questions on the Questionnaire are addressed.

7. Treat the crew as friendly until contraband is found and then apply then Search, Silence, Segregate, Secure, and Speed them to the rear with a POW tag.

8. If contraband is found the vessel will be either brought in tow or a prize crew assigned to bring it in.

9. If the boarding turns hostile and the boarding party is in danger, they jump overboard, the cover craft takes the COI under fire. Meanwhile the search boat moves away from the COI and the support craft picks up the boarding party with cargo nets over the side.

e. Breakaway

1. Ensure that the craft continues along its original course and does not double back to warn anyone.

2. Keep weapons trained on the craft until out of sight.

3. Notify higher headquarters that boarding is complete and prepare for next COI.

4. Ensure Questionnaire is completed and either forwarded to higher headquarters immediately or collected for the debrief.

4. **Fixed Site Board And Search**

a. Forward Operating Base

1. The FOB is set up in four elements.

a. Security element -responsible for perimeter security. Depending on the enemy threat, the FOB may only be manned for a short period of time before being compromised.

b. Headquarters element - Command and Control for coordinating the actions of the FOB and the RACs.

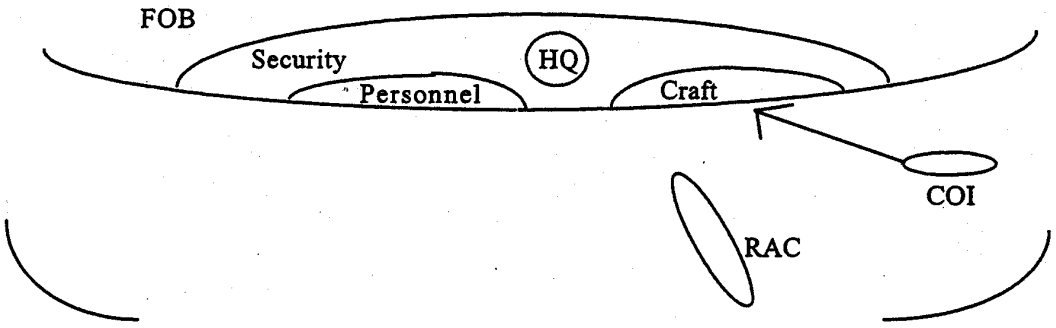
c. Craft Search element -responsible for searching the craft one they are escorted to the site.

d. Personnel Search element -responsible for searching the personnel once they are ashore.

2. Far bank security can be set up as required.

b. Riverine Assault Craft

1. Waterborne Guard Posts if possible or inserted teams if insufficient concealment is available are positioned on the flanks of the FOB. These must be positioned far enough away so that once a COI is close enough to see the escort craft or the FOB, they are past the Waterborne Guard Post and cannot escape.



2. An escort craft is positioned offshore of the FOB to escort COIs to the FOB and to provide far bank security if required.

c. Board and Search The phases of the Board and Search are identical with the escort craft performing all the functions during the identification, stopping and hailing, and approach phases. The Boarding is performed by the Craft Search element and the Personnel Search element. The Breakaway phase is resumed by the escort craft and the Waterborne Guard Posts.

5. **Advantages And Disadvantages**

a. Riverine Board and Search

1. Advantages

a. Does not require a lot of personnel

b. Can be done in conjunction with patrolling.

c. It is very mobile.

d. Less likely of being compromised from the land or from craft moving in both directions alerting other craft up or downstream.

2. Disadvantages

a. Difficult to do so many things at once, search, maintain security , maneuver craft.

b. Not enough personnel to effectively search unless augmented by embarked Marines.

c. Cannot search large numbers or large craft.

a. Fixed Site

1. Advantages

a. Can search large craft if the FOB is placed in a port facility or has access to cranes to move large cargo containers.

b. Can search multiple craft at once.

c. Can devote personnel to individual tasks.

d. Can contain large numbers of prisoners or seized craft.

2. Disadvantages

a. FOB can only be occupied for a short time.

b. Requires large numbers of personnel.

6. **Questionnaire**

a. Craft Information: Any craft that is equipped with either more horsepower, fuel or electronics than is required for the stated purpose is suspicious. A craft doesn't need 200 horsepower to get rice to market.

b. Registry Information: Any craft where the owner or craft master is not present or the craft is a great distance from the registered location should be considered suspicious.

c. Crew/Passenger Information: The crew should be locals for small craft. The passengers should be of a nationality relevant to the crafts departure point or destination.

d. Cargo Information: The cargo should be the same as listed on the manifest and not of any declared controlled.

e. Weapons: The registration should be correct and the purpose consistent with the weapon type.

f. Hidden Compartment/Suspicious Indicators: These alone are not enough for seizing the craft but should only intensify the search.

g. Boarding Kit: The listed items in the boarding kit should assist the Boarding party during the search.

EPW tags for personnel in possession of contraband.

Equipment tags for equipment from seized craft.

Inspection mirror for looking into compartments before entering and examining spaces too small to enter.

SUMMARY: So far we have discussed the purpose, types and advantages/disadvantages of each board and search and what to look for in a board and search. Those student with my IRF's please fill them out, the rest of the class take a 10 minute break.

REFERENCES:

1. United States Coast Guard Manual

NOTES:

ATTACHMENTS: None.

SO-555-8

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group , II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

TAB 301
Jan 98

STUDENT HANDOUT

NAVIGATION ON PUBLICATIONS AND EQUIPMENT

TERMINAL LEARNING OBJECTIVE. With the aid of references, use the required equipment and publications for small boat navigation in accordance with the references. **(0043.01.09)**

ENABLING LEARNING OBJECTIVES

1. Without the aid of references, state in writing the purpose of charts and publications used in navigation planning in accordance with the references. **(0043.01.09a)**

2. Without the aid of references, identify in writing the purpose of equipment used for .small craft navigation, in accordance with the references. **(0043.01.09b)**

OUTLINE

1. Nautical Charts**. (0043.01.09a)** A great number of charts, tables and publications are published by various government agencies for navigational aid.

a. Magnetic Variation Charts. National Imagery and Mapping Agency (NIMA) shows the different magnetic variations of the world. Used to update old nautical charts and charts with questionable magnetic variation.

b. Time Zone Chart. NIMA shows the standard time zones and time corrections for the world. Used for local time conversion during mission planning.

c. Tidal Current Charts. The tidal current tables are supplemented by 11 sets of tidal current charts. These charts present a comprehensive view of the hourly speed and direction of the current in 11 bodies of water: Boston Harbor, Narragansset Bay to Nantucket Sound, Narraganset Bay, Long Island Sound and Block Island Sound, New York Harbor, Delaware Bay and River, upper Chesapeake Bay, Charleston Harbor, San Francisco Bay, Puget Sound (northern part), and Puget Sound (southern part). They also provide a means for determining the speed and direction of the current at various localities throughout these bodies of water.

d. The National Weather Service Charts of the U.S. Department of Commerce (See attachment C)

(1) The National Weather Service annually publishes a series of small charts called *Marine Weather Services Charts.* These charts show the locations of all points where visual storm warnings are displayed. In addition, they list the various National Weather Service Offices together with their telephone numbers and the hours when forecasts and warnings are available.

(2) Also listed are the radio station is located in the area covered by each chart which broadcast weather data. The call letters are given for each station, frequency and the times of the weather broadcasts.

(3) Each chart covers a considerable stretch of the coast; the easternmost, for example, covers the area from Eastport, Maine, to Montauk Point, New York. The next extends from Montauk Point to Manasquan, New Jersey; the next from Manasquan to Cape Hatteras, North Carolina, etc. The latter-mentioned chart includes stations serving the Delaware and Chesapeake Bays. These charts are available from the National Ocean Survey.

e. Beaufort Wind Scale Chart. There is a relationship between the speed of the wind and the state of the sea in the immediate vicinity of the wind. Wind speeds are usually grouped in accordance with the Beaufort scale. It is useful in predicting the sea conditions to be anticipated when future wind speed forecasts are available. It can also be used to estimate the speed of the wind (see attachment A).

f. Weather Forecasting Chart. There is a relationship between the wind direction and barometer level reading with the predicted character of the weather. The wind direction and the rate of barometer change are

important. You must note whether the change was rapid or gradual, or if the readings are steady, the length of time the condition has existed. Using this information, you can make short-range forecasts of local weather (see attachment B).

2. Publications

a. Reference Publications. Publications which contain general information on several navigational subjects. Their use is invaluable as reference material.

(1) *American Practical Navigator*. Usually called *Bowditch*, after its original author. We will refer repeatedly to Bowditch in this course. It is an encyclopedia of navigational information and useful tables. It is published by the defense mapping agency in two volumes.

(2) *Dutton's Navigation and Piloting*, published by the U.S. Naval Institute, Annapolis, Maryland. This is the Navy's and Coast Guard's standard reference on navigation and is in general use throughout both services. It is recommended to all students who wish to obtain a good background in all aspects of marine navigation. *Dutton's* may be purchased from the U.S. Naval Institute or from bookstores.

(3) FM 55-501 *Marine Crewman's Handbook*. U.S. Army Manual written for water craft operators. It provides a great deal of general seamanship and navigation information easily understood by the serviceman. It is purchased from the government printing office.

(4) NIMA Catalog. Contains necessary information on ordering charts, maps and publications from the national mapping and imagery agency. Ordering information is located in NIMA catalog, part 2, hydrographic products, volume X, miscellaneous charts and publications. (Battalion S-2s maintain or have access to these documents, as well as the navigation department of most ships.)

(5) *Chapman Piloting, Seamanship & Small Boat Handling*. Published by Hearst Marine Books and written by Elbert S. Maloney. It is an invaluable reference for boating. It is recommended by the U.S. Coast Guard auxiliary.

b. Navigational Publications. Publications which contain detailed information on a specific navigational topic include:

(1) Nautical Chart Symbols and Abbreviations (Chart #1). (NIMA) The only publication that contains all symbols and abbreviations approved for use on nautical charts published by the United States and abbreviations used on foreign charts.

(2) *Coast Pilots*. Contains helpful chart information which cannot be conveniently presented on charts, such as navigation regulations, outstanding landmarks, dangers, weather, port facilities and tidal data. Coast Pilots is published in a series of nine volumes. It covers the waters of the United States and its possessions.

(3) *Sailing Directions*. The sailing directions are published and kept up-to-date by NIMA. The Sailing Directions provide the same type of information as the Coast Pilots, except the Sailing Directions pertain to foreign coasts and coastal waters. Typical information includes pilotage; appearance of coastline (mountains, landmarks, visible foliage, and so forth); navigational aids in general; local weather conditions; tides and currents; local rules of the road, if any; bridges -type and clearance; anchorage facilities;

repair facilities; availability of fuel and provisions; transportation service ashore; and local industries. They consist of forty-seven publications broken down into two classifications.

(a) Ten "Planning Guides" that cover ocean basin transits. Each of the planning guides contains information on the countries. Government, regulation, search and rescue, communications, the ocean, basin environment, danger areas, ocean routes and nav-aid system.

(b) Thirty-seven en route directions for piloting in coastal waters. The en route publications are designed to be used in conjunction with the applicable planning guide in its corresponding geographic area. The En route volumes incorporate panoramic photographs of coastal features of the more heavily traveled coasts and harbors, graphic keys to charts within sectors and "graphic direction" plates that combine an annotated chart of an area with an orientation photograph and line drawings of prominent navigational features.

(4) Fleet Guides. Fleet guides are published by DMAHTC for the U.S. Navy's use only. Publication #940 covers the Atlantic area and publication #941 covers the Pacific area. They contain information on particular ports of interest to U.S. naval ships. For the most part, the larger ports.

(5) Tide Tables. Tide tables are published annually by the National Ocean

Survey (NOS) in four volumes. The height of the high and low tide is listed for selected stations called reference stations. Additional stations called substations list the correction value which would be applied to the daily predictions of the reference station.

(6) Tidal Current Tables. Tidal current tables are published annually by the National Ocean Survey (NOS) in two volumes. The Atlantic Coast of North America and the Pacific Coast of North America. The daily prediction of speed and direction of the current is listed for selected stations called reference stations. Additional stations called .substations list the correct value which would be applied to the daily predictions of the reference station.

(7) Atlas of Pilot Charts. The atlas of pilot charts contains twelve pilot charts, one for each month of the year. There are five atlases which provide world wide coverage. Pilot charts present, in graphic form, averages obtained from data gathered over a 10-year period in meteorological and oceanographical information. Pilot charts are designed to aid the navigator in selecting the best route. They contain information on weather, air temperature, wave height, gales, cyclones, prevailing winds surface currents, and magnetic variation.

(8) Light List. An annual publication listing all lighted and sound navigational aids within the United States and its possessions. There are seven volumes of the light list which provide specific information, such as light name, number, height of light, nominal range and characteristics of the light.

(9) List of Lights. An annual publication listing all lighted and sound navigational aid in Foreign, waters. There are seven volumes of the list of lights, which provide specific information such as light name, nominal range and characteristic of light.

(10) Chart Correction Publications. All charts published by both the National Mapping and Imagery Agency and the National Ocean Survey are edited and corrected to reflect the latest information available at the time the chart was printed. Unfortunately, a considerable amount of time often elapses between successive printings of a given chart or other navigational publication. As a result, provisions must be made for keeping mariners apprised of changes in hydrographic conditions that will affect the accuracy of their charts and publications as soon as possible after the changes occur. The principal means by which necessary periodic corrections to NIMA and NOS charts and publications are disseminated .are the *Notice to Mariners* and *Local Notice to Mariners*. These are bulletins in pamphlet form distributed by mail each week that contain all corrections, additions, or deletions to all NIMA and NOS charts. Additionally, the Summary of Corrections consolidates the changes into one publication.

(a) *Notice to Mariners* contains all changes relating to oceanic and coastal area charts and publications worldwide and is distributed weekly by NIMA.

(b) *Local Notice to Mariners* issued by each of the twelve U.S. Coast Guard districts contain navigational information of local interest and is issued weekly.

(c) *Summary of Correction*. Five volume publication contains all corrections for the previous year and is distributed by NIMA.

3. Navigation Equipment. **(0043.01.09b)** In determining position and safely conducting a vessel from one position to another, the navigator uses a selection of navigation equipment. The correct use of the equipment and the ability to interpret the information obtained from these instruments requires skill and experience. We will discuss the tools which have been found useful for navigation in small craft not on the bridge of a large ship. The choice of equipment to use in each category is a personal one depending on many factors including availability of equipment (open purchase, etc.) and type of vessel. The following is a list of equipment to utilize to navigate from over the horizon:

- Instruments for measuring direction.
- Equipment for measure speed.
- Techniques for measuring speed.
- Piloting equipment.
- Plotting equipment.

a. Instruments for Measuring Direction. A boat compass is used to reference direction and accurately steer the craft over a long track. The compass must be hard mounted and parallel with the fore and aft center line of the craft. The compass should be illuminated, which can be accomplished by a shielded chemlite.

- Ritchie, navigator 2000 #FN-201, 4 ½ -inch card.

b. Equipment for Measuring Speed. There are two kinds of speed with which the navigator of a small boat is concerned - "true" speed or speed relative to the earth (often called "speed over the ground" (SOG), and ship's speed through the water. True speed is normally calculated mathematically by measuring the time required for the ship to traverse a known distance. Equipment that can be utilized are as follows:

(1) Plugger. The plugger is a hand held GPS that has the capability of providing the course, speed, and distance all from within the one unit.

(2) Navigation Console. The navigation console has the capability of providing the course, speed, and distance all from within the one unit.

c. Technique for Measuring Speed. The primary method that is used to measure speed is by the use of speed runs, speed runs should be conducted on a calm day in an area where there is no current and carrying a normal operational load. Speed runs are conducted by finding a measured nautical mile with beacon indicators or a range on the chart; if none are nearby, measure off a mile on the chart between buoys or landmarks on which bearings may be readily taken. Run the mile at full speed on a constant heading. Then, reverse course and repeat run in opposite direction, again maintaining full speed. Average the two to obtain the speed. Repeat the same process but at half speed.

d. Piloting Equipment. Navigation at sea in a small rubber boat is difficult at best, and the piloting equipment must be adaptable for a small unstable craft.

(1) Plotting Board. The PBC Mk III plotting board is a precision navigation instrument designed to accommodate small boat navigation, particularly from the lap. The plotter permits "instant" navigation in true or magnetic direction without protractors or parallel rules. Position is determined by means of a visual or bearing plot.

(2) Nautical Slide Rule. The nautical slide rule is used while underway for rapid solution of time, speed and distance problems. Given any two of these factors, the third can be obtained. The time scale gives the hours in green figures, and minutes and seconds in black figures. The distance scale shows nautical miles in green figures and yards in black figures. Yards are stated with the assumption that 1 NM = 2.000 yards.

(3) Binoculars

(a) Aids in detecting aids to navigation and at night and serves as a night vision device to intensifying ambient light. Military binoculars have a mil scale that is used to determine the distance in yards and the height in yards of an object.

$$\text{DIST} = \frac{\text{Height (Meters) X 1000}}{\text{Mils}} \quad \text{or} \quad \frac{\text{Height (Meters)}}{\text{Mils}} \text{ X 1000}$$

$$\text{HEIGHT} = \frac{\text{Dist (Meters) X Mils}}{1000} \quad \text{or} \quad \frac{\text{Dist (Meters)}}{1000} \text{ X Mils}$$

(b) Steiner. Commander RS 2000 7X50. Superb light gathering capability, illuminating magnetic compass and mil scale.

(4) Hand Bearing Compass. Designed for bearing determination and shooting Lines of Position (LOP). Okay as a backup for the Steiner binoculars.

(5) Laminated Latitude Scale. Used measuring distance on a plotting board while underway.

(6) Grease Pencils. Used to plot on the plotting board.

(7) Watch. Used to clock transit times between two points at specified speeds.

e. Plotting Equipment. These instruments are used during the initial planning phase on ship and are not normally taken out on the small boat.

(1) Pencils and Erasers. A medium-soft pencil, such as a no. 2, is best for general plotting, as work done with a very hard pencil is difficult to erase and a very soft pencil tends to leave smudges. Several pencils should be available and, if there is room for

it, a pencil sharpener. Draw light lines and avoid drawing them longer than necessary. Label all lines and points as soon as drawn; standard labeling is described in the dead reckoning class. An art gum eraser is convenient for cleaning a considerable area, while a chisel-pointed eraser serves to make small erasures.

(2) Dividers. The dividers are an essential tool to the navigator, primarily for measuring distance. Their legs should be at least six inches in length, and they should be tight enough to hold a setting. Protect the points from damage, rust and sticking other students.

(3) Mechanical Compasses. The mechanical compass is convenient for drawing distance circles, such as the computed visibility circle of lights. What was said about the size and protection of dividers applies equally to compasses. Navigator's sets that include a set of dividers and a compass in a storage case are popular .

(4) Parallel Rulers/Paraglides. Parallel rulers are the navigator's traditional tool for determining the direction of any line on a chart by moving the rulers to a compass rose, while they are maintained parallel to the reference line. The most commonly used parallel rulers consist of a pair of rulers of equal length joined near each end by metal strips, which permit one ruler to be moved relative to the other while remaining parallel to it. The paraglide plotter consists essentially of a straightedge fitted with rollers knurled to prevent slipping. The ruler retains its original alignment while being rolled across the chart. Parallel rulers render satisfactory service when used on an absolutely flat surface and if they themselves are not warped.

(5) Calculator. Any electronic or solar-powered device for making mathematical calculations.

REFERENCES

1. *American Practical Navigator Volume I*

2. *Dutton's Navigation and Piloting*

3. *FM 55-501, Marine Crewman's Handbook, pp. 8-4*

NOTES

ATTACHMENTS

A - Beaufort Wind Scale Chart

B - Weather Chart

C - Warning Displays Chart

ATTACHMENT A

BEAUFORT WIND SCALE CHART

APPENDIX V
BEAUFORT WIND SCALE
WITH CORRESPONDING SEA STATE CODES

Beaufort number or force	Wind speed				World Meteorological Organization (1964)	Estimating wind speed			Sea State	
	knots	mph	meters per second	km per hour		Effects observed far from land	Effects observed near coast	Effects observed on land	Term and height of waves, in meters	Code
0	under 1	under 1	0.0-0.2	under 1	Calm	Sea like mirror.	Calm.	Calm; smoke rises vertically.	Calm, glassy, 0	0
1	1-3	1-3	0.3-1.5	1-5	Light air	Ripples with appearance of scales; no foam crests.	Fishing smack just has steerage way.	Smoke drift indicates wind direction; vanes do not move.		
2	4-6	4-7	1.6-3.3	6-11	Light breeze	Small wavelets; crests of glassy appearance, not breaking.	Wind fills the sails of smacks which then travel at about 1-2 miles per hour.	Wind felt on face; leaves rustle; vanes begin to move.	Calm, rippled, 0-0.1	1
3	7-10	8-12	3.4-5.4	12-19	Gentle breeze	Large wavelets; crests begin to break; scattered whitecaps.	Smacks begin to careen and travel about 3-4 miles per hour.	Leaves, small twigs in constant motion; light flags extended.	Smooth, wavelets, 0.1-0.5	2
4	11-16	13-18	5.5-7.9	20-28	Moderate breeze	Small waves, becoming longer; numerous whitecaps.	Good working breeze, smacks carry all canvas with good list.	Dust, leaves, and loose paper raised up; small branches move.	Slight, 0.5-1.25	3
5	17-21	19-24	8.0-10.7	29-38	Fresh breeze	Moderate waves, taking longer form; many whitecaps; some spray.	Smacks shorten sail.	Small trees in leaf begin to sway.	Moderate, 1.25-2.5	4
6	22-27	25-31	10.8-13.8	39-49	Strong breeze	Larger waves forming; whitecaps everywhere; more spray.	Smacks have doubled reef in mainsail; care required when fishing.	Larger branches of trees in motion; whistling heard in wires.	Rough, 2.5-4	5
7	28-33	32-38	13.9-17.1	50-61	Near gale	Sea heaps up; white foam from breaking waves begins to be blown in streaks.	Smacks remain in harbor and those at sea lie-to.	Whole trees in motion; resistance felt in walking against wind.	Very rough, 4-6	6
8	34-40	39-46	17.2-20.7	62-74	Gale	Moderately high waves of greater length; edges of crests begin to break into spindrift; foam is blown in well-marked streaks.	All smacks make for harbor, if near.	Twigs and small branches broken off trees; progress generally impeded.		
9	41-47	47-54	20.8-24.4	75-88	Strong gale	High waves; sea begins to roll; dense streaks of foam; spray may reduce visibility.		Slight structural damage occurs; slate blown from roofs.		
10	48-55	55-63	24.5-28.4	89-102	Storm	Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility reduced.		Seldom experienced on land; trees broken or uprooted; considerable structural damage occurs.	High, 6-9	7
11	56-63	64-72	28.5-32.6	103-117	Violent storm	Exceptionally high waves; sea covered with white foam patches; visibility still more reduced.		Very rarely experienced on land; usually accompanied by widespread damage.	Very high, 9-14	8
12	64 and over	73 and over	32.7 and over	118 and over	Hurricane	Air filled with foam; sea completely white with driving spray; visibility greatly reduced.			Phenomenal, over 14	9

Note: Since January 1, 1955, weather map symbols have been based upon wind speed in knots, at five-knot intervals, rather than upon Beaufort number.

ATTACHMENT B

WEATHER CHART

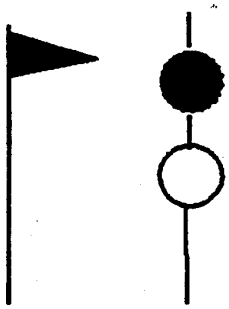
Wind	Barometer at sea level	Probable Weather
SW to NW	30.10 to 30.20 steady	Fair for 1 or 2 days. Little temperature change
SW to NW	30.10 to 30.20 rising 30.20 & above, steady	Fair followed by rain Continued fair, no decided temperature change
SW to NW	30.20 & above, falling slowly	Slowly rising temperature, fair for 2 days
S to SE	30.10 to 30.20 falling slowly	Rain within 24 hours
S to SE	30.10 to 30.20 falling rapidly	Increasing winds, rain within 12-24 hours
SE to NE	30.10 to 30.20 falling slowly	Rain within 12-18 hours
SE to NE	30.10 to 30.20 falling rapidly	Increasing wind and rain within 12-24 hours
E to NE	30.10 & above falling slowly	In summer with light winds, rain may not fall for several days. In winter, rain in 24 hours.
E to NE	30.10 & above falling rapidly	In summer, rain probable in 12 hours. In winter, rain or snow with increasing winds when wind to NE.

ATTACHMENT C

WARNING DISPLAYS CHART

NATIONAL WEATHER SERVICE COASTAL WARNING DISPLAYS

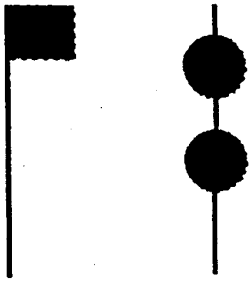
SMALL CRAFT ADVISORY



DAYTIME SIGNAL **NIGHT SIGNAL**

One RED pennant displayed by day and a RED light over a WHITE light at night to indicate winds as high as 33 knots (38 m.p.h.) and/or sea conditions considered dangerous to small craft operations are forecast for the area.

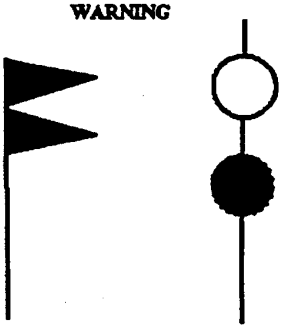
STORM WARNING



DAYTIME SIGNAL **NIGHT SIGNAL**

A single square RED flag with a BLACK center displayed during daytime and two RED lights at night to indicate that winds 48 knots (55 m.p.h.) and above are forecast for the area. If the winds are associated with a tropical cyclone (hurricane), the "Storm Warning" disply indicxates winds 48 to 63 knots (55 to 73 m.p.h. are forecxast

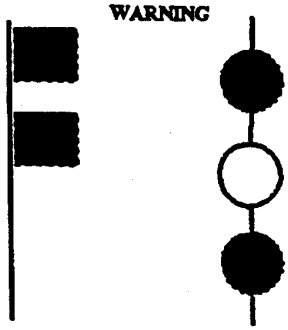
GALE WARNING



DAYTIME SIGNAL **NIGHT SIGNAL**

Two RED pennants displayed by day and a WHITE light above a RED light at night to indicate winds within the range 34 to 47 knots (39 to 54 m.p.h.) are forecast for the area

HURRICANE WARNING



DAYTIME SIGNAL **NIGHT SIGNAL**

Displayed only in connection with a tropical cyclone (hurricane). Two square RED flags with BLACK centers displayed by day and a White light between two RED lights at night to indicate winds 64 knots (74 m.p.h.) and above

UNITED STATES MARINE CORPS
.Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, -II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

NAVIGATION HOMEWORK

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

HMWK
SEP 98

HOMEWORK DAY 1

1. What are the 2 types of Radio Navigation ?

_____ _____

2. What are the 5 elements of Dead Reckoning ?

_____ _____ _____

_____ _____

3. What is your speed if it takes you 30 minutes to travel 8 NM ?

_____

4. If you maintain a speed of 12 knots for 40 NM, how long will you have traveled?

_____

5. What are 3 of the 5 problems of Navigation?

_____ _____ _____

6. Who makes up the Navigation Team?

_____

7. What publication would you look in to find symbols and abbreviations found on Nautical Charts?

_____

Navigation Homework

8. Tide Tables are published how often?

_____

9. The Nautical Slide Rule is used while underway to solve for what?

_____

10. Define scale in regards to a chart.

_____

11. Small scale covers a _____area.

12. Large scale covers a _____area.

13. To find the Title, Scale, and Soundings, you would look in the _____.

14. Latitude and Longitude scales are found on the top, bottom, and sides of a chart, and are broken down into _____ _____ _____

15. Meridians run _____.

16. Parallels run _____.

17. One minute of Latitude is equal to how many nautical miles?

_____

18. The inner scale of the Compass Rose gives you _____North.

19. The 72 ColRegs govern the safe operation of vessels where?

_____

Navigation Homework

20. The inland rules govern the safe operation of vessels where?

_____

21. Not under command means a vessel is _____

22. Three factors governing safe speed are.

_____ _____ _____

23. The stand on vessel does what?

_____

24. The give way vessel does what?

_____

25. Red lights are found on the _____side.

26. Green lights are found on the _____side.

27. A towing light is _____in color.

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

Day 1
NEW RIVER INLET CHART 11542

1. The student will be given 10 problems which to work. The first (5) you will provide the latitude and longitudes; the second (5) you will be given the latitude and longitudes and you will state what is located there.

a. _____ Bouy RW "NR" MO (A)
_____

b. _____ SOUTH TOWER
_____

c. _____ BOUY Y "H" FL Y 4S
_____

d. _____COURTHOUSE BAY SOUTH TANK
_____

e. _____ COURT HOUSE BAY G "1"

3. What is located at the following latitudes and longitudes?

a. _____34°34'06"N
77°16'27"W

b. _____34°37'41"N
77°22'03"W

c. _____34°32'55"N
77°16'30"W

d._____34°30'00"N
77°25'46"W

e. _____34°39'37"N
77°21'20"W

Navigation Homework

Day 1
Course and Distance Problems

1. The student will be given 5 sets of latitudes and longitudes which he will mark point (A) and point (B). He will then determine the course and distance on chart 11542.

a. 34°30’53”N/77°18’21”W C_____
34°29’24”N/77°16’42”W D_____

b. 34°29’18”N/77°19’22”W C_____
34°32’48”N/77°15’28”WD _____

c. 34°34’14”N/77°23’41”WC_____
34°33’57”N/77°21’54”WD_____

d. 34°35’48”N/77°14’41”WC_____
34°33’55”N/77°16’51”WD_____

e. 34°44’02”N/77°25’49”WC_____
34°44’26”N/77°26’00”WD_____

~~on Homework Day 1~~

~~.Identify the following day shapes in accordance with the 72 ColRegs.~~
~~a. %~~
~~. b. : I~~
~~. C. ,~~
~~. I~~
~~d t~~
~~. e .~~
~~I~~

Navigation-5

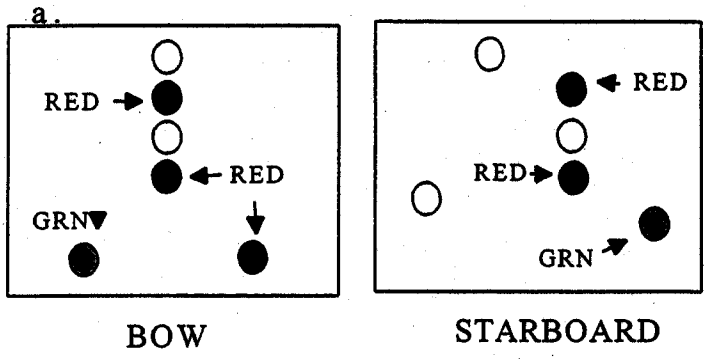
Navigation Homework

Day 1

Rules of the Road – Night Lights

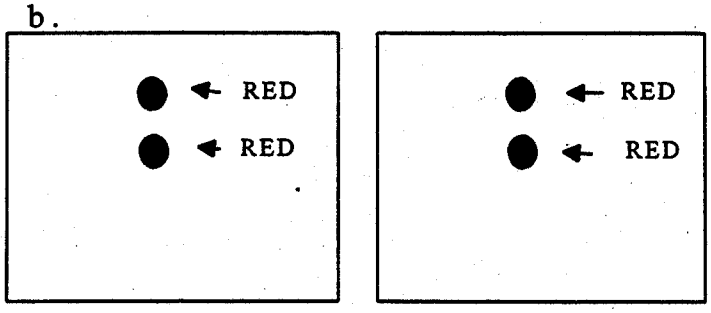
1. Identify the following configuration in accordance with the 72 ColRegs.

a.



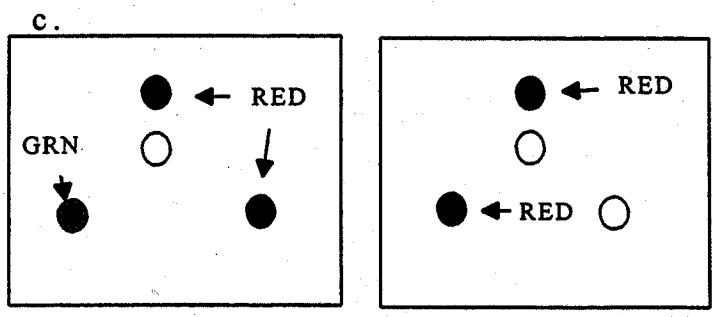
BOW STARBOARD

b.



BOW PORT

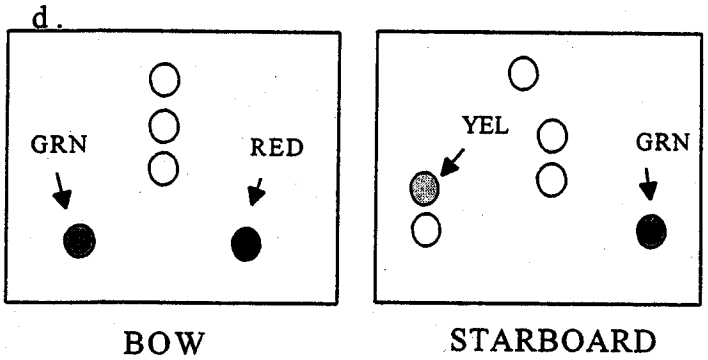
c.



BOW PORT

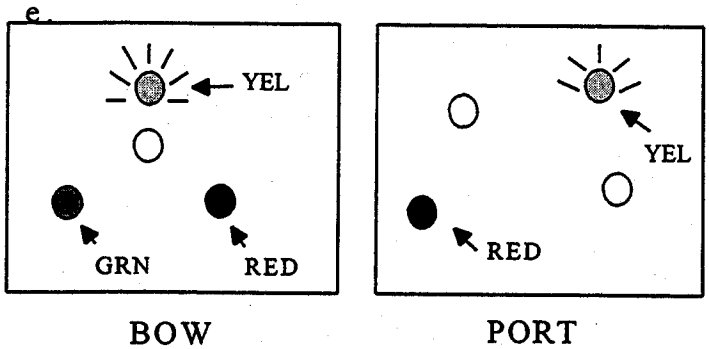
Day 1
Rules of the Road – Navigation Lights

d.



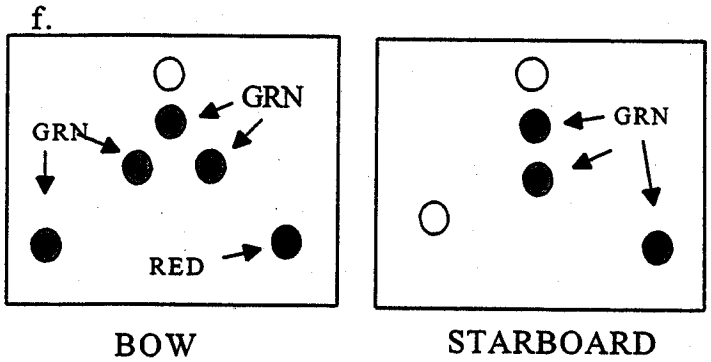
_____

e.



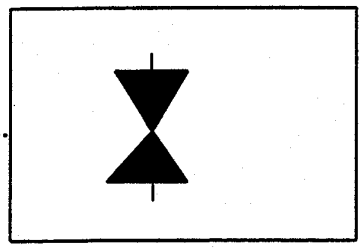
_____

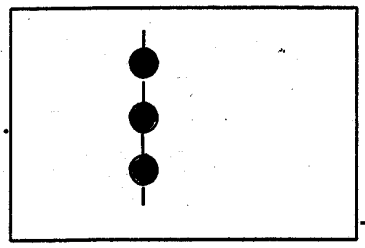
f.

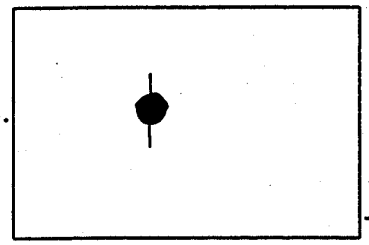


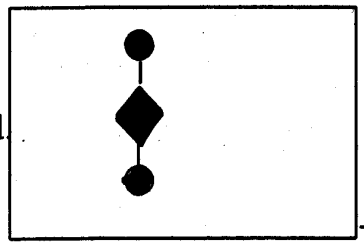
_____

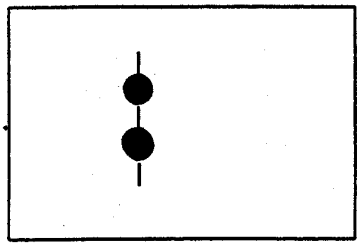
Identify the following day shapes in accordance with the 72 ColRegs.

a. 

b. 

c. 

d. 

e. 

UNITED STATES MARINE CORPS
Amphibious Raid Branch/Riverine Training Center
Special Operations Training Group, II Marine Expeditionary Force
Camp Lejeune, North Carolina 28542

HOMEWORK DAY 2

1. The purpose of the Nautical Compass is to
_____

2. The angular difference between the magnetic meridian and true meridian is called?
_____

3. Deviation is
_____

4. The 3 types of headings are ?
_____ _____ _____

5. When uncorrecting you subtract _____errors and add _____errors.

6. The purpose of swinging a compass is to determine ?
_____

7. When making a deviation table you use _____degree increments.

10. IALA stands for
_____

11. System A is used in?
_____
_____

12. System B is used in?
_____
___

13. We use _____to identify symbols for buoys and other aids to navigation.

14. _____lights are used on nun buoys.

15. Green lights are used on _____.

16. Major lighthouses have _____while minor lighthouses are described only.

17. Red day beacons are? _____

18. Green day beacons are? _____

Navigation-9
Navigation Homework

Day 2

Nautical Compass

1. Calculate the missing values on problems 1 (a-j) **WITHOUT** the use of the Table. On problems 2 (a-f) and 3 (a-e) use the Direct Reading Deviation Table.

	T	V	M	D	C
a.	347°	3°W	350°	4°E	____
b.	230°	10°W	240°	7°W	____
c.	122°	10°E	_____	3°E	109°
d.	_____	10°E	020°	2°W	022°
e.	262°	_____	248°	4°E	245°
f.	187°	15°W	_____	8°E	_____
g.	_____	10°W	140°	3°W	_____
h.	350°	12°W	_____	_____	356°
i.	015°	15°E	_____	10°W	_____
j.	288°	15°E	_____	_____	245°

2. Using the Direct Reading Deviation Table on page 8 of this supplement, determine the value of the Deviation in each case below:

a. Deviation for a compass heading of 220 degrees. _____

b. Deviation for a magnetic heading of 225 degrees._____

c. Deviation for a compass heading of 119 degrees._____

d. Deviation for a magnetic heading of 222 degrees._____

e. Deviation for a compass heading of 019 degrees._____

f. Deviation for a magnetic heading of 155 degrees._____

Day 2
Direct Reading Deviation Table Exercise, continued:

3. In all problems below, use Variation 10° WEST. Use the Direct Reading Deviation Table for deviation values.

a. We are holding a compass heading of 110°, what is the Mag. course? …….._____

b. We wish to make good a true heading of 315°, what compass course should we steer?……._____

c. We are cruising on a compass heading of 128° and wish to return to our point of departure. What compass course should we steer (CTS)? ……._____

d. We are holding a true heading of 140° and wish to change course 60° to the port. What will the new compass course be? ……._____

e. We are holding a compass heading of 160°. We wish to come starboard 45°. What will the new compass course be? _____

f. We are holding a compass heading of 300°. We wish to come starboard 30°. What will the new compass course be? _____

g. We are holding a compass heading of 126°. We wish to come about 180°. What will the new compass course be?….._____