c. Port Screw Ahead, Starboard Stopped. The offset of the rotating screw from the centerline throws the stern to port, the bow to starboard. (See Figure 8-30).

d. Starboard Screw Ahead, Port Stopped. The offset of the rotating screw from the centerline throws the stern to starboard, the bow to port. (See Figure 8-31).

e. Port Screw Ahead, Starboard Screw Astern. This accomplishes pivoting a twin screw boat to starboard in a circle in which the diameter is only slightly greater than the boat's length. The rudders can be left amidships or given right full rudder to add speed to the pivot. A boat drives forward more easily than astern, and the screw going ahead at the given rpm has more thrust than the screw going astern. Increasing the rpm on the reversing screw will prevent the boat from making headway while it pivots. (See Figure 8-32).

f. Starboard Screw Ahead, Port Screw Astern. This accomplishes pivoting a twin screw boat to port in a circle in which the diameter is only slightly greater than the boat's length. The rudders can be left amidships or given left full rudder to add speed in the pivot. As mentioned above a boat drives forward more easily than astern, and the screw going ahead at a given rpm has more thrust than the screw going astern. Increasing the rpm on the reversing screw will prevent the boat from making headway while it pivots. (See Figure 8-33).

2. Maneuvering Twin Screw Boats. The basic principles which apply to single screw boats with regard to forces produced by propeller action also apply to each propeller of a twin screw boat. The major difference is that with counter-rotating screws (starboard screw clockwise, port screw counter-clockwise), each screw can cancel out the unequal blade thrust effect of the other. With the screws being off-centered, high maneuverability is obtained. The maneuverability of a twin screw boat provides several advantages over a single screw boat, not only in close quarter operations, such as docking and undocking, but while underway in open waters. The effects of leeway caused by wind or current can be overcome by increasing the rpm's of the leeward engine to maintain the desired heading without applying constant "left" or "right" rudder. Increase the rpm's of the leeward engine until the desired heading is maintained (bow stops falling off).

3. Clearing the dock (port side to).

a. When in the clear with no wind or current, clearing the landing presents no difficulty.

b. With wind and current setting the boat against the dock, complete these maneuvers:
   (1) Leave the bow springline secured to the cleat, bitt, or bollard.
   (2) Go ahead on the STARBOARD engine and astern on the PORT engine with left full rudder until the stern is clear, then cast off the bow springline.
   (3) Pull the STARBOARD throttle in reverse (the PORT is already engaged), and back down. Rpm's can be regulated to obtain desired speed. (Because of the counter-rotation of the screws, a twin screw boat will back in a straight line; however, in strong winds the boat will tend to back into the wind.) (See Figure 8-34).

4. Mooring (port side to). The basic principles of mooring single screw boats applies also to mooring twin screw boats. Make a slow approach at a flat angle as safely as possible, approximately 20 degrees. Wind will cause the bow of a twin screw boat to fall off as it does a single screw boat. To dock a twin screw boat, follow these maneuvers:

a. When the bow is alongside the dock, secure the bow springline to a cleat, bitt, or bollard. Do not snub the springline too short.

b. Apply right full rudder and go ahead on the inboard engine (Port) and astern on the outboard engine (Starboard).

c. This combination will swing the stern to the dock. (See Figure 8-35).

5. Clearing (starboard side to).

a. As in clearing the dock, port side to with no wind or current setting the boat against the dock, clearing the landing presents no difficulty. "Right" rudders are applied instead of "left".

b. With wind and current setting the boat against the dock, complete these maneuvers:
   (1) Leave the bow springline attached to the cleat, bitt or bollard.
   (2) Go ahead on the port engine and astern on the starboard engine with right full rudder until the stern swings clear. When the stern is clear, cast off the bow springline.
Figure 8-30 Twin Screw Boat, Port Screw Ahead, Starboard Screw Stopped
BOW TO PORT

AS IN A SINGLE SCREW BOAT WITH "LEFT" RUDDER, RUDDER FORCE AND DISCHARGE SCREW CURRENT SWINGS THE BOATS Stern TO STARBOARD.

STERN SWINGS TO STARBOARD

Figure 8-31 Twin Screw, Starboard Screw Ahead, Port Screw Stopped
BOW TO STARBOARD

PORT SCREW GOING AHEAD; STARBOARD SCREW GOING ASTERN, PIVOTS THE BOAT TO STARBOARD IN A CIRCLE SLIGHTLY GREATER THAN THE BOATS LENGTH. APPLYING HARD "RIGHT" RUDDER INCREASES SPEED OF TURN/PIVOT.

Figure 3-32 Twin Screw Boat, Port Screw Ahead, Starboard Screw Astern
STARBOARD SCREW GOING AHEAD; PORT SCREW GOING ASTERN, PIVOTS THE BOAT TO PORT IN A CIRCLE SLIGHTLY GREATER THAN THE BOATS LENGTH. APPLYING HARD "LEFT" RUDDER INCREASES SPEED OF TURN/PIVOT.

Figure 8-33 Twin Screw Boat, Starboard Screw Ahead, Port Screw Astern.
Figure 8-34 Unmooring a Twin Screw Boat, Port Side to
Figure 3-35 Mooring a Twin Screw Boat, Port Side to
(3) Pull the port throttle in reverse (the starboard engine is already engaged) and back down. RPM's can be regulated for the desired speed. (See Figure 8-36).

6. Mooring (starboard side to).
   a. When the bow is alongside the dock, secure the bow springline to a cleat, bitt or bollard. Do not snub the springline too short.
   b. Apply left full rudder and go ahead on the inboard engine (Starboard) and astern on the outboard engine (Port).
   c. This combination will swing the stern to the dock. (See Figure 8-37).

7. In the event of loss of rudder control, maneuvering can be accomplished by use of the throttles. The Port or Starboard engine is set at a desired rpm and the other engine’s rpms are increased or decreased to accomplish steering. INCREASING the rpms on the starboard engine will turn the boat to the LEFT; DECREASING the rpms will turn the boat to the RIGHT. This advantage is invaluable in the event loss of steering occurs during heavy weather operations or towing evolutions where it would be unsafe to rig the emergency tiller.

G. BOAT HANDLING IN A NARROW CHANNEL.
1. Bank Cushion. A boat will veer or be set off the nearer bank when proceeding along a straight, narrow channel, especially as the draft of the boat approaches the depth of the water. This effect is called “bank cushion.” Bank cushion is especially noticeable in narrow channels that shelve rapidly. As the boat moves ahead, the wedge of water between the bow and the nearer bank builds up higher than on the other side, and the bow is forced out sharply.

2. Bank Suction. As the boat moves forward, the wedge of water between the bow and the near bank builds up higher than that of the other side and the bow is forced out sharply. The suction of the screw(s), especially with a twin screw boat, and the unbalanced pressure of water on the quarter, tend to lower the water level between the quarter and the near bank, forcing the stern toward the bank. This effect is called “bank suction.”

3. The combined effect of bank cushion and bank suction may cause a boat to take a sudden sheer toward the opposite bank. (See Figure 8-38).

4. Single Screw Boat. When a single screw boat is proceeding at a very slow speed with its starboard side near the right bank and takes a sheer, the boat may be brought under control by increasing speed with a right full rudder.

5. Twin Screw Boat. A twin screw boat under similar conditions as above can usually recover from the sheer by increasing speed on the port engine, slowing, stopping or backing down on the starboard engine, and putting the rudder right full.

6. Extremely Narrow Channels. In extremely narrow channels where bank cushion and back suction may be expected, it is best to proceed at very low speeds, keeping near the middle of the channel, and meet or pass other boats much closer than normally. When approaching to pass another boat in a narrow channel, headway should be greatly reduced, but not enough to lose steerage. As you approach nearly abreast (bearing 90 or 270 degrees relative from your boat), apply a small amount of “right” rudder to head slightly toward the bank. Some “left” rudder will be required when you are abreast the other boat, because the height of the water between the boats’ bows will counteract bank cushion. As both boats’ bows come abreast of the quarters, the suction of the screws tends to pull the bows to port, swinging to mid-channel. This swing should be checked with “right” rudder. The stern will be affected by the suction and will tend to straighten the boat out. The boat may then go ahead full to increase steerageway.

7. Turning in a Bend. Bank suction, bank cushion, and currents are factors which affect a boat turning in a sharp bend in a narrow channel. Bank cushion and bank suction are STRONGEST when the bank of a channel is STEEP. They are WEAKEST when the edge of the channel SHOALS GRADUALLY and EXTENDS INTO A LARGE SHALLOW AREA. Bank suction and bank cushion increases with the boat’s speed. Channel currents are usually strongest in the bend with eddies or counter-currents on the opposite side of the point.
Figure 8.36 Unmooring a Twin Screw Boat, Starboard Side to
PORT ENGINE ASTERN

RUDDERS HARD LEFT

STARBOARD ENGINE AHEAD

STERN SWINGS TO STARBOARD

Figure 8-37 Mooring a Twin Screw Boat, Starboard Side to
Figure 8-35 Bank Cushion and Bank Suction Affects, Narrow Straight Channels
a. Head Current/Boat Against the Current. With a head current, the best position from which to commence a turn is the middle of the channel, proceeding at a slow speed.

b. With the Current. When making a sharp turn with the current, it is possible to make any one of the following maneuvers: “Hug the Point,” “Stay in the Bend,” or “Proceed Slightly on the Bend Side of the Middle of the Channel.” The latter is the safest and the preferred choice.

(1) Hugging the Point. The coxswain requires a small amount of rudder toward the bank to steer a straight course. Less rudder will be necessary as the channel begins to bend and the boat moves from the bank. This condition may be an indication that it is time to begin the turn. Slackwater or eddies may be encountered around the bend, making it difficult to prevent a sheer toward the near bank, especially in shallow water. The current under the quarter may affect the stern, resulting in an increase in sheer. (See Figure 8-39).

(2) Stay in the Bend. To make a turn in the bend, that is, away from the point, the problem is the timing of the turn. If turned too late, the boat may ground on the bank in the bend. If turned too soon, there is extreme danger that the bank suction on one quarter combined with the force of the current on the other quarter may give the boat a strong and sudden sheer. The bank cushion under the bow will increase the sheer. (See Figure 8-40).

(3) Bend Side, Middle of the Channel. This is the safest method with a fair or following current. Approach the turn on a course a little to the bend side of the middle of the channel. By doing this, the increased currents in the bend can be avoided, and the force of the current against the quarter can be used to assist in turning. A fair current tends to force a boat toward the bend side, consequently, the turn should be commenced early in the bend. Head currents tend to force the boat toward the point side; therefore, the turn should be commenced later. (See Figure 8-41).

H. SEA PAINTER

1. The sea painter is a line used to sheer a boat clear of a ship’s side, when underway or at anchor, hold a boat in position under shipboard hoisting davits and occasionally to hold the boat alongside a ship in order to embark or disembark personnel, such as a medivac situation.

a. The sea painter must be secured on the inboard side of the boat aft of the bow and led outboard of all handrails, stanchions, fittings, etc., and well forward where it is tended on the deck of the ship. It creates a pivoting point on the inboard bow of the boat. The sea painter is never secured to the boat’s stem, nor to the side of the boat away from the ship. If the sea painter was secured to the outboard side of the boat a hazardous condition would immediately result, possibly resulting in capsizing.

b. As both the boat and ship have headway, the pressure of water on the bow of the boat causes it to sheer away from the side of the ship. The coxswain employs this force by a touch of the rudder, which sheers the boat out or in, catching the current on one side or other of the bow.

2. Riding the Sea Painter, Vessel Underway. As a SAR boat coxswain, you will be called on to evacuate injured or sick seamen from seagoing vessels. Whether the vessel is underway or at anchor, riding a sea painter is a must to maintain position and control of your boat. Rarely is an accommodation ladder rigged for mooring small boats alongside. The most important tasks of the coxswain and crewmembers is the safety of personnel and to keep the boat stable while along the ship’s side without damaging the boat.

a. Before making the approach, ensure that all preparations have been made on board the ship to receive your boat alongside. Set up communications and follow these procedures:

(1) Approach the ship from the leeward (downwind or down swell) side.

(2) Rig fenders on the side of your boat that will be toward the ship.

(3) Secure the sea painter to an inboard cleat just aft of the bow.

(4) Ensure the painter is secured well forward on the deck of the ship.

(5) Reduce your engine speed slowly and drift back on the painter (ride the painter). By proper use of the rudder, the coxswain can hold the boat at the desired position either alongside the ship or at some distance off the ship.
Figure 8.39 Hugging the Point; Current Aftern

8-48
CURRENT ACTING ON QUARTER

BEND SIDE OF CHANNEL

BANK CUSHION UNDER BOW INCREASES SHEER

POINT SIDE OF CHANNEL

BANK CUSHION

BANK SUCTION

Figure 8.40 Keeping in the Bend; Current Astern

8-49
Figure 8-41 Approaching Slightly on Bend Side of the Channel; Current Aftern
SHIPHANDLING
MANEUVERING DIAGRAM

TURNING CIRCLE - The path followed by the pivot point of a ship making a turn of 360 degrees or more.

ADVANCE - The distance gained in the direction of the original course, maximum when the ship has turned through 90 degrees.

TRANSFER - The distance gained at right angles to the original course when the ship has turned through 90 degrees.

TACTICAL DIAMETER - The distance gained to the right or left of the original course when a turn of 180 degrees has been completed.

FINAL DIAMETER - The distance perpendicular to the original course between tangents drawn at the points where 180 and 360 degrees of turn has been completed.
MANEUVERING CHARACTERISTICS IN SHALLOW WATER.

SQUAT - a decrease in bottom clearance and an increase in draft. When entering shallow water the vessels trim will change, usually the bow will suck down farther than the stern.

RUDDER RESPONSE - will become sluggish and the Turning Diameter will increase.

BANK EFFECTS

BANK CUSHION - forces the bow of the ship away from the nearer bank.

BANK SUCTION - pulls the stern toward the bank.

STEERING CONTROL

SINGLE SCREW - Almost all single screw vessels have Right-Handed Propellers, a Left-Handed screw would produce the opposite effect to the following general rule:

PROPELLER - Think of the propeller as the tire on your car where the rubber meets the road. The stern of the vessel will move in the direction of rotation and the bow will move in the opposite direction because of the SIDEWISE PRESSURE. Propeller effect is much less than the Rudder effect therefore the Rudder will effect the swing of the ship until headway or sternway is lost, then the Propeller will have its greatest effect.

ENGINE GOING AHEAD - ships head tends to go to the Port., Stern goes to Starboard.
**KICK** - The distance the ship moves sidewise from the original course away from the direction of turn after the rudder has been first put over.

**DRIFT ANGLE** - The angle at any point of the turning circle between a tangent to the circle and the heading of the ship.

**PIVOT POINT** - That point about which the ship turns, usually 1/3 the length of the ship from the bow.

**HEAD REACH** - The distance the vessel will run between taking action to stop her and being stationary in the water.

**MANUVERING UNDER PILOT**

**PILOT** - is a specialist hired to give navigational advice. He holds an advisory position and ultimately the Master is responsible for the safe navigation of the ship. Before a Pilot can be relieved of his duties though, the Master must foresee danger to the vessel if it were to remain on its present course of action.
ENGINES GOING ASTERN - ship's stern tends to back to Port and the Head tends to Starboard.

RUDDER - The greatest Rudder effect occurs with the faster motion of the vessel.

TWIN SCREW - Most twin screw vessels have outboard turning propellers and will steer a fairly straight course with the rudder amidships, both in the forward and astern directions. These vessels are usually easier to maneuver because they can turn without using the rudder.

FLANKING RUDDERS - Rudders attached forward of the propeller used to assist in moving the vessel laterally.

BERTHING AND UNBERTHING

CURRENT - When mooring a vessel alongside a dock, you should, if possible go in against the current (parallel to the pier from ahead).

DOCKING - Due to the effects of the propeller it is easier to dock a right handed vessel if there is no current present by approaching Port - Side to the dock.

PORT SIDE TO - Approach the dock at an angle of approximately 15 degrees, when you have reached the desired position off the dock, you back the engines with the rudder amidships, and you would expect the vessel to turn its stern towards the dock and move the bow away.

STARBOARD SIDE TO - Approach at a shallower angle (more parallel) to the dock as when the engines are backed the bow will tend to move towards the pier and the stern will move away.

USE OF MOORING LINES - A spring line led aft from the bow is the most common line use to assist in bringing a vessel into and away from the dock.

DISPLACEMENT EFFECTS

DISPLACEMENT - The amount of water in tons that the vessel actually displaces, the larger the displacement the larger the vessel. A vessel will displace more water when loaded than when light.

FULLY LOADED VESSEL - will be slower to respond to the engines will maintain her headway longer require more rudder

LIGHT VESSEL - will respond quicker to the engines will be more effected by the wind requires less stopping distance
HEAVY WEATHER OPERATIONS

RUNNING BEFORE THE WIND AND SEA - the sea is aft or quartering

RUNNING IN THE TROUGH - This is the most dangerous position for a vessel and may cause it to BROACH (turn broadside into the wind and sea) and capsize.

POUNDING - The bow rising out of the water and then "Pounding" down causing the vessel to shudder.

ROLLING - the full inclination from one side to the next full inclination on the same side.

SYNCHRONOUS ROLLING - When the period of the seas coming from the beam matches the rolling period of the vessel. This results in dangerous excessive rolling.

YAWING - The stern of the vessel being thrown off course by a following sea. When the seas get too heavy the vessel will rush down a slope from crest to trough, and, stern high the propeller comes out of the water and races. The rudder now partly out of the water losses effectiveness and the sea may take charge causing the vessel to broach in the trough.

THE LOWER THE SPEED AT WHICH THE VESSEL IS RUN IN ANY DIRECTION, THE EASIER SHE WILL RIDE.