3.1.Basics of Operation Boat

3.1.1.Classification by hull performance

Planing vessel(Deep-V hull)

Boats with planing hulls are designed to rise up and glide on top of the water when enough power is supplied. These boats may operate like displacement hulls when at rest or at slow speeds but climb towards the surface of the water as they move faster.

Displacement Mode: A planing hull, when operated at very slow speeds, will cut through the water like a displacement hull.

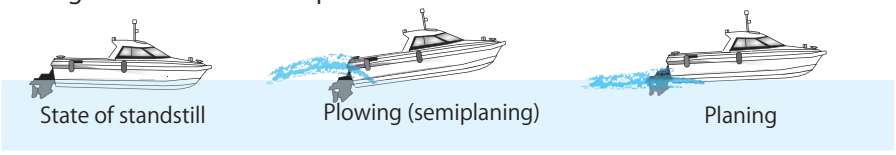
Plowing Mode (semi planing (hump)) : As speed increases:

1. the bow will rise up.
2. the driver will not be able to see.
3. the boat will have a large wake.

Do not keep your boat in plowing mode.

IAt planing speed when the rudder turns, the boat leans “into" the turn.

Planing Mode: Your boat is in planing mode when enough power is applied so that the hull glides on top of the water. Different boats reach planing mode at different speeds.



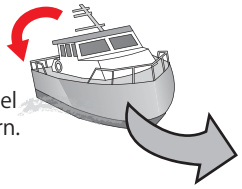
Displacement vessel

Boats with displacement hulls move through the water by pushing the water aside and are designed to cut through the water with very little propulsion.

• If you lower a boat into the water, some of the water moves out of the way to adjust for the boat. If you could weigh that displaced water, you would find it equals the weight of the boat. That weight is the boat's displacement.

• Boats with displacement hulls are limited to slower speeds.

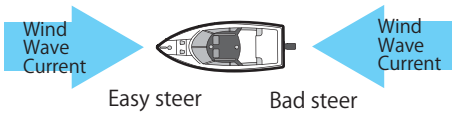
• A round-bottomed hull shape acts as a displacement hull. Most large cruisers and most sailboats have displacement hulls, allowing them to travel more smoothly through the water.



A displacement vessel leans "out" of the turn.

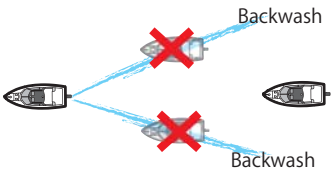
3.1.2.Steerability

1. The rudder is more effective at high speeds than it is at low speed.
2. The rudder is more effective going ahead than going astern.
3. A boat is easier to steer when going against the wind, waves, or current.
4. Water-jet propelled boats have no steerage without propulsion.



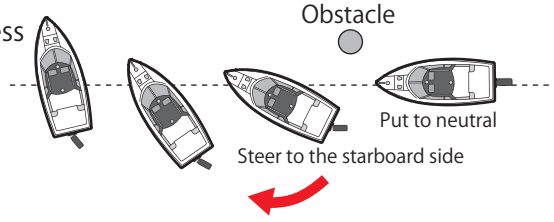
3.1.3.How to steer

1. Make small steering corrections.
2. The maximum steering correction is approximately 35 degrees.
3. Avoid the backwash of other boats.



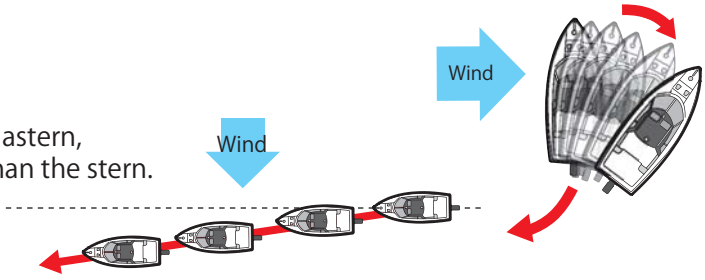
3.1.4.Kick effect (Pivot points)

1. Boats have a moving pivot point around which it swivels in the process of turning. This point, when going ahead, is about 1/3 of the boat length from the bow. Thus, when turning, the stern will turn away from the direction of the turn as the bow turns in the direction of the turn. The rudder aids the effect of the swivel.
2. If an obstacle appears near, shifting to neutral and turning towards it may push your stern away and around the object.



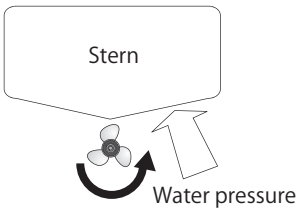
3.1.5.Wind

1. If you have wind on the beam of your boat while going ahead, the boat will drift to leeward.
2. If you have wind on the beam of your boat while going astern, your bow will drift to leeward more dramatically than than the stern.

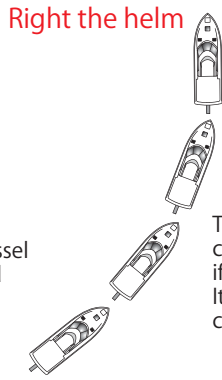


3.1.6.Propeller action(Transverse thrust)

1. Most power boat have a right-handed rotating propeller・These are called 'right-handed' meaning they rotate clockwise in forward gear when viewed from astern.
2. If a boat with a right hand prop runs astern, uncorrected Prop Kick will pull the stern to the left.



When a single-right-handed screw vessel runs astern, the propeller goes around counterclockwise.
Water pressue of propeller push the starboard side of stern, and the boat runs astern counterclockwise.

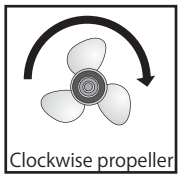


The boat runs astern counterclockwise.
if it is not steered early,
It will be difficult to correct course.

The boat runs astern counterclockwise.

A rudder balances, and the boat runs straight.

Rudder action becomes strong, and the boat runs astern to the right.



4. If the rudder is put to the left to balance the Kick, the boat will run straight.
5. But, if the rudder action becomes strong, the stern will turn to the right.

3.1.7.Running on inertia

1. A boat slows down by the resistance of water to the hull when an engine is made a neutral position while runs ahead. (Boats don' t have brake systems.)
2. Stopping distance is subject to the boat speed, the boat weight, wind, wave and the resistance of water on the bottom of the boat.
3. If the boat is put into reverse (after the prop has stopped), the stopping distance will become the shortest possible stopping distance.

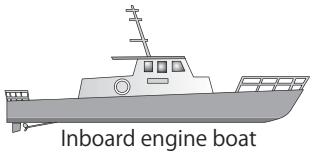
3.2.Departure and Arrival / Mooring / Anchoring

Boat

3.2.1.Coming alongside a Pier

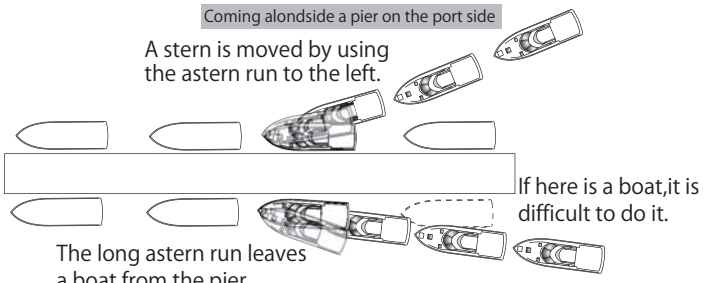
How to come alongside a pier by a vessel with a right-handed propeller)

1. Port side・Enter at an angle of about 30 degrees to the pier, move the stern to the left with an astern run.
2. Starboard side・Enter slowly and almost parallel to the pier and stop the boat with a short astern run.



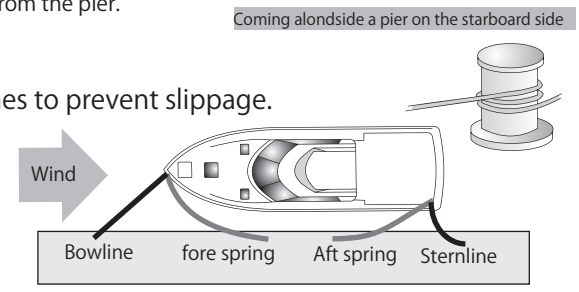
Inboard engine boat

A propeller shaft and a rudder come out from the bottom.



3.2.2.Mooring / Unmooring

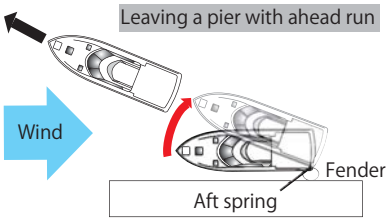
1. Mooring・Always secure the end facing the wind or current first.
2. Unmooring・ First untie the line away from the wind or current
3. Wrap the line around the metal fittings (such as a bitt) several times to prevent slippage.

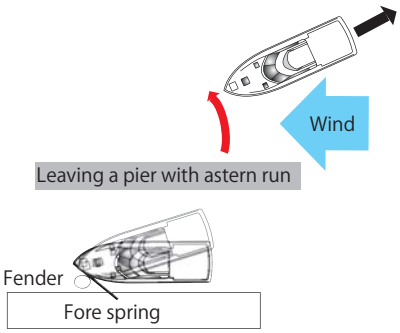


3.2.3.Leaving a pier

How to leave a pier with a spring and wind?

When a boat with single-right-handed-screw is docked on the port side and leaves a pier with an astern run, the stern move to the left side in the beginning. (First, the bow is moved to the pier side with helm starboard and ahead run, after that, a boat leaves the pier with port helm and astern run?)

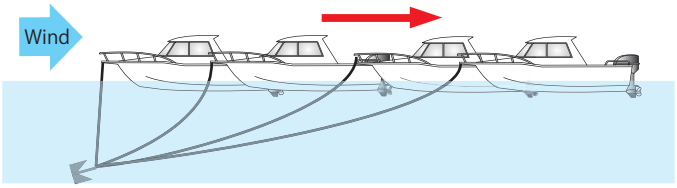




3.2.4.Anchoring

1. Sand or mud are preferred bottoms for anchoring. (Well-anchor-hold)
2. The scope of three times of the depth of water is necessary for the anchor rope even in smooth water if the anchor is watched.(The scope of 5 ˜10 times of the depth of water is necessary in rough seas and/or if the anchor will not be continuously watched.)
3. Enter an anchorage point toward the windward (i.e. head to wind).

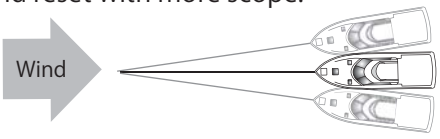
Anchorage with astern run



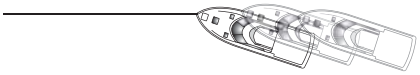
1. Enter an anchorage point head to wind.
2. Apply astern run.
3. When a boat begin to go astern, let go a anchor.
4. Run astern until the proper scope is deployed.
5. Put the engine to neutral position, and let the anchor set.
6. The anchor should set in the bottom of the sea by inertia.

3.2.5.Draging anchor

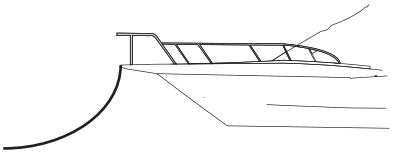
1. Causes that allow the anchor to drag: the anchor rode is too short. the anchor is too small. the quality of the bottom is poor. the weather.
2. If tide or wind causes the boat to drift in the reverse direction from which the anchor was set, pulling the rode over the anchor in the process, it is possible for the anchor rode to foul in the anchor, pulling it out of the bottom.
3. If the anchor does not set, but drags, try to increase scope to cause it to set. If is does not set, heave the anchor up and reset with more scope.



If an anchor is effective, wind blows alternately and a boat swings slowly right and left.



When a boat has the wind in only one side, the boat drifts to backward.



If an anchor is effective, when wind decrease, the anchor rope slackens.

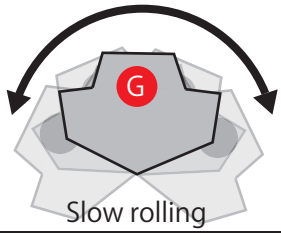
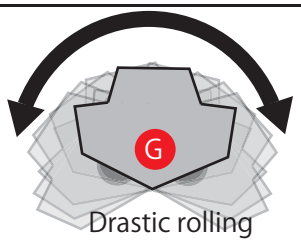
3.3.Stability of a hull / Trim

Boat

3.3.1.Stability

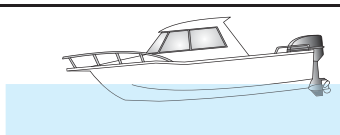
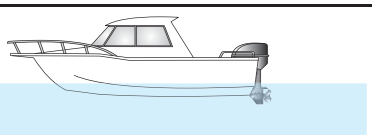
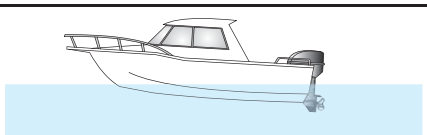
It is subjeted to the center of gravity, the buoyancy, the shape of bottom.

3.3.2.Top-Heavy / Bottom-heavy

	Top-heavy	Bottom-heavy
As this difference is bigger, stability grows bigger. Buoyancy Center of gravity(G)	 Slow rolling	 Drastic rolling
A position in the center of gravity	high	Low
Stability	Poor	Good
Cycle period	Long	Short
Heeling angle	Big	Small
Cause	(a)A person and baggage are loaded **in the high place** too much. (b)Large quantities of bilge water on the deck. (c)Icing of the hull in winter	(a)A person and baggage are loaded in the low place too much. (b)Large quantities of bilge water in the bottom of the boat.

3.3.3.Trim

The difference in draft of the bow and the stern.It changes by the distribution of the laden weight of bow and stern.

Trim by the head	Even keel	Trim by the stern
		
(a)Bad steer, the straight advancement stability is bad. (b)Poor acceleration (c)A bow goes into the wave.	(a)Easy to run in a shallow area. (b)The turning radius is small.	(a)The **moderate stern trim** has easy steer and the good advancement stability. (b)The turning radius is big.

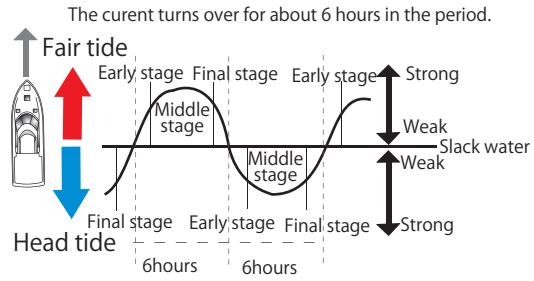
3.3.4.Navigation under Reduced Visibility / Navigation in Narrow Channels

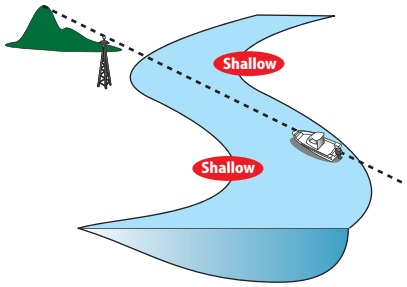
3.3.4.1.Navigation under reduced visibility

1.If you are in restricted visibility conditions and a wind starts, do not navigate to leeward. The mist/fog will clear away from windward.
2.If you do not know the position of your boat: stop, drop anchor and wait for the weather to clear.
3.Do not use sound signals to judge the distance to other vessels.
The transmission of sound is influenced by wind and land features.
4.Comply with The Law for Preventing Collisions at Sea.

3.3.4.2.Navigation in narrow channels

1.Steerage with a following tide (fair tide) is difficult. Navigate in a following tide during the early and final stages and avoid the middle stages where the current is strongest. (see chart)
2.Steerage increases in a curved channels. You had better to navigate in slack water or the early and final stage of head tide.
3.Navigate a narrow channel parallel with the current. The depth of the channel near the inside of a curve is shallow.
4.Use a range for the course, A LOP where two landmarks line up. A compass course is not useful.(See chart)
5.Current influences steerage. Maintain power (and speed) to help control current effects.





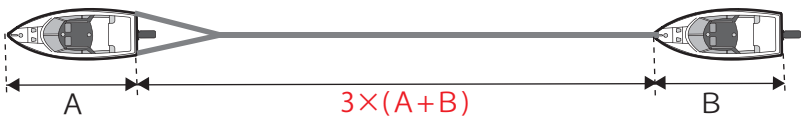
3.3.4.3.Navigation at river mouth

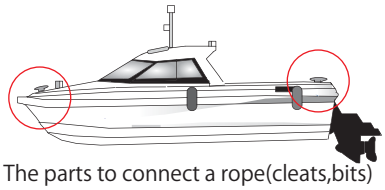
1.Tide. at the mouth of a river, will cause several effects. The speed of the current.The influence of the tide is taken around the mouth of a river.The speed of the river current will change and may even flows backward.
2.The depth of the water will become shallow at the time of the low (ebb) tide.
3.Heavy rain and the release of water from dams will effect the depth of the water.
4.Heavy rain will bring trash such as driftwood to the mouth of a river.
5.Chopping waves may appear around the mouth if a river caused by the river''s current, tidal current, and wind and wave around the mouth of a river.

3.4.Towing Operation

3.4.1Towing operation

1.A towing rope is about three times of the length of both boats.
2.The bow rope of the towed boat is connected so that the rope is on the center line of the hull, and may be disconnected in an emergency.
3.Lighten the towed boat as much as possible.
4.Under reduced visibility or in heavy traffic the towing rope is shortened, and the boat speed is decreased.
5.The towing rope is extended if the water becomes rough.
6.When the boat slows down, take care to prevent the towing rope from wrapping around the prop.

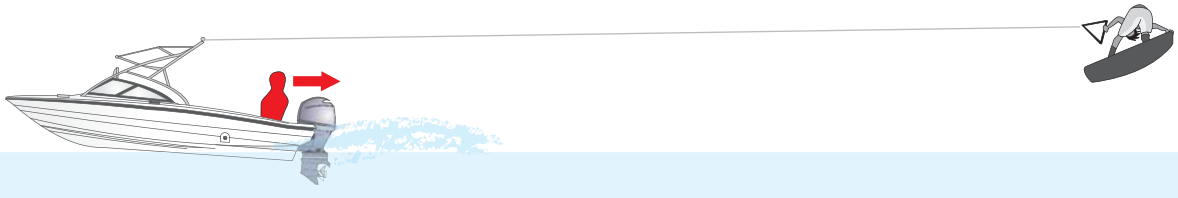




The parts to connect a rope(cleats,bits)

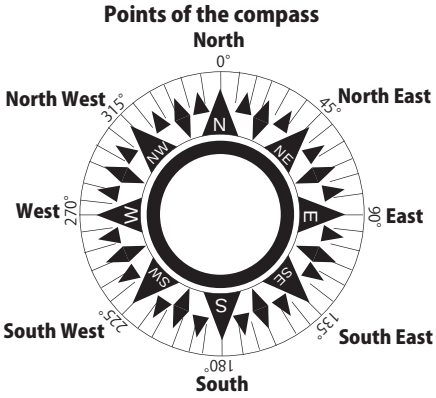
3.4.2Water-skiing / Wake-boarding

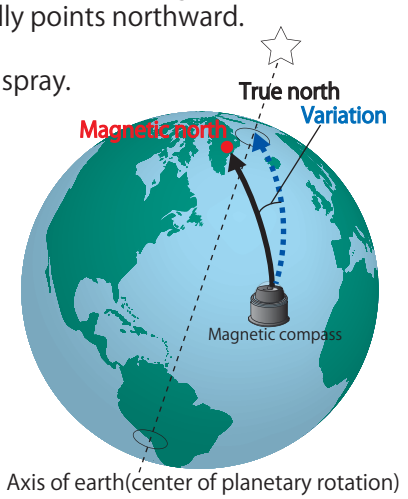
1.Two people should be on board the boat. The operator drives the boat. The observer watches the skier.
2.Determine a set of gestures to communicate between the boat and the skier in advance of the action.
3.Centrifugal force grows big in proportion to the speed and the weight of a towing object.
4.Stop the engine when ropes and human beings are raised onto the boat.



3.6.1.Magnetic compass

1. A compass is an instrument used for navigation and orientation that shows direction relative to the geographic cardinal directions (or points). Usually, a diagram called a compass rose shows the directions north, south, east, and west on the compass face as abbreviated initials. When the compass is used, the rose can be aligned with the corresponding geographic directions; for example, the "N" mark on the rose really points northward.
2. Magnetic compasses are influenced by any magnetic fields nearby.
3. As much as possible, install it in the place shaded from direct sunlight and wave spray.





3.6.2.Variation(Var.)

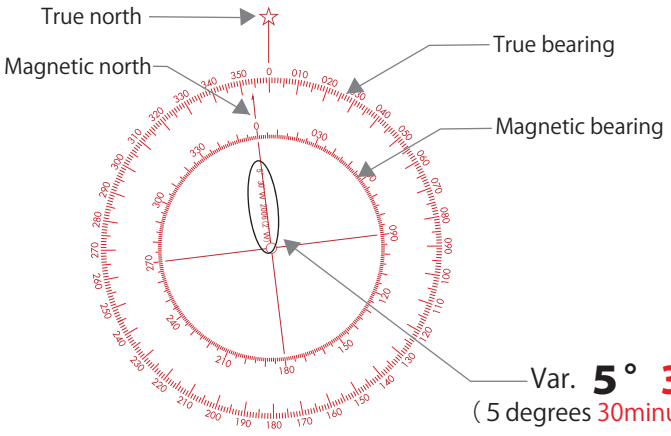
1. This is the difference, in degrees, between true and magnetic. Variation can be east (easterly variation) or west (westerly variation). On the above compass rose we can calculate the variation visually by drawing a straight line, starting from the the center then going through the inner rose and continuing across the outer rose. The difference between the two is variation. We can also read, inside the rose, the variation (abbreviated VAR) in 1985 for this chart is 4° 15' West.
2. Variation of the seas nearby Japanese is 5˜8 degrees Westerly.
3. Variation changes every year, because the magnetic north moves around the true north.(annual equation)

3.6.3.Deviation(Dev.)

1. Deviation is stated the same way as variation; that is, by degrees east or west. When it points at the west side from the magnetic north, it is called westerly deviation.and when it points at the east side from the magnetic north, it is called easterly deviation. Deviation is not as simple as variation however since deviation can and does change on different compass headings. Magnetic compasses don't point at the magnetic north precisely when an influence such as a radio speaker which has magnetic force in the inside of the boat is near the compass..
2. If the hull is made of the iron, the deviation changes by a bow direction's changing. And, it changes if the position of the magnetic compasses and a position of of the ironmongery change. We would normally have a deviation table made up for our ship's compass so that we would know how much deviation there is on any given heading.

3.6.4.Compass rose

1. **The outer rose (circle)**. This represents true bearings on the chart where '0', at the top of the rose,always points to true north. True north is often represented by a star icon, a symbol of the north star, also known as Polaris. True north represents the axis about which the Earth rotates on a daily basis (see Latitude & Longitude). A line drawn through '0' and '180' will always point to the north and south poles. A line drawn through '270' and '90' will always point east and west and be parallel to lines of latitude on the chart.
2. **The inner rose (circle)**. This represents magnetic bearings on the chart where '0', in the upper part of the rose, points to the magnetic north pole at the time the chart was printed. Since the magnetic poles are moving and shifting we need a way to be able to update the chart to know where the magnetic pole is now. This is accomplished by reading the inside of the rose where an annual increase or decrease is written. In the above rose we can see that 8' (the slash after the 8 represents minutes of degrees) must be subtracted from the variation every year after 1985 in order to be accurate.



Var. **5° 30′ W 2017 (2′ W)**

(5 degrees 30minutes Westerly variation in 2017 annual equation Westerly 2 minutes)

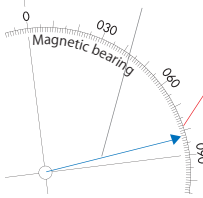
※1° =60′

3.6.5.Compass error

1. The combination of variation and deviation which is the horizontal angle between the direction indicated by a magnetic compass and true north.

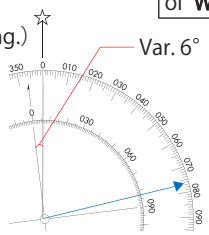
" A "was measured by the compasses in the boat in 078° .If a deviation is 4° E' ly and the variation is 6° W' ly, How many degrees is the true bearing of " A" ?

078° which the compass points at in the boat
(It is pointing at the east at 4° from the magnetic bearing.)



The magnetic bearing 078°

When the compass bearing is modified to the magnetic bearing.
078° +4° = 082°

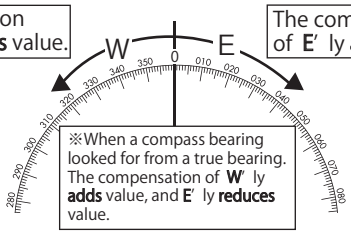


Var. 6° W' ly

When the magnetic bearing is modified to the true bearing.
082° -6° = 076°

The compensation of **W'** ly **reduces** value.

The compensation of **E'** ly **adds** value.



※When a compass bearing looked for from a true bearing. The compensation of **W'** ly **adds** value, and **E'** ly **reduces** value.

Answer 076°

3.6.6.GPS (Global Positioning System)

1. The Global Positioning System (GPS) is a U.S.-owned utility that provides users with positioning,navigation, and timing (PNT) services. This system consists of three segments: the space segment, the control segment, and the user segment. The U.S. Air Force develops, maintains, and operates the space and control segments.
2. the basic unit will provide latitude and the longitude..
3. GPS information can be used in a charting program to provide charting information.
4. A geodetic datum or geodetic system is a coordinate system, and a set of reference points, used to locate places on the Earth (or similar objects).

3.6.7.Using an analog clock for finding South

1. Hold the watch horizontally. This trick can be used anywhere in the Northern Hemisphere during the day, when the sun is visible. Lay the watch flat and face-up in your palm so that its face is parallel with the ground.
2. Point the hour hand in the direction of the sun. Turn the watch, your hand, or your entire body so that the hour hand of your watch is pointing directly at the sun. The time on the watch doesn't matter, as long as it's accurate.
3. Bisect the angle between the hour hand and the 12 o'clock mark to find South.This is the tricky part. Find the middle point of the angle between your hour hand and the 12 o'clock mark on your watch.Before noon, you'll have to measure clockwise from your hour hand to the 12 o'clock marking, while afternoon, you'll have to measure counterclockwise from your hour hand to the 12 o'clock marking. The middle point between the two marks South, while the point directly across from it marks North.

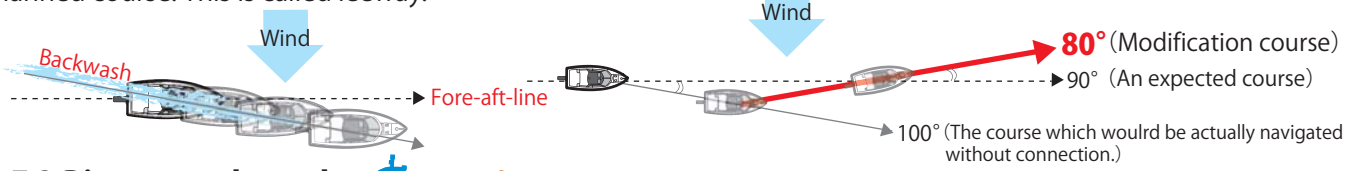
3.6.8.Other navigational instruments

1. Radar - For low power (less than 5KW), a radio operator's license is not required, but opening procedures for a radio station(registration) are necessary.
2. AIS (Automatic Identification System)-The VHF band radio wave is used to display the position and movement.

3.7.Coastal navigation Boat

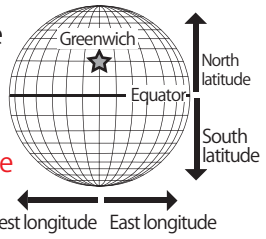
3.7.1.The expected course and the actual course

A boat usually doesn't follow a planned course; wind and current will cause the boat's track to differ from the planned course. This is called leeway.



3.7.2.Distance and speed Boat PWC

1. Latitude• Lines that run horizontally. Latitude lines are also known as parallels since they are parallel and are an equal distant from each other. Each degree of latitude is approximately 69 miles (111 km)apart. The equator, as 0°, in north and south 90 degrees (°Lat.˜°N(S)).
2. Longitude•The vertical longitude lines are also known as meridians. They converge at the poles and are widest at the equator (about 69 miles or 111 km apart). Zero degrees longitude is located at Greenwich, England (0°). The degrees continue 180° east and 180° west where they meet and form the International Date Line.

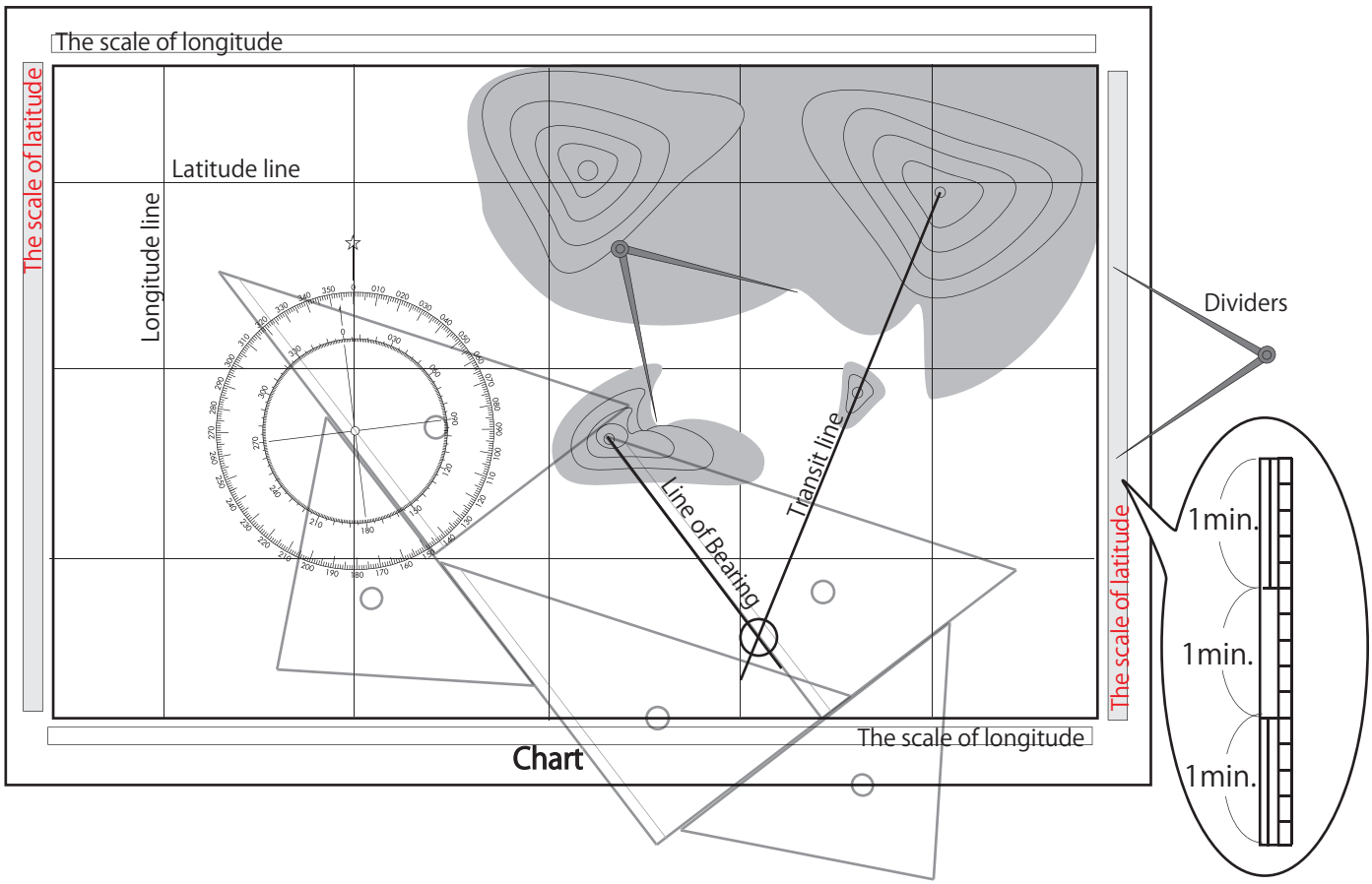


3. 1N.M (nautical mile)•A nautical mile is a unit of measurement defined as 1,852 meters (6,076.1 ft;1.1508 mi). Historically, it was defined as one minute of latitude, which is equivalent to one sixtieth of a degree of latitude.
4. 1knot•The knot is a unit of speed equal to one nautical mile per hour, approximately 1.852 km/hr or about 0.5 m/s.

※Speed (knot) × time required (h) = navigation distance (N.M.)

3.7.2.FIX / Cross bearing Boat

1. To measure a distance•Put the needles of the dividers between 2 points on the chart, and that interval is measured in the scale of latitude (the side).
2. Fix (Cross bearing)• A fix is where two or more lines of position intersect at any given point on a chart.



In this graphic there are 2 lines of positions. One is a line of bearing and the other is a transit line.
(Triangles have been overlaid to show how to move the line of bearing to the compass rose to determine the degrees.)