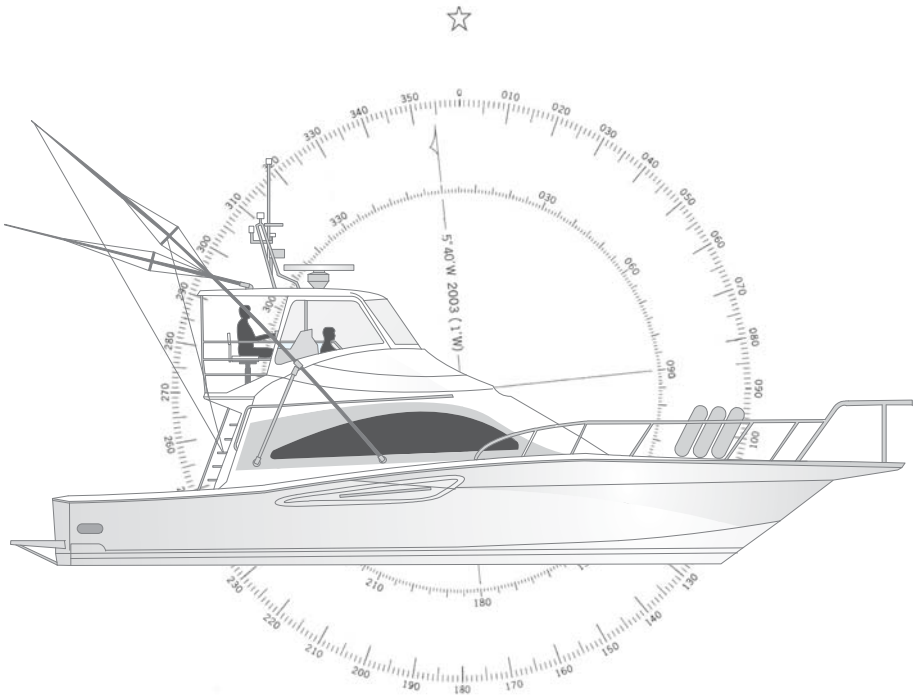
Advanced Operaton I

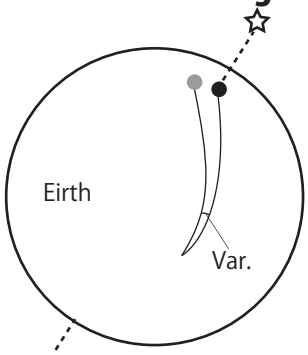


1 .Navigation Program
2 .Position Fix
3 .Course and Speed Made Good
4 .Preparation for a Long Voyage
5 .Weather Prediction
6 .Tide • Tidal current • Ocean Current
7 .Navigation in Heavy Weather
8 .Case Study of Marine accident

1.Navigation Program

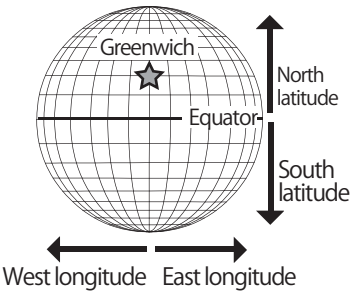
Question to figure out by the drawing in a chart

1 .Basic Knowledge of the Navigation

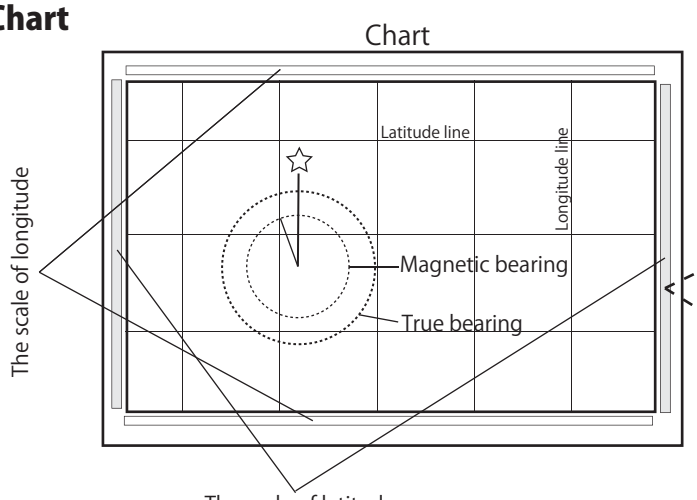


● **True north**(T.N.)・・The center of axis of earth
● **Magnetic north**(M.N.)・・The magnetic pole
Variation(Var.**)**・・The difference in angle of the true north and the magnetic north.

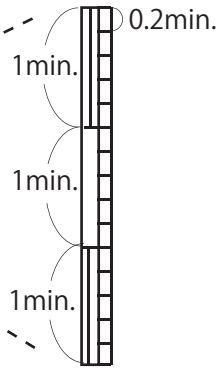
Gyro compass・・The compass which the true north is indicated as 0°（Generally a large vessel equips it.）
Magnetic compass・・The compass which the magnetic north is indicated as 0°
Deviation(Dev.**)**・・The error which arose with an influence of other magnetic force in the magnetic compass.



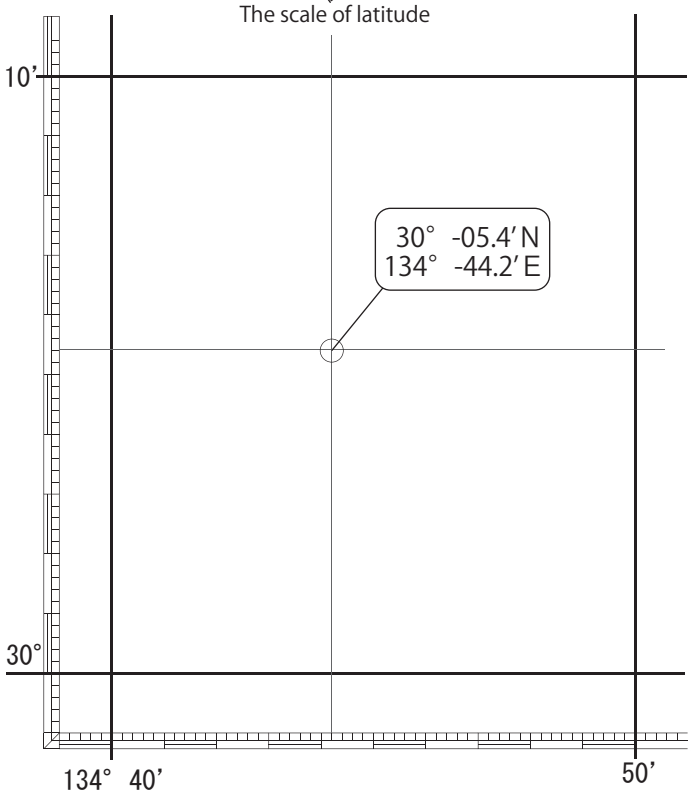
2 .Chart

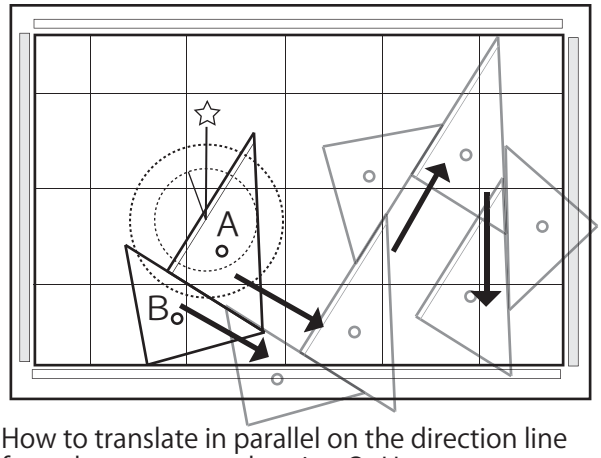


1 minute of latitude＝ **1 N.M.**
1 knot＝1N.M./h

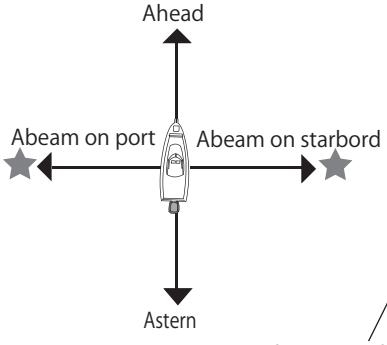


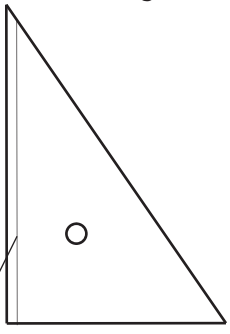
Measure a distance with the the scale of latitude.





How to translate in parallel on the direction line from the compasses bearing.Or How to measure a direction line with the compasses bearing.





Measure it by using the line of the triangle A.
（Pay attension to face and back of the triangle.）

Stationery
1.Pencils or an automatic pencil
2.A gum eraser
3.Plain triangles
4.A divider（A distance is measured on a chart.）
5.A compass（Draw a circle on a chart）

2 .Position Fix

Question to figure out by the drawing in a chart

2.1 Bearings

The 000* on the boat' s compass does not point North, it doesn' t even point to Magnetic North. It just points. There are two types of 'errors' that prevent that 000* for showing true north: 1) the magnetic field of the earth, known as variation, and 2) the stuff on the boat that sway the compass, known as deviation. Three of the Question 52 group will test your skill at calculating part of the compass error equation.

Position Fix Terminology

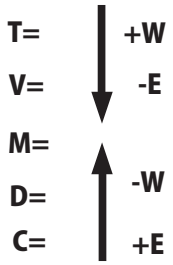
1. TRUE NORTH - is true North – an imaginary line through Earth' s poles and extending beyond. We can express a position in relation to True North.
2. MAGNETIC NORTH - the direction a magnetic compass will point if there is no interference.
3. COMPASS BEARING -The direction which the magnetic compass on the ship points. (Variation and deviation have an effect on bearing compass.)
4. VARIATION – the difference in degrees between True North and Magnetic North.Variation changes and differs according to your location on the surface of the earth.
5. DEVIATION – the affect that nearby metal sources in the boat that interfere with the magnetic field.

Deviation problem

Our concern with this set of problems is how to compensate for deviation and this will require a review of basic compass information. The magnetic compass is the basic instrument used to measure direction on board ship. It responds to the earth' s magnetic field, that is, the magnetic North and South Poles.
The compass, we think, points to Magnetic North, not True (geographical) North. The "error" , or difference, between True North and Magnetic North is called Variation. The compass rose on your chart tells you the general variation for that area covered by the chart and the annual change to that variation. This angle changes when a vessel changes position on the earth' s surface. Variation is caused by natural forces outside the vessel.

Magnetic North

Deviation, on the other hand, is the total of all other errors on a compass. Deviation is caused be factors inside the boat (a radio, for example, mounted next to the compass). Unlike variation, deviation will change according to the vessel' s heading. Deviation, being a source of error to the compass, will cause the needle to deflect to the right or left. Deviation deflecting to the right is called 'east' while deviation to the left is called 'west' .Errors of variation and deviation will cause the compass needle to deflect east or west and the total effect of these two errors is called "Compass Error" . If compass error is not allowed for, the compass will become less a precise navigation instrument and more an unreliable approximation.
Most compass correction problems involving deviation and variation can be solved by using the T-V-M-D-C formula.
A mnemonic aid to remember this formula:
True **V**irgins **M**ake **D**ull **C**ompanions, just add Whiskey.
Thus:
True **V**ariation **M**agnetic **D**eviation **C**ompass - add West.(and subtract East when going from true to compass settings).
One way to illustrate this formula is shown at the right.The TVMDC formula is written vertically and two arrows are placed to the right of them. The arrow pointing down will produce a compass bearing given a true bearing. The upward arrow will produce a true bearing given a compass bearing. To the right of the arrows are a +W-E reminder that we are to add W and subtract E when going from true to compass. The opposite occurs when we are finding true given compass. The process is to fill all the givens and perform the appropriate math to solve the equation.



Compass Error Problem:

Vessel A was navigating on the fix course off Yamano Ko. She measured Ushi Saki lighthouse on the compass bearing of 306° and Okino Shima lighthouse on a compass bearing of 055° .Which of the following corresponds to her position in latitude and longitude? The magnetic deviation for the heading at the time was 5° West chart 200

1. 39° 56.0 minutes N 139° 59.0 minutes E
2. 39° 55.6 minutes N 139° 58.2 minutes E
3. 39° 55.8 minutes N 139° 57.5 minutes E
4. 39° 55.3 minutes N 139° 58.2 minutes E

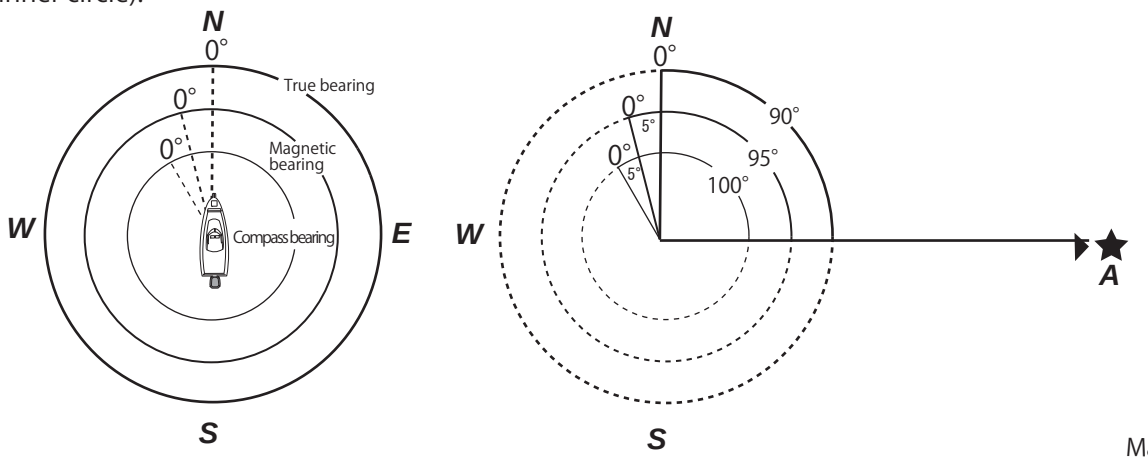
Compass error calculation:

T	301	050
V	0	0
M	301	050
D	-5	-5 (5° W)
C	306	055

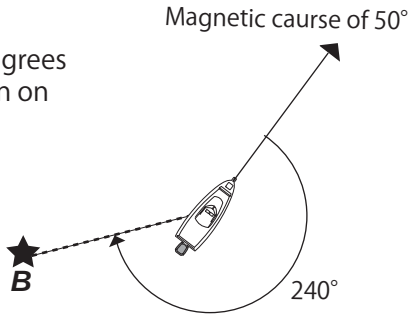
Now you can use either the True or Magnetic circles from the compass rosette to find your fix. After that, determine the Latitude and Longitude.

Relative bearing Problem:

Vessel 1 has a variation is 5°W'ly and a deviation is 5°W'ly,
The bearing from the true north to object A is 90° (outer circle). But the bearing from Magnetic north to object A is 95° (middle circle). And, It is 100°when it is measured with the compass which has 5°W'ly deviation and a 5°W'ly variation (inner circle).



In nautical navigation the relative bearing of an object is the clockwise angle in degrees from theheading of the vessel to a straight line drawn from the observation station on the vessel to the object.
Relative bearings are usually radar fixes where the bow of the vessel is 0 degrees and the measurement is made clockwise from that point.



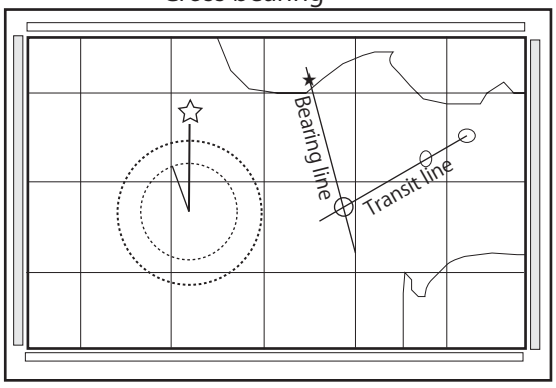
Transit or Ranges

If two geographic features are visually aligned (a light is aligned with the top of a bridge, for example), the extension of the line joining the features is called a "transit" or "range" . A transit is not affected by compass accuracy, and is often used to check a compass for errors.

2.2 Fix (Cross bearings)

1. Use a Hand Bearing Compass. There is no Deviation, only a Magnetic Course reading.
2. Take a sighting on at least 2 fixed objections on a shore. (These may be single identifiable objects or ranges)
3. Plot the sighted bearing lines on the chart.
4. Your position is at the intersection of the bearings lines.

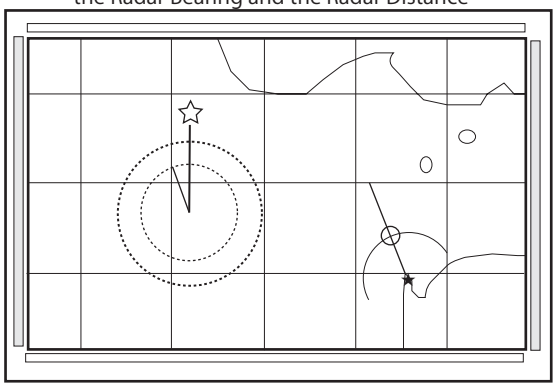
Cross bearing



2.3 Measuring ship's Position with the Radar Bearing and Distance

How to find a ship's position with a bearing line calculated with a compass course and radar relativebearing of one object, and a distance indicated with radar. If the compass has a deviation, draw them on a chart after the compass bearing are modified to the magnetic bearing.

The Position Measuring with
the Radar Bearing and the Radar Distance

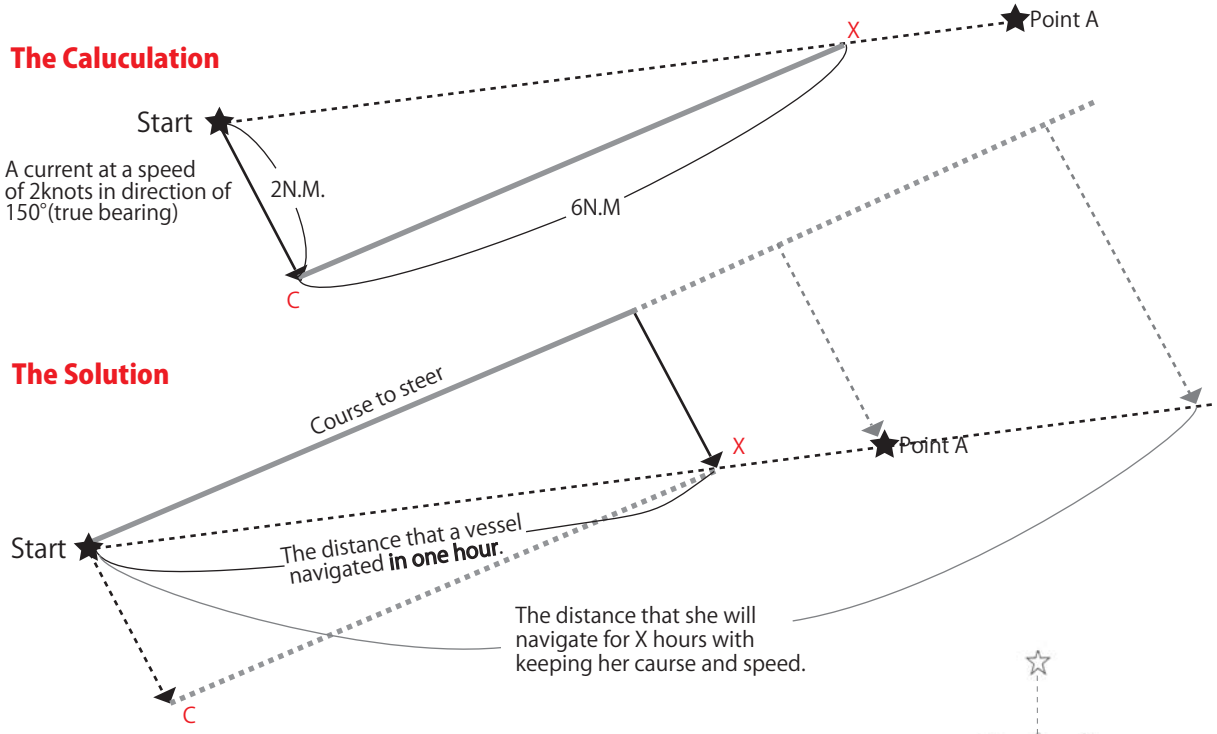


3 .Course and Speed Made Good

Question to figure out by the drawing in a chart

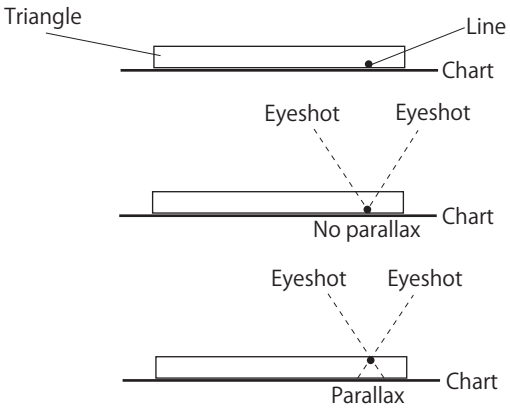
Actual course and speed・・・The course and speed which a ship actually navigated with the influence of current.

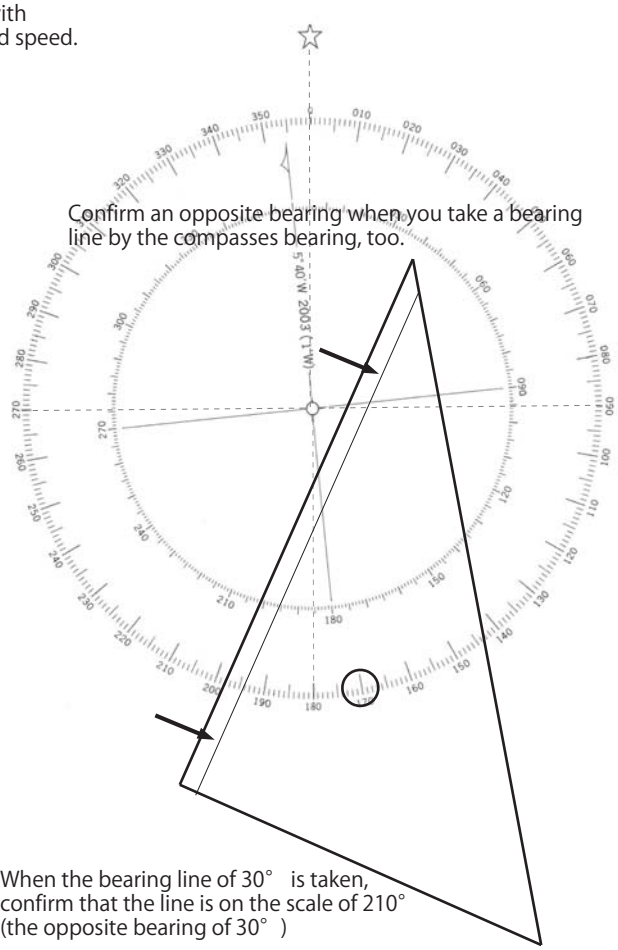
Problem: A vessel navigates at a speed of 6 knots on a magnetic course of 090° M, but there is a current at a speed of 2 knots in the direction of 150° T(true bearing).....
What is the COURSE TO STEER to maintain the magnetic course of 090° M?
1. Draw the magnetic course 090° M from the Start position (Start - Point A)
2. Draw the current vector (2 NM) at 150° T from the Start position. (Start - C)
3. Measure 6 NM on the Lat scale.
4. From C, measure 6 NM to the Start - A course line. Call this X. This is the Course to Steer.
5. The distance from Start to X is the true speed for 1 hour (Speed made Good).



Attention in drawing

Triangle A has a measuring line in one of the sides. A direction is looked for by aligning this line with a compasses bearing. But, when face and back of the triangle are mistaken,It causes the error of the drawing by a parallax. Lay a triangle with the line side down.





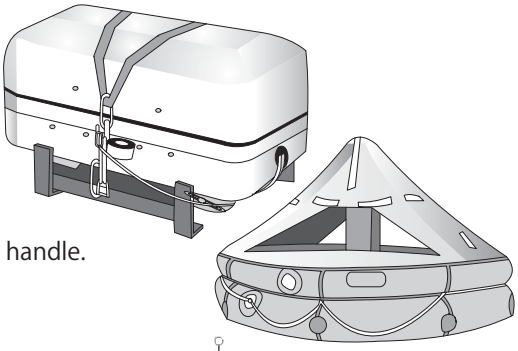
Confirm an opposite bearing when you take a bearing line by the compasses bearing, too.

When the bearing line of 30° is taken, confirm that the line is on the scale of 210° (the opposite bearing of 30°)

4 .Preparaion in Long Voyage

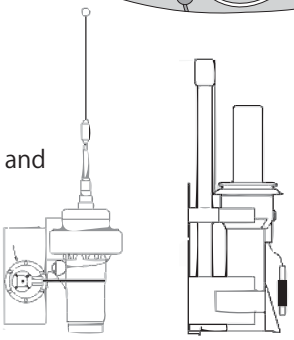
Including: Radar, Sonar, Life raft, Communication equipment for Life saving

1 .Liferaft



1 The Life raft is carried on deck.In an emergency situation, it is possible to manually initiate a gravity fall of the container along an inclined cradle; the operating wire is pulled and the inflation of the life raft is triggered, opening the container and allowing the life raft to inflate automatically.
2 Emergency medical supplies, drinking water, food,repair kit, a drainage tool, signal flares, and so on are carried inside.
3 The operation wire is set on a stand on the deck.
4 Some types of life raft feature an automatic release device with a manual dropping handle.
5 Confirm that:
• The life raft container is **not lashed** with a rope or other bond.
• An automatic release device is **not painted**.
• The operation wire has not been replaces by another rope.
6 Carry a EPIRB, ASRT, etc., on the ship in case of an emergency.

2 .EPIRB



EPIRB SART

1 The distinction ID code of the ship is input in advance.
2 The satellite EPIRB is activated when it is removed from the installed position in the parent ship, and transmission starts automatically; the name and position of the vessel in distress, etc. are sent to the earth station via satellite.(It works for about 24 hours.)
3 Some types of EPIRB float automatically when going under the water, and send out signals.

3 .SART rader transponder

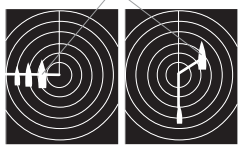
1 The SART radar transponder is used for search and rescue of survivors via GMDSS.
2 It receives transmission from radar unit installed on search and rescue boats, aircraft, etc.,
3 A distressed ship's position is made to indicate on the other ship' s radar.(It works for about 48 hours.) and transmits response signals. (A FRP boat is hard to be confirmed by a radar.)

4 .Wireless telegraphy

1 SSB radio 2 International VHF 3 International maritime satellite system 4 Maritime mobile telephone
5 HF digital selective-calling system

5 .Radar

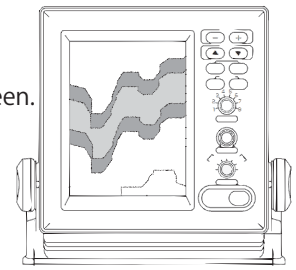
Real image



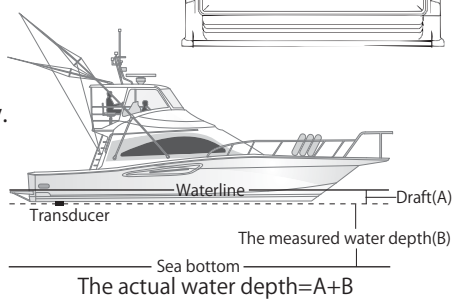
Multiple reflection Double reflection

1. Radars emits radio waves in horizontal direction with 360-degrees, and a distance and a direction to object can be measured.
2. Radar may be used for the lookout under low visibility and for measuring position.
3. The true north is indicated in the top end on a screen, targets are relative to the course of the vessel
Anti-Sea Clutter: (STC)- A control which reduces the sensitivity of the receiver at a short range. The "anti-sea clutter" control reduces the echoes of sea clutter, which is strongest near the origin of the radar signal. (similar to surface clarity in sonar).
Rain Clutter: Unwanted echoes reflected by rain drops or snow.
Radar false echoes: When a boat navigates at short range in parallel with a large ship,Radio wave reflect many times between the boat and the large ship, and false echoes appear at regular intervals on a screen. (multiple reflection) And, double reflection appears when an radio wave reflects on a mast or a chimney of its own.And when the radar wave of other ships is received, spiral-shaped dashed line to go to the outside from the center sometimes appears.
Anti-Sea Clutter: (STC)- A control which reduces the sensitivity of the receiver at a short range. The "anti-sea clutter" control reduces the echoes of sea clutter, which is strongest near the origin of the radar signal. (similar to surface clarity in sonar).

6 .Sonar, Echo-sounder



1 The depth of water is measured continuously by the supersonic waves. Moreover, the depth of water is measured, and a ship position can be estimated by using the chart.
2 The sonar can guess quality of the bottom material of sea from the form of the reflected wave of the screen.
3 The sonar can't measure when there is a bubble of the water flow.
4 The difference with the position of installation of a transducer and the waterline is added, and the accurate depth of water is found.
5. The bottom material of sea and the characteristics of the reflected wave:
Rock・・Double reflection and triple reflection appear.
Sand・・A received line is indicated clearly and thickly.
Mud・・A received line is indicated fuzzy and thickly.
Mud on a rock・・The line which is clearly appears under the line which is fuzzy and thickly.



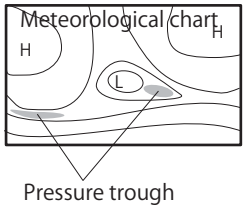
7 .Voyage

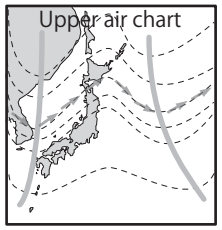
1 Select ports of refuge when charting course.
2 Confirm the ships position and the engine room regularly when under power.
3 If you are under the restricted visibility, consider anchoring out of the main channel.
4 Calculate fuel consumption, food and water when charting course.

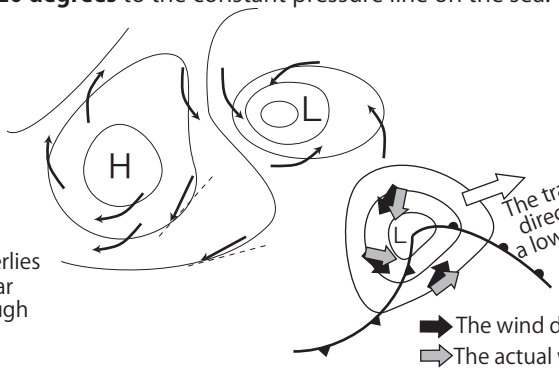
5 .Weather Prediction

1.Anticyclone and atmospheric depression

1. Japan is located in subtropical westerly, and generally the weather changes in **the east from the west.**
2. The low pressure part between two high pressure is called pressure trough.
   When a trough grows in the east and west, wind is weak, and the weather becomes stable.
3. Wind blows in the angle of approximately **20 degrees** to the constant pressure line on the sea.

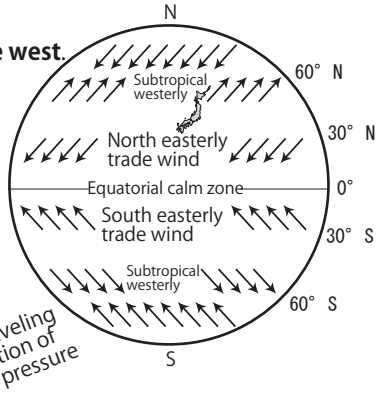






Subtropical westerlies
Upper-level isobar
Upper-level trough

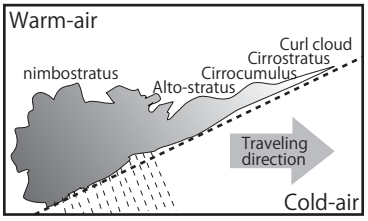
The wind direction estimated from the isobar
The actual wind



2.Weather Front

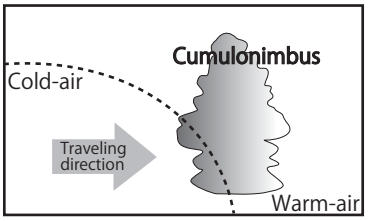
2.1.Warm front

1. A front starts when a warm air mass is stronger than a cold air mass.
2. Warm-air climbs over cold-air from the warm-air side to the cold-air side.
3. Cloud approach
- high altitude clouds: cirrocumulus
- middle cloud: alto-stratus, alto-cumulus
- low cloud: nimbostratus
4. Temperature **rise** after a front passes.



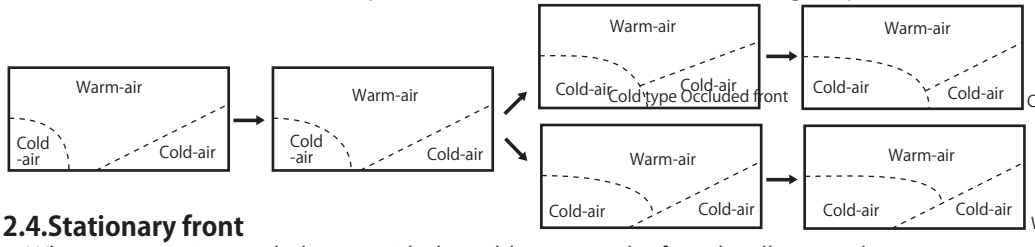
2.2.Cold front

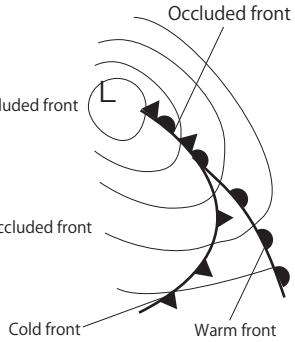
1. A front is made when a cold air mass is stronger than a warm air mass.
2. A cold-air crawls under a warm-air, and the cold-air lifts warm-air.
3. It makes a **cumulonimbus** and cumulus clouds, and shower, rain, wind **gusts** and thunder may appear.
4. A southerly or a southwesterly front changes to westerly or northerly suddenly after a front passes..
5. Temperature **drop** after a front passes.



2.3.Occluded front

1. The part where a cold front caught up with the a warm front.
2. When a cold-air which catches up is colder than a cold-air which is caught up, it has the nature which is close to a cold front.
3. When a cold-air which catches up is warmer than a cold-air which is caught up.it has the nature which is close to a warm front.





2.4.Stationary front

1. When a warm air mass balances with the cold air mass, the front hardly moved.
2. These may be called Bai-u front, or autumnal rain front

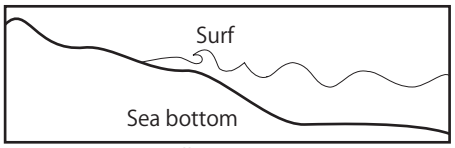
3.Fog

Advection fog requires air that is moving horizontally from one place to another. When warm and moist air blows over a cold surface, the surface cools the air. Once the air temperature cools enough to equal the dew point temperature, condensation forms and creates a blanket-like thick fog formation. Fog is made when wet, warm air moves on the surface of the sea, and when the colder air than the surface of the water flows on the surface of the water. Generally the duration of fog on the sea is longer than fog on the land.

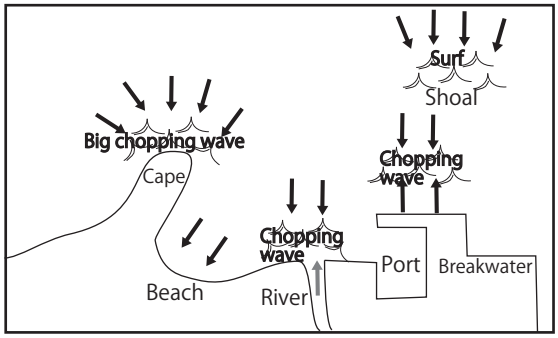
"Fog" ・・・Distance of vision of 1km and under
"Haze" ・・・Distance of vision over 1km

4.Waves

1 "Wind wave"....The wave which appears on the wind which blows in that place.
"Swell"....The wave being traveled from the occurrence point.

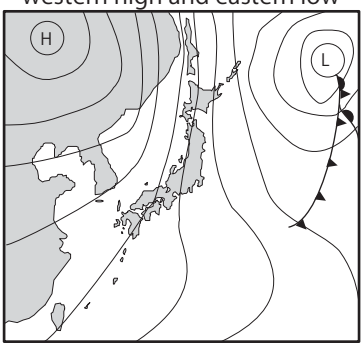


"Swell Waves"



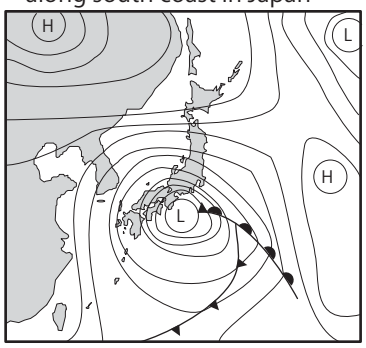
7 .Seasonal distribution of atmospheric pressure

1 .Atmospheric pattern of western high and eastern low



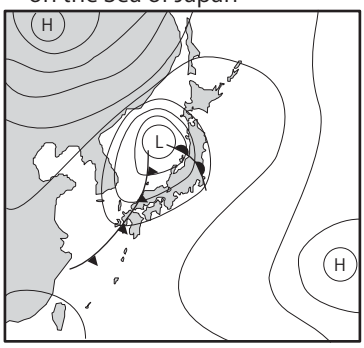
①The typical distribution of atmospheric pressure of **winter**.
②The strong wind of the **north** or the **northwest**(Onishi-kaze)
③It is very to **snow on the Sea of Japan side**, and a **Pacific side dries**.
④An overhang of the Siberian high changes in periodic.(Sabkan-shion)

2 .Pattern of low pressure system along south coast in Japan



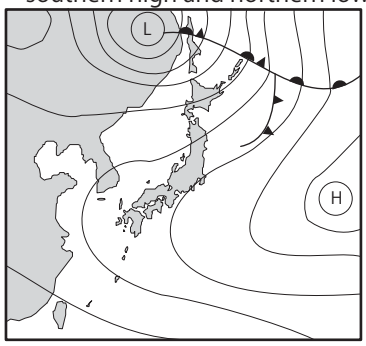
①Much distribution of atmospheric pressure in spring and autumn.
②When low pressure develops rapidly, it becomes the bad weather.
③The strong wind of the **north** or the **northwest**
④It is very to **snow** in the **Pacific side** at the time of the low temperature.

3 .Pattern of low pressure system on the Sea of Japan



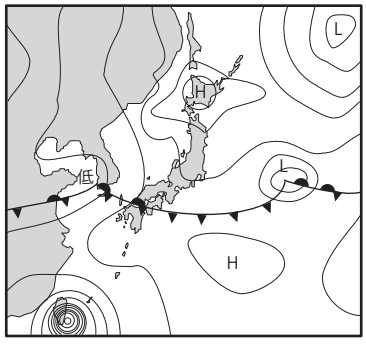
①Much distribution of atmospheric pressure in spring and autumn.
②The strong wind of the **south**(Haru-ishiban)
③**A foehn** on **the Sea of Japan side**
④It is two ball low pressure when low pressure appears on the south shore.
⑤After that passes, it changes into the north wind.

4 .Atmospheric pattern of southern high and northern low



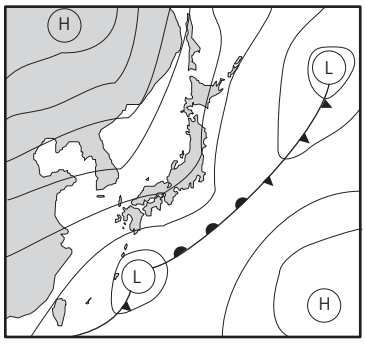
①The typical distribution of atmospheric pressure of **summer**.
②The **moderate wind** of the **south** or the **southeast**.
③The weather becomes stable.
④North pacific(Ogasawara) high

5 .Bai-u front



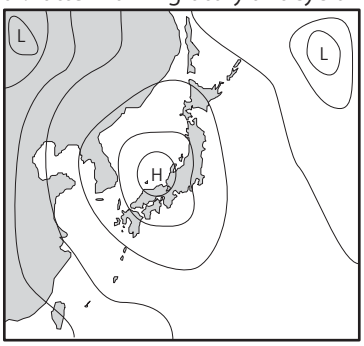
①It occurs between the north **Pacific high** and **Okhotsk sea high**.
②Generally it exists in the latter half in July from the first half in May.

6 .Autumnal rain front



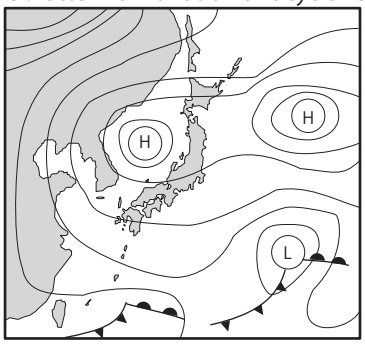
①It is made by going south of the cold high pressure from the continent and the weakness of the north Pacific high pressure .
②It is very rainy when the damp air of a typhoon flow in.

7 .Pattern of migratory anticyclone



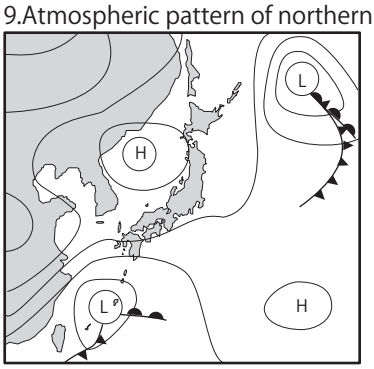
①It appears in spring and autumn.
②Because low pressure approaches after that, the fine weather doesn't last long.

8 .Pattern of zonation anticyclone



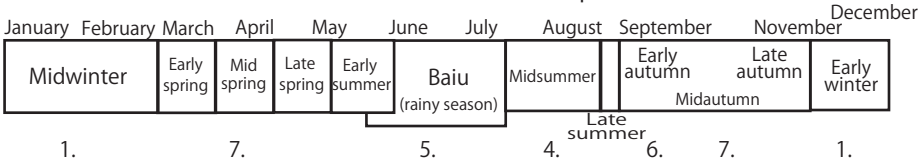
①It appears in spring and autumn.
②The fine weather lasts for several days.

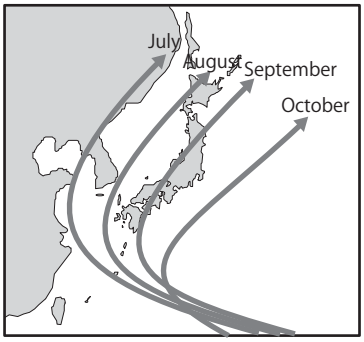
9.Atmospheric pattern of northern high



①The cold east wind of summer(Yamase) brings cold weather damage to Sanriku area.
②The weather is unsettled in a Pasific side.

The calendar below identifies the types of rainfall to be expected throughout the year.
The number under the calendar refers to the numbered patterns shown above.





8 .Typhoons

1. Typhoon season is from July to October.
2. From July to October the paths of the typhoons, as illustrated in the graphic, moves northwest across Japan from the Pacific ocean to the Japan Sea

6 .Tide • Tidal current • Ocean current

6.1.Tide table

Tide tables are printed for Standard Ports in Japan. These tables will include the times and heights of the high and low tides for the day. Secondary Ports, smaller ports between Standard Ports, are given tide and time differentials to a nearby Standard Port.
To calculate the time and tide in the Secondary Port you must add or subtract the time differential and multiply the height differential.

Example: Obtain the time and height of high tide at Habu, Oshima in the afternoon of February 25 According to the tide table, the standard port of Habu, Oshima is the Port of Yokohama. The tidal time difference at Habu, Oshima is -0 hr and 20 min and the tidal ratio is 0.78.

February			
		Time	Height
		h m	cm
High tide in the morning		04 33	163
Low tide in the morning	25	09 30	112
High tide in the afternoon		14 24	154
Low tide in the afternoon		21 43	4

Time of high tide at Habu,Oshima in the afternoon

14 : 24—25min＝**13 : 59**

Height of high tide at Habu,Oshima in the afternoon

154 c m×0.78＝Approximately**120 c m**

(Simple method)

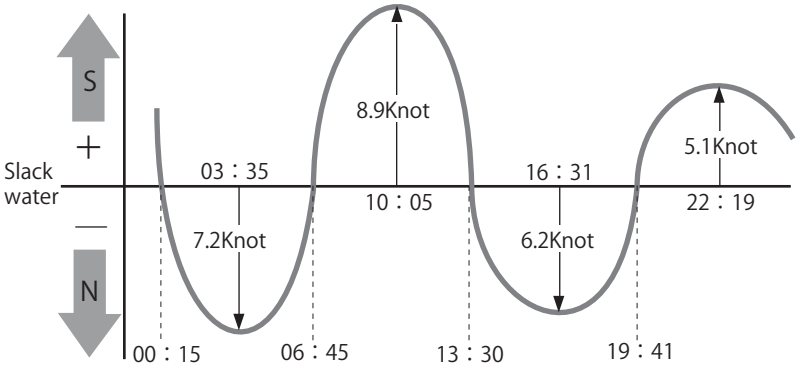
Tidal range:
The tidal range is the vertical difference between the highest high tide and the succeeding low tide.
The height of the first (high) tide of Feb 25 was 163cm. The height of the first low tide was 112 cm. The tidal range, the vertical difference, is 51 cm (163-112).

6. 2 Tidal current table

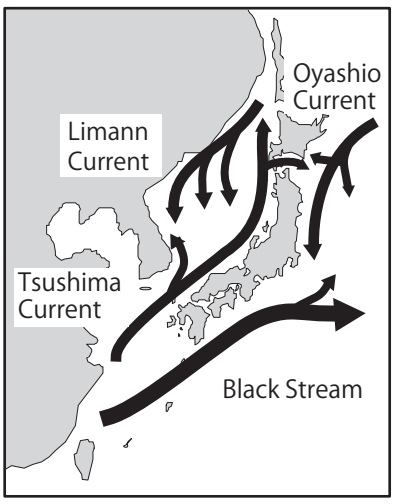
Some currents in Kanmon Channel, Kurishima Channel, Naruto Channel, or Akashi Channel may reach **10 knots** of maximum speed.
When a voyage is planned that transits one of there channels, the direction and speed of the tide are important elements.

KURUSHIMA KAIKYO-NAKA SUIDO
34° 7' N 133° 0' E
＋: S —: N

December				
	Slack	Maximum		
	h m	h m		kn
4	00 15	03 35	—	7. 2
	06 45	10 05	＋	8. 9
	13 30	16 31	—	6. 2
	19 41	22 19	＋	5. 1



2 .Ocean current



Circulation features around the seas of Japan include the Tshushima Current, the Oyashio Current, the Liman Current, and Black Stream. The Japan Sea is a meeting place for warm currents from the south and cold currents from the north, with the confluence being the Polar

1 Black Stream・・A warm Current.The current speed may be more than **5 knots**.
2 Tsushima Current・・A warm Current.It separates from Black Stream in the Okinawa west. It flows through the Sea of Japan side.
3 Oyashio Current・・A cold current from the Bering sea and the Okhotsk sea
4 Limann Current・・A cold current from the Okhotsk sea. It flows through the Sea of Japan side.

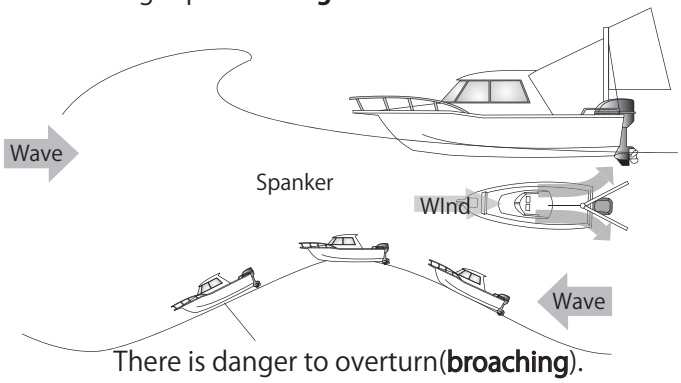
7 .Navigation in Heavy Weather • How to Avoid a Typhoon

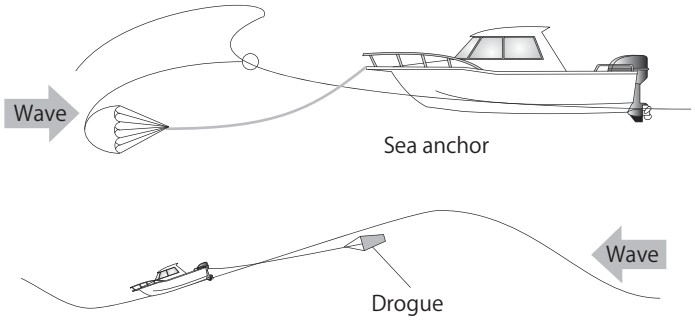
1 .Preparation for Heavy Weather

1. Secure all movable objects.
2. Secure all hatches, windows, and openings.
3. Open scuppers.
4. Prepare emergency tools.
5. Deploy life lines and jack lines.
6. Trim boat aft to keep prop under water.

2 .Navigation in Heavy Weather

1 Drive the bow about **30 degrees** against the waves and slow down to help the rudder' s effectiveness.
2 Use a **sea anchor** or **spanker** to keep the bow to the wind when necessary.
3 When a boat goes down on a following sea the stern will drifted away in the wave, and there is possibility of broaching.
4. Run a long rope or a **drogue** from the stern to slow the boat down and keep it climbing surface of the wave.

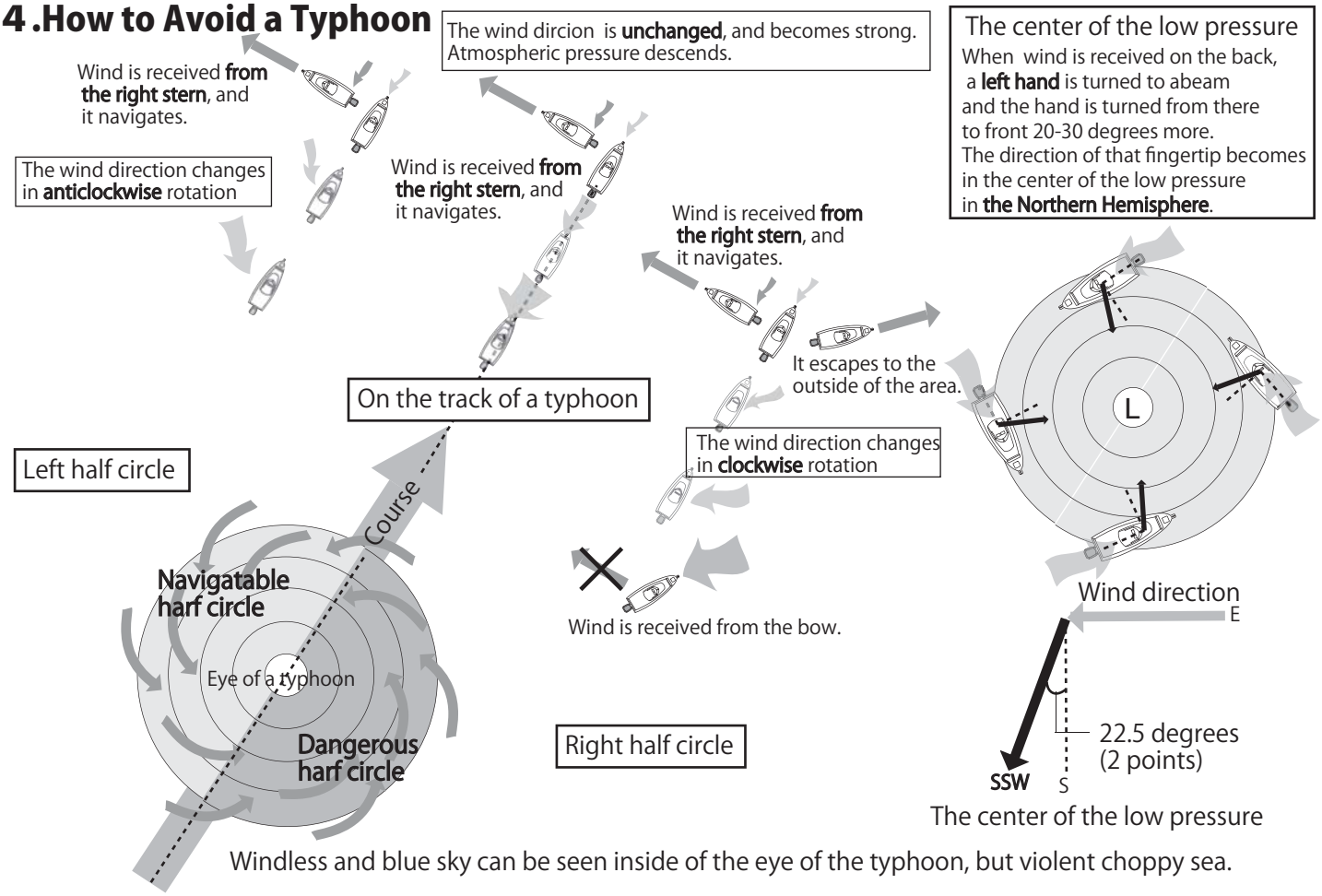




3 .Harbor of Refuge

1 Choose refuge ports along the course that are suitable for anchoring, mooring, or docking.
(consider the water depth and sea bottom).
2. Consider options to avoid the path of low pressure areas and possible typhoons.
3. Add mooring ropes and fenders to reinforce safety. Consider tide, too.

4 .How to Avoid a Typhoon



Windless and blue sky can be seen inside of the eye of the typhoon, but violent choppy sea.

8 .Marine Accident

Marine accidents happen. Following is a list of the major classifications of marine accidents and some more obvious causes:

8.1. Collision

Cause	Possible Reason
Poor lookout	Drowsiness, Distraction, Inattention
Improper steering	Speeding, Distraction, Human error, Intoxication
Equipment malfunction	Poor mantanance
Piloting error	Lack of knowledge of Rules and Regulations

8.2. Aground

Cause	Possible Reason
Improper study of the water area	Poor training and lack of experience
Inattention to weather and sea condition	Poor training and lack of experience
Poor lookout	Drowsiness, Distraction, Inattention
Wind, Tide, Current,Weather	Improper study of the route prior to departure

8.3.Capsizal

Cause	Possible Reason
Weather and sea condition	Improper study of the route prior to departure
Stability	Negligence in the stability of own boat, positioning of cargo and passengers, running water on a deck.

8.4. Engine Failure

Cause	Possible Reason
Poor inspection of machinery before departure.	Poor training and lack of experience
Poor maintenance	Poor training and lack of experience
Inattention to instruments or gauges during navigation.	Poor training and lack of experience

8.5.Flooding•Sinking

Cause	Possible Reason
Poor inspection of machinery before departure.	Stern tubes, bellows, exhaust pipes, drainage facility
Poor maintenance	Stern tubes, bellows, exhaust pipes, drainage facility
Damage to the hull due to the collision or going aground.	

8.6.Trouble of Propeller

Cause	Possible Reason
Poor look-out	Ropes or the fishing net entangled in prop
Damage of propeller	Driftwood
Poor maintenance	
Poor inspection of machinery before departure	