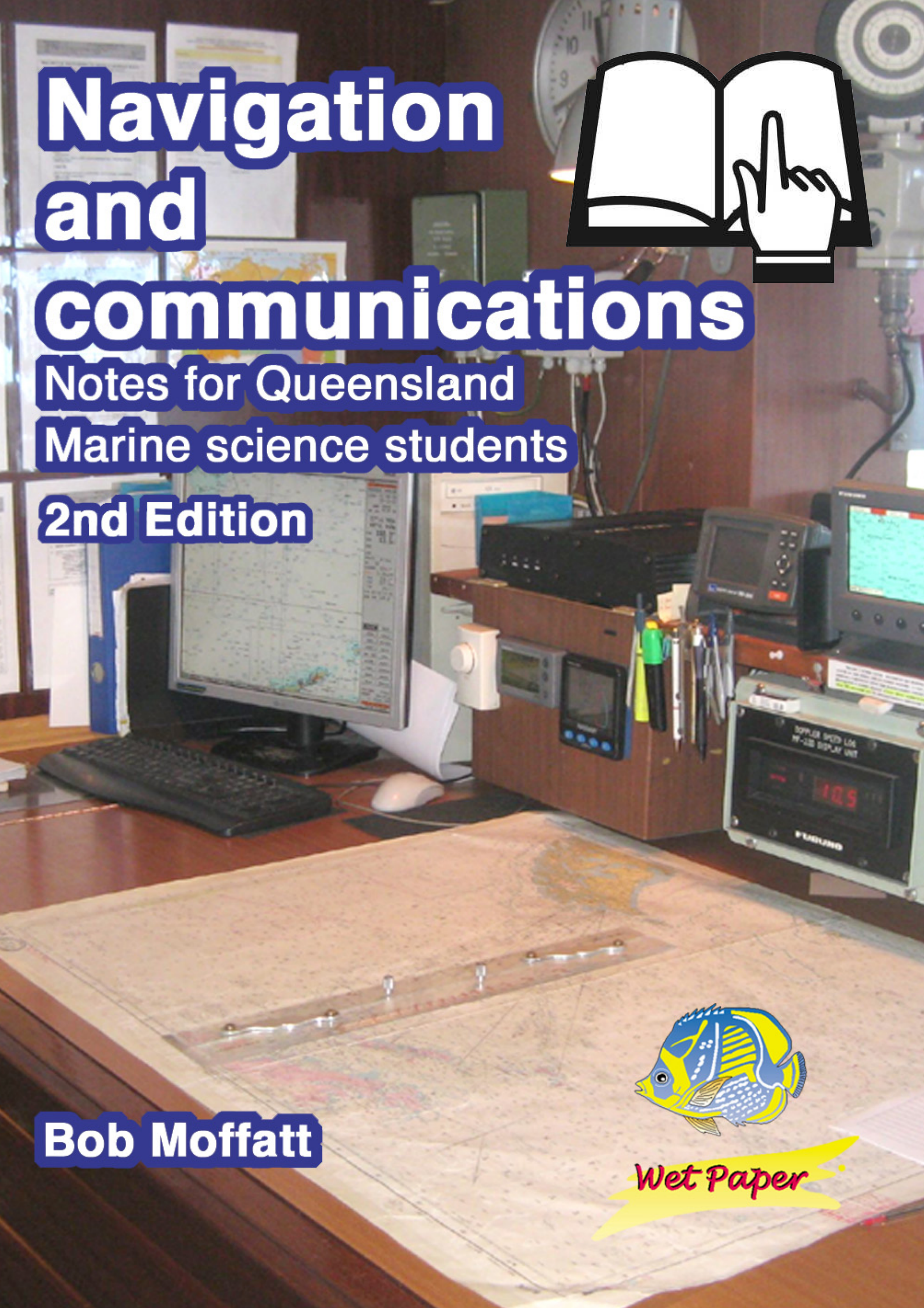
Navigation and communications

Notes for Queensland Marine science students

2nd Edition



Bob Moffatt

Wet Paper

ISBN
978-1-86283-147-6

Publisher

Wet Paper Publishers and Consultants

A division of the Moffatt Group Australia Pty Ltd

ACN 086 521 084

PO Box 540 COOLANGATTA Q 4225

Telephone (07) 5525 6122

www.wetpaper.com.au

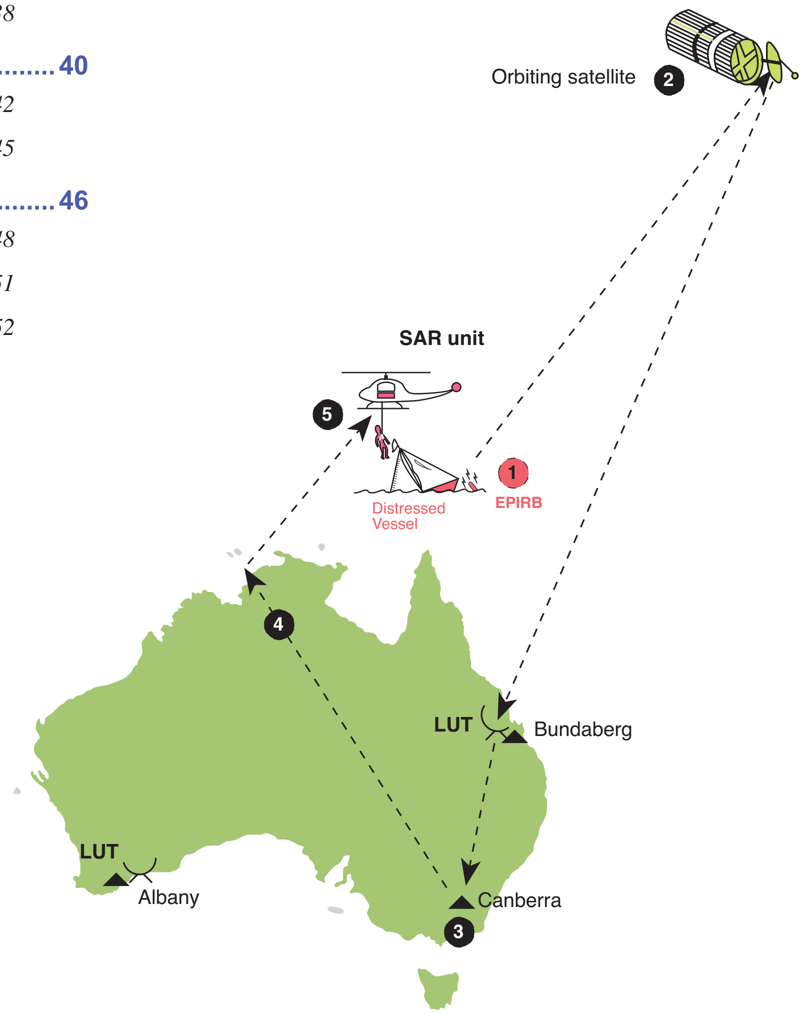
Acknowledgements

The publisher would like to thank the Hydrographer of the Navy, 1982, Commonwealth of Australia for permission to publish sections of the Cape Hillsborough Channel training chart, John Wiley, Bob Critchley, Len Couzins, Sea World, John Armstrong, Derrick Bann, Coral Princess Cruises, AUSAR, Bruce Chapman, GME Electrophone, TAFE NSW, Capt Dick Gandi, Australian Maritime College, students of Maryborough and Benowa High Schools for their assistance in this publication. Thanks also to Bruce Parmenter for his useful suggestions for the 2009 revision and the answer booklet.

Disclaimer

Although all care has been taken to provide safety instructions, and offers of training and advice, Wet Paper or any of its employees, advisors or consultants accept no responsibility for any accident that may occur as a result of students performing any of these activities. If schools are unsure of any method, they are advised first to consult with their own State regulations and then if further assistance is required, contact us here at Wet Paper at the above address.

Contents



Orbiting satellite
2
SAR unit
5
1
EPIRB
Distressed Vessel
4
LUT
Bundaberg
LUT
Albany
Canberra
3

Section 1 Marine Navigation Devices

Navigation devices and their use

A navigation device is a piece of equipment used to safely move a vessel from place to place at sea.

Devices can include satellites in the air, radios and receivers in base stations on land or form part of a system of devices, power supplies and software packages that operate as one to provide information to a ships master.

They can be located on various parts of the ship and connected to alarm systems to indicate their failure or be located on chart tables and be as simple a pencil, parallel ruler, chart, watch and binocular set (as shown on this page).

These devices are connected from various places in the ship creating a system that enables the ship's master to make safe navigation decisions.

- For example to monitor the depth of water under a boat so the boat does not run aground, a transducer, to collect signals from the sea floor, is mounted on the hull with cables running to a sounder mounted at the helm. A marine grade battery, mounted in a well ventilated place will power the device. Marine grade cables will connect the devices.
- Procedures to ensure safe operation will include regular inspections of cables, battery terminals and checking to ensure the battery is fully charged.

Figure 4.1 Chat plotter and GPS

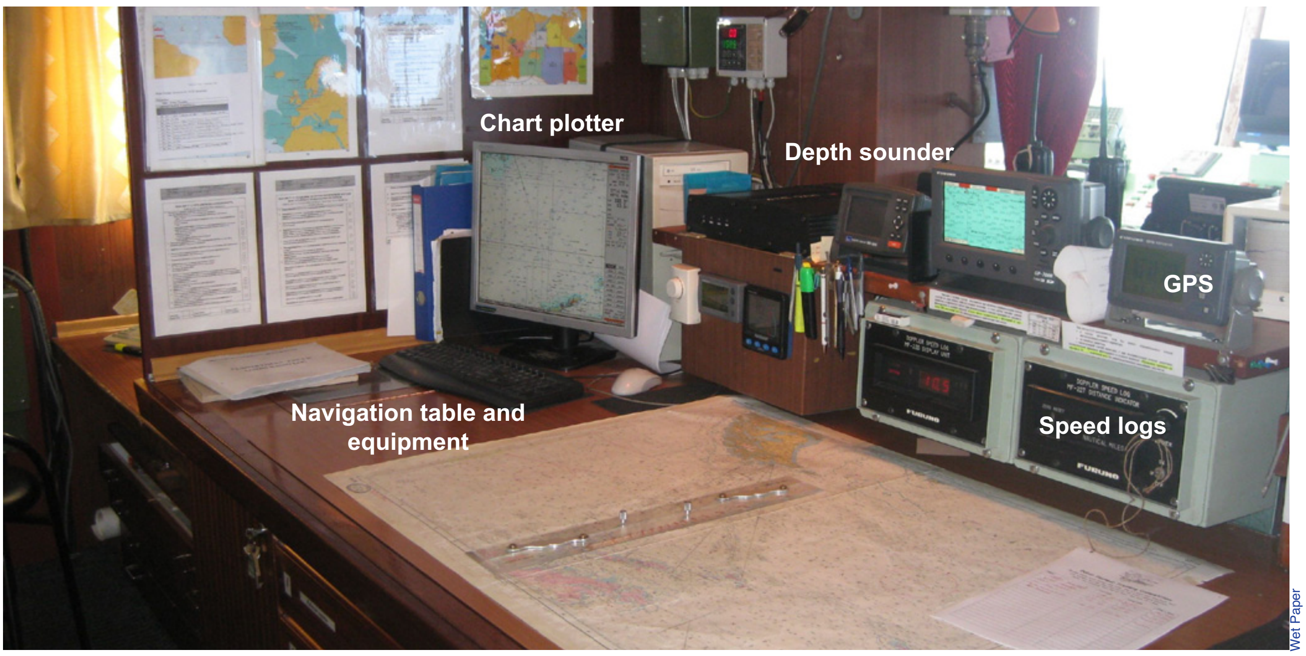


Figure 4.2 Navigation equipment on a chart table at the bridge

Watch a video on an oil tankers ships bridge

http://www.youtube.com/watch?v=380uVZJibyY

Watch a simple chart plotter demo video

http://www.youtube.com/watch?v=VRAVI-pkUyU

Traditional navigation devices

Even in the digital age, ships still use traditional devices in navigation from a navigation table where charts, pencils, dividers and parallel rules are used.

Ship's masters require watchkeepers to continually use charts, binoculars and manual navigation equipment to check for errors in electronic equipment on the bridge.

Ships coming into port need to safely navigate around kayakers, recreational boaties, sailing vessels and ecotourism operations. A set of binoculars, the ship's horn, the skipper's eyes and ears also become navigation devices for co-ordination and safety.

Navigation rescue equipment

In the case where a ship has to be abandoned, all crew get into life rafts or life boats. These are fitted with emergency beacons (EPIRBS) that allow the rescue craft to be found. The life boat will also carry a marine radio and basic navigation equipment that is used to communicate with other ships or drive the liferaft to a safe location.

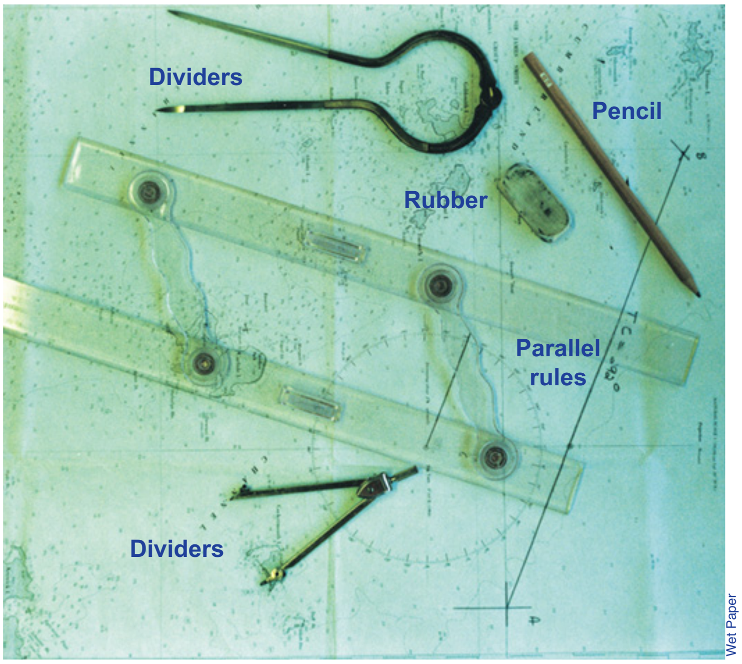


Figure 5.1 Navigation equipment found on a chart table

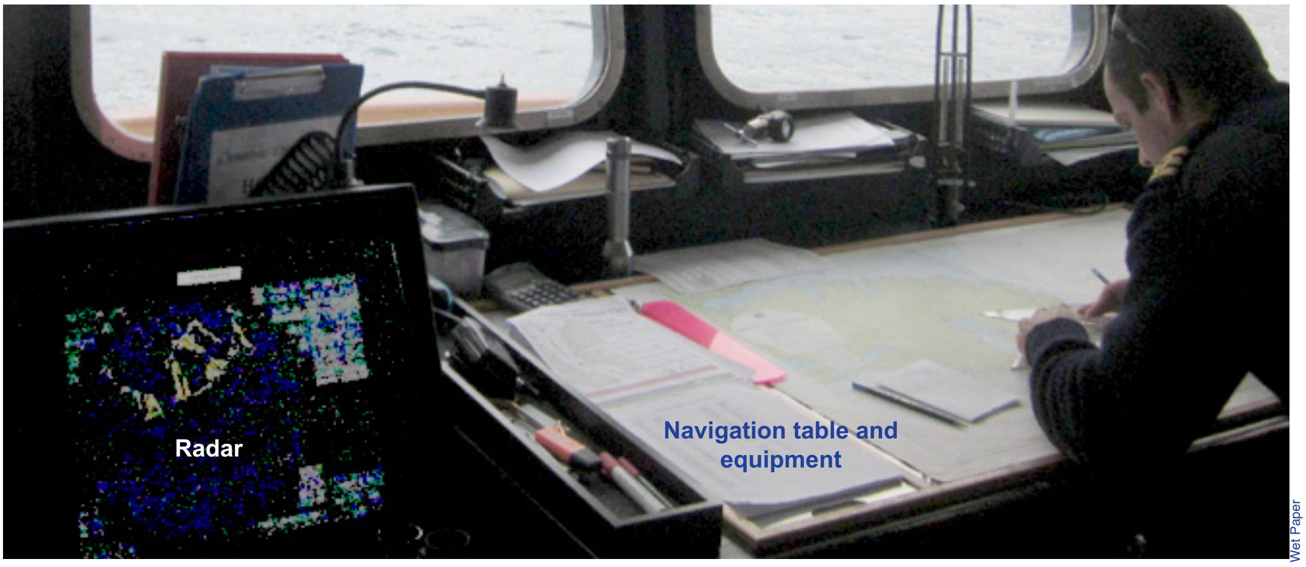


Figure 5.2 Chart table larger ocean going vessel

Figure 5.3 Large ocean going vessel showing rescue craft that will contain emergency communication equipment

The steering compass

The steering compass is a magnetic compass used to steer the ship on a course that has been plotted from a chart. Two main features include:

- A compass card that is graduated in 360 degrees mounted in the bowl of a compass.

  The card is a circle marked off in a clockwise direction in 360 equal units (360 degrees). North is marked at 0°, east at 90°, south at 180° and west at 270°.
- A lubber line is a mark or projection on the compass bowl which allow the skipper to sight the compass course calculated from the chart (Figure 6.2).

Location

A steering compass will be fitted with corrector magnets to compensate for errors caused by the magnetic fields in a ship. A licensed compass technician will have set these up when the compass was adjusted and are not interfered with.

It is installed on the centre line of the ship, high up, giving the observer an unobstructed view.

It may be located on top of the bridge or wheelhouse with a periscope to allow it to be read from the helm position.

Deviation errors

Erros occur due to the effect of Earth's magnetic field on the ship's individual magnetic field (see Figure 7.1 page over).

One error, called deviation, is corrected by creating a deviation card (Figure 6.3). To do this the ship's compass is swung around a known mark. It is then corrected by a set of magnets as shown in Figure 6.4.

DEVIATION TABLE

For use with Chartwork Exercises

Ship's Head by Compass	Deviation	Ship's Head by Compass	Deviation
000°	3½°E.	180°	2½°W.
010°	4°E.	190°	4°W.
020°	4½°E.	200°	5°W.
030°	5°E.	210°	5½°W.
040°	5°E.	220°	6½°W.
050°	5°E.	230°	6½°W.
060°	5½°E.	240°	7°W.
070°	5½°E.	250°	6½°W.
080°	5°E.	260°	6½°W.
090°	5°E.	270°	5½°W.
100°	4½°E.	280°	4½°W.
110°	4°E.	290°	3½°W.
120°	3½°E.	300°	2½°W.
130°	3°E.	310°	1½°W.
140°	2°E.	320°	½°W.
150°	1°E.	330°	½°E.
160°	½°W.	340°	1½°E.
170°	1½°W.	350°	2½°E.
180°	2½°W.	000°	3½°E.

Figure 6.3 Deviation table

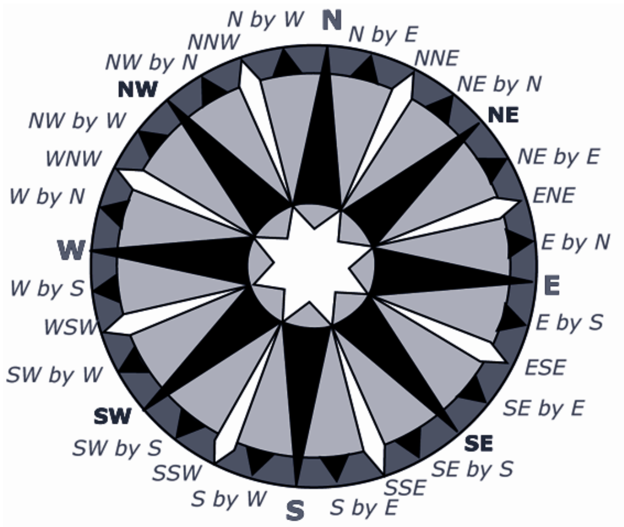


Figure 6.1 A compass card

Wet Paper

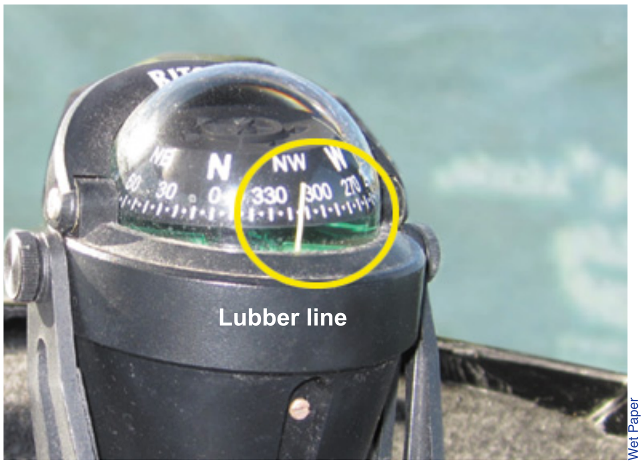


Figure 6.2 Steering compass and lubber line

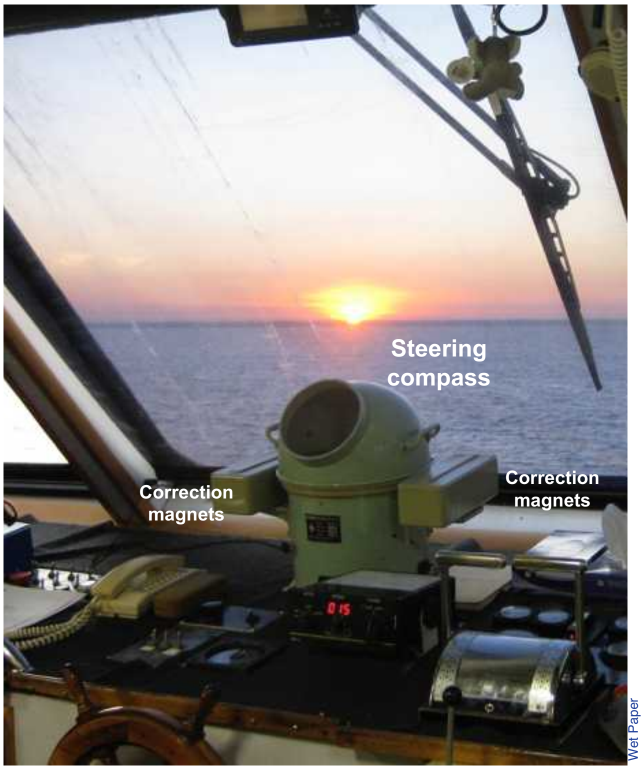


Figure 6.4 Ships compass with correction magnets

Swinging the compass

To find whether or not deviation exists in a vessel's compass, the compass has to be swung (see figure 7.2).

If the vessel is a large commercial vessel intended for coastal and offshore work, the compass is swung by a compass adjuster who will make up a deviation table for that ship (see previous page).

The deviation of a compass in a smaller vessel can be determined by lining up a fixed mark and/or a charted mark with a distant conspicuous mark as shown in Figure 7.2.

For example, compare the magnetic bearing with the compass bearing on the line as shown.

The deviation here at point (A) is 2° East.

The vessel is then moved through each of the four compass bearings along the transit line and a note is taken between the compass bearing and the known chart bearing and a table constructed.

Use in navigation

Deviation is used in calculations that enable a ship's navigator to plot a course and locate positions on a voyage. This is discussed later in Section 3.

Pelorus

A pelorus, as shown in Figure 7.3, is another navigation device and may be described as a dumb compass card engraved on metal or plastic.

- The dumb card is mounted on a central axis so that it can be rotated freely or clamped in any position. Sight vanes that may be rotated are fitted to read off a bearing from the card.
- The pelorus is used to take bearings that are not visible from the steering compass.
- It is usually mounted on either sides of the bridge to allow the master easy access for taking bearings.

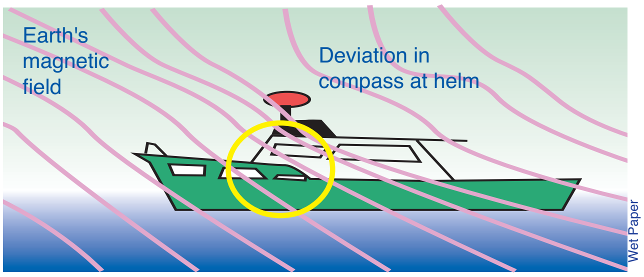


Figure 7.1 Deviation

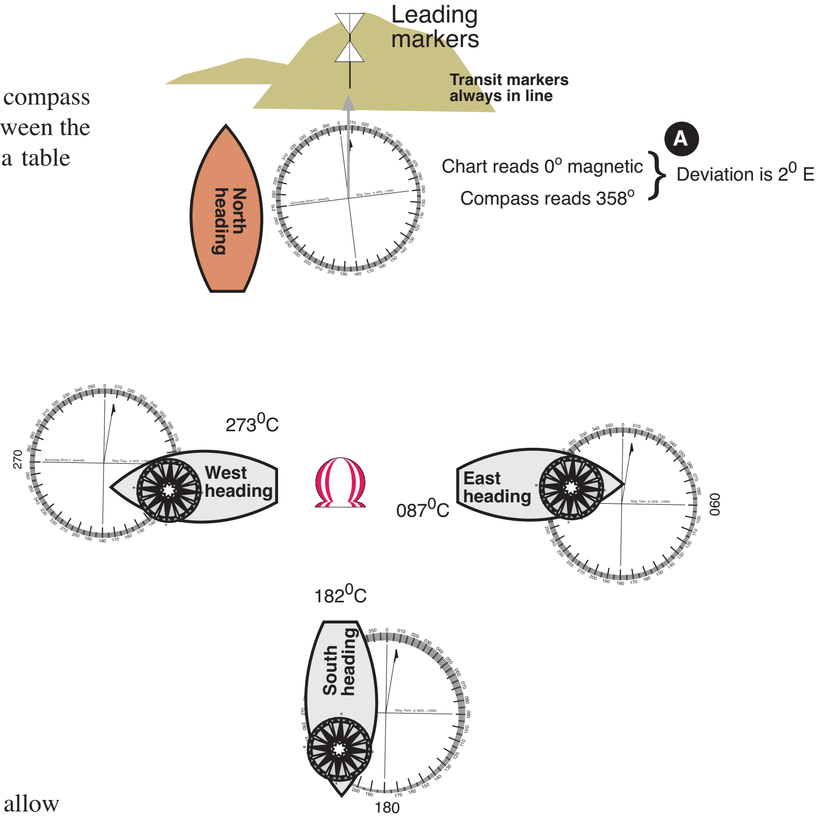


Figure 7.2 Swinging the compass
Wet Paper

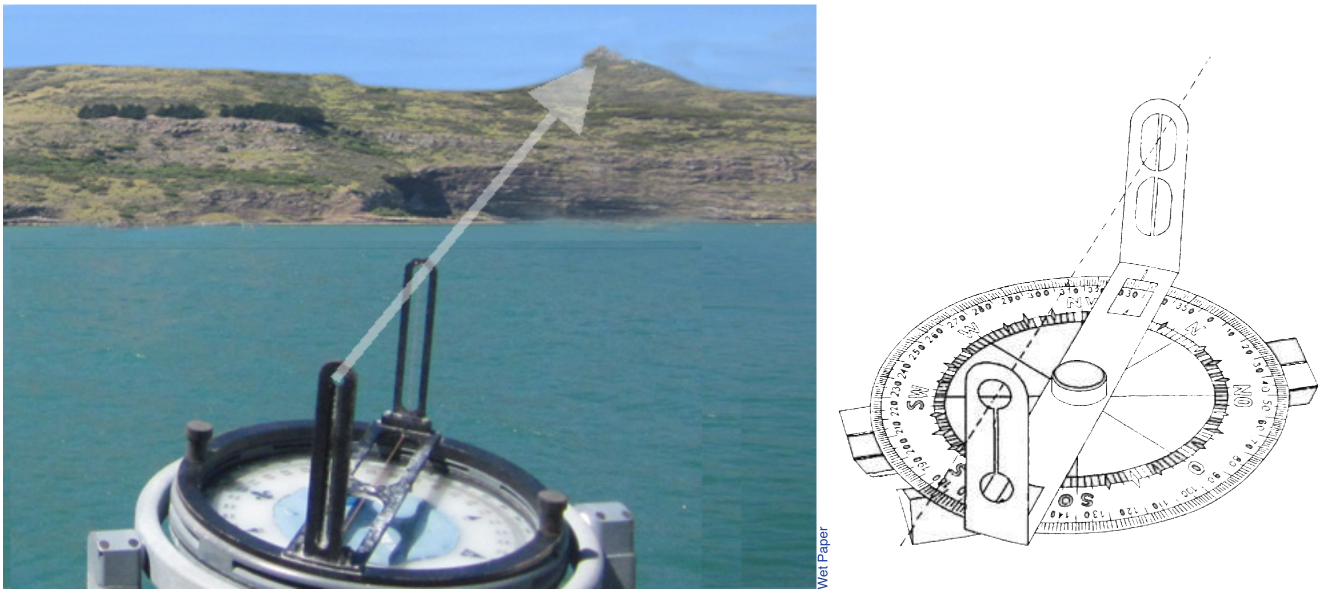


Figure 7.3 A ship's pelorus

Hand bearing compass

A hand bearing compass is free and can be carried to the most suitable spot on the boat for navigational observations. The steering compass is usually a fixture near the helm.

For this reason, the hand bearing compass is usually much smaller and lighter and incorporates some form of sighting device. Because it is relatively small, this type of compass usually has a magnifying glass to enlarge the figures on the card.

Others like the one shown in Figure 8.1 may have a built-in prism which reflects the bearing back to the eye.

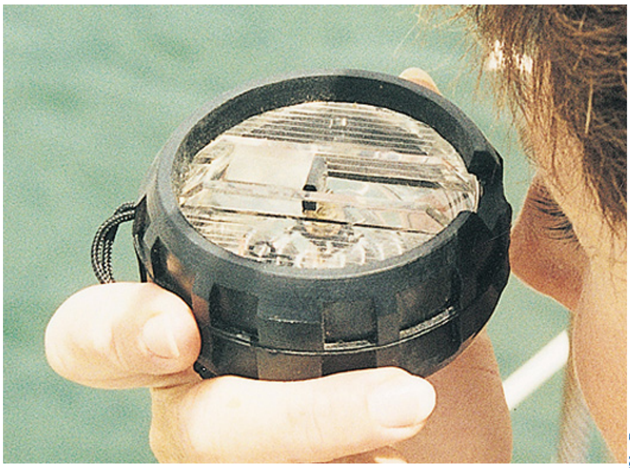


Figure 8.1 Prism mounted handbearing compass

Fluxgate compass

The fluxgate compass does not use a magnetic needle to provide direction but consists of two coils carrying electric current. One coil is mounted horizontally and the other vertically. If the vessel changes its heading or position in the Earth's magnetic field it alters the flow of current in one coil relative to the other.

Being electrical, the information can be displayed digitally. It can be fitted with microprocessors which can automatically compensate for both deviation and variation thus providing a true bearing.

The fluxgate compass does require power from a small battery for it to operate. This compass must also be held fairly steady for accurate readings and is still subject to the errors of a magnetic compass and needs to be treated similarly.

A fluxgate compasses is shown in Figure 8.2.

Figure 8.2 Fluxgate compasses

Depth sounders

Depth sounders operate on the echo principle. Triggered by an electrical impulse at regular intervals, a transducer (ceramic or nickel element) transmits downwards a sound wave. By measuring the time taken for the echo to return to the transducer, depth can be determined.

The transducers may be mounted through-hull, in-hull or on the transom. Correct installation and positioning are vital to accurate performance.

Because of signal variations, depth capabilities and resolution definition will vary between different sounders. Four examples are:

- power output (200 – 3000 watts)
- beam width (8º – 30º)
- pulse length
- frequency (50 – 200 kHz)

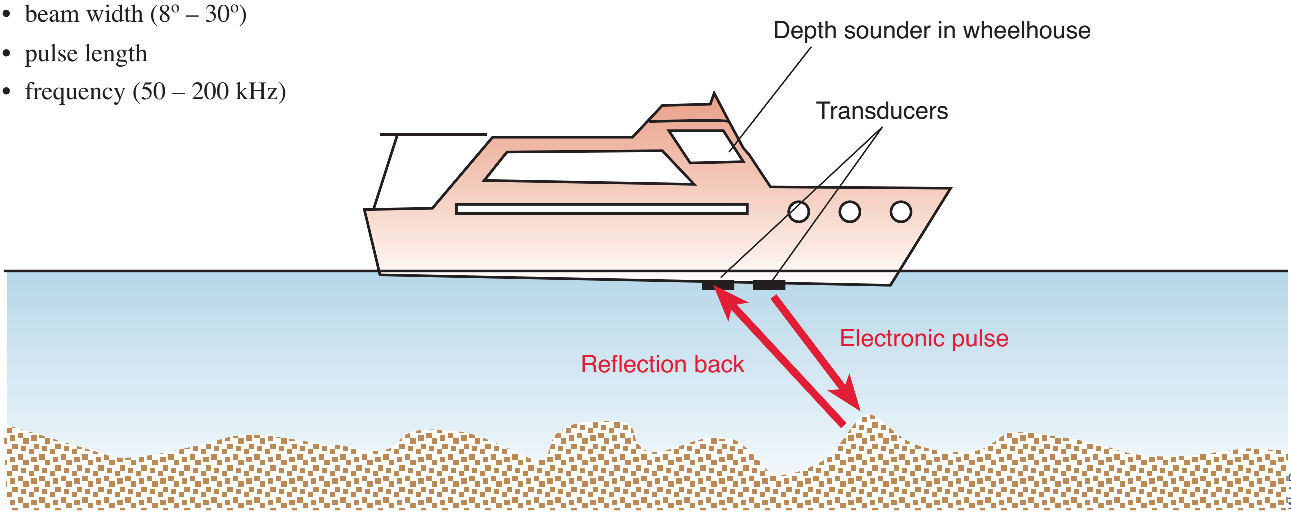


Figure 8.3 How a depth sounder works.

Depths are commonly displayed digitally or in graphic liquid crystal or video formats. The master of a vessel is trained in interpretation skills such as:

- differences in the reflective properties of the seabed
- maladjustment of controls (particularly sensitivity)
- marine growth on the transducer
- ship rolling and pitching
- temperature, salinity and sediment layers in the water
- second trace returns (echoes from great depth returning after the next pulse transmission)
- schools of marine life
- turbulence around the transducer (especially in heavy weather and when reversing)
- water too deep

A depth sounder may also be calibrated by comparing readings with depths derived from a lead line. It is important for an operator to know whether the sounder has been calibrated to read actual depth, depth from the transducer or depth below the hull (under keel clearance).

Radar

(Stands for **Ra**dio **D**etecting **a**nd **R**anging.)

Radar is, perhaps, the best coastal navigation instrument since it eliminates so many of the problems of visual navigation. It is however subject to incorrect readings in strong rain squalls.

It can 'see' in the dark, penetrate fog and mist and combine all the usual coastal navigation plotting systems into one. This enables the navigator to check a boat's progress at regular intervals without leaving the wheelhouse.

Radar works on a similar principle to the depth sounder. An electronic pulse is transmitted from the scanner which 'bounces' back off shore or other objects close by. The 'echo' is picked up by the receiver.

As the scanner on top of the wheelhouse rotates through 360 degrees, these echoes are converted into a map-like picture on a screen with the boat as the centre of the picture, and the local scene spread out around a 360 degree horizon.

The set incorporates a method of measuring bearings and distances enabling the navigator to carry out position plotting.

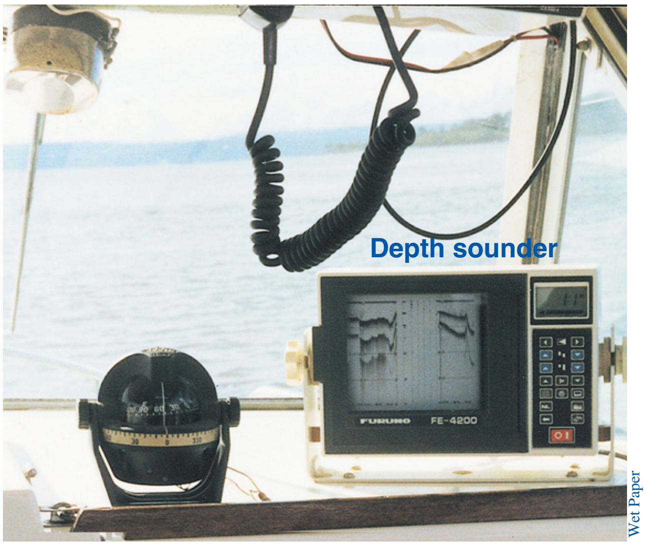


Figure 9.1 Depth sounder mounted in wheelhouse of small boat. (Photo Courtesy Dave Claridge)

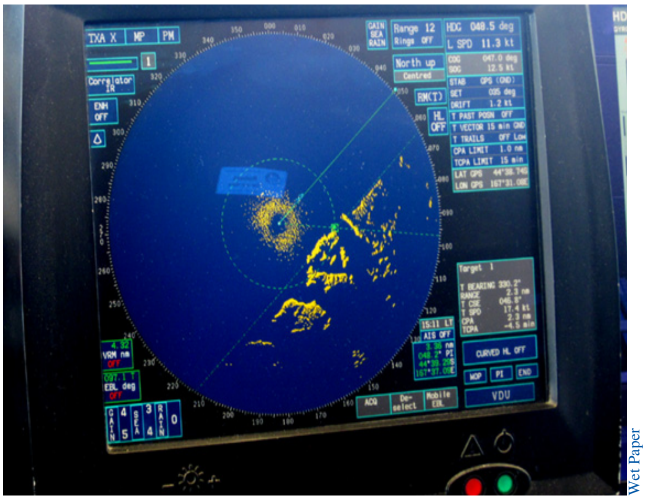


Figure 9.2 Modern navigation instruments contain computer chips for radar, sonar, GPS and many more.

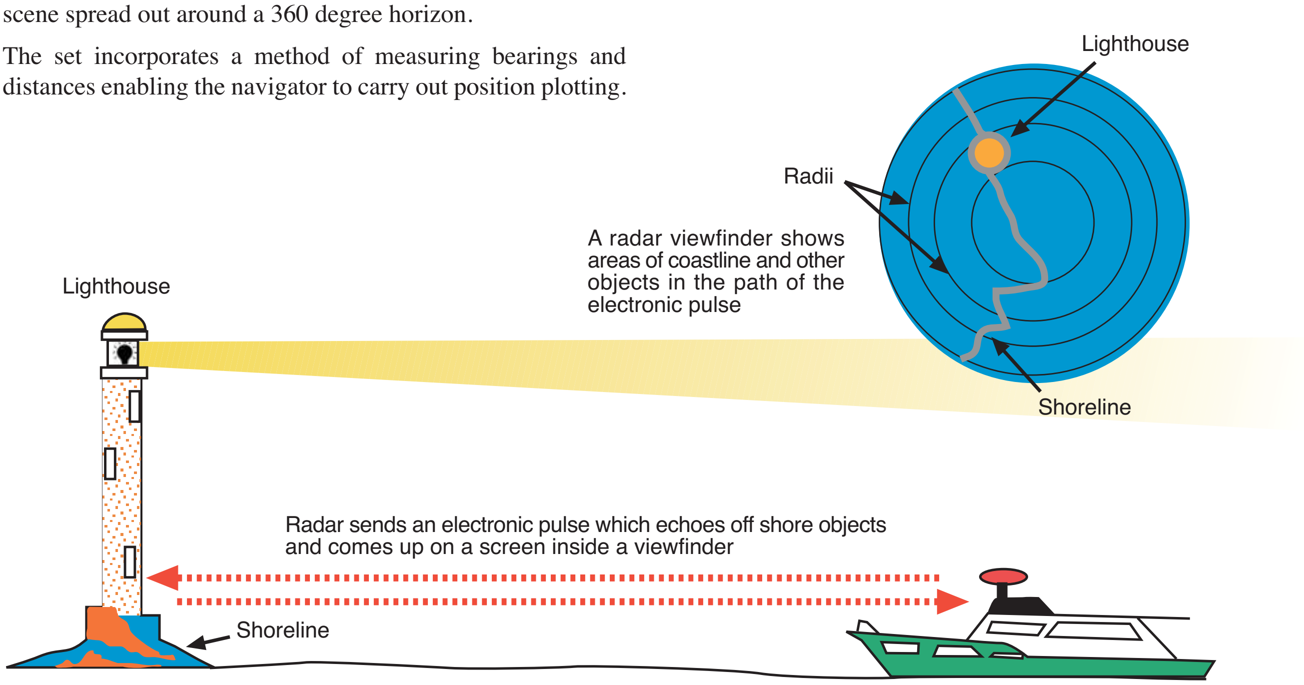


Figure 9.3 How radar works
Wet Paper

Radars incorporate a number of limitations and must be used with caution. One of its biggest problems is the tendency of the pulse to 'echo' only off certain objects.

A cliffy coastline, for example, will usually present an excellent picture on the radar screen, whereas a low sandy shoreline may show up only faintly, perhaps not at all.

Navigation marks such as buoys or channel indicators may not show up too well on the screen unless they are fitted with radar reflectors. These reflectors increase the strength of the radar echo and create a much stronger 'blip' on the screen.

Figure 10.1 Radar tower and scanner

GPS

Definition

GPS, or Global Positioning System, is a satellite-based navigation system based on the precise timing of signal transmission paths between at least three (up to eight) satellites and a receiver on board a ship. The intersection of the (three-dimensional) ranges so derived provides a position fix of accuracy of about 100 m.

Latitude and longitude

Lines of latitude run around the globe and are parallel with the equator. Lines of longitude run as meridians east or west from a suburb of London called Greenwich. A GPS will fix a position in terms of latitude and longitude as shown in Figure 10.2.

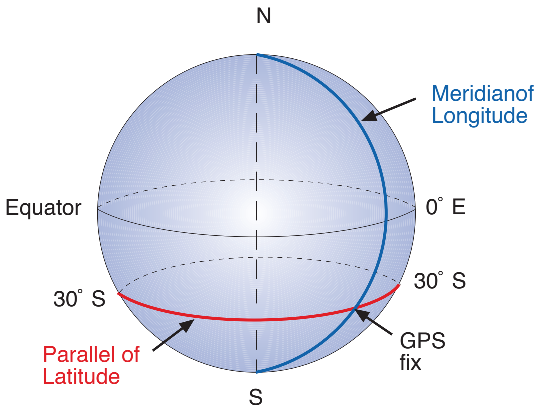


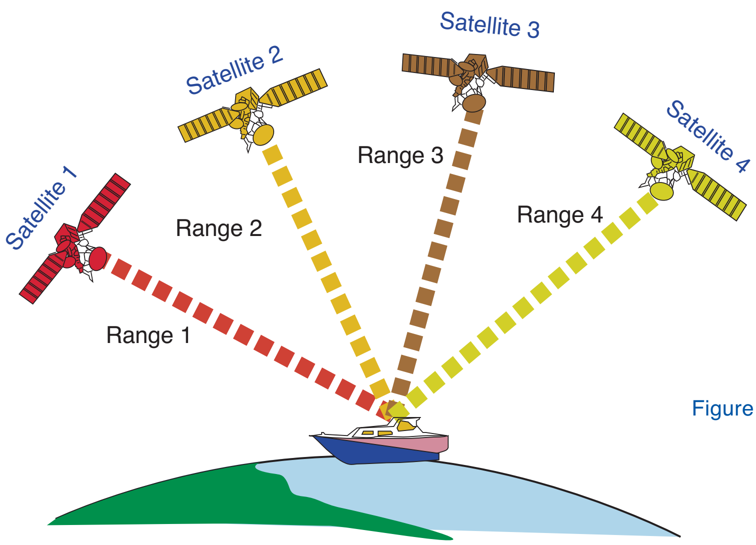
Figure 10.2 Latitude and longitude
Wet Paper

Datum checking

- It is advisable to switch a GPS on and select the correct chart datum before departing. Many boat ramps have signs showing datum points.

  GPS units require time to initialize, and the skipper needs time to assess the accuracy of the position information prior to starting the voyage.
  - The accuracy of GPS units can be compromised by power failures or poor electrical connections.
  - Ship's masters need to ensure electrical charts are updated with supplier upgrades. When they go to a waypoint in a straight line, they always check what is in between their vessels's initial location and the waypoint.
  - The figure below shows a GPS image of a track around a headland from A-B. One chart uses a datum called WGS 84 and the other AGD 66 (an out of date datum).
  - If the ship's master used the wrong datum the vessel would end up smashing into the headland endangering the life of all those on board.

ALWAYS USE WGS 84



The receiver position is determined by the intersection of the spheres centred around each satellite with a radius equal to the respective range.

Figure 10.3 GPS and satellites
Wet Paper

Speed logs

A log is an instrument for measuring speed and distance. Bottom logs are attached to or through the hull with a paddle wheel or mini rotator spinning in response to the movement of the water past the hull. One type is a doppler log, which measures speed by comparing the frequencies of transmitted signals and those of the echoes returning from the seabed or water boundary layers. Comparison of these speeds helps the ship's master compensate for the effect of currents and tidal flows.

Wet Paper

Figure 11.1 Ship's log

Chart plotters

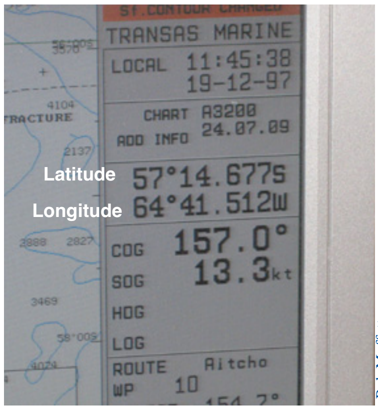
An electronic chart plotter is a navigation device that contains digitally scanned or constructed charts which, when interfaced with the global position system and combined with navigation software, provide a graphical representation on a screen of the ship moving across a chart.

Waypoints

A waypoint is identified by a specific latitude and longitude and forms the basis of modern digital navigation. A waypoint is shown in Figure 11.3 below.

Waypoints provide a range of navigational capabilities, including waypoint navigation, and can provide track control data to an autopilot.

Many small GPS display units also provide simple track plotters based on a latitude/longitude grid and increasingly, ships are being equipped with electronic chart systems that provide detailed chart representations on screen.



Bob Moffatt

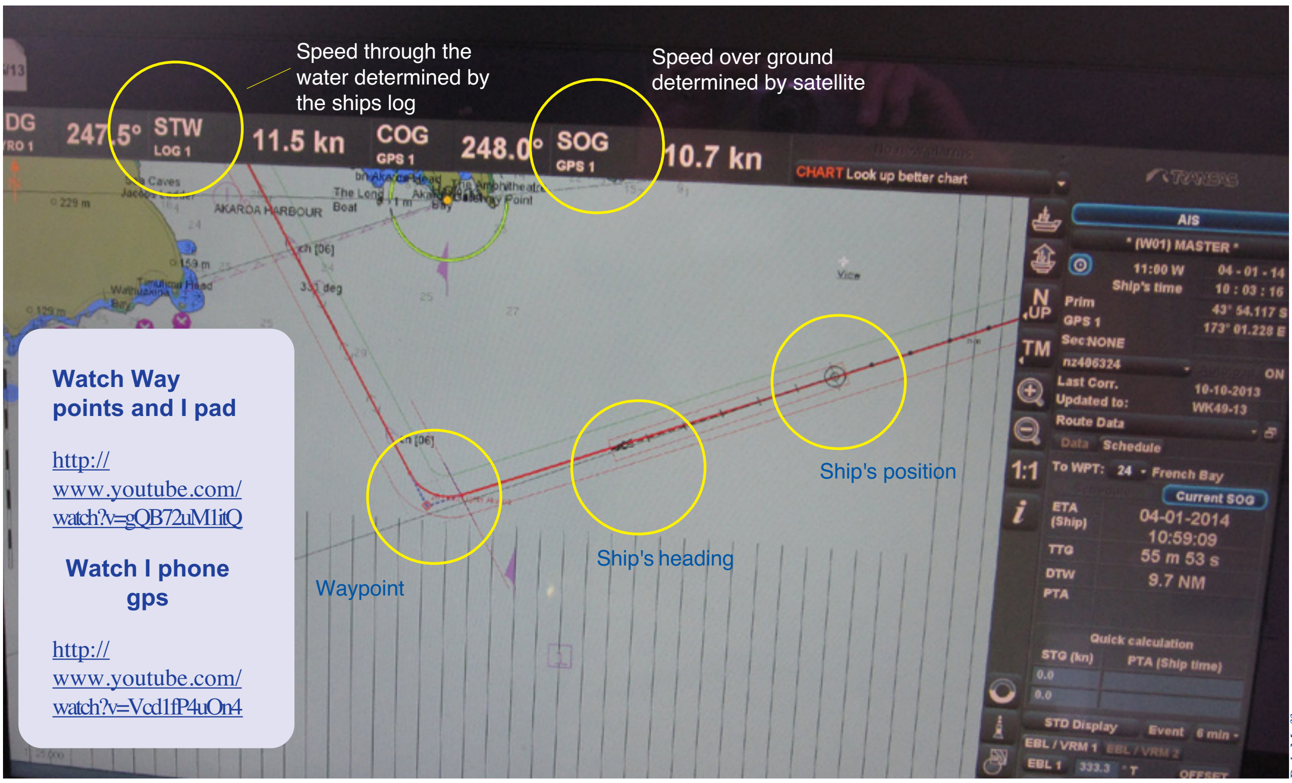
Figure 11.2 Latitude and longitude

Speed "over the ground"

A GPS can calculate speed over the ground or SOG. A ship's log calculates speed through the water and is particularly important when calculating fuel use and times of arrival in ports. Figure 11.2 shows speed of a ship about to enter a harbour through the water of 11.5 kn by ships log but only 10.7 kn by satellite. So the ship is being slowed by wind, tide or currents. This allows the master to calculate arrival times at a port.

Mobile phones and radios

For example the mobile phone could be used to contact the ships pilot for messages and the radio used to advise shore station of arrival times. The shore station would then advise small craft of the arrival of a bigger ship in the harbour. Some mobile phones can even be used as a gps and chart plotter (check out the U tube link below).



Bob Moffatt

Figure 11.3 Screen of a ship's chart plotter showing waypoints, SOG and STW

Worksheet 1: Navigation devices

Q1. Define a navigation device and explain why the definition is so wide ranging. (Page 4)

Q2. Using the depth sounder as an example, describe how the integration of devices and procedures are used for safe navigation. (Page 4)

Q5. Identify two rescue devices that are used in the case where a ship has to be abandoned and name two safety devices that assist in search and rescue (Page 5)

Q6. Explain the use of a steering compass and identify three features used with this navigation device. (Page 6)

Q7. a. Define term deviation and describe how it is recorded and corrected. (Pages 6 and 7)

b. Identify the deviation for the following ship's headings from the table on page 6,

100^{o}

240^{o}

40^{o}

Q8. Describe how a pleorus is different from the steering compass. (Page 7)

Q9. Describe one difference between a steering compass and a hand-held compass. (Page 8)

Q10. Describe one advantage of a fluxgate compass (Page 8)

Q11. List any three errors that may give an incorrect readings on a depth sounder. (Page 9)

Q12. Explain why radar is considered the best coastal navigation device (Page 9)

Q13. Define the term GPS and describe the information it provides (Page 10)

Q14.Identify the ship's position and waypoint on the display opposite. (Page 11)

Wet Paper

Q15.Distinguish between speed over the ground and speed through the water and give
(Page 11)

Q16.Explain how the following navigation and communication devices could be used to enter a port. (Pages 4-11)

Radar:

Ships log:

Echo sounder:

GPS:

Binoculars:

Chart plotter:

Navigation parallel rules:

Pelorus:

Steering compass:

Radio:

Mobile phone:

Communication devices

Marine communication devices and procedures are used for coordination and safety.

The main types of marine communication devices used for coordination and safety include

- Marine radios
- EPIRBS
- Flares and signals
- Navigation lights and shapes

Marine radios

Three types of radio operate in Australia and overseas.

27 Mhz sets

27 Mhz sets (Figure 14.1) are inexpensive, basic entry marine radios with a limited range of up to 10-15 nautical miles and are affected by terrain, islands and atmospheric conditions.

These do not require registration of a licence to operate, however they very limited in their ability to aid coordination and safety.

VHF sets

VHF sets (Figure 14.2) are recommended for better quality and communication. Effective range is up to 20 nautical miles and they contain DSC (Digital Selective Calling) and GPS connectivity functions making them very useful in coordination and safety.

MF/HF sets

MF/HF sets are required for coastal and overseas cruising, trading and research vessels. Their range is 200 nautical miles and contain sophisticated digital selective calling technology with allows identification of the ship and accurately tracking its position at sea.

Digital selective calling (DSC) communications

One Global Maritime Distress and Safety System is known as digital selective calling or DSC. The DSC is a semiautomated means of establishing initial contact between stations.

It involves a brief burst of digitised data being transmitted from one station to another station or group of stations to provide an alert and some basic information.

Once this contact has been established normal radiotelephony is used for subsequent radio communications.

DSC alert

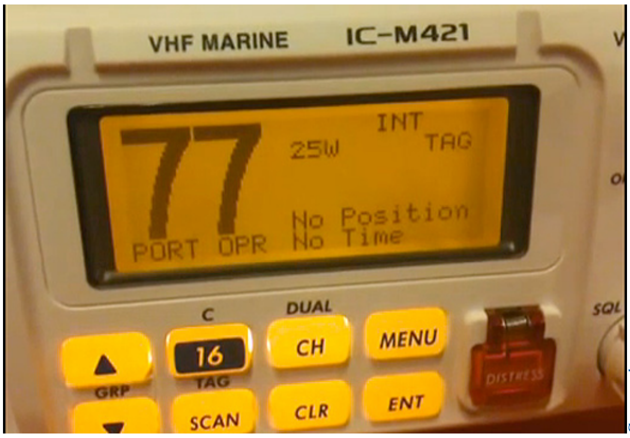
A DSC alert is a brief burst of digital information (typically 7 seconds on MF / HF and 0.5 seconds on VHF).

Information contained in this alert includes:

- the distress alert message
- latitude and longitude and the time
- the type of emergency eg fire, piracy, man overboard, flooding,
- the time the message has been sent

Section 2 describes the process in more detail.

Figure 14.1 Small craft 27 Mhz radio
GME



Comwatch

Figure 14.2 VHF radio with DSC - watch the video link

Watch DSC Routine Call on U tube

Click on the link

http://www.youtube.com/watch?v=IPE0hRERcKk

Figure 14.3 Ship VHF and MF/HF radios with DSC alert
Wet Paper

Information contained in a DSC alert

A DSC alert contains the following information as digitised data:

1. the identity of the calling station (a 9 digit identification number)
2. priority of the alert - distress, urgency, safety or routine and
3. the station being called (a specific station or a group of stations).

Marine satellite communication

The international maritime satellite organisation (**Inmarsat**) operates a system of satellites providing a range of telecommunications services to vessels.

Operating at super high frequencies, (UHf — see Figure 15.2), the Inmarsat system provides a full range of communications including telex, telephone, fascimile and computer data.

It also provides a dedicated distress alerting system whereby a ship in distress is automatically connected to a maritime rescue co-ordination centre.

The Inmarsat system employs four operational satellites in a geostationary orbit above the equator, over the Atlantic, Indian and Pacific Oceans as shown in Figure 15.3.

In combination the satellites provide continuous high quality communications to virtually the entire Earth's surface. Back up satellites are ready for use if necessary.

The geostationary orbits of the satellites means that each moves at exactly the same rate as the Earth's own rotation and therefore remains in the same relative position to any point on the Earth. Powered by solar energy, each satellite acts as a transmitting and receiving station, relaying messages between stations located on the Earth's surface.

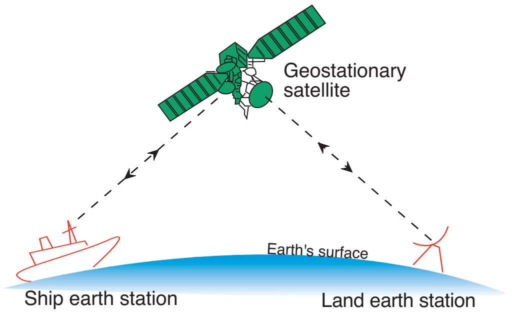


Figure 15.1 Ship - Satellite communication
Wet Paper

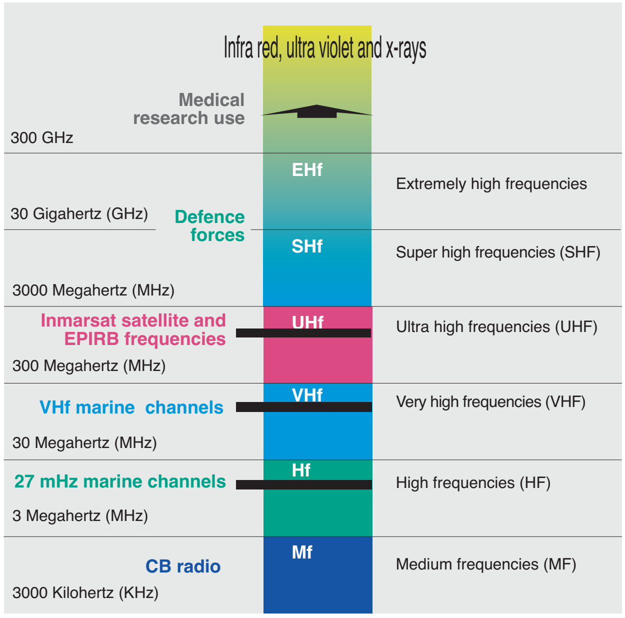


Figure 15.2 Radio frequencies
Wet Paper

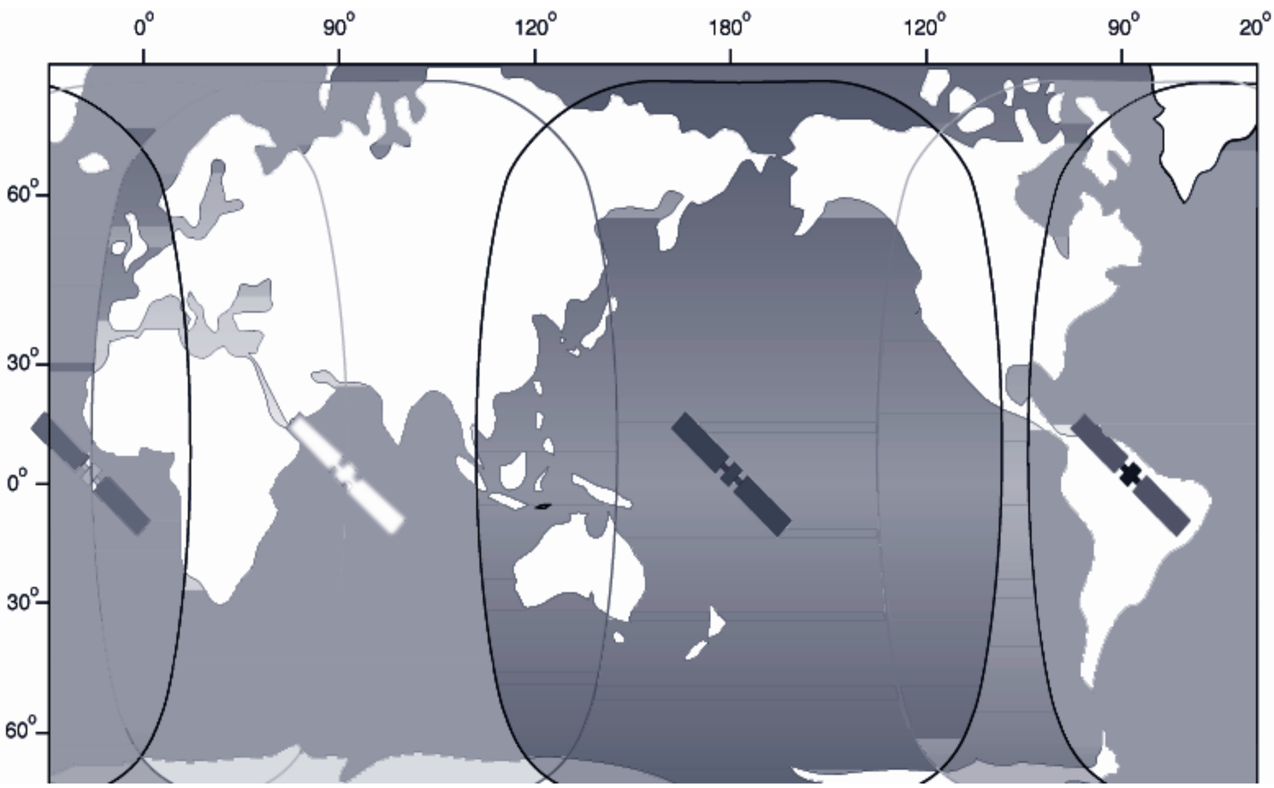


Figure 15.3 Geographical areas for co-ordinating and promulgating radio-navigational warnings
Wet Paper

EPIRB's

An EPIRB is a *emergency position indicating radio beacon* and when activated in a life-threatening situation, assists rescue authorities in their search to locate those in distress.

- EPIRBs are designed to float in the water for up to 48 hours to optimise the signal to a satellite.
- 406 MHz EPIRBs come in two basic types: those that provide an encoded (GPS) location and those that do not.
  - The satellite system can calculate a beacon's location, but locating a distress site is usually much faster if the beacon signal provides a GPS location.
- A HexID or Unique Identity Number (UIN) is the unique code programmed into each 406 MHz distress beacon and transmitted when the beacon is activated. This is shown in the photograph opposite.

Registration

- EPIRBS have to be registered with AMSA (Australian Maritime Safety Authority) www.amsa.gov.au/beacons
- Documentation is required and a sticker is sent in the mail. This must be attached to the EPIRB
- For the latest information on EPIRB coding and decoding see: ***www.amsa.gov.au/beacons***

Figure 16.1 EPIRB registration
Wet Paper

Use

- EPIRB's should only be used when there is a threat of grave and imminent danger. In the event of an emergency, communication should first be attempted with others close by using radios, phones and other signalling devices. Mobile phones can be used but should not be relied upon as they can be out of range, have low batteries or become water-damaged.
- **Operation:** Break the tamper seal and switch on. After three minutes a red light will flash indicating the EPIRB is transmitting. There are more expensive types that can be activated when they touch water.
- **Stowage**: In a boat, an EPIRB should be stowed in its mounting bracket where it is visible and easy to access in an emergency or in a grab bag along with flares, a torch or strobe and other safety equipment.
  - Water activated EPIRBs should always be stowed in their brackets correctly when not in use.
- **Batteries:** EPIRB batteries need to be replaced before the expiry date noted on the label of the beacon. This will ensure that the beacon will transmit for the minimum time required once activated.
- **Servicing:** The manufacturer or its agent should service batteries.

Regulations

An EPIRB must be carried;

- When boating in open waters more than 2 nautical miles from land, beyond partially smooth waters and
- Must display the service expiry date with current AMSA registration.

Unwanted EPIRBS must be disposed of responsibly. Dispose of your unwanted EPIRB at no cost by placing it in the collection bins of any Battery Word store around Australia.

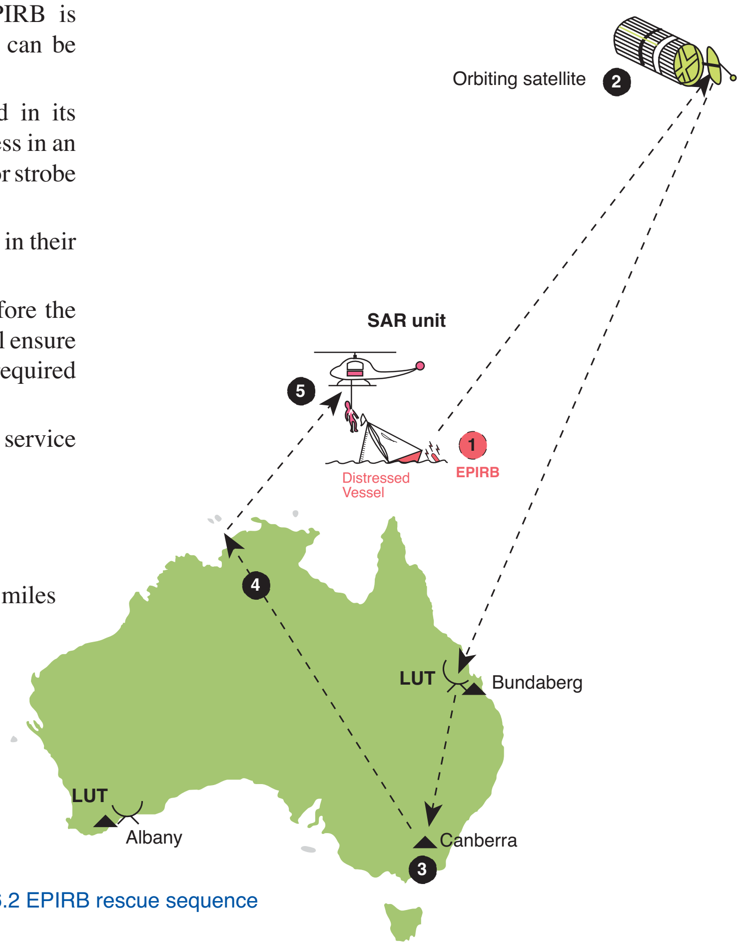


Figure 16.2 EPIRB rescue sequence
Wet Paper

Flares and distress signals

Flares are either red (night) , orange (day) or parachute (day or night) and should be stowed in a safe and preferably dry place on board ideally in water tight containers.

Flare ignition

- Reading the instructions, unscrewing a cap, pulling a tab up and out quickly and holding the flare to leeward as shown in the figures below.
- Red flares are visible by aircraft for about 8 nautical miles at night and 4 nautical miles during the day.
- Parachute flares are usually fitted with a firing mechanism located underneath the bottom cap.

  These flares are visible for about 20 nautical miles at night and a lesser distance during the day.

Regulations

The number and type of flares to be carried depends on where the vessel is operating. and must not exceed their expiry date.

Use

Flares are ONLY to be used to attract attention in a distress situation at sea.

Responsibility

It is the responsibility under maritime law to go to the assistance of anyone in distress. So if a vessel at sea sights a flare, that vessel must go to help as well as report the flare to a marine rescue authority,

Other emergency signals

Other types of distress signals are shown in the diagram below. The V sheet is a common signalling device used on small recreational craft. Other boats in the vicinity can then go to the aid of the stricken vessel

Figure 17.1 Flares and ignition

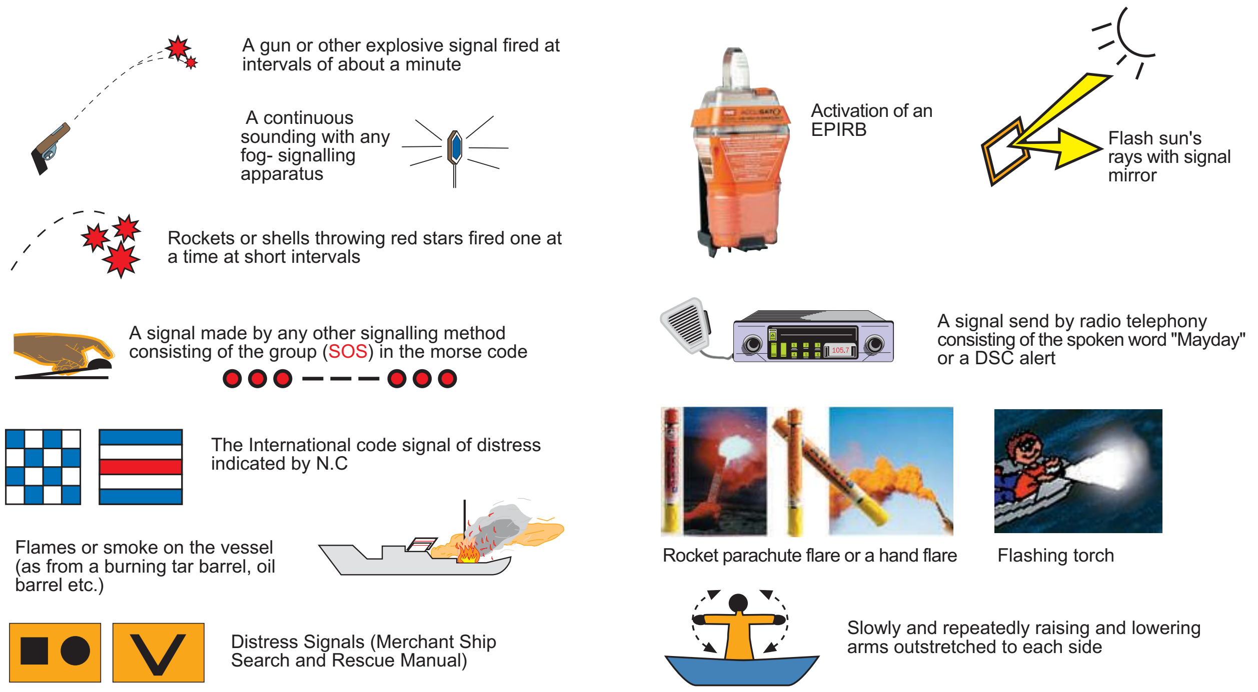


Figure 17.2 International rescue signals
Wet Paper

Flags and shapes

For centuries flags have been used to communicate. The illustration below shows the internationally recognised system for the alphabet.

Often flags are used to communicate safety issues. For example:

- Flag A Diver down below is used to indicate divers or snorkellers in the water and warms boats to travel 30 metres away and slow down as the diver may surface at any time in the vicinity of the boat.
- Flags R over Y indicates boats are to slow down and create no wash as they pass other boats fitted with delicate or equipment that is difficult to manoeuvre if the craft is rocking. For example the crane lifting heavy loads on the barge in Figure 18.2 could loose its load if struck by a large wash.
- Flags NC adjacent is the international signal for distress. For example fire on board or grounded in heavy seas.

Navigation day shapes

Shipping activities

Knowledge of the activities aboard a ship is essential to navigation and communication at sea 24 hours a day as it allows skippers of other vessels to navigate safely around them to avoid collisions

These activities are wide ranging wide ranging but become important in coastal and inland waters.

During the day there are navigation devices in the form of shapes, that allow skippers to determine the activities of other vessels. For example:

- The dredge in Figure 18.3 has an obstruction, ie a dredging bucket extending out from the bow, and a flexible pipe that carries the dredge spoil to a dumping site. This could be another barge or on land where the dredge spoil can be used.

  The three day shapes are used.

  a. Two balls on top of each other indicate which side other vessels can pass

  b. Two diamonds on top of each other indicates where the obstruction is and

  c. One ball over one diamond over one ball, indicates that this type of vessel is restricted in its ability to manoeuvre around other vessels.

- The ship in Figure 18.4 is at anchor and will show a shape of a round ball on the bow of the vessel so other ships using a pair of binoculars can plan a course of safely navigate around her.

  The shape in this case is made of marine ply which can be folded and stowed in the anchor well just before the ship weighs anchor.

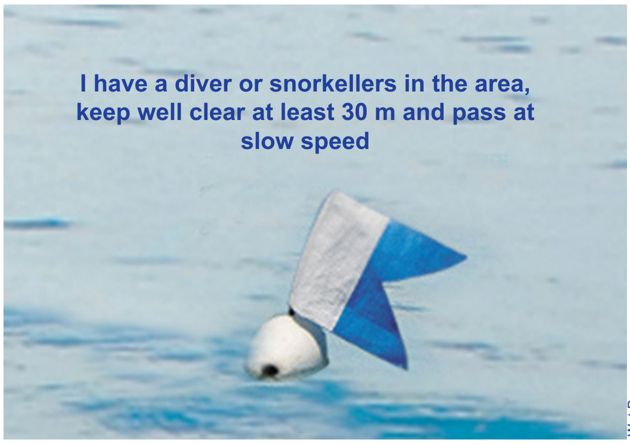


Figure 18.1 Dive flag

Figure 18.2 Slow down create no wash flags

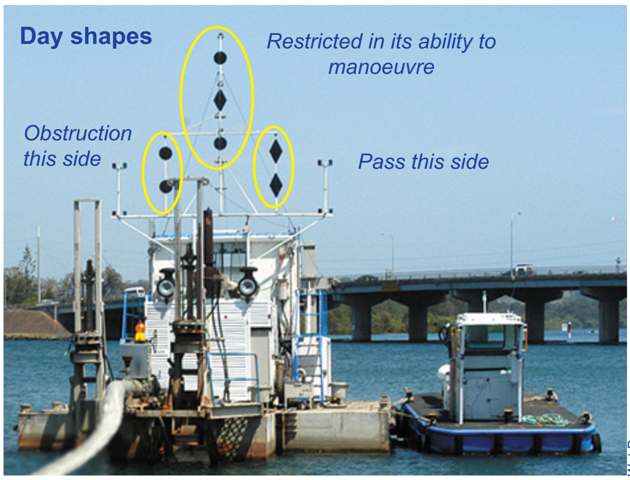


Figure 18.3 Day shapes for a dredge

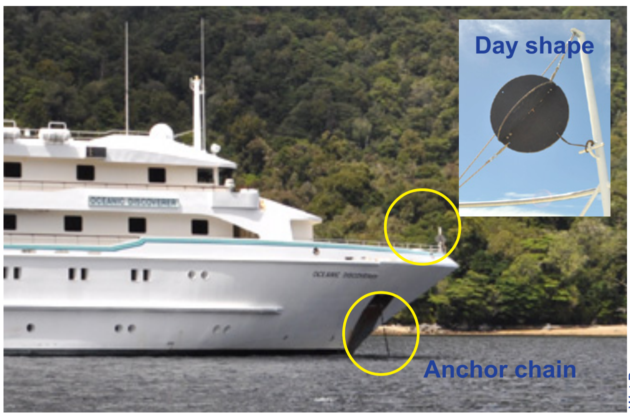


Figure 18.4 Day shapes for a anchored vessel

Navigation lights

Navigation lights are devices shown by a ship that indicate its position and orientation. They are compulsory on all ships around the world and are used at night or in periods of restricted visibility so that the vessels can avoid collisions.

The colour and location of navigation lights helps determines the type of the vessel which allows other vessels to determine the vessels movement. Green indicates starboard and red port as shown in Figure 19.1.

Let's look at a simple example in Figure 19.3 where a powered boat under 12 metres has a port, starboard and masthead head light.

- If you are in another boat at night and see a white light above a red and green light, the red on the right and green on the left, you know that boat is heading straight for you (Figure 19.2).
- White over green means the boat is crossing from left to right and conversely white over red means crossing from right to left (Figure 19.2).

Rules

The positioning and colours of lights is governed by strict installation rules and failure to observe these rules means a ships master will be fined. Figure 19.3 shows the positing and angles of lights so that other ships can determine where ships are at night and what they are doing.

Example

A small boat is passing and then circling another power boat underway.

- At positions A and B she will only see the masthead light and in this case cannot determine if the vessel is anchored or underway. So the skipper approaches with caution deciding to pass on the port side.
- When she gets to position C she will see a red light under the white light and then realise show is passing a powered vessel and take appropriate action.
- At D she will be dead in from of the powered vessel and she both port and starboard navigation lights.
  - If she was to stop now all the other vessel would see is a white light and there would be risk of a collision.
  - So the boat passing steams to a safe position E where she can turn.
  - At this point she sees a white light over a green lights and travels to point F where the green disappears. This means she is in a safe position and can carry on.

There are many lights and situations you will learn about if you get your boat licence.

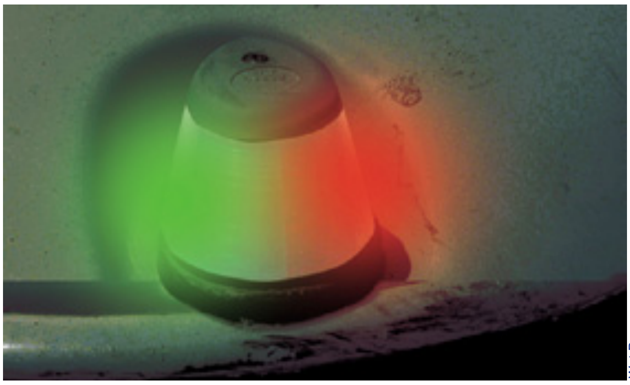


Figure 19.1 Starboard and port navigation lights

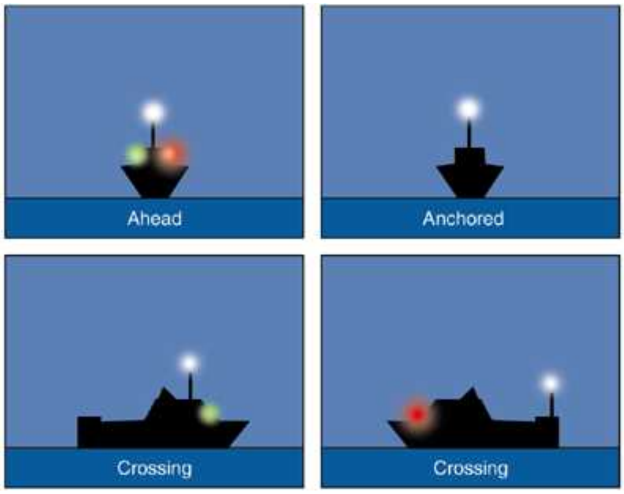


Figure 19.2 Interpretation of powered boat nav lights

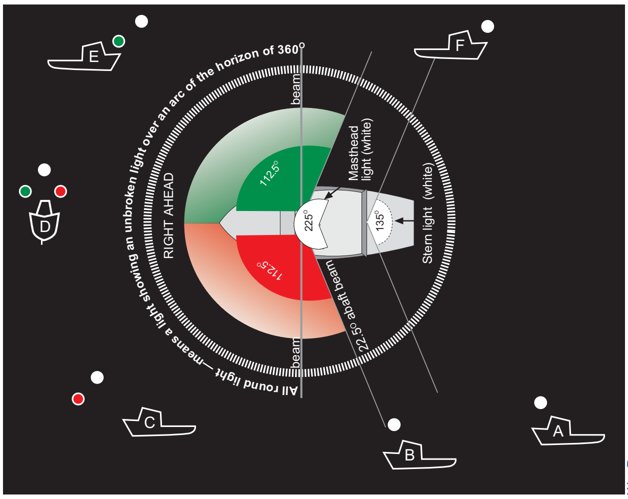


Figure 19.3 Navigation light communication

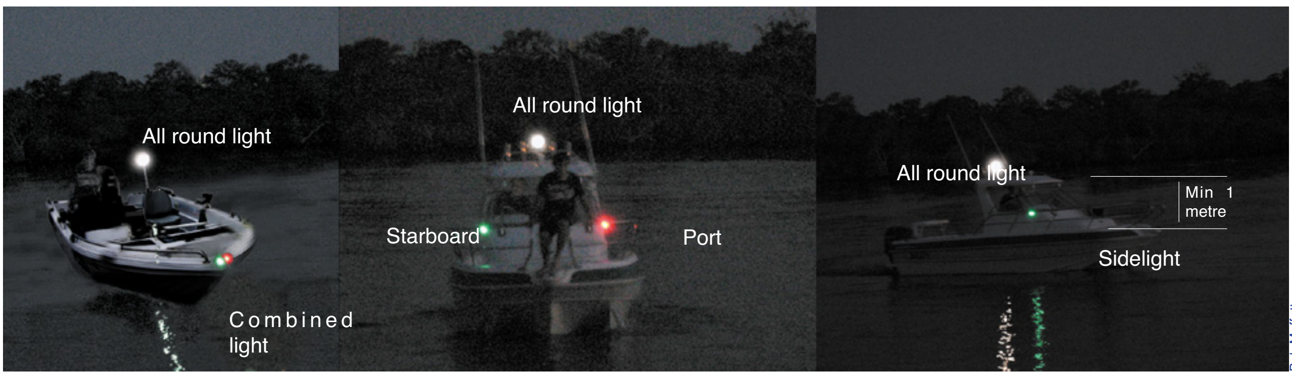


Figure 19.4 Navigation lights

Worksheet 2: Communication devices

Q1. Distinguish between three types of radio with respect to their range , effectiveness in coordination and safety Page 14)

Q2. List the information contained in a DSC alert (Page 14 and 15)

Q3. Complete the diagram below of radio frequencies to distinguish between frequency type, name and use (Page 15)

FREQUENCY TYPE AND NAME	Infra red, ultra violet and x-rays	Extremely high frequencies (EHF)	Super high frequencies (SHF)	Ultra high frequencies (UHF)	Very high frequencies (VHF)	High frequencies (HF)	Medium frequencies (MF)
USE	MEDICAL SCIENTIFIC	DEFENCE FORCES		Inmarsat satellite frequencies	VHf marine channels	27 mHz marine channels	Cb radio

Q4. Explain what an EPIRB is, what it is designed to do and how it is used in coordination and rescue (Page 16)

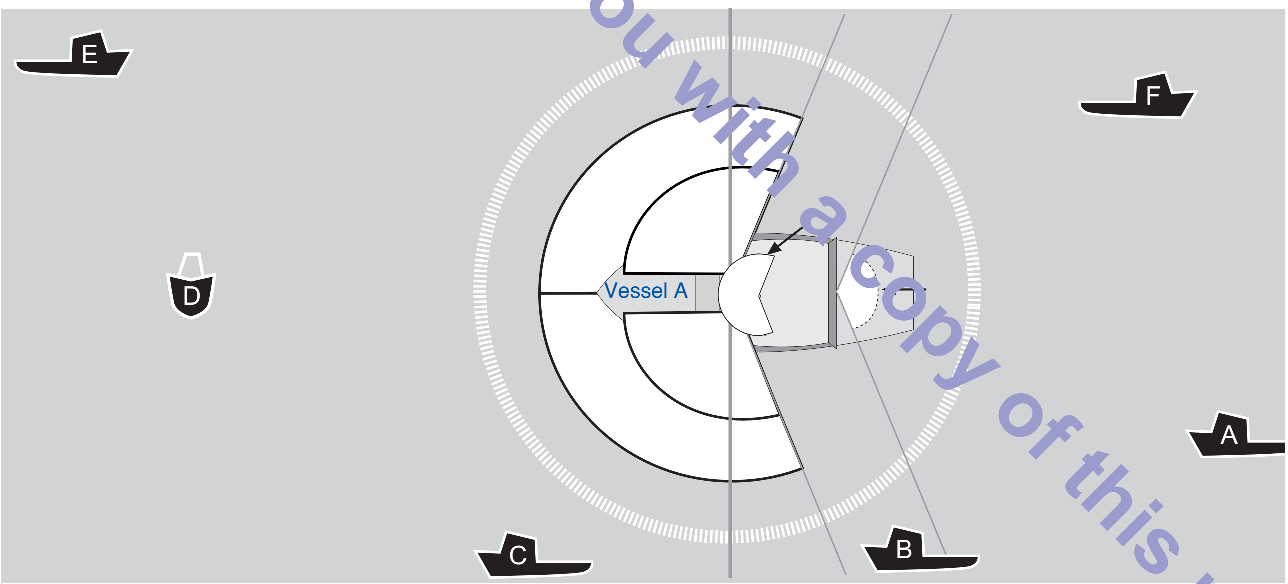
Q5. Explain how flares are ignited, and distances they can be seen in distress situations (Page 17)

Q6. Describe three flag signals used to communicate warnings or distress giving an example for each (Page 18)

Q7. Explain why ships have day shapes and give two examples explaining how their shapes communicate safe navigation (Page 18)

Q8. Define navigation lights on a ship and explain why they are compulsory (Page 19)

Q9. Complete and colour in the diagram below to show the installation of navigation lights (Page 19)



Q10. On the diagram above explain how another powered vessel travelling at the stern would circle vessel A at night on the port side, then turning to starboard when safe to do so. Use the letters A-F to illustrate your answer (Page19)

Marine radio procedures

Correct communication procedures involving navigation devices are essential for coordination and safety. The procedures for registration, use and servicing for an EPIRB as discussed on page 18. This section describes how a marine radio is used as a communication device and in emergency situations.

Marine radios

Small boat operators use radios to obtain up-to-date weather forecasts, report arrival and departure times if going out to sea, listen to fishing details, communicate with shore stations and other vessels and listen to radio broadcasts advising of overdue vessels at sea.

Different frequencies have different uses which have resulted in three main types of marine communication equipment. These sets are VHF, 27 MHz sets and MF/HF.

VHF sets

This is the preferred radio for short range communications due to their better performance over 27mHz but require the operator to have a licence.

All large boats and an increasing number of smaller boats monitor the emergency Channel 16. A marine radio is normally left on Channel 16 to receive incoming calls or monitor distress signals.

Controls

The following are the general controls that are found on most, but not all, radio transceivers.

- Channel selector. This control is used to select the channel or frequency that you wish to transmit or receive on.
- On/off and volume control. Turns the equipment on or off and controls the volume of signals coming from the loudspeaker.
- Squelch or mute control. Stops the constant and annoying background hiss or roar from the receiver. The correct setting is so that the hiss or roar just cannot be heard. Further rotation of this control will progressively desensitise the receiver.
- Display. Has huge array of functions including scan, weather channel, scan and dual and triple watches which will permit a listening watch on two or three different VHF channels.

Frequencies

Areas with large boating populations usually have marine rescue stations monitoring Channels 16 and 67 on a 24 hr basis. Weather information is regularly broadcast on Channel 67. Most areas have a local 'chat' frequency or a common use re-broadcast frequency and Channel 73 is often used for this purpose.

Routine calls

Example of a radio check. Call on channels 16 or 88. Note in areas of poor reception say station identification three times

- Redcliffe Coast Guard, Redcliffe Coast Guard, this is Reef Seeker, Reef Seeker (OVER)
- Reef Seeker this is Redcliffe Coast Guard please switch to Channel 73.
- Redcliffe Coast Guard, this is Reef Seeker Reef Seeker, am going out boating today and wanting a radio check (OVER)

Figure 22.1 VHf radio (Courtesy GME)

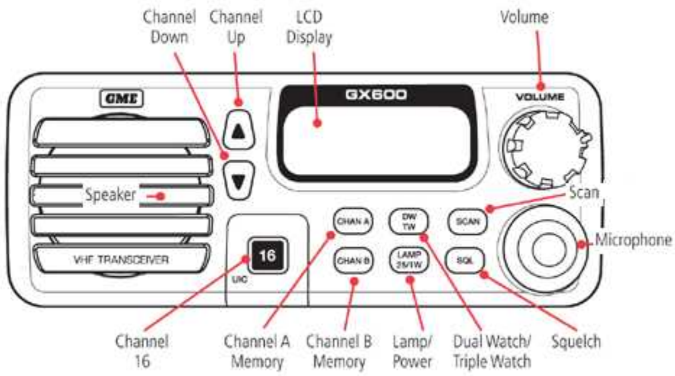


Figure 22.2 VHf radio controls (Courtesy GME)

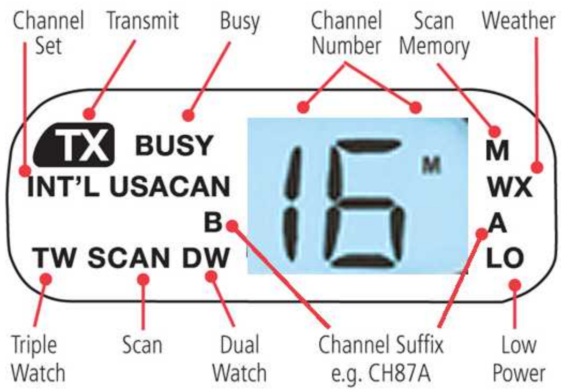


Figure 22.3 VHf radio display (Courtesy GME)

U tube: Routine call

This U tube video shows how a routine call is made on channel 16 and then the radio is switched to a working channel

Click on the link

http://www.youtube.com/watch?v=F7BUdn_9v-Y

U tube: Watch DSC

As your teacher to play the following video in class

Click on the link

http://www.youtube.com/watch?v=03DYQVUzg84

- Reef Seeker this is Redcliffe Coast Guard your signal strength is FOWER to FIFE (OVER)
- Redcliffe Coast Guard, this is Reef Seeker Reef Seeker, thank you (OUT)
- Reef Seeker this is Redcliffe Coast Guard (OUT)

Radio use rules

- Keep your radio tuned to Channel VHF 16 or 27.88mHz.
  - You make a call on VHF 16 or 27.88mHz and then respond to the station change as requested.
  - When you hear a call acknowledge and then ask the caller to change to a working channel for your local area. You can get this information from your local VMR station.

  This time has been reserved internationally as the time for the time a vessel in distress repeats calls.
- Listen before transmitting and follow the local area protocols.
- Do not transmit unnecessarily or allow children to play with the radio.
- Always use your call sign and the name of your boat for identification.
- Avoid interfering with other stations.
- For non distress messages, ask to switch to a "working channel" once you have contacted the other station.
- For distress messages, stay on channel VHF 16 or 27.88mHz or as directed by the local marine radio station.
- Keep your message brief and clear.
- Stop transmitting when requested to do so by a coast station.

Emergency calls

There are three types of emergency call on a marine radio.

Safety signal - Securite

Securite is a safety signal used when a station wants to pass information concerning safety such as navigational warnings or weather warnings and are identified by the word.

Urgency signal - Pan Pan

Pan Pan is an urgency signal indicates that the station sending it has a very urgent message to transmit concerning the safety of a ship or aircraft, or the safety of a person.

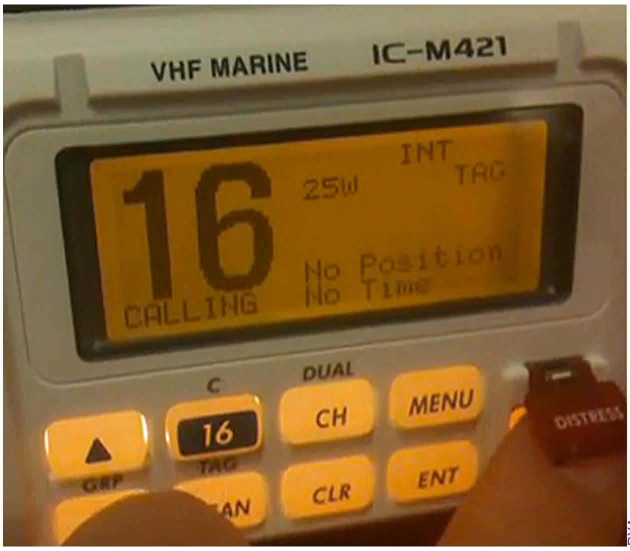
Urgency messages are sent on all distress frequencies and are identified by the words PAN PAN - PAN PAN - PAN PAN

Distress signal - Mayday

A Mayday call is a distress signal and denotes an emergency involving grave and imminent danger to life or a vessel. An example is given below.

If a shore station fails to respond to the call, all craft in the vicinity should attempt to relay the message and render any assistance.

Further information can be found at www.amsa.gov.au or why not visit a local marine rescue association and arrange for a guided tour. As they are voluntary you may like to do some fund-raising first and make a small donation to express your thanks.



RYA

Figure 23.1 Distress signal is sent first

U tube: Mayday

http://www.acma.gov.au/Citizen/Consumer-info/All-about-spectrum/Marine-and-Amateur-Radio/marine-vhf-radio

http://www.youtube.com/watch?v=taXBKDVIoRs

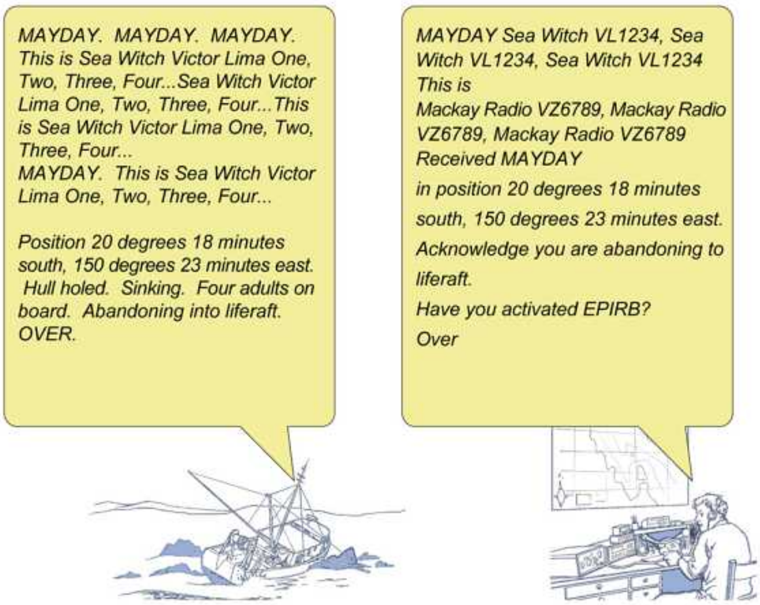


Figure 23.2 A Mayday call
Wet Paper

DSC distress alert

The DSC distress button is located on VHf/Mf/Hf radios and is pushed when there is an emergency involving grave and imminent danger to life or a vessel. It is pushed once to send the distress alert message, latitude and longitude and the time (Figure 24.1). The category menu is then used to choose the type of emergency eg fire, piracy, man overboard, flooding, etc. The button is then pushed again for five seconds to send the emergency situation. A loud confirmation sound will be heard.

Immediately after messages have been sent, the radio is used to send a mayday call as outlined on the previous page.

How the message is received

The message will be received at the Marine Rescue Coordination Centre, Coast Stations and all radios in receiving range. The message will indicate the distress alert, the Maritime Mobile Service Identity (MMSI), what channel the Mayday call will be coming on, the type of emergency, latitude and longitude and time of emergency Figure 24.2.

MMSI

A Maritime Mobile Service Identity (MMSI) is a series of nine digits which are sent in digital form over a radio frequency channel in order to uniquely identify ship stations, ship earth stations, coast stations, coast earth stations, and group calls.

These identities are formed in such a way that the identity or part thereof can be used by telephone and telex subscribers connected to the general telecommunications network to call ships automatically.

Search and rescue

Australia's area of responsibility for marine search and rescue (SAR) covers one-ninth of the world's surface, more than 20 million square nautical miles.

Under the national search and rescue plan, searching for missing pleasure craft and fishing vessels is the responsibility of State or Northern Territory SAR authorities (i.e. the police).

However, if an incident reaches a point where police resources are over extended, the Commonwealth's rescue co-ordination centre (RCC) can be asked to take over co-ordination.

Contacting relatives of missing persons and organising port and beach searches remain police duties. In searches where the MRCC is the coordinating body, the responsibility for keeping relatives informed of progress is undertaken by the MRCC management team.

Search and rescue operations

The major function of the centre is to coordinate the search and rescue of mariners in distress in Australia's area of responsibility.

Each year the centre deals with hundreds of marine incidents. It conducts searches, answers requests for medical evacuations, traces overdue yachts and handles other less dramatic incidents such as investigating unexplained flare sightings. When searches are coordinated by State police, the centre is often asked to provide expert advice and information.

When the centre takes over a search, the senior co-ordinator assumes total control of the operation. The first task is to decide what to search for, a disabled yacht, wreckage, a life raft etc. A description of the vessel, skippers experience and likely course of action he or she may take is some of the information required.

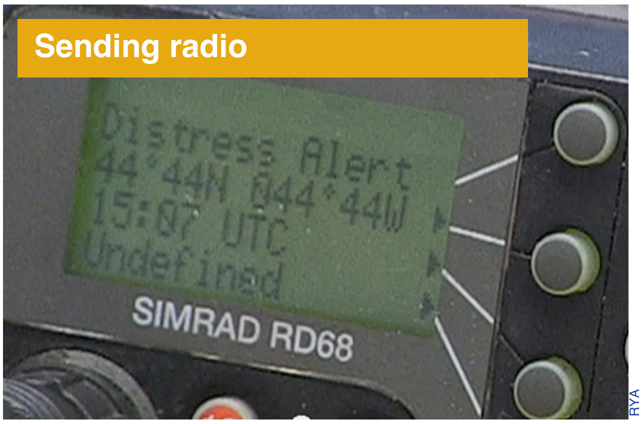


Figure 24.1 Distress alert sending message

U tube: DSC - distress alert

As your teacher to play the following video in class

Click on the link

http://www.youtube.com/watch?v=oS5n3QIqgfM

Figure 24.2 Distress alert receiving screens

The second task is to calculate the search area. To do this, the co-ordinator draws on information about the movement of objects in the water, tidal flows and weather conditions and combines use of computer systems with years of practical experience of the search and rescue team.

Australian ship reporting system (AUSREP)

The AUSREP system is a ship reporting system which monitors the movement of many vessels undertaking voyages anywhere within Australia's search and rescue areas.

Before departure, a sailing plan is lodged with the rescue coordination centre in Canberra. Position reports are then sent every 24 hours or when changes are made to the original sailing plan; and on arrival a final report is made. This information is used to track the vessel along its entire route.

The Australian Maritime Safety Authority advised that small vessel operators using AUSREP should be aware that it is a positive system. They advise that once a sailing plan is lodged, failure to make daily reports or a final report will result in the rescue coordination centre making preliminary checks to ascertain the vessel's safety.

If after these checks are completed, the vessel is still unreported or overdue, a further assessment will be made to determine the next course of action.

Small vessels may participate in AUSREP. No charges are made, however certain conditions must be met including:

- the voyage must be more than twenty-four hours between different ports, or greater than 200 nautical miles
- a satellite compatible EPIRB must be carried
- a current ‘Small Craft Particulars Form” must be lodged with the authorities in Canberra
- approved GMDSS (Inmarsat C and/or HF DSC) equipment must be carried to enable the vessel to report to AMSA throughout the voyage.

Maritime rescue and co-ordination centre

This centre is located in Canberra and operates around the clock and is staffed by ex-mariners with wide experience in maritime and search and rescue operations.

Its computer controlled communications system enables contact with a wide variety of organisations including the police in all States, the defence forces, international maritime and SAR organisations, merchant ships, fishing cooperatives, harbour and marine authorities, yacht clubs and volunteer marine rescue groups. The MRCC may contact aviation authorities for search purposes.

Rescue coordination centre Australia

Search and rescue (SAR) uses the latest technology including satellites to assist distressed mariners.

The rescue coordination centre (RCC) employs these aids to establish the most likely area in which to find distressed mariners.

Radio equipment located on shore is loosely referred to as a coast station. There are three types of stations that are found on land:

- maritime communication stations
- State and Northern Territory HF (coast radio) stations
- limited coast stations.

Figure 25.1 AMSA web site

Activity

Go to the AMSA web site

www.amsa.gov.au

- Click on the search and rescue icon, choose the Rescue Co-ordination Centre
- Read the scroll down to the Silhouette II case study at the bottom and down load the three files.

  Prepare a presentation on the rescue identifying all the devices used and embed the movies in your presentation

Figure 25.2 AMSA web site activity

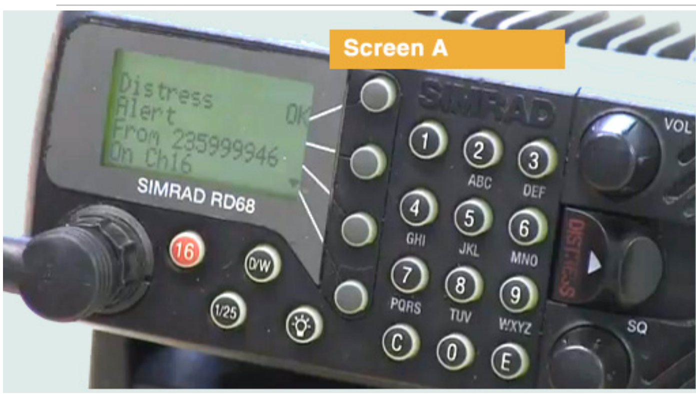
WORKSHEET 3: COMMUNICATION PROCEDURES

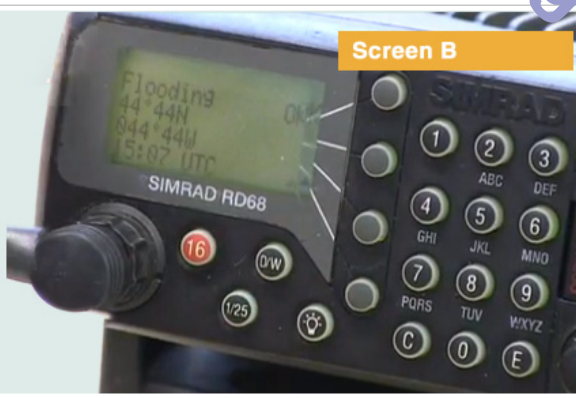
Q1. Describe the procedure involved in obtaining a radio check and log in from a base station called Redcliffe Coast Guard, on a vHf radio before setting out for a days research aboard a vessel called Research I that had its ship's details registered with the Coast Guard. (Pages 22-23)

Q2. Describe three types of emergency call given on a marine radio and describe when they are used (Page 23)

Q3. Explain how a DSC distress button is used in emergency coordination and what follows immediately after its use. (Page 24)

Q4. Interpret the messages on the two screens below and predict what will happen next (Page 24)





Q5. Analyse COMSAR Circular 25 below and justify the flow chart in terms of search and rescue following a ship's receipt of a DSC alert. (Pages 26-27 + AMSA web page)

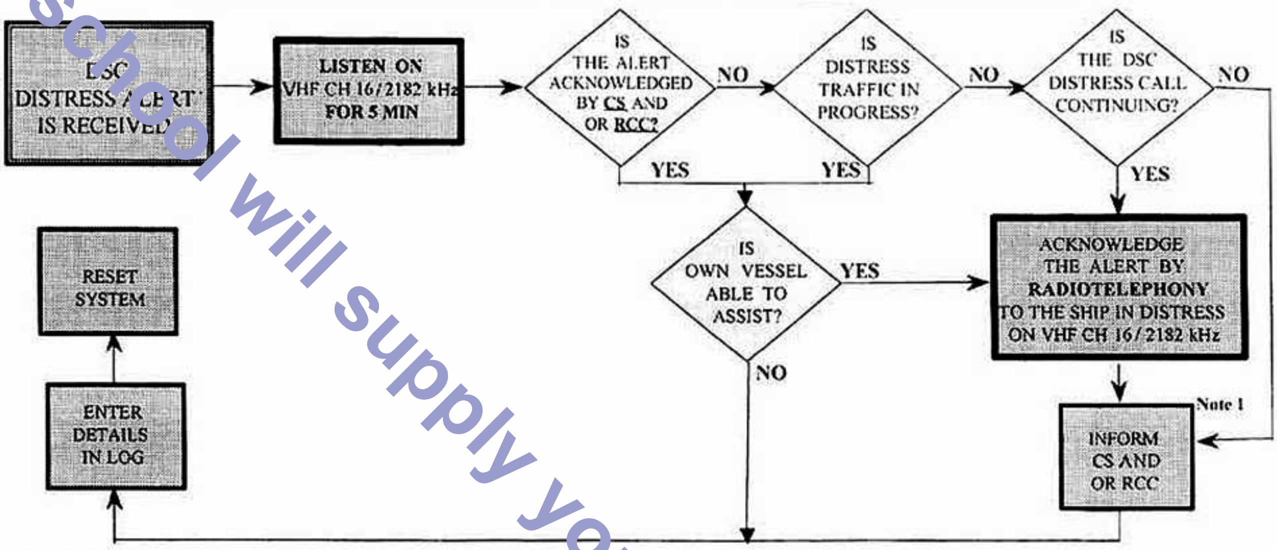
Your analysis should:

a. Identify the parties involved and their roles in the response and the devices used

b. Provide a justification for each step in the process

FLOW DIAGRAM 1

ACTIONS BY SHIPS UPON RECEPTION OF **VHF / MF** DSC DISTRESS ALERT



REMARKS:

Note 1 : Appropriate or relevant RCC and/or Coast Station shall be informed accordingly. If further DSC alerts are received from the same source and the ship in distress is beyond doubt in the vicinity, a DSC acknowledgement may, after consultation with an RCC or Coast Station, be sent to terminate the call.

Note 2 : In no case is a ship permitted to transmit a DSC distress relay call on receipt of a DSC distress alert on either VHF channel 70 or MF channel 2187.5 kHz.

CS = Coast Station RCC = Rescue Co-ordination Center

SECTION 2 BUOYAGE SYSTEMS

IALA Buoyage A*

IALA - A International Association of Lighthouse Authorities region A buoyage system

Pilotage is a inshore navigation system involving frequent use of five types of markers and a variety of markers with other navigation directives located in coastal and inshore waterways. Its use is to guide ships safely in and out of port so as to avoid collisions

The five type of markers are lateral, cardinal, isolated danger, safe water and special marks which can be shaped as cans, cones, spheres, pillars or spars.

Lateral marks

- These indicate port and starboard hand sides of the channel and are positioned in well established channels.
- The port mark is coloured red and has a basic top shape of a can as shown in Figure 28.1.

  At night the port buoy shows a red light and flashes to any of the sequences shown in Figure 28.3.
- The starboard mark is green and has the basic conical top shape. At night the starboard buoy shows a green light and flashes to any of the sequences shown in Figure 28.3.

Entering port or leaving a port using lateral marks

Upon entering port, the port hand mark (red) should be passed on your vessels port side as shown in Figure 28.1.

When departing a port, the port hand buoy (red) should be passed on the vessels starboard side as shown in Figure 28.2b.

Direction of buoyage

Where there may be doubt about where a shipping port is located on a chart, the direction of buoyage may be indicated by the symbol shown in Figure 28.1.

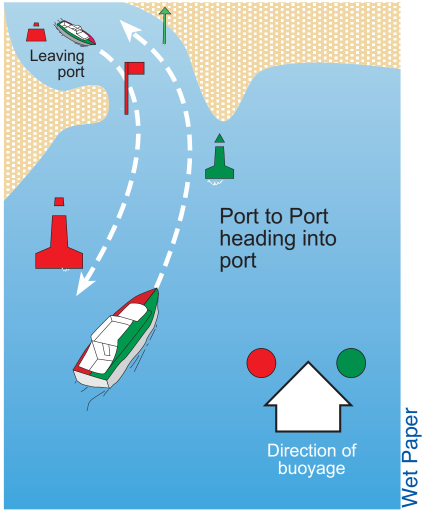


Figure 28.1 Buoyage rules

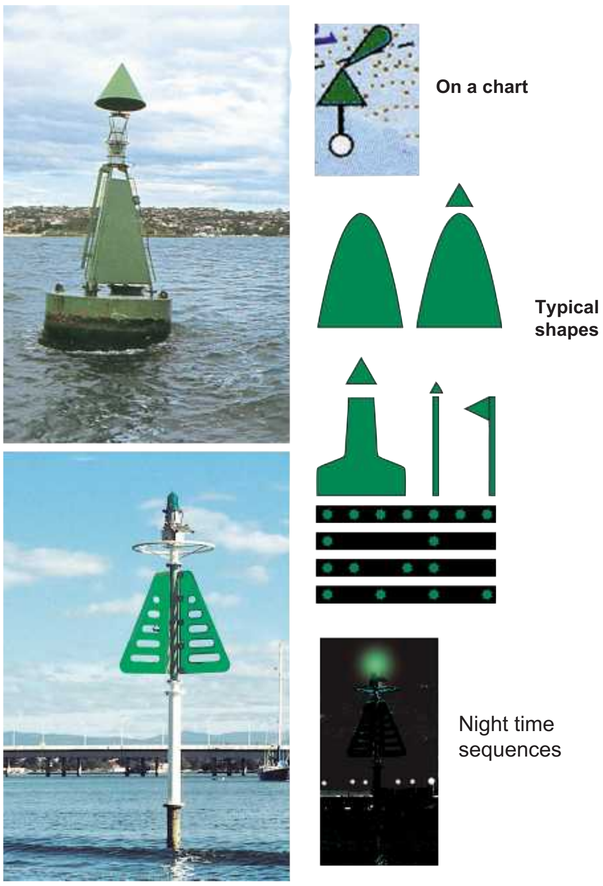


Figure 28.2 Lateral marks (Top marks courtesy TAFE NSW)

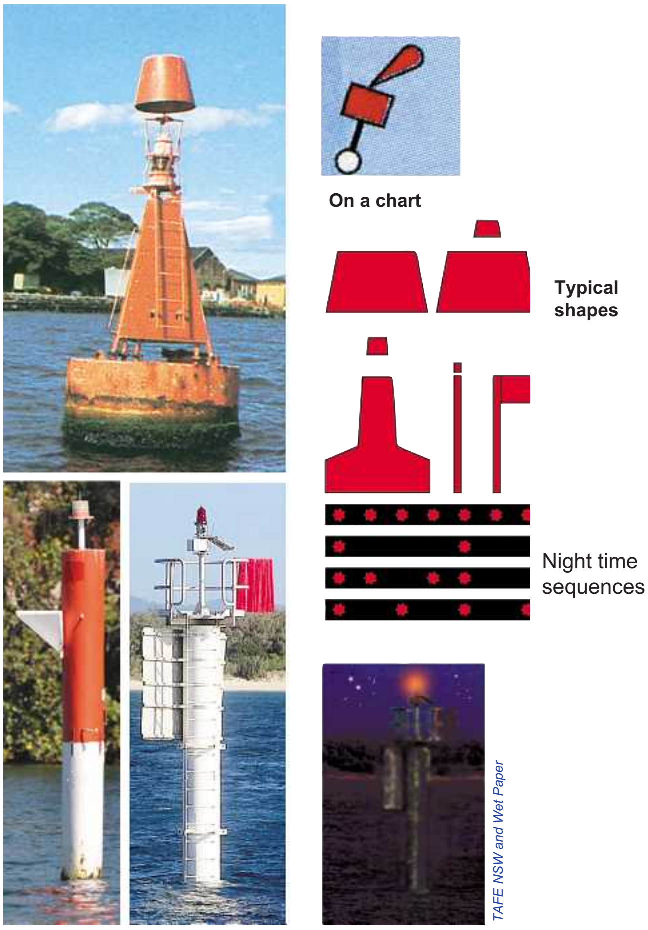


Figure 28.3 Lateral marking system including light sequences

Cardinal marks

A cardinal mark indicates where safest water may be found and is used in conjunction with the compass.

These marks are show in Figures 29.1 and include the following features:

- Two black double cones are clearly separated.
- Black and yellow horizontal bands with the position of the black band (or bands) relative to the respective cardinal points.

Figure 29.1 Cardinal marks (Courtesy TAFE NSW)

Figure 29.2 shows how cardinal marks could be used to navigate around a reef if the skipper passes north of the north mark, east of the east mark, south of the south mark or west of the west mark.

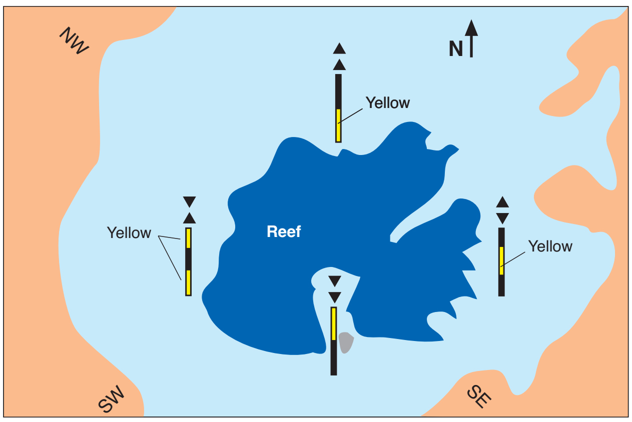
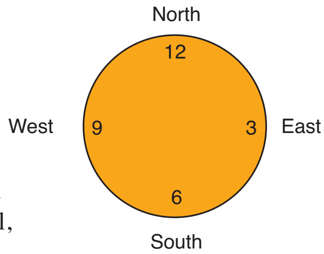


Figure 29.2 Cardinal marks protecting a reef (after TAFE NSW)

At night a white light flashes in a sequence that indicates the type of mark. The flashes are:

North	Uninterrupted continuous flash
East	3 flashes in a group
South	6 flashes in a group plus one long
West	9 flashes in a group

To help you remember this associate the number of flashes of each group with that of a clock face.



Isolated danger marks

These designate an isolated danger of limited extent which has navigable water all around it. For example an isolated shoal, rock or wreck.

These marks are black with one or more horizontal red bands.

The top mark has two black spheres positioned vertically and clearly separated.

The light comprises a white flash showing groups of two flashes.

The best way to remember this is by associating the two flashes with the two spheres.

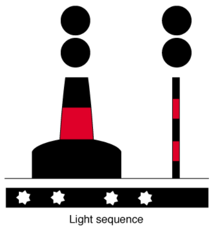


Figure 29.3 Isolated danger mark (Courtesy TAFE NSW)

Buoys, beacons and lighthouses

Buoys are used to delineate channels, indicate shoals, mark obstructions and warn the mariner of dangers. Buoys are floating aids that are anchored into position.

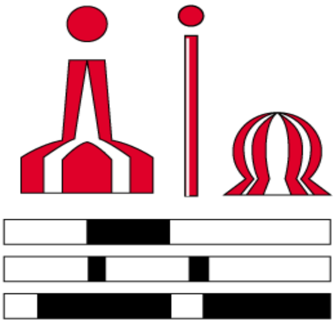
Safe water marks

These are painted with red and white vertical stripes and have one red ball on the top (see over).

They indicate that there is safe water beyond this point and are usually found at the end of a channel or when entering a port.

At night they flash with a white light followed by a period of darkness.

Safe water marks



Light sequence

Beacons

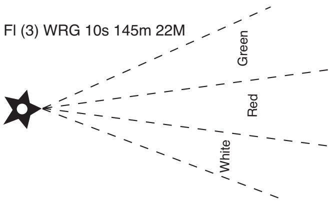
Beacons are fixed aids to navigation that are placed on the shore or in shallow water as shown opposite.

Beacon

Lighthouses

Lighthouses have characteristic flashes which are clearly marked on a chart.

The lighthouse below has a light that flashes three times and each separate sector is white, red and green in 10 seconds. The height of the light is 145 metres and the visibility is 22 nautical miles out to sea.



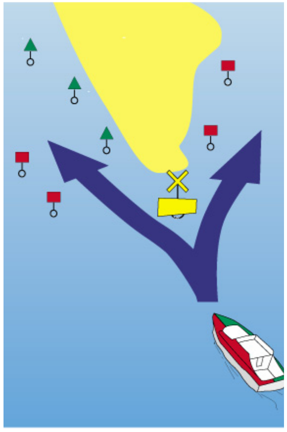
A lighthouse and its chart symbol

Special marks

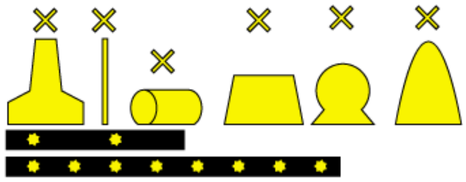
These indicate a special feature such as a cable, outfall pipe, recreational diving area or ground marks. They also define a channel within a channel. For example a channel for deep draught boats in a wide estuary within the limits of the channel for normal navigation. Generally they are used where no other mark can be so the top of the mark carries a single yellow cross.

At night they show a yellow light with any light sequence (other than that used for the white lights or cardinal, isolated danger and safe water marks).

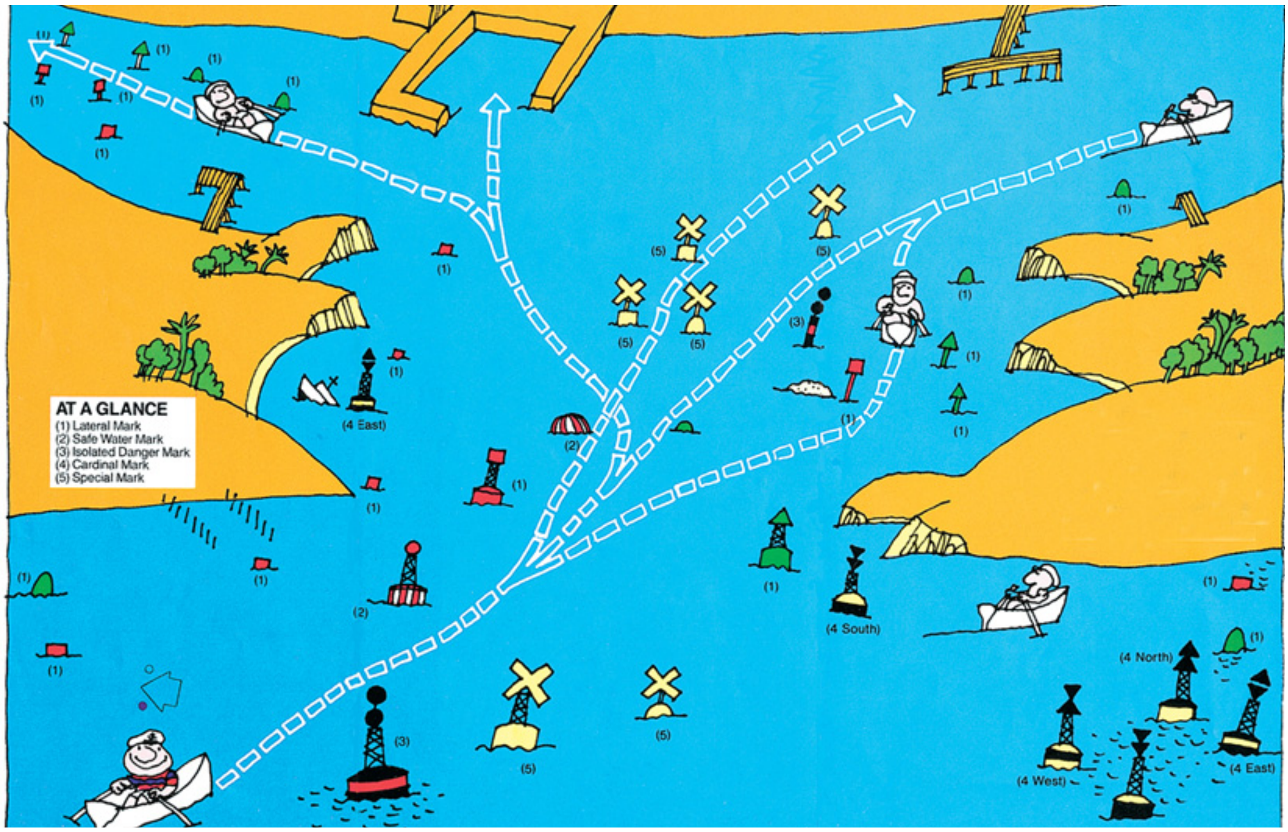
When you see a special mark – consult your chart.



Wet Paper



Special marks



Summary of buoyage system (Courtesy Qld Transport)

Navigation directives

Lead lights

- Leads marked on a chart are used to guide boats into port or through restricted channels in waterways.
  - If following leads, keep them open "half a board" to starboard so that you stay on the starboard side of the channel and turn where the solid line ends.

Leads in-line

Leads open half board to port

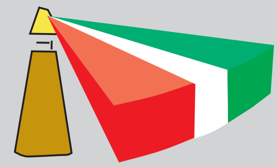
Wet Paper

TMR

LEADS AND LEADING LIGHTS

Sector and directional lights

- These are also on charts to help you navigate inshore waters.
  - A directional light may only show a small arc, eg, 70 degrees and is similar to a leading light.
  - A sector light has different colours as shown in the illustration opposite.
- It is essential to consult the chart for information regarding these lights.



SECTOR LIGHT

Wet Paper

TMR

Cable crossings

- Often telecommunications companies run extremely expensive cables along the sea bed.
  - To protect these, warning signs like the one shown opposite are erected on shore to advise no anchoring or dredging.

Anchorages

- The little red anchor on the yellow background in the illustration opposite shows how anchorages are marked on a chart.

TMR

ANCHORAGE

Boat ramp signs

Datum checking - fixed points at boat ramps

- The Qld Government is erecting signs at boat ramps to assist people in checking their GPS.
  - It is advisable to switch the unit on and select the correct chart datum before departing. Many boat ramps have signs showing datum points.

Bob Moffatt

DATUM CHECKING SIGN

Bob Moffatt

CABLE CROSSING SIGN

Marine reserves

- These signs will show protected species, zones with navigation co-ordinates, closed seasons and marine environment protection information.

VMR/Coast Guard services

- The call sign and name of the local marine rescue service is shown with contact details and what and when the service is offered.

Water ski areas

- These will show designated zones and hours of operation, along with penalties for infringements.

Bob Moffatt

BOAT RAMP SIGNAGE

Worksheet 4: IALA Buoyage A

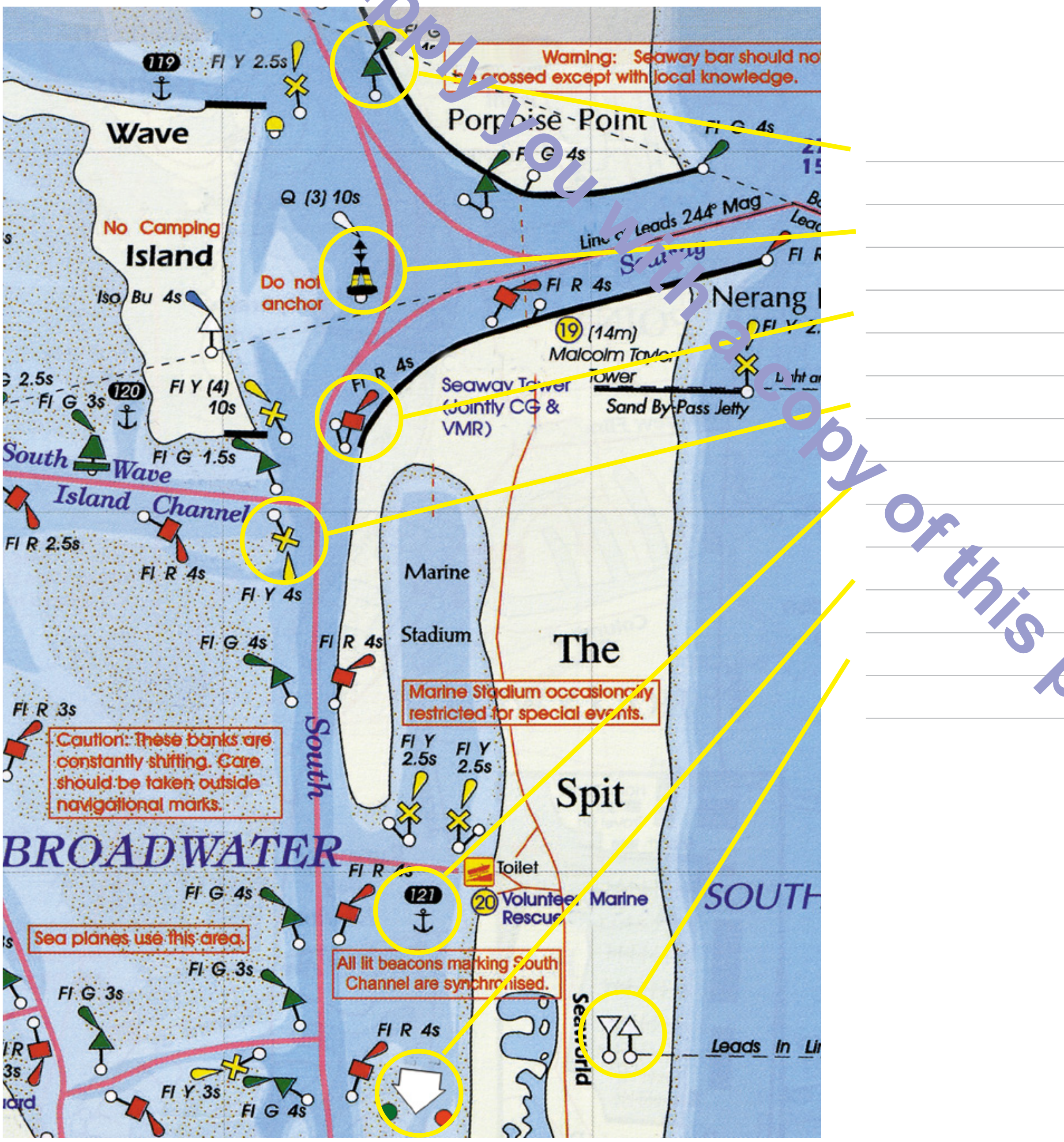
Q1. Define the term pilotage and state its use (Page 28)

Q2. List the five types of IALA markers and describe their possible shapes (Page 28)

Q3. State the rules using these markers, for entering and leaving port (Page 28)

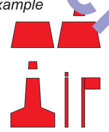
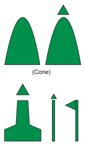
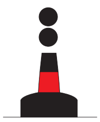
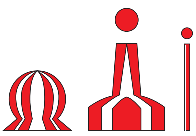
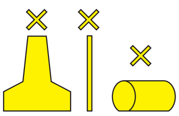
Q4. Explain how a skipper knows the location of a main shipping port on a chart (Page 28)

Q5: Identify the following on the chart below by drawing lines to them. (Pages 28 - 31)



Q6. Explain why the correct chart datum and chart software is used with a GPS when operating vessels in marine environments (Page 10)

Q7. Complete the table below to identify the marks, flags and lights shown in the first column.

Beacon	Day shape	Side to pass	Colour	Light colour	Flashing sequence
Example  Port lateral mark	*Can*	*When going into port pass on port side*	*Red*	*Red*	*Various Check the chart*
					
					
					
					
					
					
					
					

Section 3 Establishing research sites

Charts are used to establish research sites and come in different scales. Large scale charts cover large areas of coastline and allow planning of longer voyages as shown in Figure 34.1 whereas planning a research site involves a small scale chart which show greater detail.

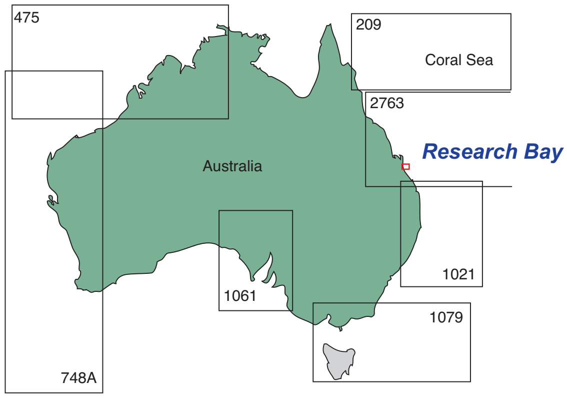


Figure 34.1 Large scale charts allow planning of voyages
Wet Paper

Research bay

Figure 34.2 shows a small chart entitled Research Bay, an adaptation of the Cape Hillsborough Channel 1964 practice chart prepared by the Hydrographer for the Navy.

To complete the rest of this section you need to print out the A3 version of this chart, which can be found at the wet paper web site. As you will have logged in to read this flipbook, you go to the resources section, locate this book and download the file called Research Bay A3 chart:

www.wetpaper.com.au/resources

Internet maps and research bay

You can locate the islands on Research Bay on the internet. Just type in Brampton Island, Queensland and you should get something like that shown in Figure 34.2. Now use the scales to locate the islands and reefs in Figure 34.3.

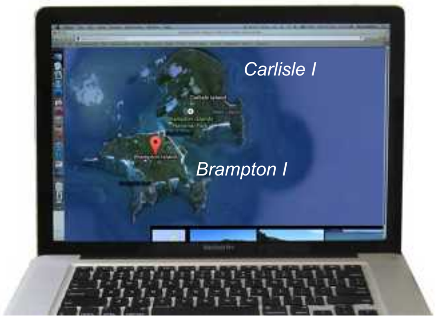


Figure 34.2 Research Bay as seen on the internet
Wet Paper

In the centre is the compass rose which tells us when the chart was made and the variation for the year. The latitude scale is at the side and the longitude at the bottom.

For the purposes of exercises, Brampton Island is the research base from which research expeditions are undertaken in Research I a 45 metre research vessel anchored in Maryport Bay.

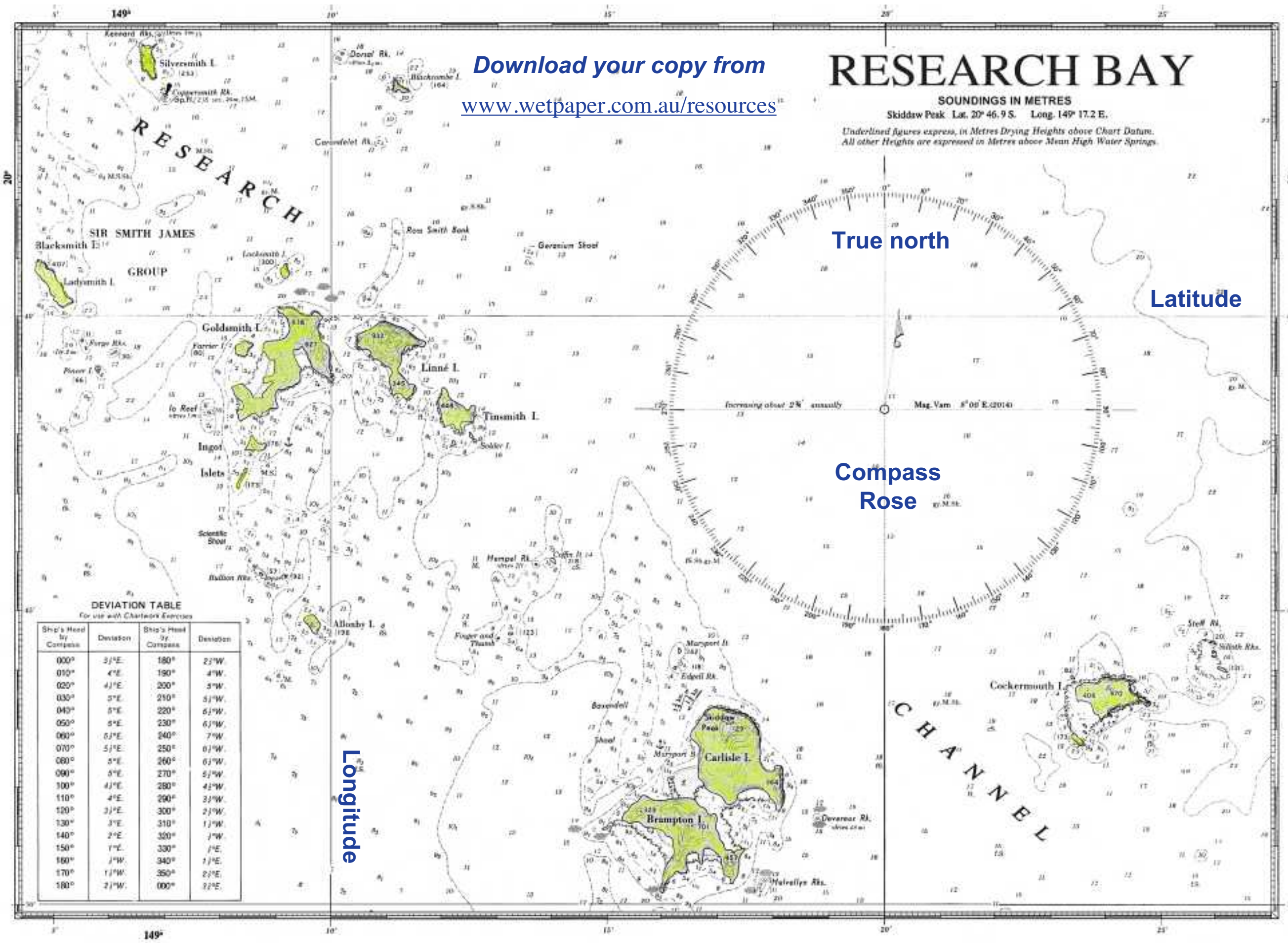


Figure 34.3 Small scale charts allow planning of sites
Wet Paper

Anchorages and island topography

A safe anchorage is necessary for all work in a research site. Figure 35,1 shows that Carsile and Brampton Islands are protected from the wind and waves on any part of the island.

Internet maps

Some of the features that need to be considered when selecting a offshore research site are facilities such as fresh water, camping, chart features, anchorages, tides, currents.

Internet maps will also show some features on a chart. For example, look at the south eastern tip of Brampton Island. Goggle maps will show areas of sand, reef hills and rocks as well as some information on water depth.

Compare these with the chart features,

Admiralty chart booklets have the definitions of many more chart features.

Soundings and tidal datum

This is the depth of water calculated from mean low water mark.

- Locate. Devereux Rock South East of Carlisle Is. Notice at mean low water it dries at tide height of 4.5 metres.
- Notice that around Carlisle Is, there are reefs, rocks and sandy beaches and that the depth of water varies around the island
- Near Edgell rock there is information about the speed of the current caused by a tidal flow.

Chart tidal datum

Chart datum is the level of water that charted depths on a nautical chart are measured from.

Figure 35.2 shows that the datum is derived from the lowest point of mean low waster springs.

Chart block

- At the top of the chart is the chart block which identifies the chart features. Notice
  - Depth of water is marked by soundings and these are in metres and these are reduced to mean low water spring. Note: Many chart blocks use lowest astronomical tide as the datum.
  - Places are located by Latitude and Longitude.
  - Positions are related to world geodetic system 1984 datum (WGS 84)

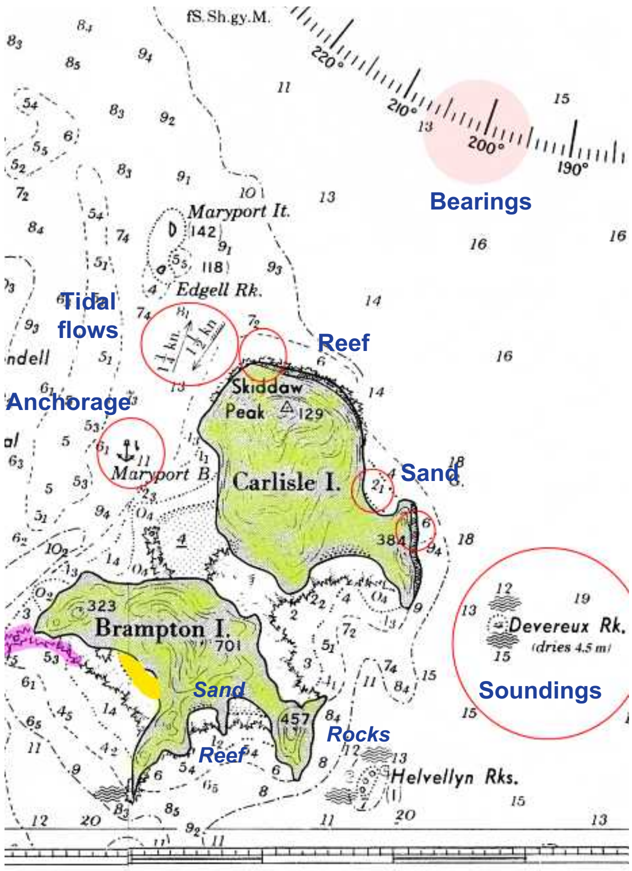


Figure 35.1 Chart features and soundings as seen on chart
Wet Paper

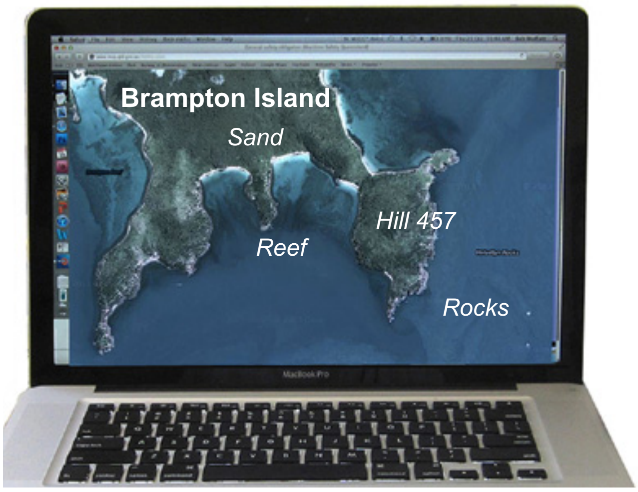


Figure 35.2 Chart features and soundings as seen on internet
Wet Paper

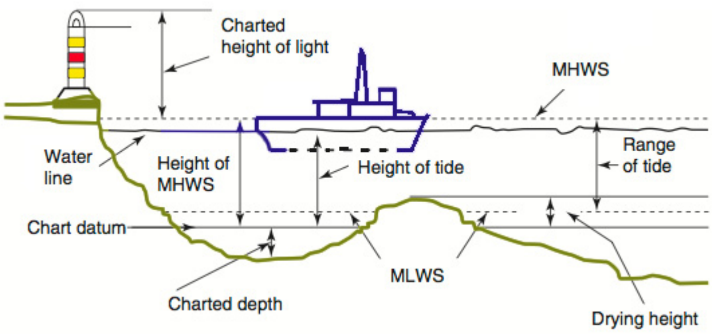


Figure 35.3 Tidal terms of reference to a chart datum
Wet Paper

Figure 35.4 Research I
Wet Paper

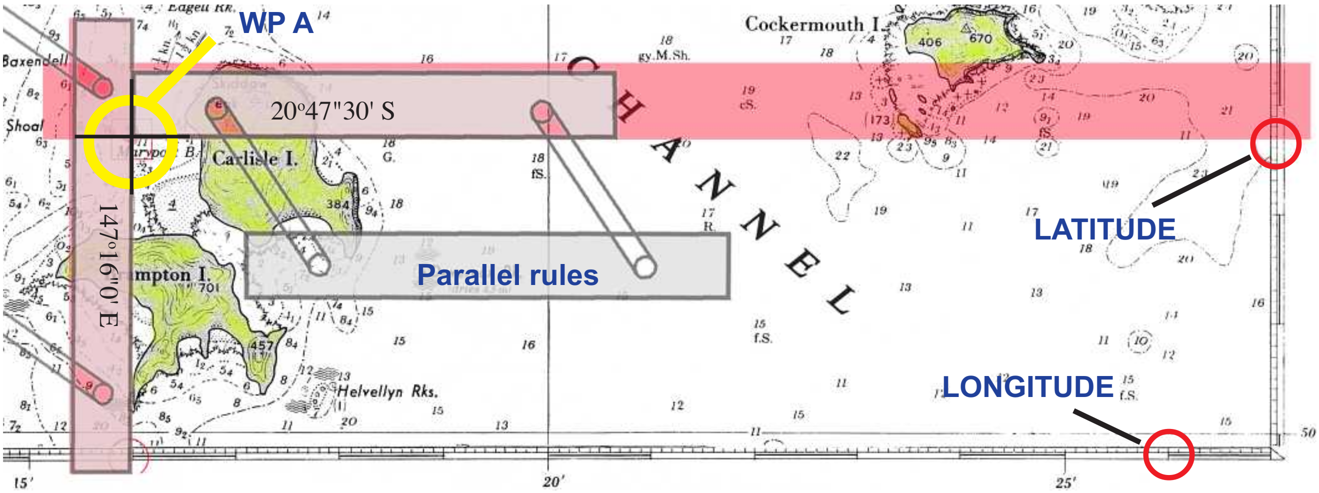


Figure 36,1 Latitude and longitude by chart
Wet Paper

Latitude and longitude

Lines of latitude run around the globe and are parallel with the equator. Lines of longitude run as meridians east or west from a suburb of London called Greenwich.

Waypoints

Waypoints are sets of coordinates that identify a location at a particular place.

Example

Find the anchorage at Maryport I and using a ruler mark the ships position with a square and a waypoint - WPA.

Use a ruler as shown above to find latitude 149°16' E and then longitude 20° 47.30' S.

Now locate a second position WPB as shown in Figure 36.2 find the latitude and longitude and mark as WPB.

Question

What is the latitude and longitude of Skiddaw Peak on Carlisle Island? Did you get Lat 20°46.10' S and Long. 149°17.2' W?

Accuracy of GPS positions

The photograph below shows the inaccuracy of a GPS on a charter boat over a 3 week period.

According to the skipper the vessel maybe 100m away from its pontoon, some days it is on the other side of the canal, sometimes on the land and other times on the other side of the street.

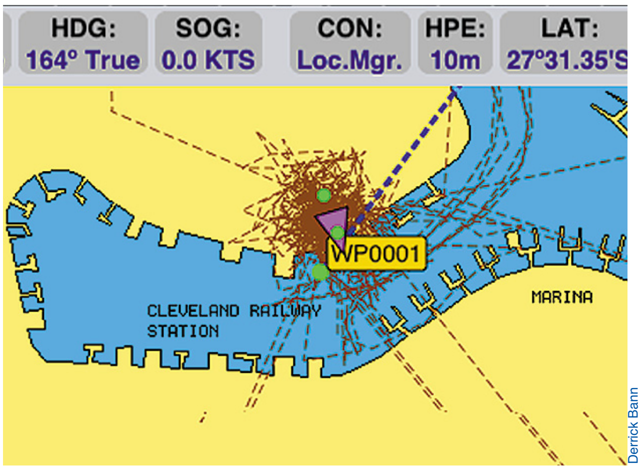


Figure 36.4 Latitude and longitude by GPS
Copyright Derrick Bann (Reproduced with permission)

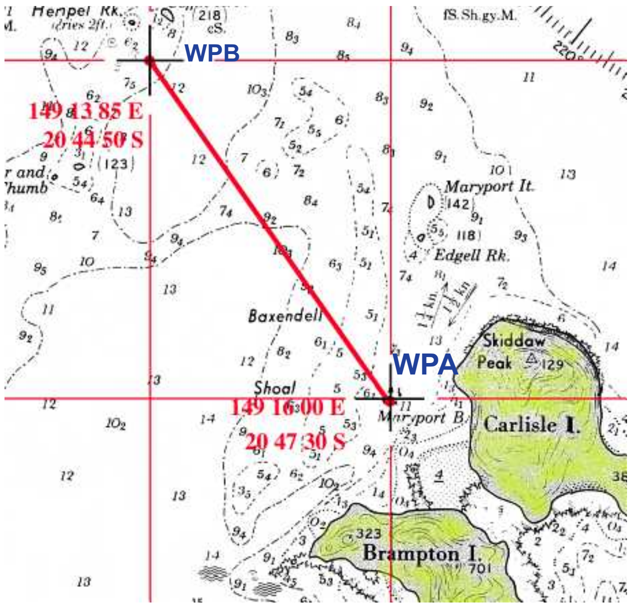


Figure 36.2 Latitude and longitude by using a manual chart
Wet Paper

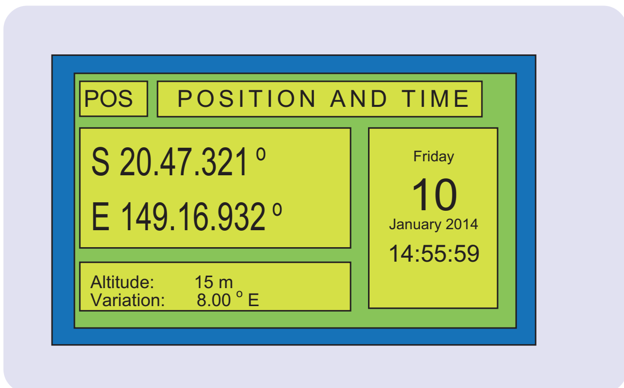


Figure 36.3 Latitude and longitude by GPS
Wet Paper

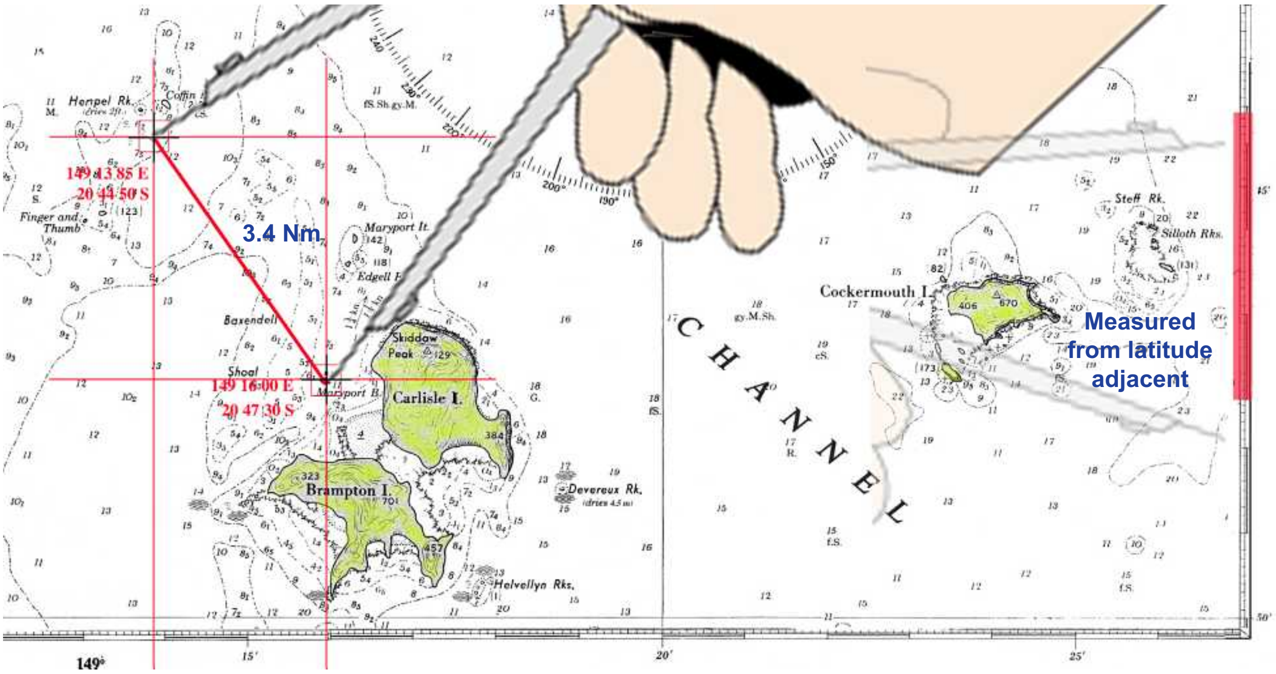


Figure 37.1 Nautical mile
Wet Paper

Distance speed and time

You will need

A ruler and the A3 Research Bay Chart

www.wetpaper.com.au/resources

The nautical mile

Because the Earth's surface is divided up in degrees and minutes, kilometres and metres are not used. The scale of measurement used is the **nautical mile**, which is represented by one minute of latitude.

Because of variations due to the chart's distortion, distance readings should be taken from the latitude scale at a point approximately level with the boat's position.(Figure 37.1).

1 Nautical Mile = 1 Minute of Latitude

- Locate waypoints WP1 and WP 2 as shown in Figure 37.1.
- Now spread your dividers and measure the nautical miles between the two points as shown. You should get 3.4 Nm.

Speed and distance

Speed is the total distance travelled, divided by the total time taken, and can be summarised in the magic triangle as shown in Figure 37.2.

The speed of a vessel is measured by a speed log as discussed earlier and is measured in **knots**.

The nautical mile is equal to a boat travelling at one knot for one hour in completely still water.

Question

How long will it take to travel from WP1 to WP 2 if Research I travels at 3 knots straight into the current from Research Channel?

Time = Distance/Speed so we have measured 3.4 nautical miles and divide this by 3

Ans: 1.14 hours one 1 hour an approx 8 minutes

Question

- How long will it take for her to travel back if she can make 5 knots with the current from Research Channel?
  - Did you get 0.68 hrs or 40 minutes?

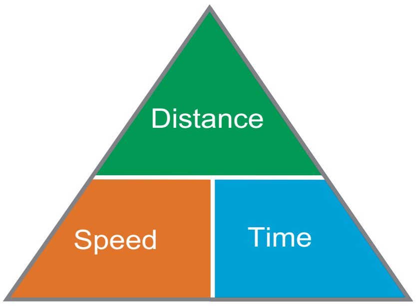


Figure 37.2 Formulas for distance, speed and time
Wet Paper

Factors affecting speed

Some of these include the state of the ships engines, the engines hp, the skill of the helmsman, wind, tide and current.

For the purposes of the following exercises, it will be assumed that engines are run at a constant revolution and all other factors for example current, wind, tides etc, have no affect on the calculations.

Worksheet 5: Locating a research site

Questions

Q1. List some of the features that need to be considered when selecting a offshore research site (Page 35).

Q2. Locate the following possible research sites latitude and longitude on the A3 version of Research Bay Chart: Hempel Rock, Coppersmith Rock Lighthouse and Hill 670 Cockermouth Island and Devereux Rk. (Download A3 Chart from www.wetpaper.com.au - Resources section)

a) Hempel Rock

b) Coppersmith Rock Lighthouse

c) Hill 670 Cockermouth Island

d) Devereux Rk

Q3. Calculate distance speed and time for the following information for a research boat. (Page 37)

a. How far can the boat travel in 10 hours if she is travelling at 9 knots?

b. How far can the boat travel in 6 hours at a constant speed of 4 knots?

c. For 2 hours she travels at 10 knots, and for the next 3 hours she can only make 5 knots. How far has she travelled?

d. The boat travels 10 Nm in two hours. How fast did she go?

e. The boat left harbour at 7 a.m. and travelled 5 Nm to a research site arriving at 10 a.m. How well did the boat perform?

f. How long did it take a skipper of a vessel to travel 20 Nm at an average speed of 5 knots?

g. Your research boat is travelling at 4 knots and your navigator predicts 32 Nm to go. How many hours will it take to reach your destination?

Q3. Define the term chart tidal datum (Page 35)

Q4. Calculate the distance and departure time from the Anchorage at Maryport Bay off Carlisle Island to a position north east of Geranium Shoal Lat: 20° 44' S, Long: 149° 16.00' E using the following information.

Research vessel can do 6 knots and draws 1.9 m and is grounded on the 0.4 m mark at Brampton Island.

Estimate the ETD for the morning of 4 January and how long will it take to get to Lat: 20° 44' S, Long: 149° 16.00' E? Use the tide tables in Figure 38.1 .

Tide tables for Brampton Is

Date	Time	m	Date	Time	m
Jan 1	0221	0.99	Jan 4	0409	1.26
	0815	2.32		0930	1.93
	1424	0.51		1559	0.54
	2101	2.55		2252	2.66
Jan 2	0252	1.06	Jan 5	0502	1.99
	0835	2.22		1007	3.32
	1452	0.49		1642	0.71
	2133	2.58		2301	3.55
Jan 3	0321	1.16			
	0900	2.06			
	1524	0.51			
	2201	2.55			

Figure 38.1 Tide tables for Brampton Is

The compass rose

The compass rose is printed on charts to indicate direction and is aligned with the True or Geographic North.

A small half arrow head is printed inside the rose indicating the direction of the Magnetic North Pole and the angle between True and Magnetic is printed across the centre of the rose with the date of the last determination of the rate of change.

Figure 39.1 shows the variation at 8º E increasing 2.75' annually.

Magnetic effects on the compass

All navigators need to understand how a compass guides the ship as well as the errors caused by the Earth's magnetism and the steel in the ship.

Figure 39.1 shows the Earth's magnetic field and explains why charts are corrected for east or west variations. The two most significant errors are variation and deviation.

Variation

Variation is the error caused by the magnetic and true poles being in different places.

Error is defined as the angle between True and Magnetic North caused by the Magnetic North pole moving. It effects itself in every compass by deflecting the needle away from the true north until it is pointing at Magnetic North.

There may be a difference of up to thirty degrees or more between these poles and this is obviously a factor which must be taken into consideration when steering a course or taking bearings.

The deflection may be to the east or the west of True North, and varies as the boat progresses across the surface of the Earth. However, it is well plotted, and is listed on every chart so that the navigator can be immediately aware of its value.

Once found, the error is constant for that area, and changes only slowly as the boat progresses.

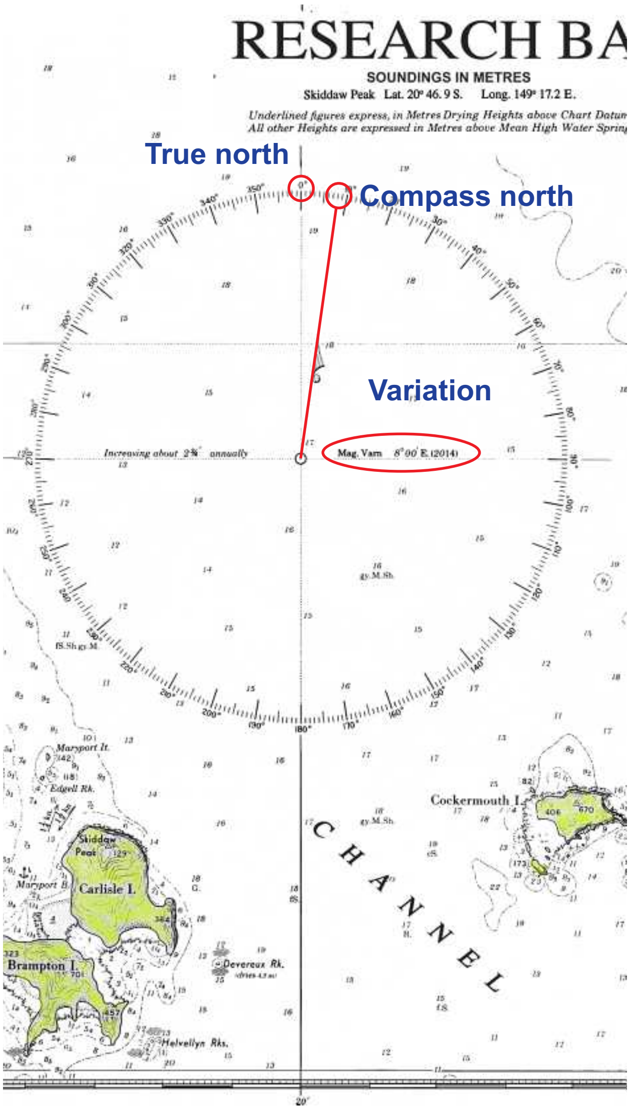


Figure 39.1 Compass rose
Wet Paper

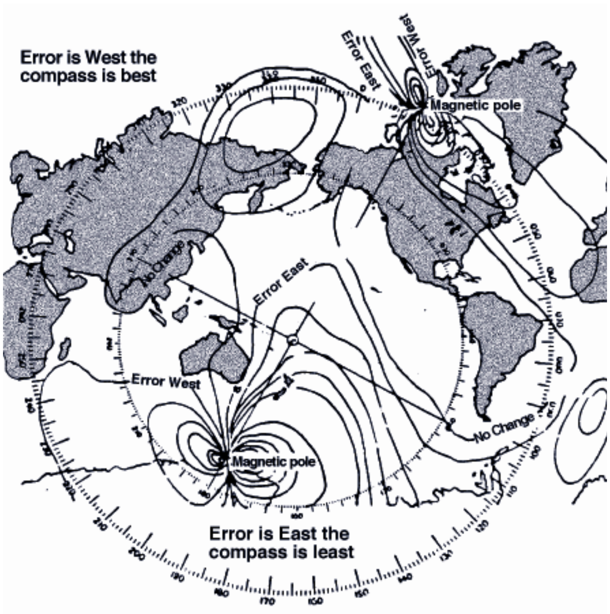


Figure 39.2 Magnetic North is now in Hudson Bay Canada.
Wet Paper

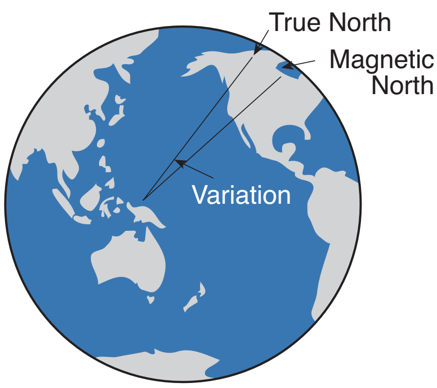


Figure 39.3 Variation
Wet Paper

Compass conversions

In any location, the Earth's magnetic field is at an angle to the meridians of longitude, and so your compass (either steering or hand-bearing) does not point to the True North of the longitude lines on the chart.

Because of this we end up with three types of angular bearings which need to be interpreted for navigation.

True bearings

These are relative to True North and are taken off the compass rose on the chart or measured with a protractor against the grid lines of the chart.

- These are usually written with a T after the angle, eg 32°T means an angle of 32° to the True North of the chart.

Compass bearings

Compass bearings are relative to the Earth's magnetic field lines in the area, and are read off the hand bearing compass or the steering compass.

- Usually written with a C after the angle, eg 165°C means an angle of 165° to the Earth's magnetic field in that area.
- The bearing (or direction) from one position to another on a chart is found by drawing a line through the compass rose that is parallel to the line joining the position.

Variation

This is the local *variation* (for the particular year). It is taken off the compass rose information on your chart, and is always given in the direction of east or west to indicate which way the magnetic field lines are pointing as well as how far. Figure 43.1 shows the variation.

- The variation was measured in 2014 as 8° 00'E

Variation conversion rule

To convert between true and compass bearings we use the CADET rule:

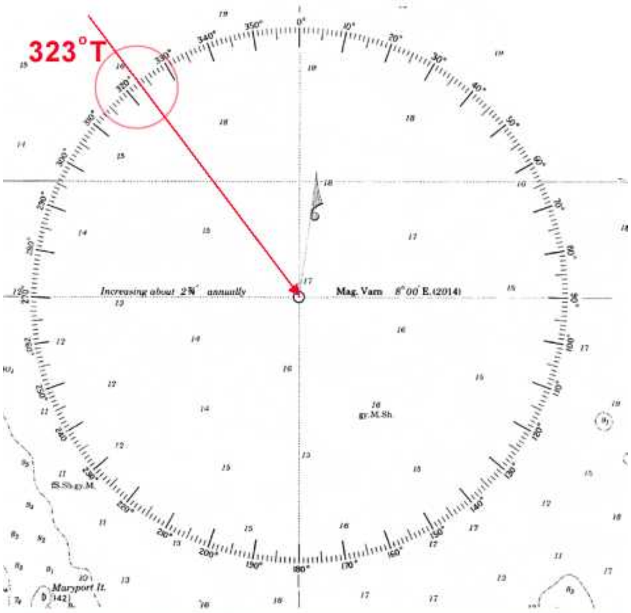
CADET: Compass ADd East to get True

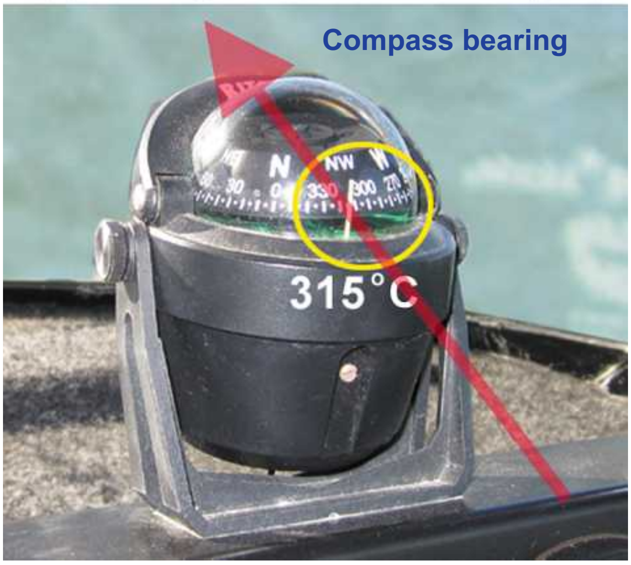
C → T: + E / - W

T → C: - E / + W

The table below shows some examples of converting true chart bearings to compass bearings.

True bearing





Compass bearing converted
Wet Paper

Example	a.	b.	c.	d.	e.
True bearing	323°T	85°T	243°T	5°T	356°T
Variation (error)	8°E	5°W	10°E	10°E	12°W
Compass bearing	315°C	90°C	233°C	355°C	8°C

In example d. think of 5°T as 365°T before you subtract the 10°. In example e. 356° + 12° = 368°, which becomes 8°C.

Deviation

As discussed earlier this error is due to the effect of each ship's individual magnetic field on the Earth's magnetic field (Figure 41.1). It is found by creating a deviation card by swinging the compass around a known mark .

Deviation conversion rule

This rule indicates the steps to be taken in changing from Compass to True (left column) and True to Compass (right column).

The rule can be remembered by writing the letters CDMVT in either the forward or reverse direction as shown in Figure 41.1.

The end result is the ships head or direction in which the ship is steered as shown in Figure 41.3.

Worked example (Variation and deviation East

Which direction do you steer a boat if you want to go 50º True North out of Sydney heads if the deviation from the compass adjusters statement is 8ºE and the variation for this year is 10ºE?

Because you are working from True to Compass, the CDMVT rule is written backwards.

T = 50º T (true bearing)

V = 10ºE (rule: error east compass least)

M = 40ºC (compass bearing)

D = 8ºE (deviation from ship's table)

C = 32ºC (error east compass least)

Course to steer = 32ºC **ANS**

A ship's heading

This is the heading of a vessel in degrees and is calculated from a chart's variation and ships deviation table.

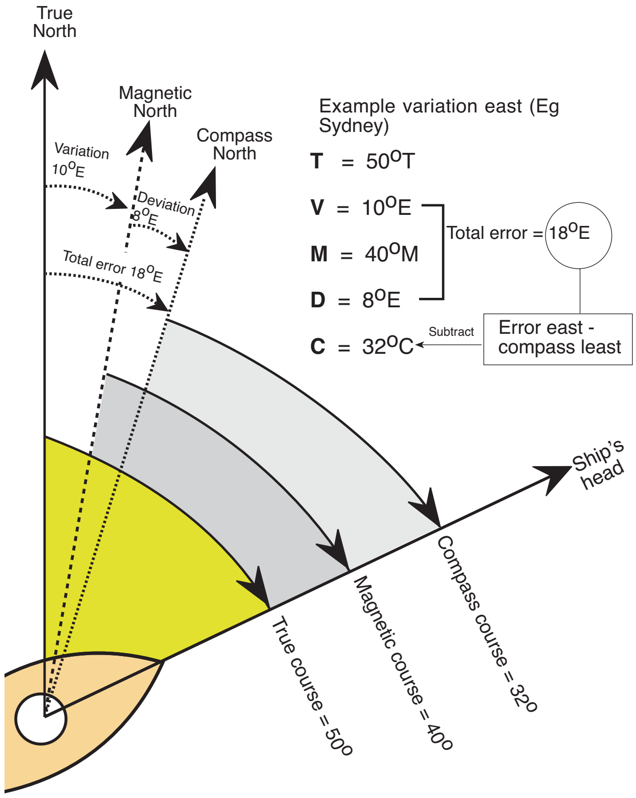


Figure 41.2 Variation east
Wet Paper

Compass/true conversions rules			
Conversions from compass to true (generally bearings)		Conversions from true to compass (generally courses)	
C an	**Compass**	**T** ele	**True**
D ead	**Deviation**	**V** ision	**Variation**
M en	**Magnetic**	**M** akes	**Magnetic**
V ote	**Variation**	**D** ull	**Deviation**
T wice	**True**	**C** ompany	**Compass**
To determine weather to add or subtract errors on the way through, note the following			
CADET: Compass ADd East to get True			
C → T (+ E, - W)		T → C (- E, + W)	

Figure 41.1 Conversions rules
Wet Paper

Worked example (Variation East and Deviation West)

Which direction do you steer a boat if you want to go 170º True South out of Sydney heads if the deviation from the compass adjusters statement is 12ºW and the variation for this year is still 10ºE?

Ans

Again you are working from True to Compass, the CDMVT rule is written backwards.

T = 170º T (true bearing)

V = 10ºE (rule: error east compass least)

M = 160ºC (compass bearing)

D = 12ºW (deviation from ship's table)

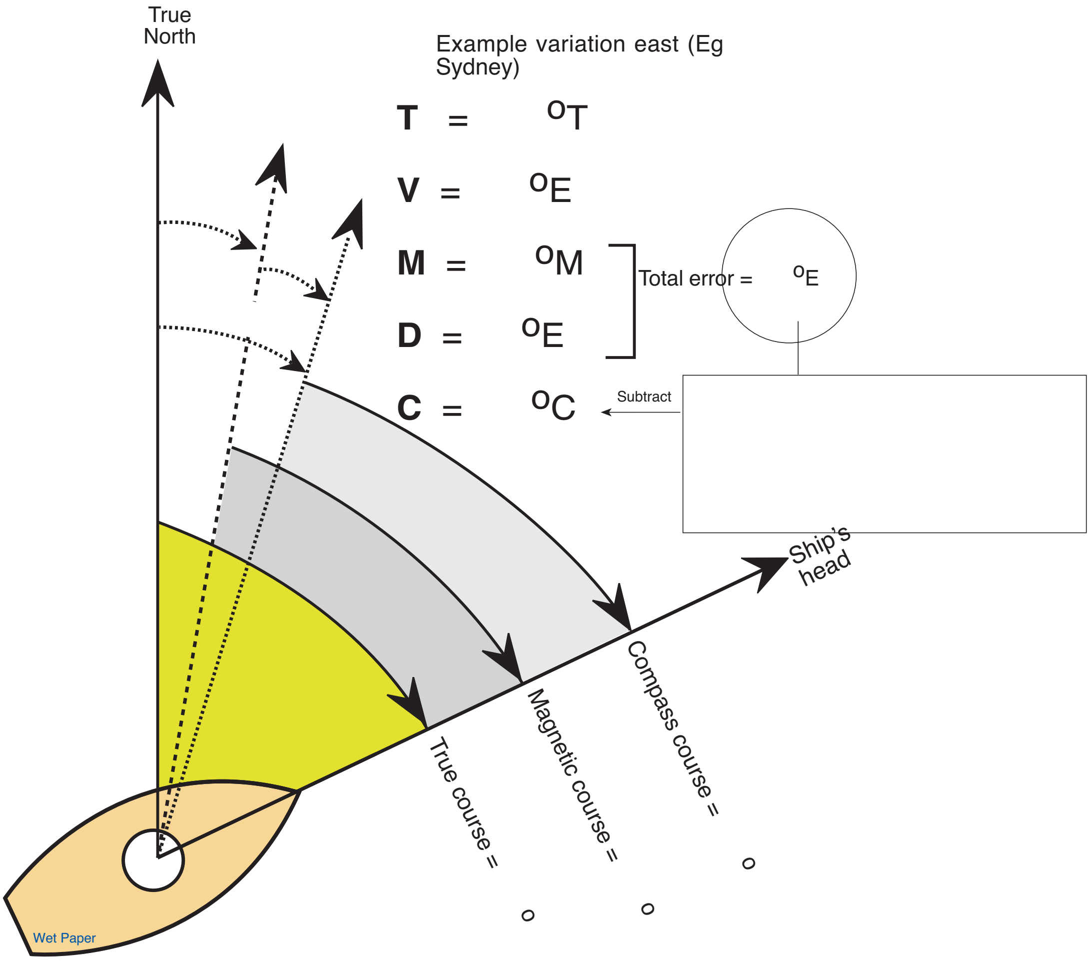
C = 172ºC (error west compass best)

Course to steer = 172ºC **ANS**

WORKSHEET 6: CALCULATING A COURSE TO STEER

Questions

Q1. Explain the meaning of the term ships head by completing the illustration below (Page 41)



Q2. Define a ship's heading (Page 41)

Q3. Calculate the ships head from the information in the table below (Pages 40-41)

Variable	a.	b.	c.	d.	e.
True bearing	323°T	85°T	243°T	5°T	356°T
Variation (error)	8°E	5°W	10°E	10°E	12°W
Compass bearing - Ship's Head					

Plotting a course to a research site

Before leaving you should study the chart along the path you would like to go. As you study the chart you should take particular notice of any dangers involving depth, currents and tides and shipping channels.

When you have decided your course you should then mark the course. Any dangers should be avoided and at least (if possible) one mile (to 5 miles) should be marked around the danger as shown in the safe margin lines in Figure 43.1.

If it is a lee shore then a greater margin of safety should be marked. To mark this danger a circle is best used around the danger and your course is to go around it.

You will need

Research Bay Chart (A3 version)

www.wetpaper.com.au/resources

- set of squares

Aim

In this example we are going to calculate a course to steer using two waypoints WP03 and WP04 using the A3 practice chart and the deviation table for our vessel Research I.

We have checked and marked the dangers and the weather and a confident that conditions are safe

What to do

- Mark in the Waypoints WP03 and WP04 as shown in Figure 43.1 as

  WP 03 20° 48.4' S 149° 19. 3' E (Devereux Rk)

  WP 04 20° 46.5' S 149° 22.8' E (Cockermouth I)

- Now take the normal set of squares and mark the sides with a series of dots and crosses with a felt pen as shown in Figure 43.1.
  - Place the hypotenuses of one square on the line you have drawn form WP03 to WP04 and match the dots with the other as shown .
  - Slide the dots until the hypotenuse of the second square passes through the centre of the compass rose and read off the bearing.

    You should get 64 degrees - the True bearing in 2014 when the chart was made.
- If you look in the centre of the compass rose you can see the variation for 2014 is 8°E so this has to factored in when calculating the course to steer

  The rule is if the error is East the Compass is least

  So we take off the variation as follows

  64° T - 8°E = 56°M (the M is for magnetic)
- BUT this is not the only error as our ship is affected by the Earth's magnetic field as well and this error is called deviation as discussed earlier).

  We need to go to the ship's deviation table now and read the error for 56°M which is 5.25°E

  So again if the error is east the compass is least and we subtract the deviation error making 50.75°M
- So 50.75°M is the course to steer the ship.

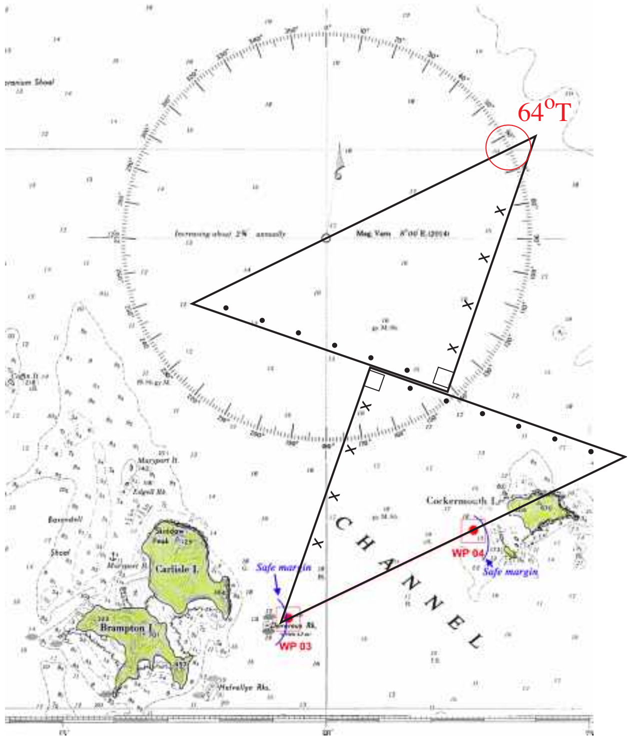


Figure 43.1 Mark your squares with dots and crosses
Wet Paper

DEVIATION TABLE
For use with Chartwork Exercises

Ship's Head by Compass	Deviation	Ship's Head by Compass	Deviation
000°	3½°E.	180°	2½°W.
010°	4°E.	190°	4°W.
020°	4½°E.	200°	5°W.
030°	5°E.	210°	5½°W.
040°	5°E.	220°	6½°W.
050°	5°E.	230°	6½°W.
060°	5½°E.	240°	7°W.
070°	5½°E.	250°	6½°W.
080°	5°E	260°	6½°W

Deviation is 5.25°E

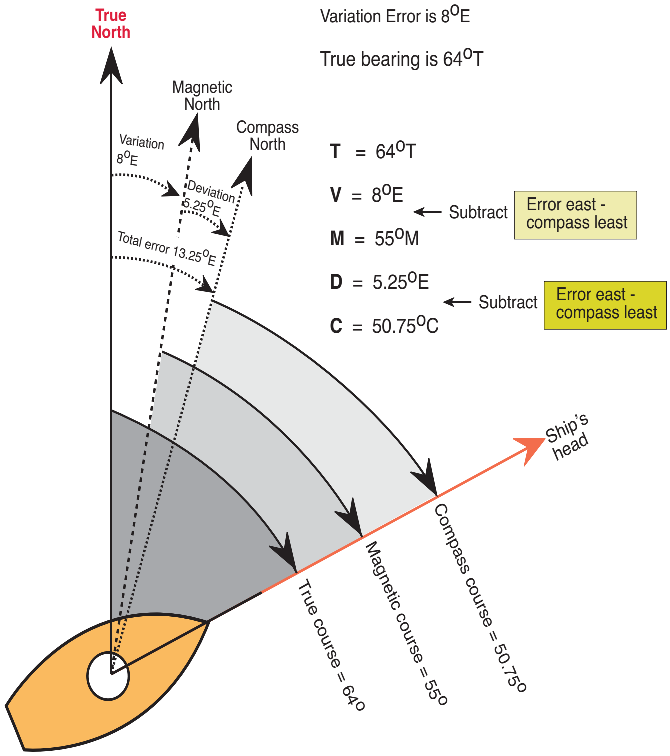
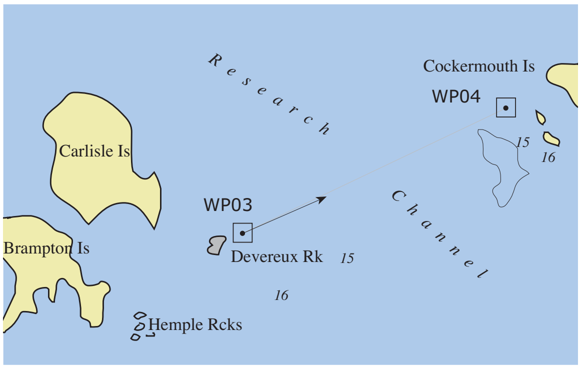


Figure 43.2 Ship's head
Wet Paper

Chart plotter and GPS

If we had a chart plotter with a vector chart we would probably see the following on the screen.



Plotting a course from a research site

Worked example

You will need

- Research Bay Chart A3 version
- set of squares

Aim

In this example we are going to calculate a new course to steer once we have reached our initial destination.

What to do

- Mark in the new Waypoints WP05 WP 05

  20° 46.30' S 149° 16.90' E   (Carlisle Is)

  as shown in Figure 44.1.

Plotting the new course

Step 1: Work out the new true bearing

Now realign you squares as shown in Figure 44.1 so you can read off the true baring of 274.5°T

Step 2: Calculate the errors (see CADET rule)

The variation is still 8°E so we subtract

274.5°T - 8°E = 267.5°M

Look up the deviation for 267.5°C and this approx. is 5.5 °W

so we add

 267.5°M + 5.5 °W = 373°C

So our course to steer by compass is 373°C to get to WP 05

So how long will this take

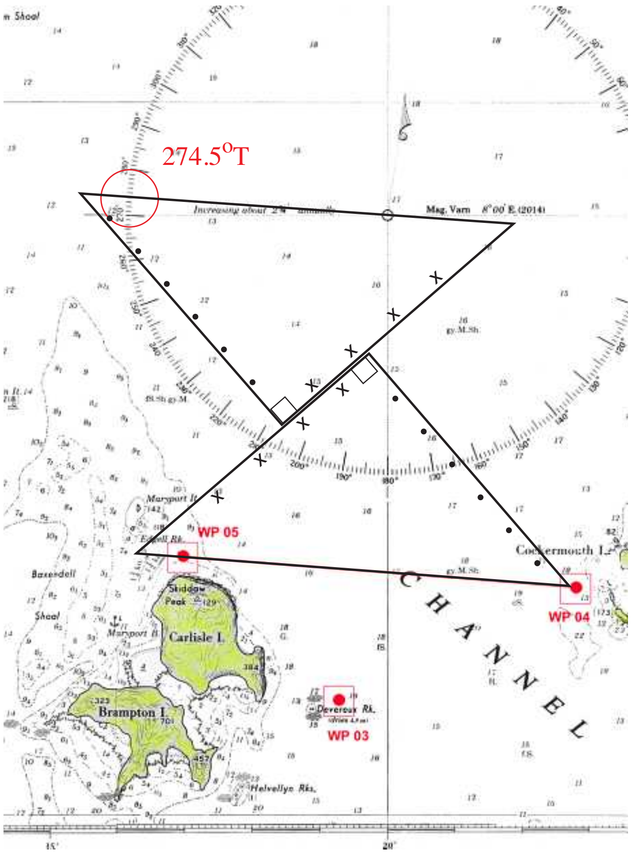
Let us assume its at the top of the tide, and there is no wind or current to affect the ships progress and the ship can make 6 knots

Measure the distance with your dividers\ = 5,6 Nm

Time therefore is distance / speed

So 5.6 nM / 6

ANS: 0.94 hrs say an hour by the time you get underway and build up speed.



Compass/true conversions rules

Conversions from compass to true (generally bearings)		Conversions from true to compass (generally courses)	
C an	**Compass**	**T** ele	**True**
D ead	**Deviation**	**V** ision	**Variation**
M en	**Magnetic**	**M** akes	**Magnetic**
V ote	**Variation**	**D** ull	**Deviation**
T wice	**True**	**C** ompany	**Compass**

To determine weather to add or subtract errors on the way through, note the following

CADET: Compass ADd East to get True

C → T: + E, - W

T → C: - E, + W

DEVIATION TABLE

For use with Chartwork Exercises

Ship's Head by Compass	Deviation	Ship's Head by Compass	Deviation
000°	3½°E.	180°	2½°W.
010°	4°E.	190°	4°W.
020°	4½°E.	200°	5°W.
030°	5°E.	210°	5½°W.
040°	5°E.	220°	6½°W.
050°	5°E.	230°	6½°W.
060°	5½°E.	240°	7°W.
070°	5½°E.	250°	6½°W.
080°	5°E.	260°	6½°W.
090°	5°E.	270°	5½°W.
100°	4½°E.	280°	4½°W.
110°	4°E	290°	[illegible]

Deviation is 5.5 °W

Worksheet 7: Plotting

A SET OF WAYPOINTS

Proposed voyage

Day 1: We have provision our vessel at Maryport Bay on Carlisle Island and plan research scientific shoal on day 1, anchoring at Goldsmith Island that night.

Day 2: Study the bird colony on Tinsmith Island and then return to the anchorage

Days 3 and 4: Estimate fish population at Geranium Shoal and try to tag fish Day 5

Return to anchorage at Maryport Bay

Set a course for these places

Q1. Mark the following waypoints on your chart

WP 01	20° 47.2' S	149° 15. 9' E
WP 02	20° 45.5' S	149° 0[illegible]. 0' E
WP 03	20° 43.8' S	149° 08. 2' E
WP 04	20° 42.1' S	149° 09. 2' E
WP 05	20° 42.4' S	149° 13. 0' E
WP 06	20° 38.9' S	149° 13. 6' E

DEVIATION TABLE

For use with Chartwork Exercises

Ship's Head by Compass	Deviation	Ship's Head by Compass	Deviation
000°	3½°E.	180°	2½°W.
010°	4°E.	190°	4°W.
020°	4½°E.	200°	5°W.
030°	5°E.	210°	5½°W.
040°	5°E.	220°	6½°W.
050°	5°E.	230°	6½°W.
060°	5½°E.	240°	7°W.
070°	5½°E.	250°	6½°W.
080°	5°E.	260°	6½°W.
090°	5°E.	270°	5½°W.
100°	4½°E.	280°	4½°W.
110°	4°E.	290°	3½°W.
120°	3½°E.	300°	2½°W.
130°	3°E.	310°	1½°W.
140°	2°E.	320°	½°W.
150°	1°E.	330°	½°E.
160°	½°W.	340°	1½°E.
170°	1½°W.	350°	2½°E.
180°	2½°W.	000°	3½°E.

Figure 45.1 Ship's deviation table

Q2. Join the lines of position to join and complete the table below using the deviations given and derived from the table above.

Course		True	Variation	Magnetic	Deviation	Compass course
From	To	T	V	M	D	C
WP1	WP2				5°W	
WP2	WP3				0°W	
WP3	WP4				4.5°W	
WP4	WP5				5°W	
WP5	WP6				3.5°W	
WP6	WP01				.5°W	

Sometimes its easier to use the total error

Q3. List potential chart hazards for the trip in the table below

From	To	*Potential hazards*
WP1	WP2	
WP2	WP3	
WP3	WP4	
WP4	WP5	
WP5	WP6	
WP6	WP01	

Q4. Calculate potential times for each leg of the trip, if the ship makes 6 knots.

From	To		From	To	
WP1	WP2		WP4	WP5	
WP2	WP3		WP5	WP6	
WP3	WP4		WP6	WP01	

Position fixing

When travelling at sea, it is very important to know where you are. It is essential to the safety of the vessel for the navigator to frequently or as continuously as possible, get positional information.

This is essential in areas where there are navigational hazards such as rocks and reef where a small error could cause loss of the vessel.

It is therefore very important to know the position of the vessel at all times. The navigator may use a number of methods to find or fix position.

Two methods are the three bearing fix and a transit bearing.

Three bearing fix

When lines of bearing are obtained from three different landmarks at the same time (Figure 46.3), the vessel can be located at the intersection of these lines.

The end result, depending on how well the bearings are taken, is a small triangle called a cocked hat.

A transit

If two objects are lined up they are said to be in transit. The vessel must be on the same line extended away from this line.

These transits may be used to check compass error or act as leads to steer a course or maintain a heading.

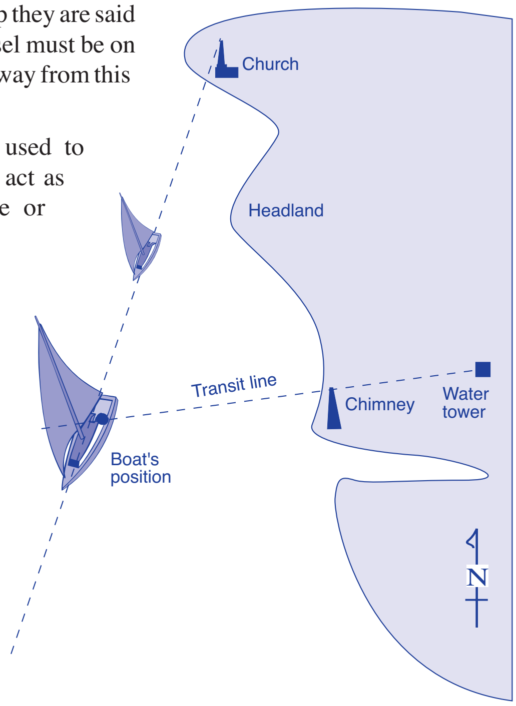


Figure 46.1 A transit
Wet Paper

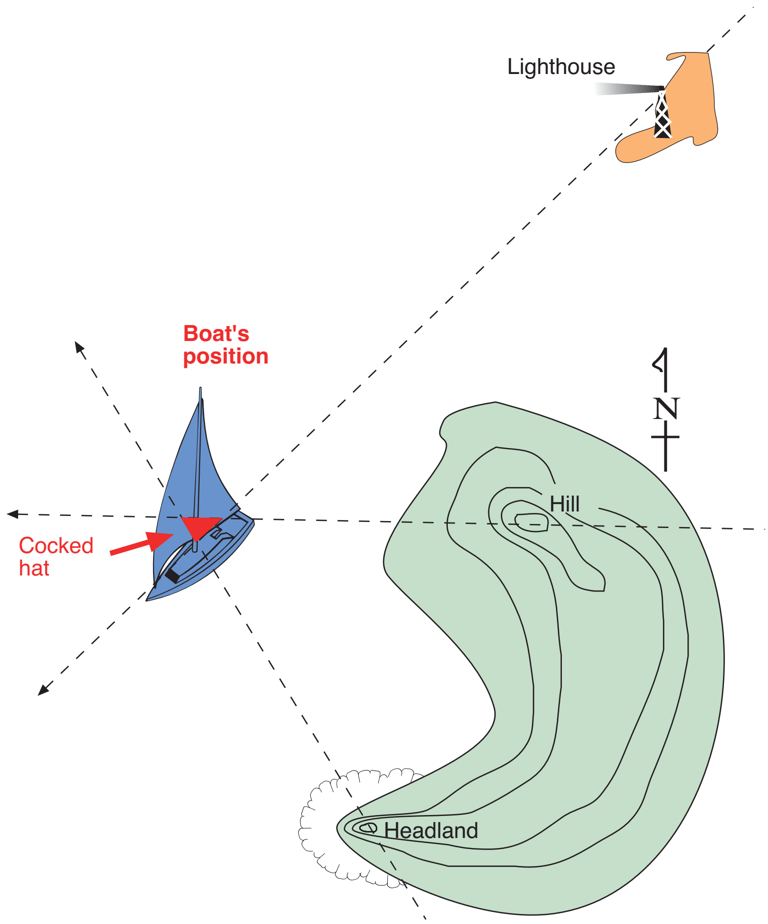


Figure 46.2 Position fixing
Wet Paper

Worked example

What is your position, in latitude and longitude (to 0.1') for each of the following fixes? In each case, the ship's head by compass is given as 10°C (use deviation table of 4° E)

Position

- Hill 323 Brampton Is 102°C
- Skiddaw Peak Carlisle Island 77°C
- Finger and Thumb 32°C

Step 1

Convert the compass bearing A to its True bearing on the chart using the rule in Figure 47.1

Can	=	Compass	=	102°C
Dead	=	Deviation	=	4° E
Men	=	Magnetic	=	106°
Vote	=	Variation	=	8° E
Twice	=	True bearing	=	114°T

Step 2

Draw the line using your parallel rules

Step 3

Repeat for the other two bearings and your position is where the lines intersect.

Compass/true conversions rules

Conversions from compass to true (generally bearings)		Conversions from true to compass (generally courses)	
C an	**Compass**	**T** ele	**True**
D ead	**Deviation**	**V** ision	**Variation**
M en	**Magnetic**	**M** akes	**Magnetic**
V ote	**Variation**	**D** ull	**Deviation**
T wice	**True**	**C** ompany	**Compass**

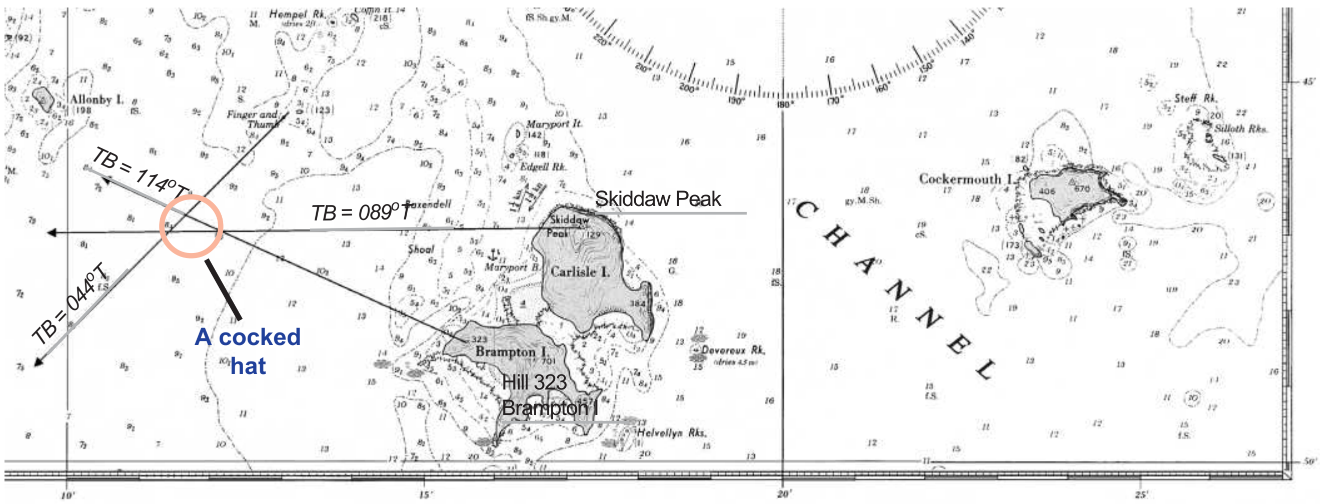
To determine weather to add or subtract errors on the way through, note the following

CADET: Compass ADd East to get True

Figure 47.1 From compass to true easterly add

Wet Paper

Worked example: Course = 10° Deviation = 4°E					
Course	Compass	Deviation	Magnetic	Variation	True
To	C	D	M	V	T
Hill 323 Brampton I	*102°C*	*4°E*	*106°M*	*8°E*	*114°T*
Skiddaw Peak	*077°C*	*4°E*	*081°M*	*8°E*	*089°T*
Finder & thumb	*032°C*	*4°E*	*036°M*	*8°E*	*044°T*
Sometimes its easier to add the total error ie 12°E					
ie: 132°T + 12 = 144°C					



ANS: Latitude and longitude

Approx = 20 °46.85' S, 149°11.7' E

Figure 47.3 Sample answer

Wet Paper

Worksheet 8: Position fixing

Complete each of the table below to determine a ship's position, in latitude and longitude (to 0.1') for each of the following fixes? In each case the course and deviations are given.

Q1: Course = 80° Deviation = 5°E

Bearing to	*C*	*D*	*M*	*V*	*T*
Solder I	272°C	*5°E*			
Coffin It	209°C	*5°E*			
Sounding	10 m	Latitude:		Longitude:	

Q2: Course = 190° Deviation = 4°W

Bearing	*C*	*D*	*M*	*V*	*T*
Allonby hill	275°C	*4°W*			
Finger and thumb	027°C	*4°W*			
Hill 323 Brampton I	128°C	*4°W*			
Latitude:		Longitude:			

Q3: Course = 10° Deviation = 4°E

Bearing	*C*	*D*	*M*	*V*	*T*
Coffin It	100°C	*4°E*			
Allonby I	226°C	*4°E*			
Solder I	178°C	*4°E*			
Latitude:		Longitude:	Water depth:		

Q4: Plot a course home from Latitude: 20 °43.6' S Longitude: 149 °12.4' E to Waypoint 01 Maryport Bay

a. Locate Waypoint 01 Maryport Bay (see previous exercise), look for hazards and draw line of position

b. Locate the true course: _________

c. Identify the chart variation ________ and calculate the magnetic course __________

d. Identify the deviation (the ship's head is 120°C) D = *3.5°E* *Correct Yes or No*

e. Describe the compass course to steer ___________________________________

f. Identify the distance to be travelled _________________________________

g. If the ships speed is 6 knots calculate the time for the voyage. _________________________________

Q5: After 28 mins, you notice the ship's head is 130°C (deviation = 3°E) and take the following bearings

Bearing	*C*	*D*	*M*	*V*	*T*
Coffin It	343°C	*3°E*			
Maryport It	71°C	*3°E*			
Skiddaw Peak (Brampton)	93°C	*3°E*			
What is your Latitude ?		Longitude ?		Water depth ?	

Q6. Convert the following compass bearings to true and then find the latitude and longitude of the following research positions and mark them on your chart.

Check your answer with the suggested answer given. Note all bearings have been made with a hand-bearing compass.

Research site 1.

Bearing to Skiddow Peak 291°C — True bearing =

Bearing to Hill 457 Brampton Is 255°C — True bearing =

Bearing to Hill 670 Cockermouth Is 35°C — True bearing =

Latitude: — Longitude:

Research site 2.

Bearing to Solder Is 187°C — True bearing =

Bearing to Finger and Thumb 224°C — True bearing =

Bearing to Hill 323 Brampton Is 104°C — True bearing =

Latitude: — Longitude:

Q7. You are at the anchorage at Maryport Bay, Brampton Island, in position 20°48' S 149°16' E. Mark this on your chart as position A and answer the following questions. Variation for 2014. No deviation.

a. You want to go to Coffin Island. What compass course will you steer?

b How far is it from position A to Coffin Island?

c. How long will it to take to arrive at Coffin Island if you travel at 6 knots?

Q8. Your GPS is playing up and are worried about your deep sea study research site and decide to fix your position. You take the following bearings: Plot this position and mark it on the chart as position C.

Allonby Island Hill 198	275° C	True bearing =
Brampton Island Hill 323	133° C	True bearing =
Tinsmith Hill 448	342° C	True bearing =

Q9 What are the rocks you can see in front of you?

Q10. How do you account for the change in position from point B to point C?

Q11. You are anchored near Geranium Shoal. Locksmith - S (southern tips of Locksmith Island) is in transit with Ladysmith - S. You also have Allonby Island Hill 198 in transit with Tinsmith Island - SE.

a. Mark this position as position D.

b. What is the latitude and longitude of point D?

c. How far are you from Geranium Shoal?

d. What course would you steer to arrive at the shoal?

e. How long will it take you to get there at 6 knots?

f. It is now a 3 m tide. What will your depth sounder read as you find the shoal?

Set and drift

To allow for currents such as ebb or flood tides (Figure 50.1), the navigator must allow for set and drift.

The ship's navigator has to set a course either to port or starboard of the course line. If the set is known (by checking charts) then the navigator can successfully navigate for these currents.

Worked example

Your boat is positioned at Point A (Figure 50.2), North West of Edgell Rock and you wish to plot a course to Solder Island making allowance of currents in this area.

The boat's speed is say 4 knots.

The direction the current is flowing (the set) is 18^{0}.

The current speed (the rate) is 1.25 knots.

1. Mark the direction of the current on the boat's course by drawing a line. (See Figure 50.2).
2. Using dividers, measure off the distance the current (drift) will run in 1 hr from A and mark it on the current line. Call this X.
3. Space the dividers to the distance the boat will travel in 1 hr and place one point of the dividers at Point X (on the current line) and sweep round until it touches the boat's course line. Mark this and call it point Y.
4. XY is the course to steer so with parallel rulers work out the T.C. and convert it to C.C. by subtracting the 8^{0}E error.
5. Steer the boat for one hour at 4 knots on C.C. 292^{0} and re-check your position. Make the necessary corrections after this time.

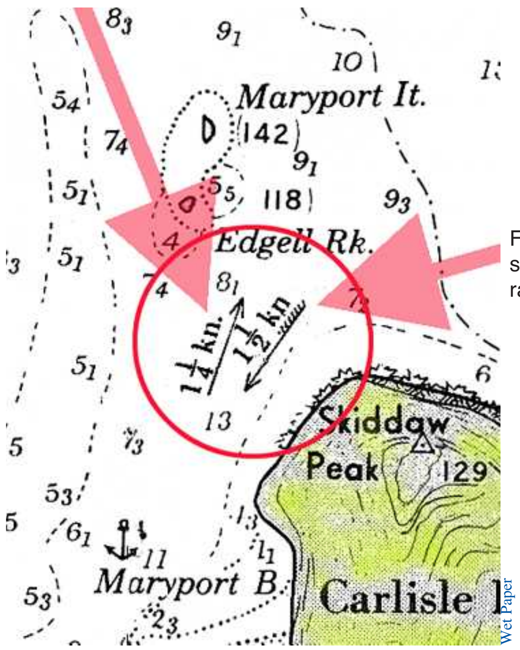


Figure 50.1 Ebb and flood tidal streams

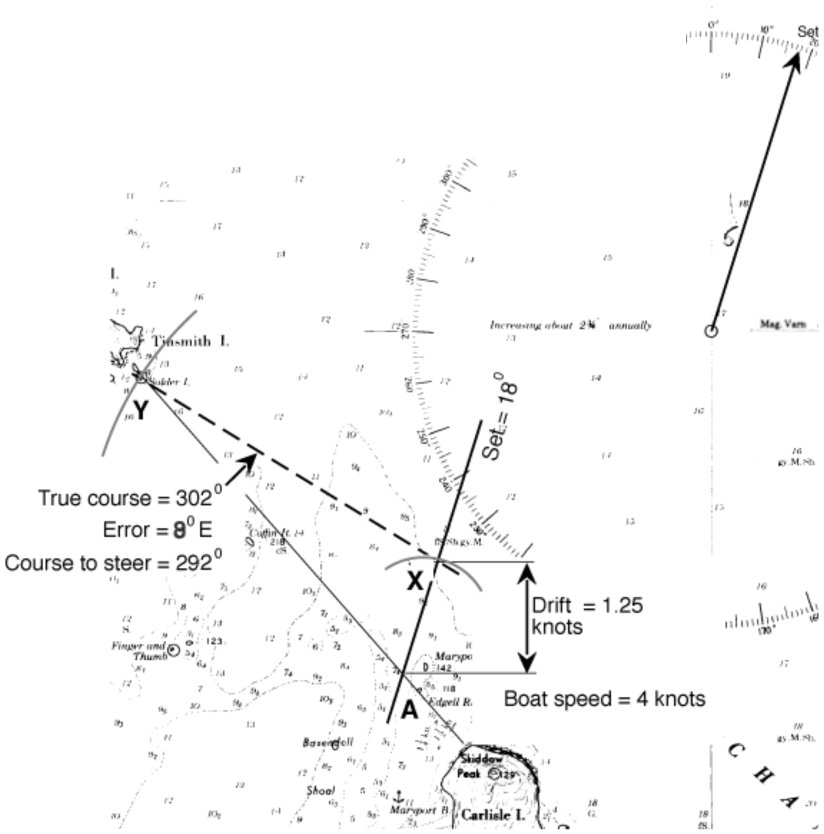


Figure 50.2 Calculation of set and drift

Some set and drift terms

Leeway

This is the amount which a vessel drifts or makes to leeward of her course by compass when she is steaming with the wind on her side.

The set

This is the **direction** in which a current or tidal stream is flowing.

The drift

This is the rate at which a vessel deviates from its course due to wind, current or tidal influences.

Tidal streams

These are marked on charts by arrows pointing in the direction of the set with the rate of the set marked on the shaft. A current is marked with an arrow pointing in the direction of the set. The arrow has a wriggle on the shaft with no arrows. The rate of the set is

WORKSHEET 9: SET AND DRIFT

Q1. Calculate the set and drift to determine a ships heading to a research site using the information below

At 0615 you depart the anchorage west of Carlisle Island, steering a compass course of 261^0 (C) at 5 knots. At 0703, Allonby Island bears 334.5^0 (C) and Skiddaw Peak (129) bears 069.5^0 (C).

a. What is your fixed position at 0703?

CC = TC =

Allonby bears C = T

Skiddaw bears C = T

Position at 0703 is approx

b. What set and drift have you experienced since departing the anchorage?

Q2. From a position 1.5 nautical miles north of the centre of Cockermouth Island, you steer a compass course of 315^0(C) at 6 knots for 1 hour.

At this time you fix your position as follows:

Carlisle Is (E)	184^0
Tinsmith Is (N)	260^0
Cockermouth Is (E)	134^0

a. What is your fixed position at this time?

b. What set and drift have you experienced?

Q3. You wish to sail from one nautical mile South of Allonby Island to Anchorage at Maryport B near Carlisle Island.

You will experience a set and drift of 1.25 Nautical miles at 20^{0}T. Your speed is 4 knots.

What is the compass course you will need to steer and how long will it take you to reach your destination?

Worksheet 10: Using a smart phone compass

Some new smart phones come with a compass app that is calibrated by rotating the phone and turning on he location setting. Not only does the app give digital bearings but also the latitude and longitude.

Worked example

Suppose you wanted to accurately locate a research site on a muddy bank.

You would then need a chart of your local area (Figure 52.2) and your mobile phone app (Figure 52,1)

Bearing 1 To T1 283°M

Bearing 2 To T2 232°M

Bearing 3 To BP1 165°M

Now draw lines of position as shown in Figure 52.1 and mark your study site.

If you have a chart that has now magnetic bearings you will have to do the compass conversions using the following rule.

What to do

Obtain a local chart and make a mud map in the space on the next page

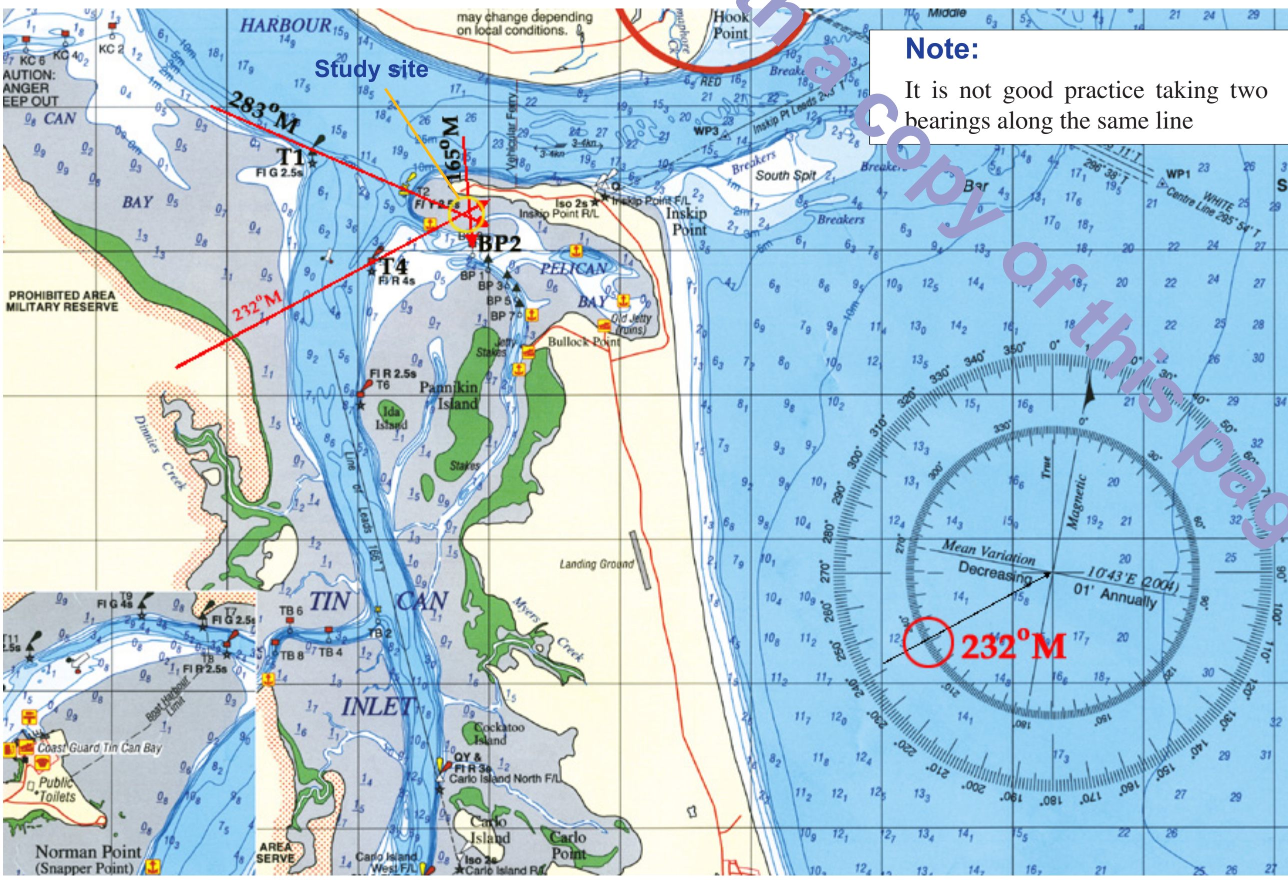
Take three bearings using your mobile phone app. Record them on your mud map and summarise details of your research site positions.

Figure 52.1 Magnetic bearing on a mobile phone app
Wet Paper

CADET: Compass ADd East to get True

C → T (+ E / - W)

T → C (- E / + W)



Note:
It is not good practice taking two bearings along the same line

Figure 52.2 Bearings translated from Internet maps
Wet Paper and TMR

Worksheet 10 results

AUSTRALIAN MADE

ISBN
978 1 86283 147 6