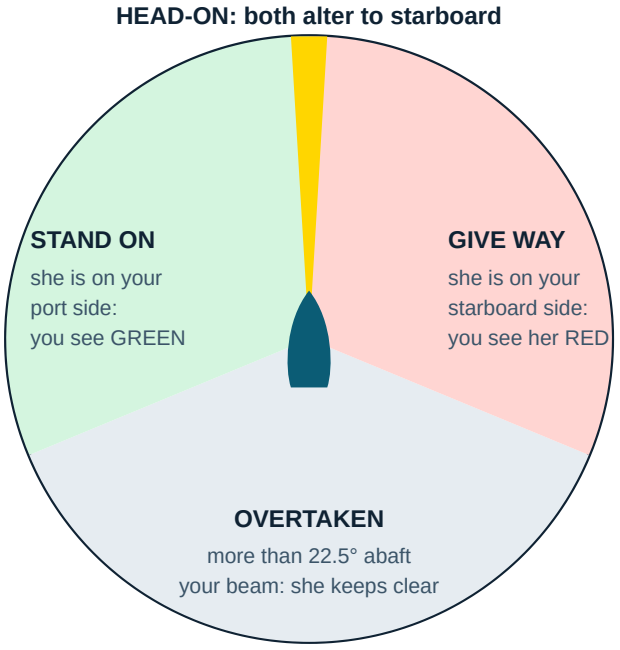
ZULU MARINER DATA CARD

1 THE COLLISION RULES ON A PAGE

COLREGs Part B: steering and sailing. The few lines that keep you alive.

WHO GIVES WAY: POWER-DRIVEN, IN SIGHT



If to starboard red appear, it is your duty to keep clear. Green to green or red to red: perfect safety, go ahead.

RULE 18: THE PECKING ORDER

Each keeps out of the way of those above it. Overtaking (13), narrow channels (9) and traffic schemes (10) come first.

1. Not under command
2. Restricted in ability to manoeuvre
3. Constrained by her draught (avoid impeding)
4. Engaged in fishing
5. Sailing
6. Power-driven
7. Seaplane and WIG craft

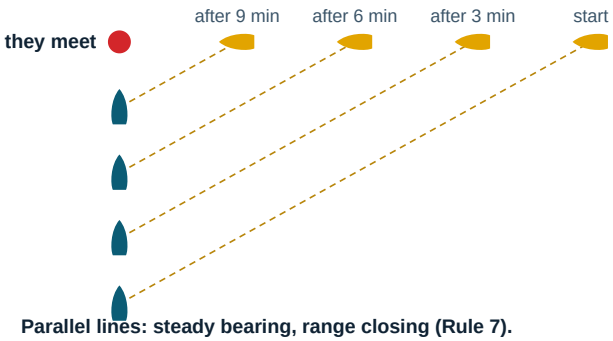
THE RULES THAT RUN EVERYTHING

5	**Lookout** by sight and hearing and every available means. At all times.
6	**Safe speed**: visibility, traffic, stopping distance, wind, sea, current, depth, background lights, radar limits.
7	**Risk of collision**: if the compass bearing does not appreciably change, it exists. Big ships and close range can fool you. If in doubt, it exists.
8	**Action**: early, large (obvious on radar or by eye), seamanlike. Slow or stop if you need time. Check it works.
9	**Narrow channel**: keep to the starboard side. Vessels under 20 m and sailing vessels must not impede a ship that can only navigate inside it.
10	**Traffic separation**: go with the flow, join at the ends, cross at right angles.
13	**Overtaking**: you keep clear until past and clear, whatever you are.
14	**Head-on** (power): both alter to starboard, pass port to port.
15	**Crossing** (power): she is on your starboard side, you give way. Avoid crossing ahead.
16	**Give-way**: early and substantial action. Keep well clear.
17	**Stand-on**: hold course and speed. You may act once it is clear she is not. You must act when collision cannot be avoided by her alone. Do not turn to port for a vessel on your port side.
19	**Restricted visibility**: no stand-on vessel. Safe speed, engines ready. Avoid turning to port for a vessel forward of the beam, or towards one abeam or abaft. Hear a fog signal ahead: slow to steerage way, stop if needed.

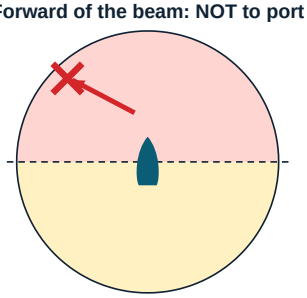
SAILING VESSELS MEETING (RULE 12)

- Wind on different sides: the one with the wind on her **port** side keeps clear.
- Same side: the **windward** boat keeps clear.
- Port tack and cannot tell what the other is doing: keep clear.

PICTURE IT



Parallel lines: steady bearing, range closing (Rule 7).



Abeam or abaft: NOT towards her
Rule 19: in fog nobody stands on.

Study aid only. Not for navigation.
Check the current official rules. Card 1 · v1.7 · © Nautical Bridge

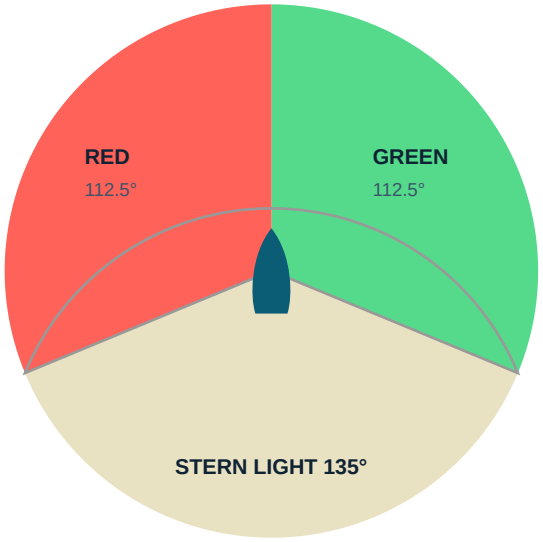
ZULU MARINER DATA CARD

2 LIGHTS AT NIGHT

Read the lights, name the vessel, know what to do. COLREGs Part C.

ARCS OF VISIBILITY

masthead light 225°, ahead to 22.5° abaft the beam



SAY IT OUT LOUD

White over red, pilot ahead.
Red over white, fishing at night.
Green over white, trawling at night.
Red over red, the captain is dead (not under command).
Red, white, red: restricted, keep clear.
Three reds in a line: deep draught, give her room.

REMEMBER

- Seeing **both sidelights** and masthead: she is coming straight at you.
- Only a **white** light: stern light, anchored or small craft. Watch the bearing.
- Power under 12 m: one all-round white may replace masthead and stern lights. Under 7 m and 7 knots max: all-round white, sidelights if practicable (Rule 23(d)).
- A towing light is **yellow**, over the stern light.



Power under 50 m
Masthead, sidelights, stern



Power 50 m or more
Two masthead, aft one higher



Sailing
Sidelights and stern only



Towing, tow 200 m or less
Two masthead lights in a vertical line (plus the aft one, 50 m or more)



Towing, tow over 200 m
Three masthead lights in a vertical line (plus the aft one, 50 m or more)



Trawling
Green over white



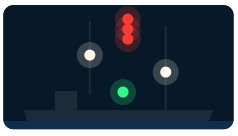
Fishing, not trawling
Red over white



Not under command
Red over red



Restricted in ability to manoeuvre
Red, white, red



Constrained by her draught
Three all-round reds in a vertical line



Pilot on duty
White over red

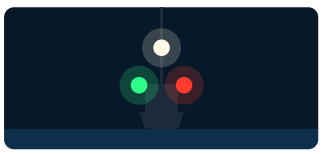


At anchor, 50 m or more
White forward, lower white aft



Aground
Anchor lights and two reds

WALK AROUND ONE SHIP: WHAT YOU SEE FROM EACH SIDE



Head-on: red and green



Her starboard side: green



From astern: white only



Her port side: red

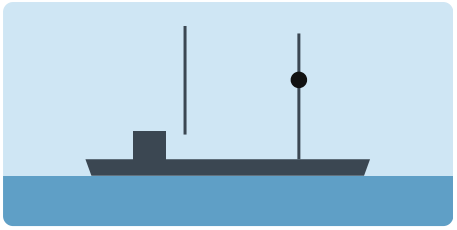
Two masthead lights in line: she is heading at you. The higher aft light opening to one side shows which way she is turning.

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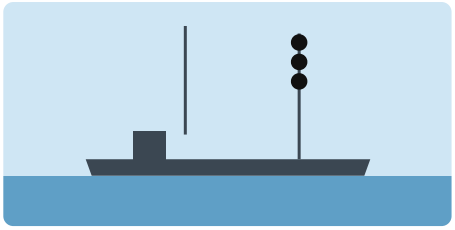
ZULU MARINER DATA CARD

3 DAY SHAPES

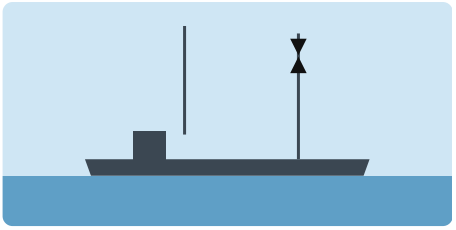
Black shapes by day. Balls, cones, diamonds and a cylinder.



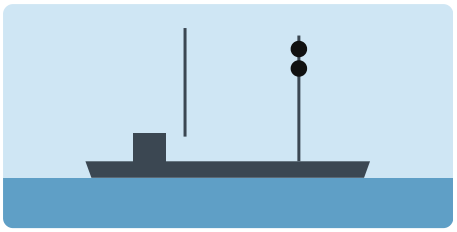
At anchor
Rule 30(a)(i)
One ball: parked.



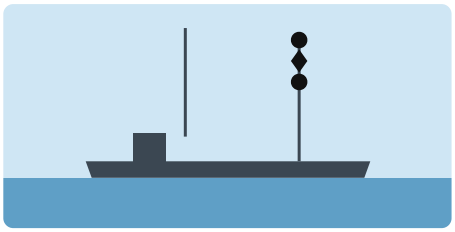
Aground
Rule 30(d)(ii)
Three balls: stuck fast.



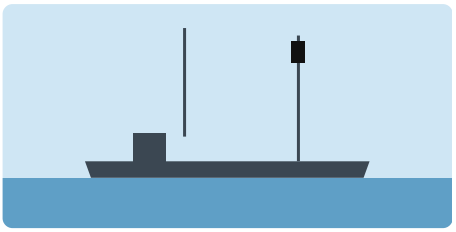
Engaged in fishing
Rule 26(b)(i), 26(c)(i)
Two cones point to point: an hourglass, she is fishing.



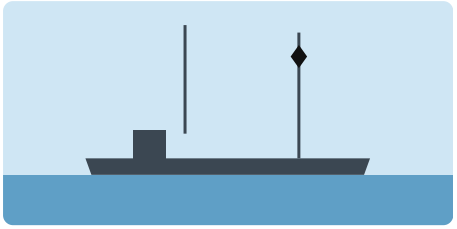
Not under command
Rule 27(a)(ii)
Two balls: two eyes, nobody steering.



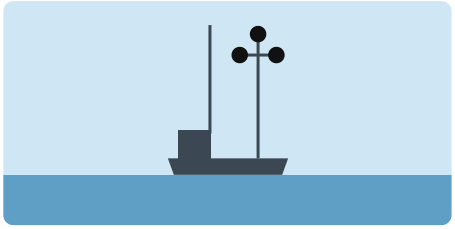
Restricted in ability to manoeuvre
Rule 27(b)(ii)
Ball, diamond, ball: busy at work.



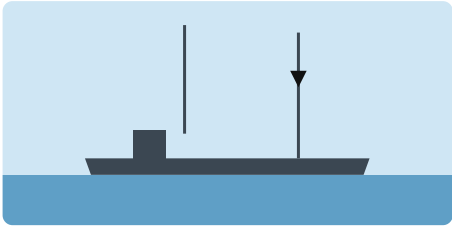
Constrained by her draught
Rule 28
A cylinder: a deep keg of draught.



Towing or being towed, length of tow over 200 m
Rule 24(a)(v), 24(e)(iii)
A diamond: tow over 200 m long.



Engaged in mine clearance
Rule 27(f)
One ball at the masthead, one at each yardarm: mines, stay 1,000 m off.



Sailing vessel also propelled by machinery
Rule 25(e)
Cone point down: sails up, engine on.

ALSO BY DAY

- Diving: a rigid copy of flag A, at least 1 m high (Rule 27(e)).
- Fishing with gear out more than 150 m: a cone point up toward the gear (Rule 26).
- Under 7 m at anchor clear of channels, fairways and anchorages: no anchor shape needed. Under 12 m aground: no aground shapes needed (Rule 30(e), (f)).
- Under 20 m: shapes may be smaller.

FOUR SHAPES, FOUR IDEAS



BALL
Stopped or stuck: anchored (1), not under command (2), aground (3)



CONE
Fishing (two, points together) or motor-sailing (one, point down)



DIAMOND
A long tow (over 200 m), or the middle of ball-diamond-ball: restricted



CYLINDER
Constrained by her draught: think of a deep drum

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ZULU MARINER DATA CARD

4 SOUND SIGNALS

Short blast about 1 second. Prolonged 4 to 6 seconds. COLREGs Part D.

IN SIGHT OF ONE ANOTHER (RULE 34)

SIGNAL	MEANING	RULE
●	I am altering my course to starboard	34(a)
●●	I am altering my course to port	34(a)
●●●	I am operating astern propulsion	34(a)
●●●●●	I am in doubt about your intentions / action	34(d)
▬	Approaching a bend or obscured area of a channel	34(e)

> *One, two, three: starboard, port, astern.*
> *Five or more: WAKE UP.*

OVERTAKING IN A NARROW CHANNEL

SIGNAL	MEANING	RULE
▬ ▬ ●	Narrow channel: I intend to overtake you on your starboard side	34(c)(i)
▬ ▬ ●●	Narrow channel: I intend to overtake you on your port side	34(c)(i)
▬ ● ▬ ●	Narrow channel: agreement to be overtaken	34(c)(ii)

Not sure it is safe to be overtaken? Sound five short.

LIGHT SIGNALS

- May add a white all-round flash to Rule 34 signals: one flash, starboard; two, port; three, astern.
- Flashes about 1 second, with about 1 second between.

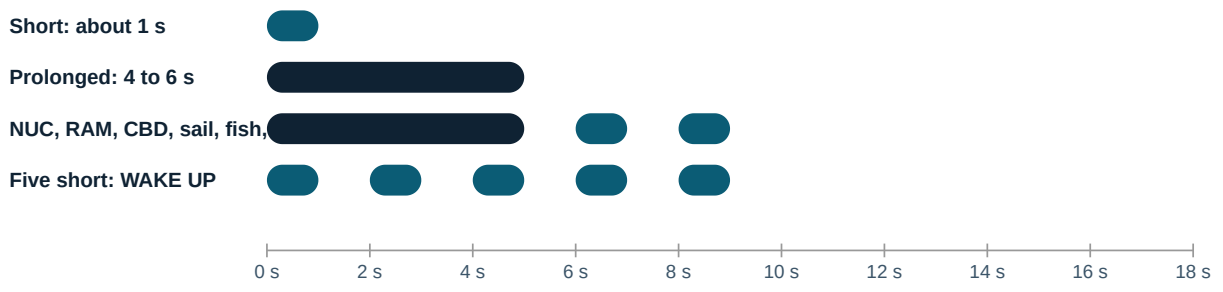
IN RESTRICTED VISIBILITY (RULE 35)

SIGNAL	WHO	EVERY
▬	Power-driven vessel making way through the water	2 min
▬ ▬	Power-driven vessel underway but stopped (not making way)	2 min
▬ ●●	NUC, RAM, CBD, sailing, fishing, or towing/pushing vessel	2 min
▬ ●●●	Manned vessel being towed (last of the tow)	after the tug
●●●●	Pilot vessel on duty: identity signal (in addition to her other signal)	with her signal
bell 5 s	Vessel at anchor, under 100 m	1 min
bell 5 s gong 5 s	Vessel at anchor, 100 m or more (bell forward, then gong aft)	1 min
● ▬ ●	Vessel at anchor warning an approaching vessel	1 min
●●● bell 5 s ●●●	Vessel aground (three strokes, rapid bell, three strokes)	1 min

REMEMBER

- Under 12 m: any efficient sound signal at least every 2 minutes.
- A fog signal tells you nothing about her direction. Slow down and listen.
- Hearing one forward of the beam: steerage way only, stop if you need to (Rule 19(e)).

HEAR THE LENGTH



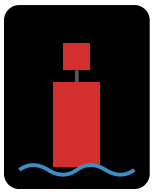
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ZULU MARINER DATA CARD

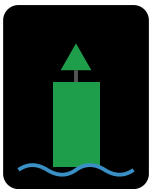
5

BUOYAGE: IALA REGION A

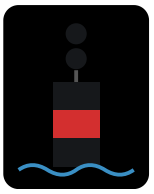
Australia uses IALA Region A. Red to port coming in from sea.



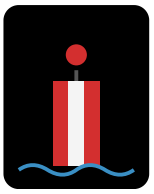
Port lateral
Red can. Red light, any rhythm.



Starboard lateral
Green cone. Green light, any rhythm.



Isolated danger
Black, red band, two balls. Fl(2) white.



Safe water
Red and white stripes, red ball. Iso, Oc, LFl 10 s or Morse A.



Special
Yellow, yellow X. Yellow light.

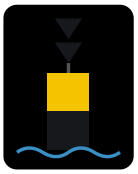
CARDINAL MARKS: PASS ON THE NAMED SIDE



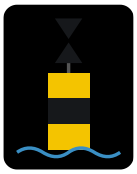
North cardinal
Cones point up. Safe water is to the north.



East cardinal
Cones base to base. Safe water is to the east.



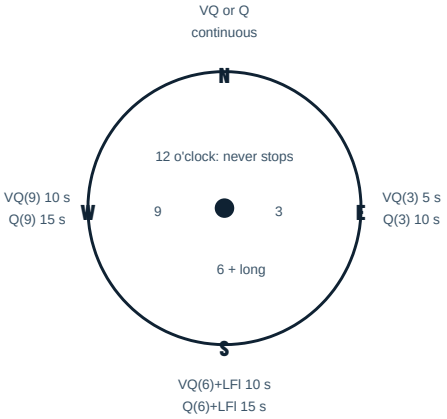
South cardinal
Cones point down. Safe water is to the south.



West cardinal
Cones point to point. Safe water is to the west.

> *Topmarks point to the black.*
> *North: both up. South: both down.*
> *East: an Egg (base to base). West: a Wineglass (point to point).*

CARDINAL LIGHTS: READ THEM LIKE A CLOCK

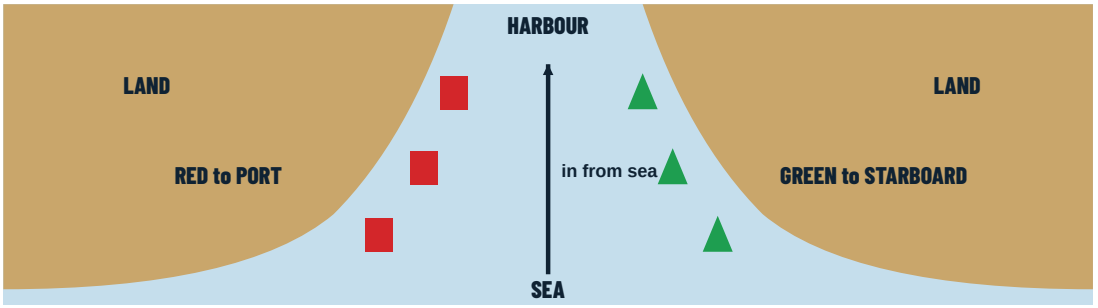


White, quick (Q, 50 to 60 flashes a minute) or very quick (VQ, 100 to 120 a minute). South adds a long flash so it cannot be mistaken for East or West.

COMING IN FROM SEA

- Red to port, green to starboard. The direction of buoyage is shown on the chart where it is not obvious.
- Preferred channel marks: read the main colour. Red with a green band is a port mark for the preferred channel, which lies to starboard of it. Green with a red band is a starboard mark; the preferred channel lies to port.
- Emergency wreck marking buoy: blue and yellow stripes, yellow upright cross, alternating blue and yellow light.

PICTURE IT: THE HARBOUR ENTRANCE



Port, red, left: all the short words go together. Going out to sea it is the other way round.

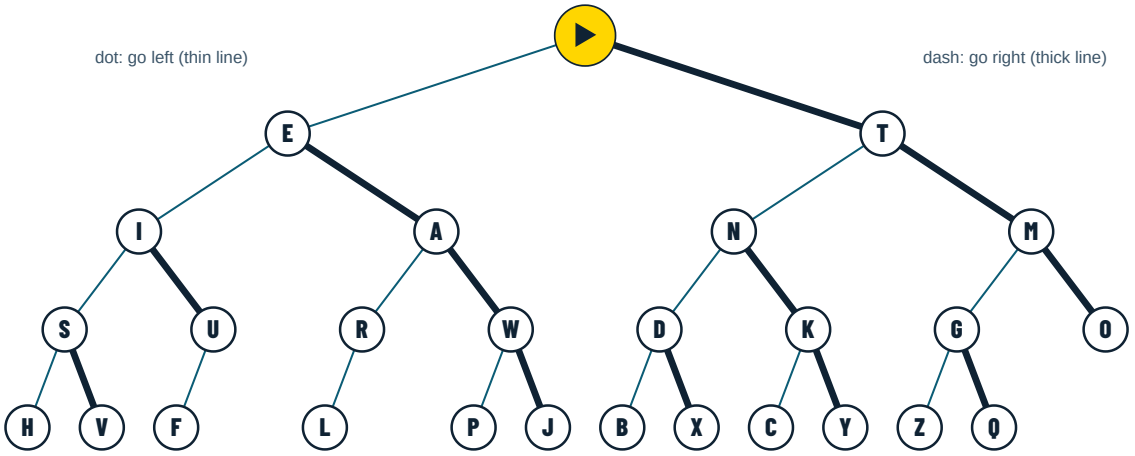
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ZULU MARINER DATA CARD

6 MORSE CODE AND THE PHONETIC ALPHABET

Learn it as a tree: dot goes left, dash goes right.

THE MORSE TREE



LETTERS AND THE PHONETIC ALPHABET

A	Alfa	B	Bravo
C	Charlie	D	Delta
E	Echo	F	Foxtrot
G	Golf	H	Hotel
I	India	J	Juliett
K	Kilo	L	Lima
M	Mike	N	November
O	Oscar	P	Papa
Q	Quebec	R	Romeo
S	Sierra	T	Tango
U	Uniform	V	Victor
W	Whiskey	X	X-ray
Y	Yankee	Z	Zulu

NUMBERS

1		2	
3		4	
5		6	
7		8	
9		0	

Numbers have five signs. 1 to 5: dots then dashes.
6 to 0: dashes then dots.

TIMING

- Dash = 3 dots.
- Gap inside a letter = 1 dot.
- Between letters = 3 dots.
- Between words = 7 dots.

MUST KNOW

SOS ●●●▬▬▬●●●

Sent as one signal, no gaps. **U** ●●▬ you are running into danger.
K ▬●▬ I wish to communicate with you. **A** ●▬ diver down.

OPPOSITES: LEARN ONE, GET ITS TWIN FREE

E ● ⇄ T ▬	I ●● ⇄ M ▬▬	S ●●● ⇄ O ▬▬▬	A ●▬ ⇄ N ▬●
D ▬●● ⇄ U ●●▬	G ▬▬● ⇄ W ●▬▬	K ▬●▬ ⇄ R ●▬●	B ▬●●● ⇄ J ●▬▬▬
P ●▬▬● ⇄ X ▬●●▬	L ●▬●● ⇄ Y ▬●▬▬	F ●●▬● ⇄ Q ▬▬●▬	

Swap dots for dashes and one letter becomes the other.

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ZULU MARINER DATA CARD

7 CODE FLAGS: SINGLE-LETTER SIGNALS

International Code of Signals. Flown alone, each letter is a complete message.



A Alfa
I have a diver down. Keep well clear at slow speed.



C Charlie
Yes (affirmative).



E Echo
I am altering my course to starboard.



G Golf
I require a pilot.



I India
I am altering my course to port.



K Kilo
I wish to communicate with you.



M Mike
My vessel is stopped and making no way through the water.



O Oscar
Man overboard.



Q Quebec
My vessel is healthy and I request free pratique.



S Sierra
I am operating astern propulsion.



U Uniform
You are running into danger.



W Whiskey
I require medical assistance.



Y Yankee
I am dragging my anchor.



B Bravo
I am taking in, discharging or carrying dangerous goods.



D Delta
Keep clear of me. I am manoeuvring with difficulty.



F Foxtrot
I am disabled. Communicate with me.



H Hotel
I have a pilot on board.



J Juliett
I am on fire and have dangerous cargo on board. Keep well clear of me.



L Lima
You should stop your vessel instantly.



N November
No (negative).



P Papa
In harbour: all persons should report on board, the vessel is about to proceed to sea.



R Romeo
No single-letter meaning in the International Code.



T Tango
Keep clear of me. I am engaged in pair trawling.



V Victor
I require assistance.



X X-ray
Stop carrying out your intentions and watch for my signals.



Z Zulu
I require a tug.

MUST KNOW



A Diver down. Keep well clear at slow speed.



B Dangerous cargo being loaded, discharged or carried.



O Man overboard.



V I require assistance.



W I require medical assistance.



NC Distress: N over C.

SORT THEM INTO FAMILIES

SWALLOW-TAILED



A B

CROSSES



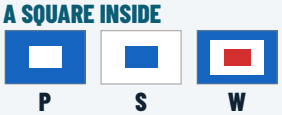
M V X R

QUARTERS AND CHECKS



L U N

A SQUARE INSIDE



P S W

A CIRCLE OR DIAMOND



I F

HALVES



H K O

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ZULU MARINER DATA CARD

8 RADIO: DISTRESS CALLS AND CHANNELS

VHF 16 first. Speak slowly, clearly, and give your position before anything else if time is short.

MAYDAY: GRAVE AND IMMINENT DANGER

1. **MAYDAY MAYDAY MAYDAY**
2. This is **(vessel name) ×3**, call sign
3. **MAYDAY** (vessel name)
4. **Position**: lat and long, or bearing and distance from a known point
5. **Nature** of distress: sinking, fire, aground
6. **Assistance** required
7. **Persons on board**
8. Other: vessel description, EPIRB on, abandoning to liferaft
9. **OVER**

PAN-PAN: URGENT, NOT IN GRAVE DANGER

PAN-PAN ×3, ALL STATIONS ×3, this is (name) ×3, position, problem, help needed, persons on board, OVER.

Engine failure drifting toward rocks. Medical help needed. Person overboard (or MAYDAY if life is at risk).

SECURITE: SAFETY MESSAGE

SECURITE ×3, all stations, this is (name), then the hazard: a floating log, a mark off station, a gale coming.

HEAR A MAYDAY

- Write it down. Listen.
- Wait for the coast station to answer; if none answers in about 5 minutes, acknowledge and relay.
- Keep silence on 16 unless you can help.

PHONETIC NUMBERS

0	ZERO
1	WUN
2	TOO
3	TREE
4	FOW-ER
5	FIFE
6	SIX
7	SEV-EN
8	AIT
9	NIN-ER

PROCEDURE WORDS

OVER	your turn
OUT	finished
SAY AGAIN	repeat
SEELONCE MAYDAY	silence: distress working
SEELONCE FEENEE	distress over

AUSTRALIAN VHF CHANNELS

CH	USE	NOTES
16	Distress, urgency, safety and calling	Call here, then move to a working channel. Watched around the clock by Maritime Safety Queensland from Cooktown to the NSW border, and by the Port Authority of NSW around Sydney, Newcastle and Port Kembla.
67	Supplementary distress and safety	Back-up to 16. Weather and navigation warnings are announced on 16 and read here.
70	Digital selective calling only	Never used for voice. The red distress button on a DSC radio sends on this channel.
72, 77	Ship to ship	Boat to boat working channels.
73	Ship to shore and ship to ship	In NSW mostly used to talk to a Marine Rescue base.
21, 22, 80, 81, 82	Repeaters	Extend your range through a hilltop station. Safety and vessel movement messages only, kept short. Which ones work depends on the area: ask the local Marine Rescue unit.
13	Bridge to bridge	Navigation safety between ships.
Port channels	Port control and vessel traffic service	Each port has its own working channel. Check the port procedures before entering a shipping channel.

DSC: lift the cover, hold the red button 5 seconds; it sends your MMSI and GPS position on channel 70, then talk on 16. 27 MHz (channel 88) is still listed as a distress channel, but watch on it is patchy and many boats no longer carry it. Carry VHF and a registered EPIRB.

Study aid only. Not for navigation.
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ZULU MARINER DATA CARD

9 DISTRESS SIGNALS

COLREGs Annex IV. Any one of these, used together or apart, means I am in distress and need help.



Red parachute rocket or red hand flare
Day or night. Hold the hand flare downwind, over the side.



Orange smoke
Day only. Let it off downwind.



Slowly raising and lowering outstretched arms
The small-boat signal everyone should know.



EPIRB or PLB, satellite alerts and approved radio signals
Including Inmarsat alerts and a SART. Register your beacon with AMSA.

DSC

DSC distress alert
VHF channel 70, MF or HF. Then MAYDAY by voice.

MAYDAY

MAYDAY by radio telephone
On VHF 16, or any frequency.

SOS

SOS by any method
Light, sound or radio: ...---...



Flags N over C
International Code of Signals.



A square flag with a ball above or below it
Anything square and anything round.



Flames on the vessel
From a burning tar or oil barrel.



Rockets or shells throwing red stars
Fired one at a time at short intervals.



A gun or explosive signal about every minute



Continuous sounding of any fog-signal apparatus



Orange canvas with a black square and circle
For aircraft to see. A dye marker also helps.

USING FLARES WELL

- Check the use-by date. Store them dry, where you can reach them fast.
- Do not fire until a vessel or aircraft could see it, or you hear one.
- Hand flares: wear gloves, hold at arm's length downwind, never look at it.
- Misusing a distress signal is an offence.

WHICH SIGNAL, WHEN?

SIGNAL	DAY	NIGHT	CLOSE	FAR
Red hand flare	✓	✓	✓	–
Red parachute rocket	✓	✓	✓	✓
Orange smoke	✓	–	✓	–
EPIRB or PLB	✓	✓	✓	✓
VHF MAYDAY / DSC	✓	✓	✓	✓
Waving arms	✓	–	✓	–
Torch: SOS	–	✓	✓	–

Carry more than one kind. A beacon gets them looking; a flare or smoke shows them exactly where you are.

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10

BEAUFORT WIND SCALE

Wind speed in knots at 10 m. Wave heights are typical open-sea values; inshore they are less.

F	KNOTS	NAME	THE SEA	WAVES
0	<1	Calm	Like a mirror	0 m
1	1–3	Light air	Ripples, no crests	0.1 m
2	4–6	Light breeze	Small wavelets, glassy crests	0.2 m
3	7–10	Gentle breeze	Large wavelets, scattered white horses	0.6 m
4	11–16	Moderate breeze	Small waves, frequent white horses	1 m
5	17–21	Fresh breeze	Moderate longer waves, many white horses, some spray	2 m
6	22–27	Strong breeze	Large waves, white foam crests everywhere	3 m
7	28–33	Near gale	Sea heaps up, foam blown in streaks	4 m
8	34–40	Gale	Moderately high waves, crests break into spindrift	5.5 m
9	41–47	Strong gale	High waves, dense streaks, spray cuts visibility	7 m
10	48–55	Storm	Very high waves, overhanging crests, sea white	9 m
11	56–63	Violent storm	Exceptionally high waves	11.5 m
12	64+	Hurricane	Air full of foam and spray	14 m

BUREAU OF METEOROLOGY MARINE WARNINGS

Strong wind warning	26 to 33 knots
Gale warning	34 to 47 knots
Storm force wind warning	48 to 63 knots
Hurricane force wind warning	64 knots or more

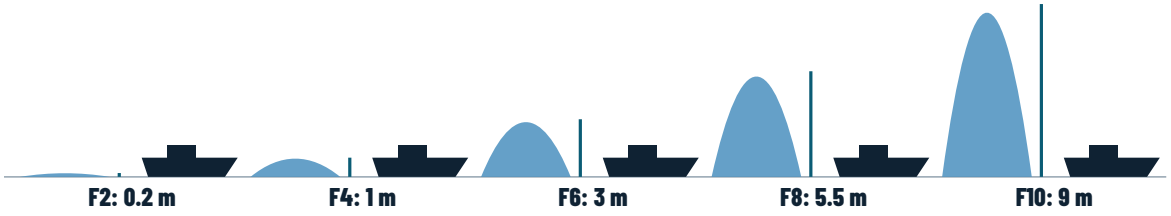
Forecast winds are averages over 10 minutes. Gusts can be 40% stronger, more in squalls and storms.

RULES OF THUMB

- Wind against tide: steeper, shorter, nastier seas.
- Waves double in height when the wind is about 1.4 times stronger.
- Swell travels far: a 2 m swell on a bar can break with no wind at all.
- Knots × 1.852 = km/h. Knots ÷ 2 ≈ metres per second.

WAVE HEIGHTS AGAINST A 5 M BOAT

Wave height (trough to crest) and a 5 m boat, drawn to the same scale. Real waves are many times longer than they are high.



Waves grow fast with the wind: about 1 m at force 4, 3 m at force 6, over 5 m at force 8.

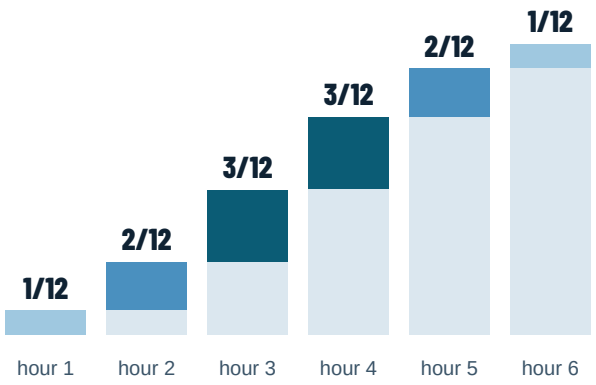
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ZULU MARINER DATA CARD

11 TIDES AND CHART DATUM

Heights, depths and the rule of twelfths.

RULE OF TWELFTHS

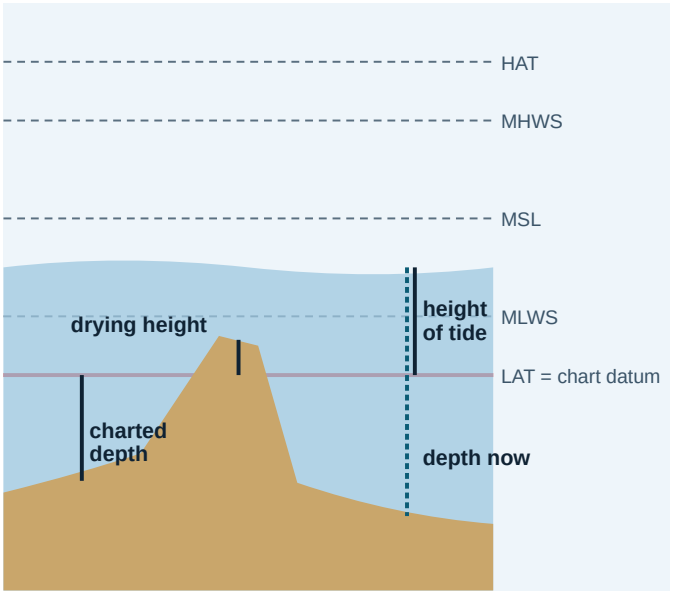


For a tide of about 6 hours, the rise or fall each hour is 1, 2, 3, 3, 2, 1 twelfths of the range. Half the range moves in the middle two hours, so that is when streams run hardest.

SPRINGS AND NEAPS

- **Springs**: biggest range, a day or two after new and full moon. Higher highs, lower lows, stronger streams.
- **Neaps**: smallest range, near the half moons.
- Gladstone and much of Queensland have two tides a day, unequal in height.

CHART DATUM AND HEIGHTS

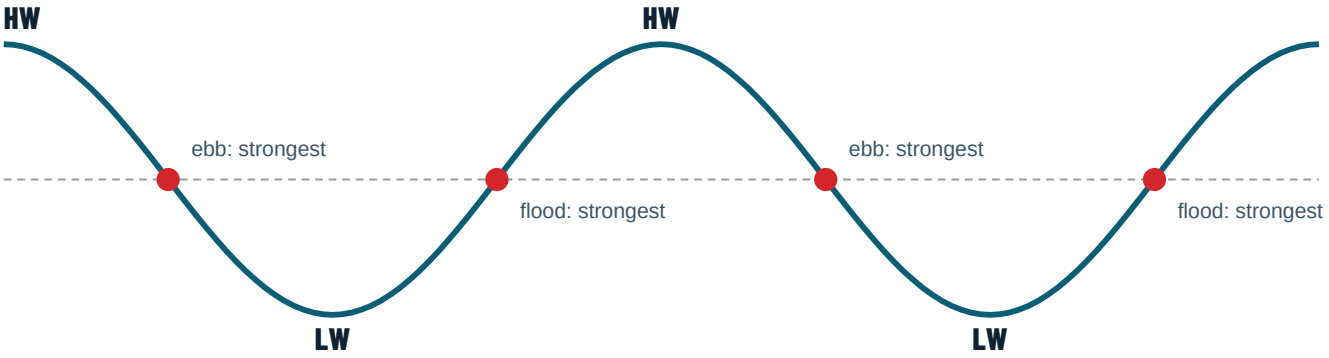


Depth now	charted depth + height of tide
Drying height	above chart datum: subtract it from the height of tide
Under keel clearance	depth now – draft (– squat underway)
Heights of lights and bridges	above MHWS (or HAT on newer charts)

RULES OF THUMB

- Chart datum in Australia is LAT, the lowest tide you can expect in normal weather. Strong offshore wind and high pressure can make it lower.
- High pressure lowers sea level: about 1 cm for each hPa above 1013.
- Use the official tide tables for your port. Times and heights elsewhere differ.

A DAY OF TIDE: ABOUT 6 H 12 MIN FROM HIGH TO LOW



Streams run hardest at mid-tide and go slack near high and low water.

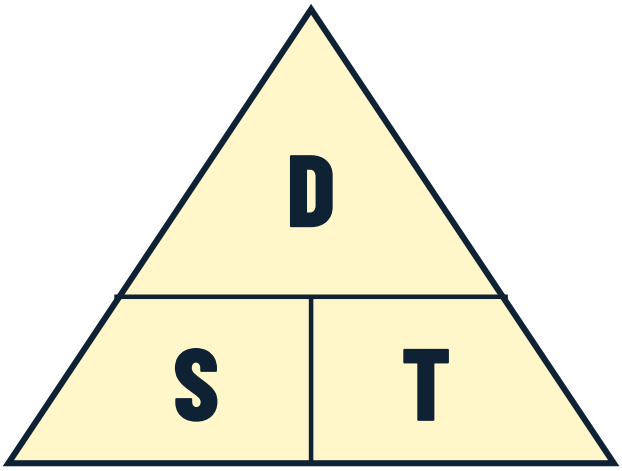
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ZULU MARINER DATA CARD

12 CHARTWORK FORMULAS

The numbers every navigator carries in their head.

SPEED, DISTANCE, TIME



Cover the one you want. D = S × T, S = D ÷ T, T = D ÷ S. Time in hours: 6 minutes = 0.1 h, so at 10 knots you go 1 mile in 6 minutes.

> *The 6-minute rule: distance in 6 min = speed ÷ 10.*
> *The 3-minute rule: metres in 3 min = speed × 100.*

COMPASS TO TRUE

T V M D C

True, Variation, Magnetic, Deviation, Compass. **True Virgins Make Dull Companions**. Going down the line (true to compass): add West. Coming up (compass to true): add East.

> *Error West, compass best (compass reads more).*
> *Error East, compass least.*
> *CADET: Compass ADd East to get True.*

FAST ESTIMATES

1 in 60	1° off track ≈ 1 mile off after 60 miles
Distance to the horizon	2.08 × √(height of eye, m) miles
Rising or dipping range	2.08 × (√eye + √light height) miles
Squat (Barrass)	open water ≈ Cb × V^2 ÷ 100 m; double it in a confined channel
Turning	wheel-over well before the course line, more for a big ship
1 minute of latitude	1 nautical mile
Longitude	shrinks with latitude: × cos(lat)

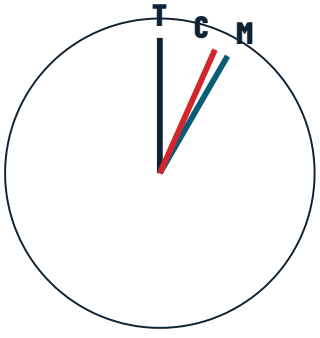
UNITS

1 nautical mile	1,852 m
1 cable	0.1 mile, 185 m
1 knot	1 mile an hour, 1.852 km/h
1 fathom	6 feet, 1.83 m
1 m	3.28 feet

FIXES

- Cross bearings: two objects about 90° apart, or three about 60° apart. Three make a cocked hat.
- Take bearings ahead and astern first, abeam last (abeam changes fastest).
- Always check GPS against a bearing, a range or the depth.

A WORKED EXAMPLE



True, magnetic and compass north. Angles drawn ×3.

True	090°	
Variation	10° E	− East
Magnetic	080°	
Deviation	2° W	+ West
Compass	082°	

True to Compass: east is least (subtract), west is best (add).

Compass to True: the other way round.

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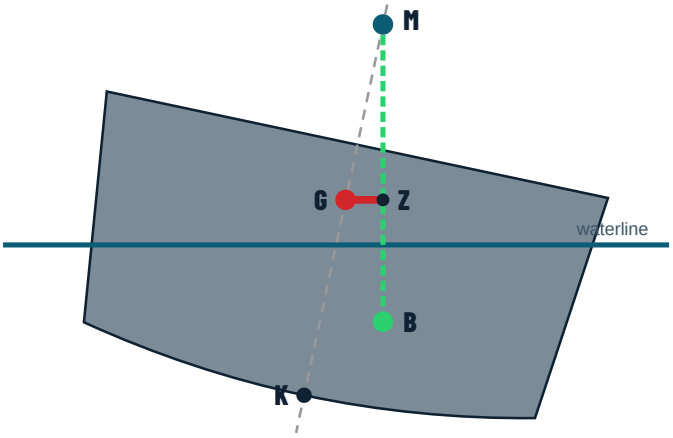
ZULU MARINER DATA CARD

13 STABILITY ON A PAGE

Why she floats upright, and the warning signs that she may not.

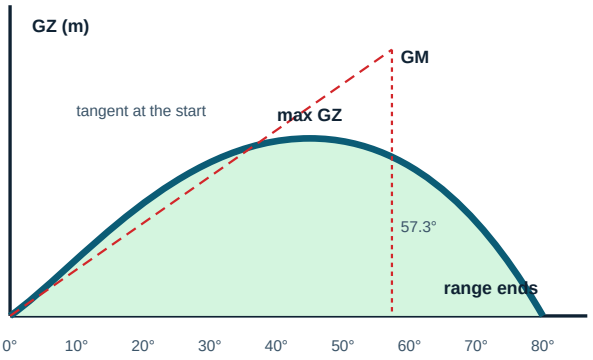
THE KEY POINTS

heeled 12° to starboard: B moves to the low side;
buoyancy acts up through B and M. GZ is the righting lever.



K	keel
B	centre of buoyancy (moves as she heels)
G	centre of gravity (moves when weight moves)
M	metacentre
GM = KM − KG	initial stability; bigger is stiffer
GZ = GM × sin θ	righting lever at small angles

THE GZ CURVE



Righting moment = displacement × GZ. Look for the angle of max GZ, the range, and the area under the curve.

ROLL PERIOD TELLS YOU GM

$$GM \approx (C \times B \div T)^2$$

T roll period in seconds, B beam in metres, C about 0.7 to 0.8 for ships. A slow, lazy roll means low GM. A quick, jerky roll means a stiff ship.

LIST OR LOLL?

	LIST	LOLL
Cause	weight off the centreline	G too high, negative GM
She leans	always the same side	either side, flops over
Roll	about the list	slow, lazy, about the loll angle
Fix	move weight to the high side	lower G: low tanks (low side first), remove top weight, kill free surface

WARNING SIGNS ON SMALL CRAFT

- Water on deck or in the bilge (free surface).
- Slack tanks; fish or ice high up.
- Lifting over the side, or nets hung from a high block.
- Everyone on one side or on the top deck.
- Freeing ports blocked.
- Towline leading across the beam (girting).

FREE SURFACE: WHY SLACK TANKS ARE DANGEROUS



Pressed full: no free surface | Slack tank, upright | Slack tank heeled: the water runs to the low side

Loose water acts as if G had risen. Keep tanks full or empty, bilges dry, freeing ports clear.

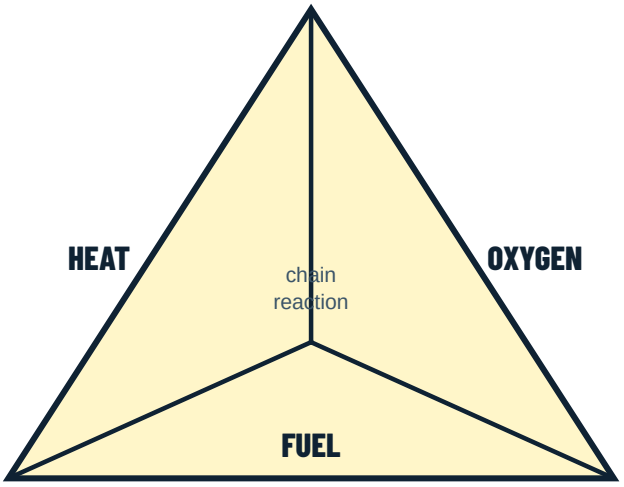
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ZULU MARINER DATA CARD

14 FIRE ON BOARD

Raise the alarm, fight it only if it is safe, and always have a way out.

TAKE AWAY ONE SIDE, THE FIRE GOES OUT



- **Fuel**: shut off fuel and gas, move combustibles.
- **Oxygen**: close doors, hatches and vents; smother.
- **Heat**: cool with water, cool the boundaries.
- **Chain reaction**: powder and some agents break it.

CLASSES OF FIRE (AUSTRALIA)

A	wood, paper, cloth, plastics
B	flammable liquids: petrol, diesel, oil
C	flammable gases: LPG
D	metals
E	electrical equipment
F	cooking oils and fats

EXTINGUISHERS BY THEIR BAND COLOUR



Water	Foam	Dry chemical powder	CO_2	Wet chemical
A	**A B**	**A B C E**	**B E**	**F (A)**

Never water on fuel, oil or live electrics. CO_2 in a small cabin can suffocate you.

> *PASS: Pull the pin, Aim at the base, Squeeze, Sweep.*

ACTIONS

1. Raise the alarm. Everyone in lifejackets.
2. Stop the engine and fans; shut fuel; isolate the power.
3. Put the fire downwind: turn the boat.
4. Fight it from low down, with your back to the way out.
5. Engine space: do not open it. Use the fixed system or port.
6. MAYDAY or PAN-PAN early, with position and persons on board.
7. Cool the boundaries. Ready the liferaft.
8. Count heads.

WHICH EXTINGUISHER ON WHICH FIRE

	A SOLIDS	B LIQUIDS	C GASES	E ELECTRICAL	F COOKING OIL
Water	✓	✗	✗	✗	✗
Foam	✓	✓	✗	✗	✗
Dry chemical powder	✓	✓	✓	✓	✗
CO_2	✗	✓	✗	✓	✗
Wet chemical	some	✗	✗	✗	✓

Read the label: it lists the classes each extinguisher is rated for. Gas fire (C): shut off the gas first.

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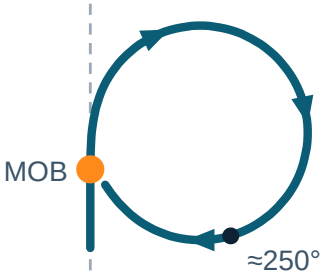
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15 PERSON OVERBOARD

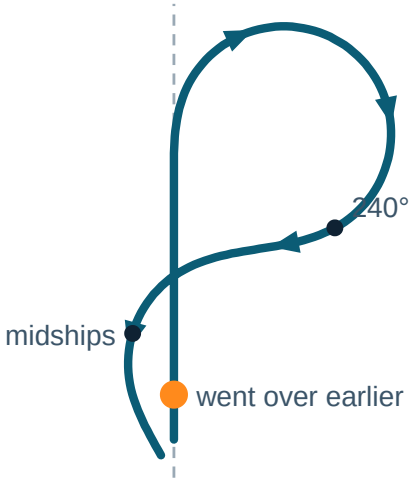
Shout, throw, point, mark, turn. The first ten seconds decide it.



Williamson turn
Hard over to the side they fell. At 60° off course, hard over the other way. 20° short of the reciprocal, midships. Brings you back down your own track. Best at night or when you did not see them go.



Anderson (single) turn
Hard over to the side they fell and keep turning. About 250° round, midships and stop when they are ahead. Fastest when you can see them.



Scharnow turn
For someone who went over a while ago. Hard over; at 240° off course, hard over the other way; 20° short of the reciprocal, midships. Back onto your own track, behind you, in less distance. No good if they just went over.

Drawn for a turn to starboard (they fell from the starboard side). The dashed line is your original track. Turning circles differ: practise with your own vessel.

DO IT NOW

1. **Shout** "Man overboard, starboard side!"
2. **Throw** a lifebuoy, with its light at night.
3. **Point**: one person never takes their eyes off them.
4. **Mark**: press MOB on the GPS or plotter.
5. **Turn**: helm toward the side they fell, swing the propeller away.
6. **Call**: MAYDAY if they are not recovered at once.
7. **Recover**: approach from downwind, engine in neutral alongside, lift them horizontal if cold.

COLD WATER: 1 - 10 - 1

1 • 10 • 1

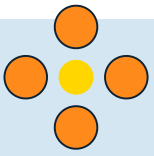
- **1 minute** of cold shock gasping: keep the head out, float, do not panic.
- **10 minutes** of useful movement before the hands and arms fail: get to safety, put on a lifejacket.
- **1 hour** or more before hypothermia knocks you out: a lifejacket keeps you alive for rescue.

Keep still in the water, legs together, arms in (the HELP position), or huddle as a group.

KEEP THE HEAT IN WHILE YOU WAIT



HELP
arms across the chest, knees up, legs crossed



HUDDLE
close together, children in the middle

A lifejacket lets you keep still. Swimming pumps cold water past your body and cools you faster.

Study aid only. Not for navigation.
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ZULU MARINER DATA CARD

16

FIRST AID: DRSABCD

The Australian Resuscitation Council action plan. Get medical advice by radio or phone early.

D
DANGER
To you, the others, the casualty.

R
RESPONSE
Talk, touch. Responds? Make comfortable, monitor.

S
SEND FOR HELP
Call 000 or 112, or MAYDAY / PAN-PAN on VHF 16.

A
AIRWAY
Open the mouth. If foreign matter, roll onto the side and clear it.

B
BREATHING
Look, listen, feel. Normal breathing? Recovery position.

C
CPR
30 compressions : 2 breaths. Hard and fast, 100 to 120 a minute, a third of the chest depth.

D
DEFIBRILLATION
Attach an AED as soon as one is there. Follow its voice.

BLEEDING

- Firm, direct pressure on the wound with a pad. Raising the limb is no longer advised.
- Limb bleeding that pressure will not stop: an arterial tourniquet above the wound (follow its instructions, or about 5 cm above), not over a joint.
- Note the time it went on and tell the paramedics. Never cover it.

BURNS

- Cool running water for 20 minutes.
- Remove rings and watches. No ice, no creams.
- Cover loosely with cling film or a clean dressing.

HYPOTHERMIA

- Handle gently, keep horizontal.
- Remove wet clothes, wrap in dry layers and a space blanket, cover the head.
- Warm sweet drinks only if fully alert. No rubbing, no alcohol.

SHOCK

- Help them lie down. Do not raise the legs.
- Keep warm, reassure, nothing by mouth. Recovery position if they vomit or lose consciousness.

MARINE STINGS

- Marine stinger in tropical waters: vinegar for 30 seconds, then ice. Watch for Irukandji symptoms.
- Stonefish: hot water, as hot as they can bear.

SEASICKNESS

- Eyes on the horizon, fresh air, sip water.
- Tablets before you go out, not after.
- A seasick crew member is not a lookout.

A memory aid, not a first aid certificate. Do a first aid course and keep a kit that suits your trip.

THE RHYTHM OF CPR



30 compressions — 2 breaths

Push hard and fast, 100 to 120 a minute: about two a second, the beat of "Stayin' Alive".
Lower half of the breastbone, a third of the chest depth. Keep going until help or an AED takes over.

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ZULU MARINER DATA CARD

17

HOURS OF REST AND FATIGUE

STCW and MLC minimums for watchkeepers. Your vessel's rules may be stricter.

One 24-hour day that meets the rules: 10 h rest in two periods, one of them 6 h, gaps no more than 14 h



10 hours rest in any 24

77 hours rest in any 7 days

2 periods at most, one at least 6 hours

14 hours at most between rest periods

SIGNS OF FATIGUE

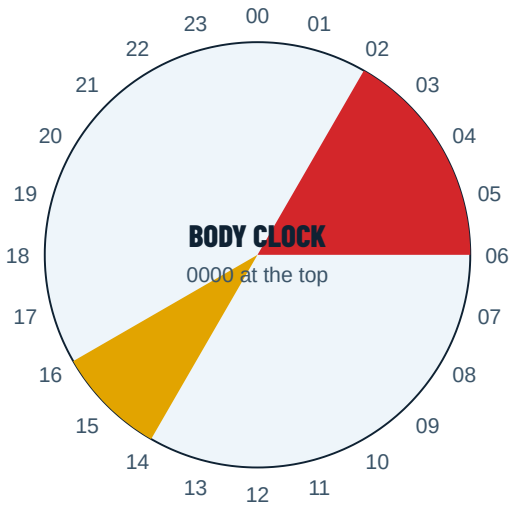
- Slow reactions, missed alarms, forgetting what you just checked.
- Microsleeps: eyes closing, head nodding.
- Irritable, careless, fixed on one thing.
- Fatigue at 17 hours awake is like a blood alcohol of 0.05.

WHAT TO DO

- Plan the watch rota to fit the rules, and post it.
- Record actual hours of rest; sign them.
- Stand down a watchkeeper who is not fit; call the Master.
- The limits may be set aside only for the immediate safety of the ship and people, or to help others in distress. Hold drills so they disturb rest as little as possible. Give compensatory rest after.
- The worst hours: 0200 to 0600 and after lunch.

Domestic commercial vessels follow the vessel's SMS and AMSA requirements. Check the current rules for your vessel.

WHEN YOU ARE WEAKEST



0200 to 0600: the deepest low.
Most fatigue accidents happen here.

1400 to 1600: the after-lunch dip.

On the middle watch: bright light, move about, talk, and never sit down in the dark with the heater on.

Sleep debt adds up over days. Only sleep repays it.

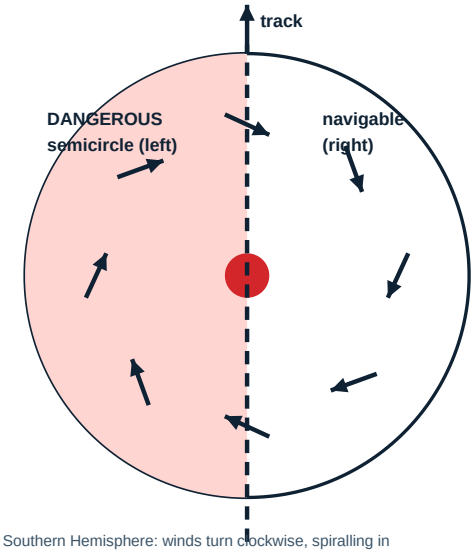
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ZULU MARINER DATA CARD

18 SOUTHERN HEMISPHERE WEATHER

Lows turn clockwise down here. Cyclones from November to April.

TROPICAL CYCLONE: WHERE AM I?



Southern Hemisphere: winds turn clockwise, spiralling in

Wind **backs** (anticlockwise)	dangerous semicircle: wind on the **port bow**, best speed away
Wind **veers** (clockwise)	navigable semicircle: wind on the **port quarter**, run
Wind steady, pressure falling	you are in the path: wind on the port quarter, into the navigable side

Southern Hemisphere. In the north it is all the other way round.

BUYS BALLOT'S LAW (SOUTH)

Back to the wind, the low is on your right

Slightly behind you. Keep it in sight on your right and you know which way the system lies.

BAROMETER TENDENCY (3 HOURS)

Steady	under 0.1 hPa
Slowly	0.1 to 1.5
Rising or falling	1.6 to 3.5
Quickly	3.6 to 6
Very rapidly	over 6

> *Long foretold, long last. Short notice, soon past.*
> *A fall of 3 hPa or more in 3 hours: strong wind coming.*
> *In the tropics, any fall outside the daily cycle is a warning.*

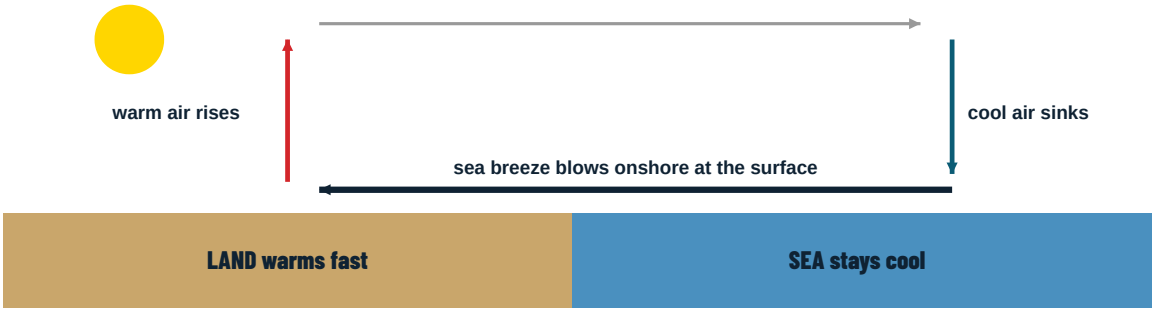
CYCLONE CATEGORIES (BOM)

1	gusts under 125 km/h
2	125 to 164 km/h
3	165 to 224 km/h
4	225 to 279 km/h
5	over 279 km/h

SIGNS AT SEA

- Long swell from an unusual direction, sometimes days ahead.
- Cirrus thickening from one direction; a red or copper sky.
- Barometer falling outside its usual twice-daily swing (about 3 hPa in the tropics).
- Sea breeze: onshore in the afternoon, strongest around 3 pm, fades at dusk.

WHY THE AFTERNOON SEA BREEZE COMES IN



It builds from late morning, peaks mid-afternoon and dies at dusk. At night a lighter land breeze can blow offshore.

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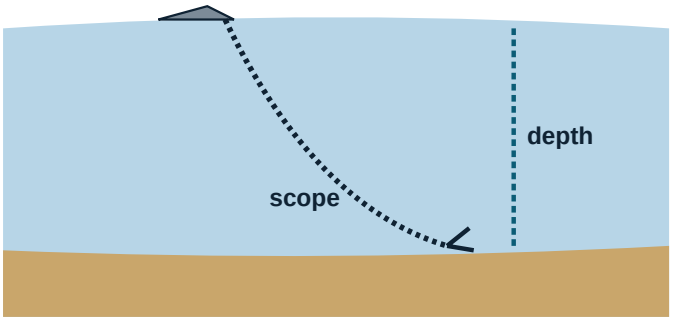
19

ANCHORING

Choose the spot, give her scope, and check she is holding.

SCOPE

scope = length out ÷ depth at high water (+ bow height)



All chain	3 : 1 in good conditions, 5 : 1 or more if it blows
Rope with some chain	5 : 1 to 7 : 1
Ships	often 4 to 6 shackles in moderate depth; follow company and pilot guidance

Use the depth at high water, not now. A shackle is 15 fathoms, 27.4 m.

SHOWN

- Day: one black ball forward.
- Night: all-round white forward; 50 m or more, a second lower white aft.
- Fog: rapid bell for 5 s every minute; over 100 m, gong aft too.

CHOOSING THE SPOT

- Shelter from the wind and swell expected, not just now.
- Good holding: sand or mud; avoid weed, rock and coral (and it may be a green zone).
- Swing room all round, clear of moorings, cables and channels.
- Enough water at low tide for the swing.

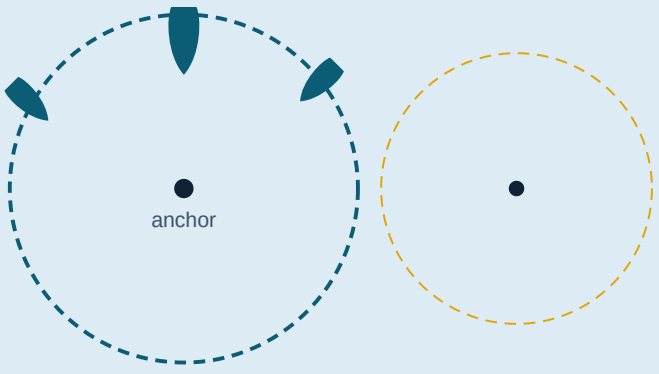
IS SHE DRAGGING?

- Set the GPS anchor alarm and a swing circle.
- Take a transit or two bearings, and check them.
- Feel the chain: it jumps or judders when the anchor drags.
- She lies beam on to the wind instead of head to it.

LETTING GO AND WEIGHING

1. Head to wind or stream, stop.
2. Let go as she starts going astern.
3. Pay out as she drops back, then snub it to dig in.
4. Back down gently to test.
5. Weighing: motor up to the anchor, do not haul the boat on the windlass.

ROOM TO SWING, GROUND TO HOLD



Swing circles must not overlap: leave room for the wind to change.

Holding ground

Sand	good
Mud	good
Shingle	fair
Weed	poor: avoid
Rock	poor: avoid
Coral	poor: avoid

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20

PASSAGE PLANNING: APEM

Appraise, Plan, Execute, Monitor. The same for a tinny and a tanker.

A

APPRAISAL

- Charts and publications, corrected
- Tides, streams, weather
- Dangers, no-go areas, marine park zones
- Vessel limits, fuel, crew
- Ports of refuge and bail-out points

P

PLANNING

- Tracks clear of dangers, waypoints
- Clearing bearings and depth limits
- Wheel-over points, parallel indexes
- Under keel clearance at the worst point
- Fuel with one third in reserve
- Reporting points and VHF channels

E

EXECUTION

- Timing for tides and daylight
- Brief the crew
- Trip plan to someone ashore
- Equipment checked and working

M

MONITORING

- Fix often enough to stay clear
- GPS checked against bearings and depth
- Watch the weather
- Off track? Find out why at once
- Reassess and change the plan

THE THIRDS RULE FOR FUEL

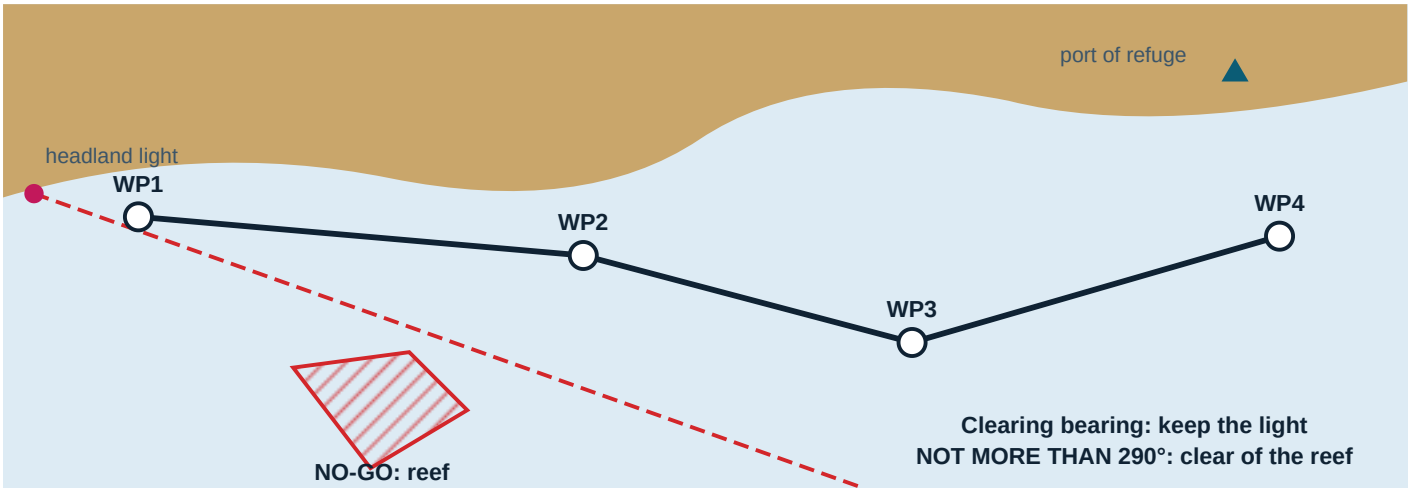
⅓ out · ⅓ back · ⅓ spare

Headwinds, a long way round or a tow home soon use the spare third.

BEFORE YOU GO

- Forecast and warnings checked, against your limits.
- Lifejackets, EPIRB, flares, radio, anchor.
- Someone ashore knows where you are going and when you will be back.
- Know your way home if the weather turns.

WHAT A PLAN LOOKS LIKE ON THE CHART



While the light bears 290° or less you are north of the dashed line, on the safe side. More than 290°: you are being set towards the reef.

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21 NUMBERS TO KNOW

Conversions and quick figures for the boat and the ship.

DISTANCE AND SPEED

1 nautical mile	1,852 m
1 cable	185 m
1 knot	1.852 km/h
1 knot	0.514 m/s
1 statute mile	0.869 nm
1 km	0.54 nm

DEPTH AND LENGTH

1 fathom	1.829 m
1 m	3.281 ft
1 ft	0.305 m
1 shackle of cable	27.4 m (15 fathoms)

WEIGHT AND VOLUME

Fresh water	1.000 t/m³
Sea water	1.025 t/m³
Diesel	about 0.84 kg/L
Petrol	about 0.74 kg/L
1 L	0.001 m³
1 US gallon	3.785 L
1 imperial gallon	4.546 L

PRESSURE

Standard atmosphere	1013.25 hPa
1 bar	1000 hPa
10 m of sea water	about 1 bar

TIME AND ARC

1 hour	15° of longitude
4 minutes	1° of longitude
1° of latitude	60 nm
AEST	UTC + 10
AEDT (NSW summer)	UTC + 11
Queensland	no daylight saving

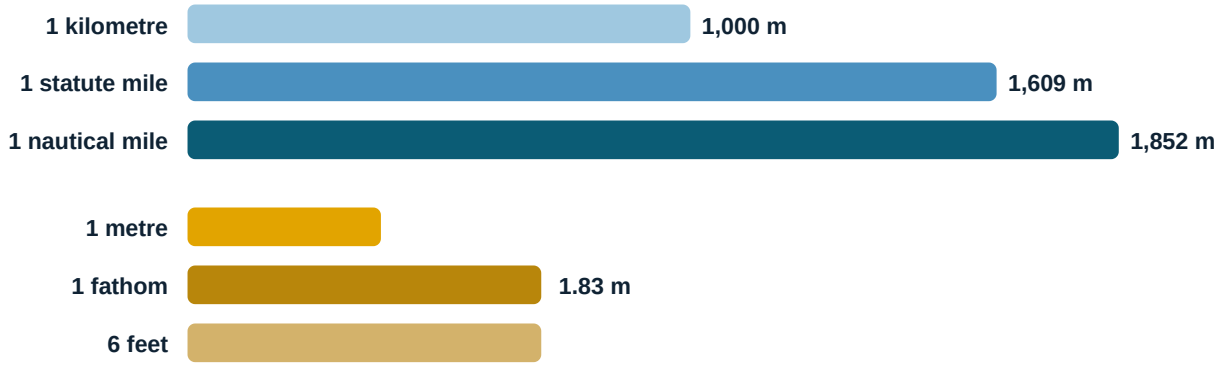
POWER

1 kW	1.341 hp
1 hp	0.746 kW
Bollard pull	roughly 1.5 t per 100 kW for a modern ASD tug; use the certificate

QUICK SUMS

- Fuel range = (litres ÷ L/h) × knots.
- Time to run = distance ÷ speed. 6 minutes is 0.1 of an hour.
- Height of eye 2 m: horizon about 2.9 nm. 9 m: about 6.2 nm.
- Temperature: °F = °C × 1.8 + 32.

SEE THE SIZES



The nautical mile is one minute of latitude, which is why it is longer than a land mile.

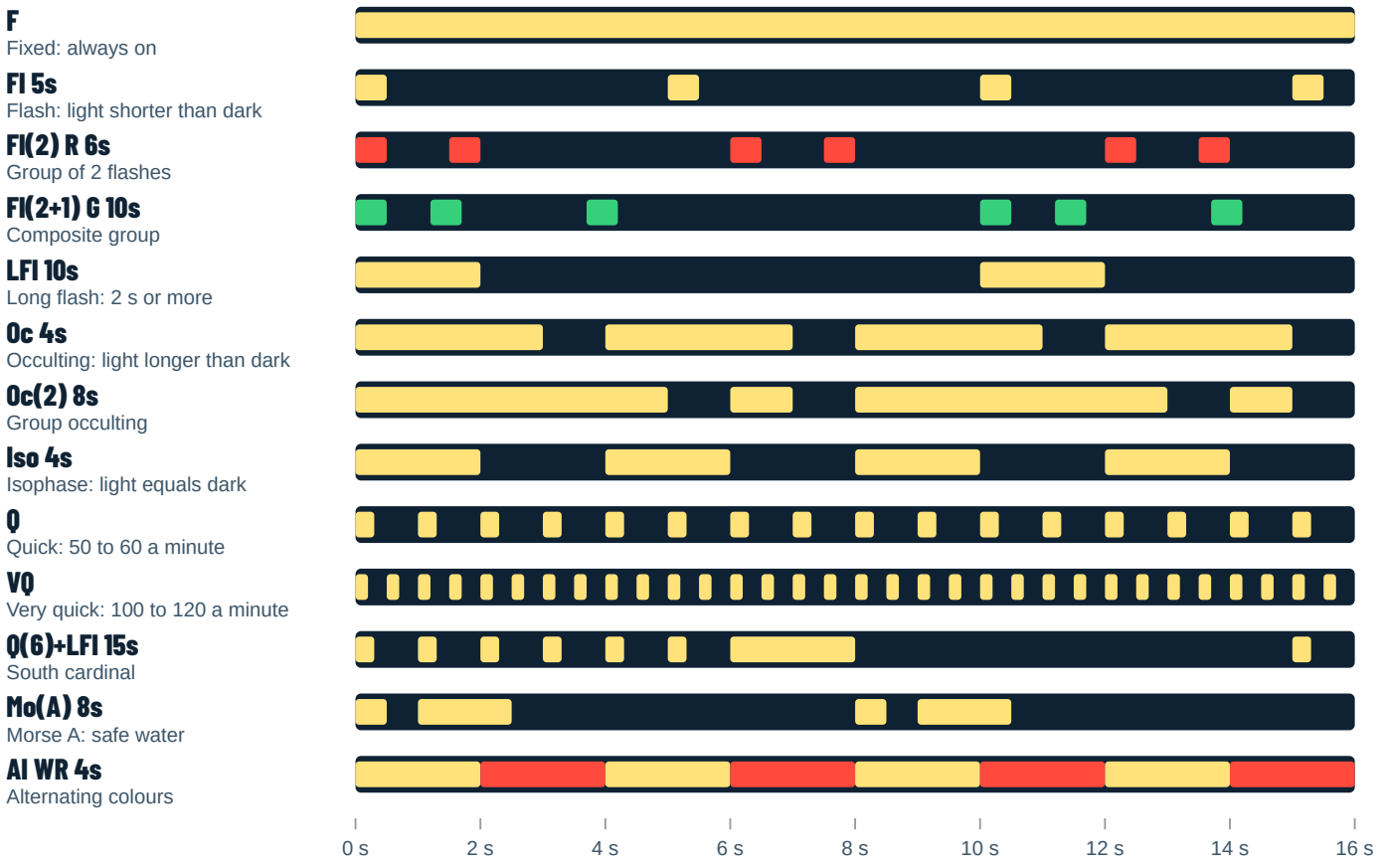
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22 LIGHT CHARACTERS

What Fl(2) R 6s means, and how to time a light to name it.

THIRTEEN CHARACTERS ON ONE CLOCK



READING THE CHART

Fl(3) G 10s 8m 4M

Fl(3)	flashing, groups of three
G	green (no letter: white)
10s	period: start of one group to the start of the next
8m	height of the light above the chart's height datum
4M	nominal range in nautical miles

NAMING A LIGHT AT NIGHT

- Time it with a stopwatch: count from the start of one group to the start of the next. Do it three times.
- Count the flashes in a group, and note the colour.
- Check the chart and the List of Lights. The height and range tell you how far off you can expect to see it.
- Sector light: the colour tells you which side of the safe track you are on. Sector bearings are given from seaward, true.

> *Flashing: mostly dark, blinks on.*
> *Occulting: mostly lit, blinks off.*
> *Isophase: half and half.*

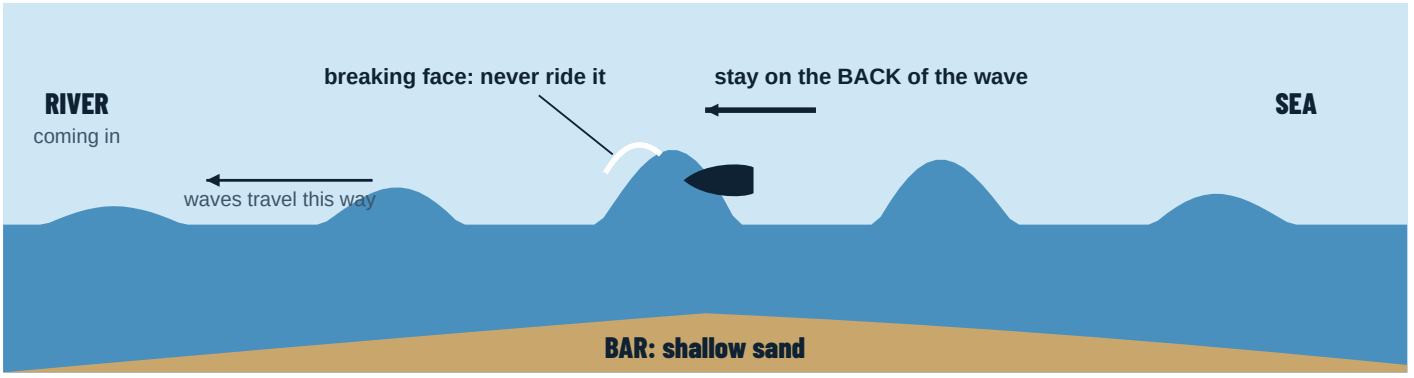
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23 CROSSING A COASTAL BAR

Where the swell meets shallow water and the tide. Plan it, watch it, then cross it.

COMING IN: RIDE THE BACK, NOT THE FACE



BEFORE YOU CROSS

1. Check the forecast, the swell, the tide and any bar warning. Look at the bar camera if there is one.
2. Log on with Marine Rescue on VHF: who you are, how many on board, where you are going, when you will be back.
3. Lifejackets on, everyone. It is the law crossing a coastal bar in NSW, and in Queensland in an open boat or the open area of any boat.
4. Bung in, hatches shut, gear tied down, bilge pump working, engine warm.
5. Watch from a safe spot for 10 minutes or more. Swell comes in sets with lulls between. Count them.

THE TIDE

- Best: an incoming tide, ideally the last of the flood near high water. More depth, smaller waves.
- Worst: the ebb (outgoing tide). Water running out against the swell stands the waves up steep and close together.
- Swell builds after you leave. A bar that was easy at 6 am can close by noon.

GOING OUT

- Wait for the lull after a big set, then go with steady power.
- Meet the waves bow on, or slightly angled.
- Ease off as you reach a crest so you do not launch off the back; power on again after.
- Never turn beam on in the break.

COMING IN

- Wait outside the break and watch the sets.
- Go in on the back of a wave, behind the last of the set, and stay there.
- Match its speed. Do not overtake it or surf down the face: that is how boats broach and roll.
- Keep the stern square to the swell. Weight aft, hands on the throttle.

IF IT GOES WRONG

- Swamped or rolled: stay with the boat, stay together, use the EPIRB and radio.
- Not sure? Do not cross. Wait for the tide, or stay inside.
- Log off with Marine Rescue when you are back. If you do not, they come looking.

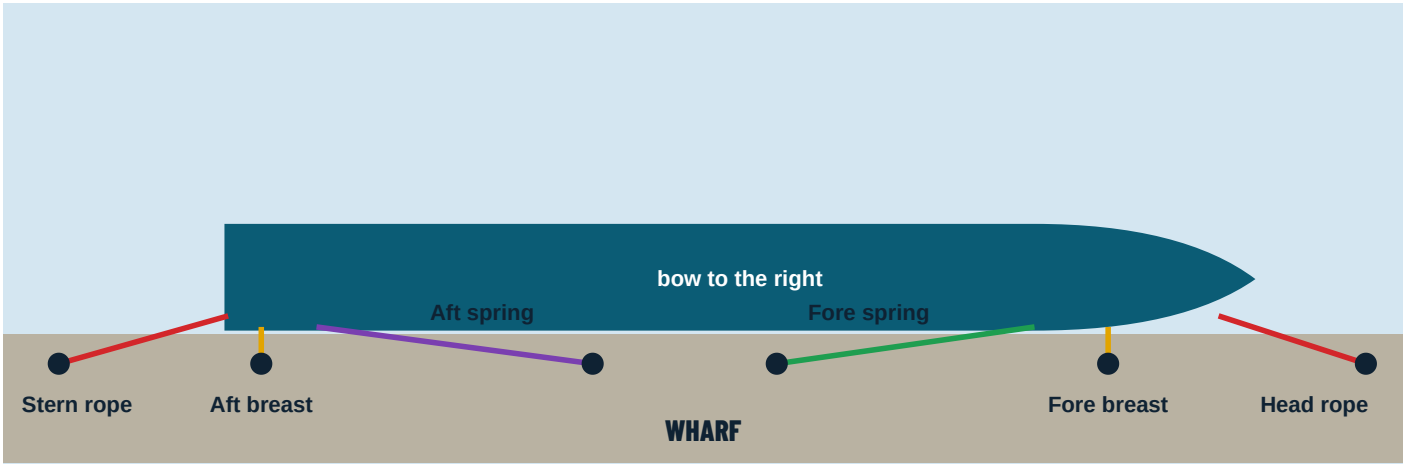
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24 MOORING LINES AND BERTHING

Name every line, know what it does, and stay out of the snap-back zone.

SIX LINES, SIX JOBS



Fore spring: from forward, leads aft. Aft spring (back spring): from aft, leads forward. Springs stop her surging along the wharf; breasts hold her in; head and stern ropes do a bit of both.

USING THE SPRINGS

Stern out	motor slow ahead against the fore spring, rudder towards the wharf: the bow is held, the stern swings off. Then go astern away.
Bow out	motor slow astern against the aft spring: the stern is held, the bow swings off.
Coming alongside	get a spring on first: it stops her and lets you work her in with the engine.
Single up	take in all but one line each end, ready to let go.

WORDS ON DECK

Make fast	secure it
Ease / slack away	let it out under control
Check	ease it but keep a strain
Heave	pull it in
Let go / cast off	free it ashore
All fast	every line secured

SNAP-BACK: WHERE PEOPLE GET HURT

- A line under load stores energy like a spring. If it parts it whips back at head height.
- Stay out of line with any loaded rope, and away from the line it would sweep if it broke, especially around fairleads and rollers.
- Never stand in a bight or step over a line under strain.
- Painted zones on deck do not show the whole danger. Think about where the rope would go.
- Keep hands well clear of bitts, cleats and drums when a line surges.

GOOD HABITS

- Chafe gear where a line crosses an edge.
- Lines doing the same job should be the same size and material, so they share the load.
- Tide and loading change the lead: tend the lines, or use long springs.
- Knots to know: cleat hitch, bowline, round turn and two half hitches, clove hitch.

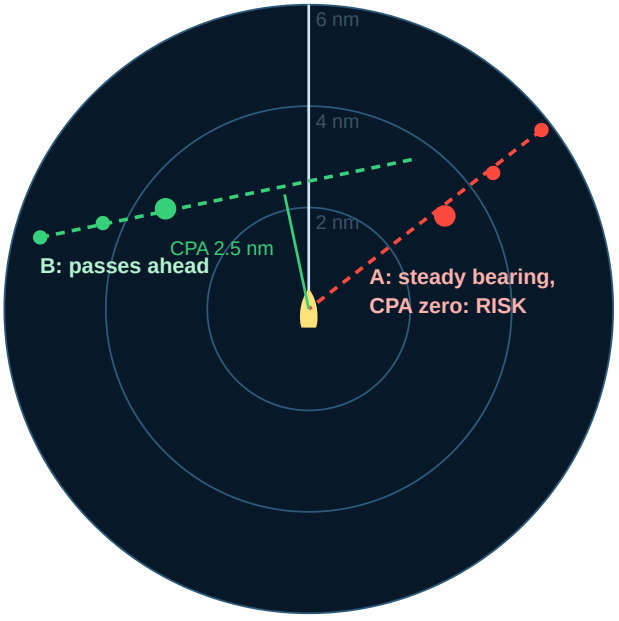
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25 RADAR AND COLLISION AVOIDANCE

Plot it, find the CPA, act early. Radar and AIS help you keep the rules; they do not replace a lookout.

READING THE PLOT



Relative motion, 6 nm range, plots every 6 min

1. Mark the target every few minutes.
2. Draw a line through the marks and extend it.
3. CPA: the closest that line comes to the centre.
4. TCPA: time to get there at the same rate.

Bearing steady, range closing: risk of collision (Rule 7).

Relative trails show who is closing.
True trails show what she is doing.

THE RULES THAT MENTION RADAR

5	Lookout by every available means, radar included.
6(b)	Safe speed with radar: its range scale, clutter, small targets and ice it may miss.
7(b)	Proper use: long-range scanning for early warning, and radar plotting.
7(c)	No assumptions on scanty information, especially scanty radar information.
8(b)	Alter enough to be readily apparent to another vessel on her radar.
19(d)	Detected by radar alone, close quarters developing: act in ample time. Forward of the beam: avoid turning to port (except for a vessel being overtaken). Abeam or abaft: avoid turning towards her.

SET IT UP

- Gain: just a speckle of noise. Sea clutter: enough to see inside the clutter, no more.
- Rain clutter only when needed: it can hide weak targets too.
- Use EBL for bearing and VRM for range. Step down the range scale as targets close.
- Check heading line and gyro or compass against a known mark.

LIMITS TO REMEMBER

- Small boats, wood and fibreglass hulls, and kayaks give weak echoes, worst in a sea.
- Shadow sectors behind masts and funnels.
- AIS is not on every vessel, and it can be wrong. Course over ground is not heading.
- Use ARPA trial manoeuvre before you turn, then watch the result.

Big and early. Turn 30° or more, not a nudge of 5°.
Then keep plotting until she is past and clear.

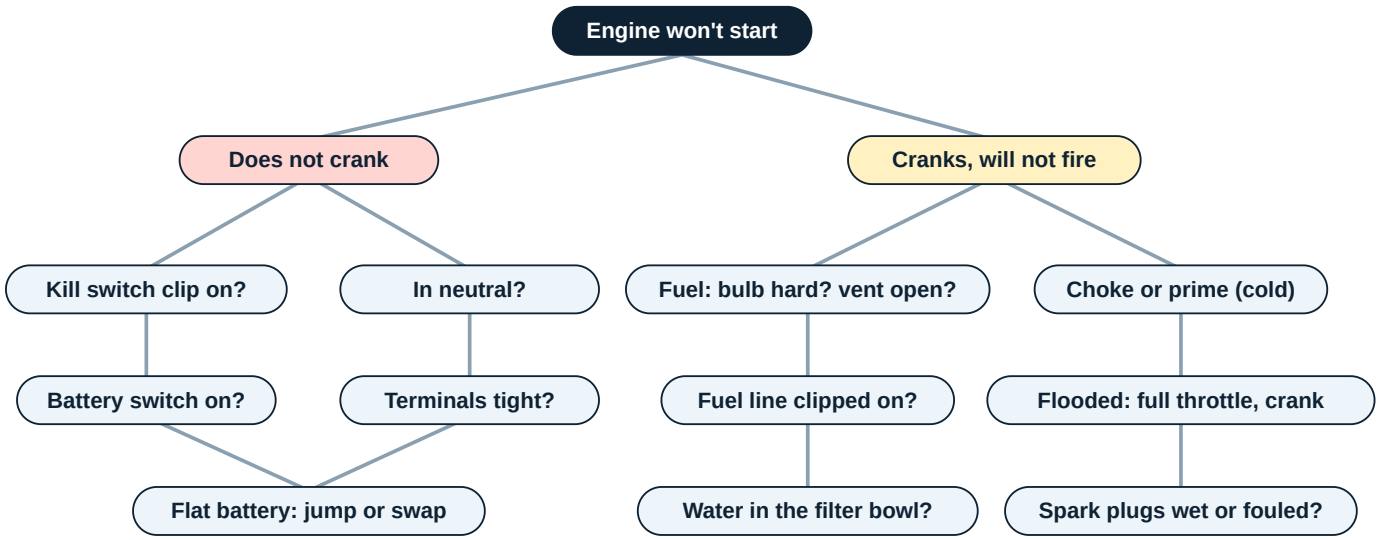
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26 ENGINE CHECKS AND WON'T-START

Most breakdowns are fuel, battery or cooling, and most can be caught at the ramp.

WON'T START? WORK DOWN THE TREE



AT THE RAMP, BEFORE YOU LAUNCH

1. **Bung in.** Then check it again.
2. Fuel: enough for the thirds rule, fresh, tank vent open, line clipped on, bulb pumped hard.
3. Oil: dipstick on a four-stroke; oil tank full on a two-stroke.
4. Battery: switch on, terminals tight, charged.
5. Kill switch clip on the engine, lanyard on the driver once under way.
6. Leg trimmed down, propeller clear of weed and line, gear in neutral.
7. Inboard petrol engine: run the bilge blower for a few minutes before starting. Seacock open.

ONCE IT IS RUNNING

- Look for the tell-tale: a steady jet of cooling water within about 30 seconds. No water: stop the engine.
- Listen for warning beeps; watch the temperature and oil lights.
- Warm it up before you load it up.

UNDER WAY

PROBLEM	LIKELY CAUSE
Overheat alarm	weed or a plastic bag on the intake, blocked tell-tale, worn impeller
Loses power, surges	blocked fuel filter, tank vent shut, water in fuel
Revs up, little drive	propeller ventilating (trim down) or a spun hub
Vibration	line or weed round the propeller, bent blade

SPARES THAT SAVE A DAY

- Spark plugs and a plug spanner, fuel filter, impeller
- Spare kill-switch clip, fuses, tape, cable ties
- Tools that fit your engine, and the owner's manual

Stuck and drifting towards danger: anchor first, then fix it. Call Marine Rescue or a PAN-PAN early.

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