Navigation Notes:

The following are notes, hints, and help for you while sailing and for basic assistance Navigation that i've compiled. READ THE USCG REGS, COLREGS, and other appropriate NAVIGATION guides.

There are SIX basic Navigation types:

- **Dead Reckoning (DR)** - used to determine on going DR position from a know starting point using time, speed, distance… sometimes also taking Set & Drift as well as Leeway into account.
- **Piloting** - Navigation in Restricted Waters using frequent or constant determination of position relative to geographic and hydrographic features.
- **Celestrial Navigation** - invloves using a sextant and angles/lines of position of stars and sun with tables, almanacs, or programs.
- **Radio Navigation** - Navigation using Radio Waves to determine position via various electronic devices.
- **RADAR Navigation** - navigation utilizing RADAR to determine distance, bearing, whose position in nown (RADAR is also used for collision avoidance)
- **Satellite Navigation** - using radio signals for satellites, with ground based correction at times, to determine position, speed, heading, etc

Some Acronyms

- CTS - Course To Steer
- COG - Course Over Ground
- SOG - Speed Over Ground
- HDG - Heading
- HDM - Heading Magnetic
- HDT - Heading True
- BWC - Bearng & Distance to Waypoint
- BWW - Bearing Waypoint to Waypoint
- CTW - Course Through Water
- DPT - Depth of Water
- PSC - Per Standard MAgnetic Compass or Per Steering Compass
- SMG - Speed Made Good
- CMG - Course Made Good
- TMG - Track Made Good
- ETA - Estimate Time of Arrival
- ETD - Estimated Time of Departure
- LOP - Line of Position
- MB - Maneuvering Board
- RADAR - RAdio Direction And Range finder
- PPI - Planned Position Indicator
- MRM - Measurement of Relative Movement
- DRM - Direction of Relative Movement
- SRM - Speed of Relative Movement
- EBL - Elecronic Bearing Line
- CPA - Closest Point of Approach
- CE - Compass Error
- C - Compass reading
- CH - Compass Heading
- D - Deviation
- M - Magnetic
- TH or T - True heading
- BRG or B - Bearing
- G - Gyrocompass heading
- GE - Gyrocompass Error
- PGC - Per Gyro Compass
- DR - Dead Reckoning
- C/A - Course provided by GPS in civilian mode
- CBDR - Constant Bearing Decreasing Range
- AP - Assumed Position
- EPIRB - Electronic Position Indicating Radio Beacon
- GMT - Greenwich Mean Time
- INMARSAT - International Maritime Satellite Organization
- AIS - Automated Information System
- DGLONASS - Differential Globalnaya Navigazionnaya Sputnikovaya Sistema
- GLONASS - Globalnaya Navigazionnaya Sputnikovaya Sistema (RUS) (GLObal NAvigation Satellite System
- GPS - Global Positioning System (US)
- DR - Dead Reckoning
- DRcor - Dead Reckoning corrected Position
- WAAS - Wide Area Augmentation System to GPS
- XTE - Cross Track Error

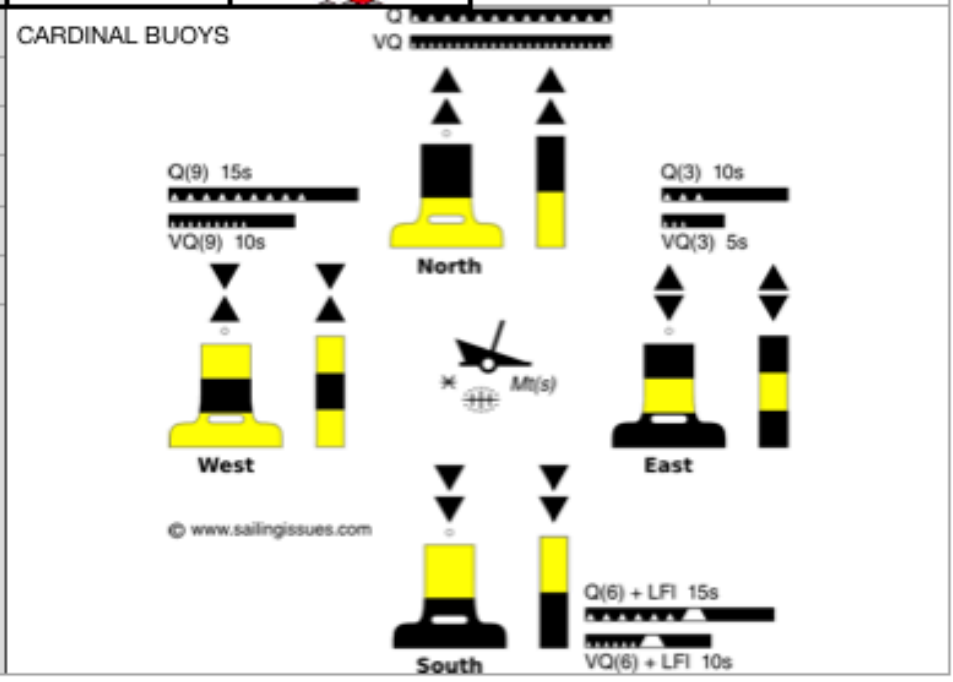
- VTG - Track Made Good and Ground Speed

FIVE Types of Buoys maintained by the USCG

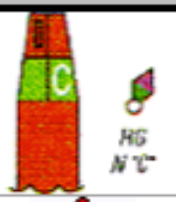
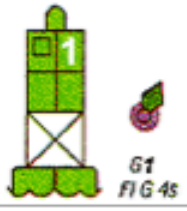
- Lateral marks - indicate port and starboard sides of a channel (IALA lateral marks are similar)
- Isolated danger marks - erected on, or moored near a specific danger
- Safe Water marks - indicates navigable water around the mark.
- Special marks - Indicates special area, or feature like ODAS buoys, ttraffic seperation, Spoil grounds, military zones, cables, pipelines, ecreational marks.
- Information Regulatory marks - marks that designate specific data such as speed limints, etc.

There is a 6th type within the IALA Cardinal Marks.

- Cardinal Marks - marks that are associated with the compass to inform mariners as to best / safest navigatble direction.

OCCULTING		more light than dark	marks for isolated danger	
ALTERNATING		alternating light change color	new wreaks	
MORSE U		flashes Morse signal U (also see MORSE A)	safe water	
MORSE A	one short / one long / pause / repeat		special marks . buoys	
	CARDINAL BUOYS 			

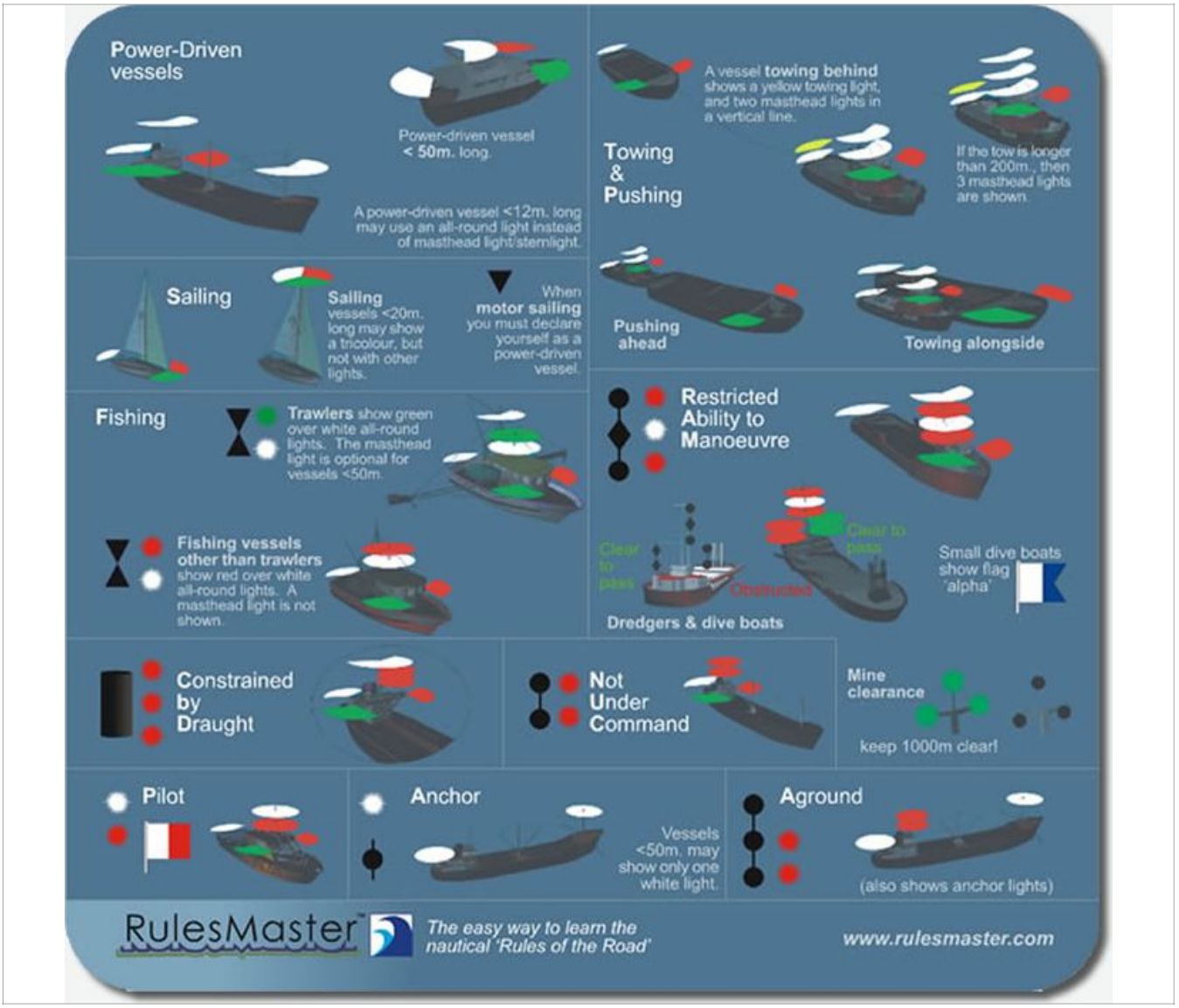
Buoys / Markers

FIXED		always on	preferred channel is top color. LETTER	
FLASHING		duration of light less than dark 30 flashes or less per minute	fairway / safe water LETTER	
LONG FLASHING		at least 2 sec long flash	Regulatory buoy Orange / White DIAMOND = danger	
QUICK FLASHING		flashes at least 60 times per minute	Can - lighted green - ODD NUMBERS	
VERY QUICK FLASH		flashes at least 100 times per minute	Nun - Red EVEN NUMBERS	
INTERRUPTED QUICK FLASH		like quick flash with moments of dark	Green Can - ODD NUMBERS	
ISOPHASE		equal time light and dark	LATERAL BUOY MARKS - border of channels and direction	**RED is even / red lights GREEN is odd / green light**
GROUP FLASH		chases in group then pause	UNDER IALA **A** - RED marks port side of channel when returning FROM Sea RRR	UNDER IALA **B** - GREEN marks port side of channel when returning FROM Sea.

NAV Lights / Sound Signals

Order	Vessel	day mark	mast lights	sound bell and/or gong - limited visibility	sound horn limited visibility (optional) (2 min intervals)	Special Notes	OTHER NOTES
	Anchored		 sec white light if over 50m	<100m 5 sec bell >100M 5 sec bell 5 sec gong (1 min interval)	warning		<20M in special anchorage do not need to signal at anchor
NUC	NOT under COMMAND				warning 		>100M add DECK lights at anchor
AGROUND	AGROUND		 sec white light if over 50m	<100m 3 bell (taps) then 5 sec ringing, then 3 taps, >100M +5 sec gong (2 min interval)	warning		short blast - 1 sec Long blast 4-6 sec
MINE	MINE SWEEPING						all around light 360° mast head 225° side light 112.5° Stern light 135° Towing 135°
RAM	RESTRICTED in ability to MANEUVER				warning		flashing: 120 pulse/min special flashing 50 -70 pulses/min (yellow) (inland on barge)
DREDGE	DREDGE						LEAVING DOCK Reverse Ops Danger/in doubt  rounding a bend manned vessel being towed - limited visibility
FISHING	FISHING	 gear our > 150m	 sec white light if gear over 150m		warning	pulsing yellow for Purse Seiner style net	(COLREGS) meet: alt course to starboard
	TRAWLER				warning	 set haul obstruction	(COLREGS) meet: alt course to port
TOW	TOWING (Short)				warning	short tow <200M stern yellow tow light	(COLREGS) overtake you on your starboard:
	TOWING (Long)		 if tug >50m		warning	long tow >200M stern yellow tow light	(COLREGS) overtake you on your port
CBD	Constrained by draft				warning	COLREGS only	(COLREGS) accepted
SAIL	SAILBOAT (under SAIL)				warning	top of mast >20m	(COLREGS) not accepted/danger
POWER	SAILBOAT (under MOTOR SAIL)		steaming light		warning	top of mast >20m	(INLAND) meet: leave you to my port side
	Power boat		steaming light		warning making way not making way	additional white mast light if over 50M	(INLAND) meet: leave you to my starboard side
	Pilot Boat				warning making way not making way	pilot boat ID signal - on duty	(INLAND) overtake you on your starboard on your port side
							do not impede crossing narrow channel RULE 9

General Lights



TOWING VESSEL and BARGES/Vessles being towed
TOW LIGHTS

WHEN NOT TOWING
Vessel requires standard running lights when <50 M red/green forward / mast light / stern light
Vessel requires standard running lights when >50 M red/green forward / mast light / stern light / range lights

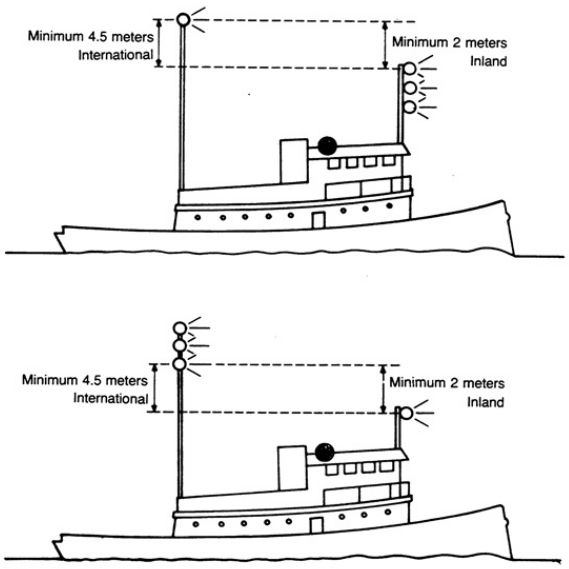
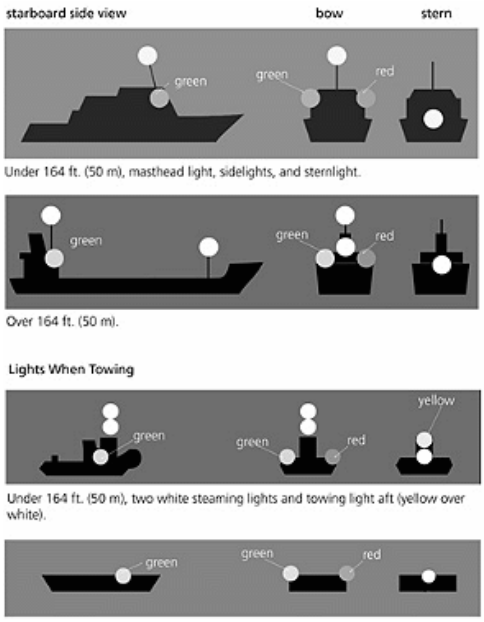
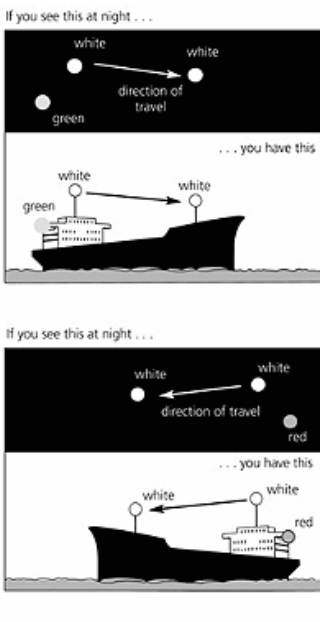
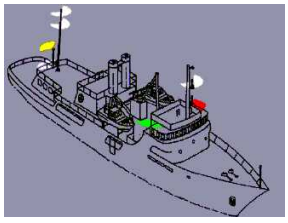


Figure 10—Vertical placement of masthead lights: towing vessels 50 meters or more in length and smaller vessels voluntarily carrying both forward and after masthead lights.

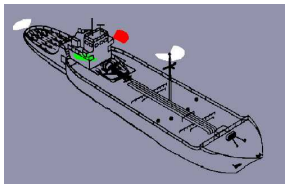




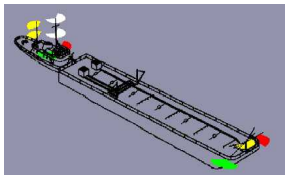
NOTE: on above graphics, 3 in line towing lights (2 or 3) are not required when NOT Towing.



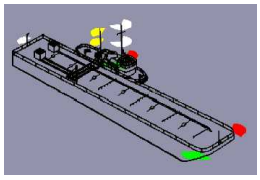
Towing (tow vessel >50M) Tow <200M

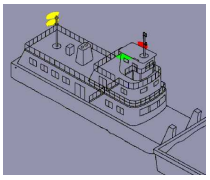


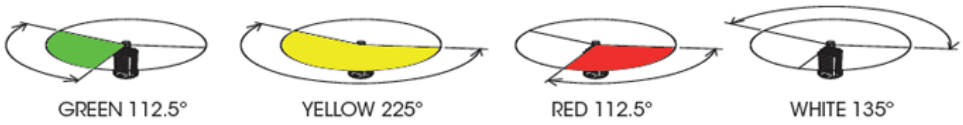
PUSHING - INTL

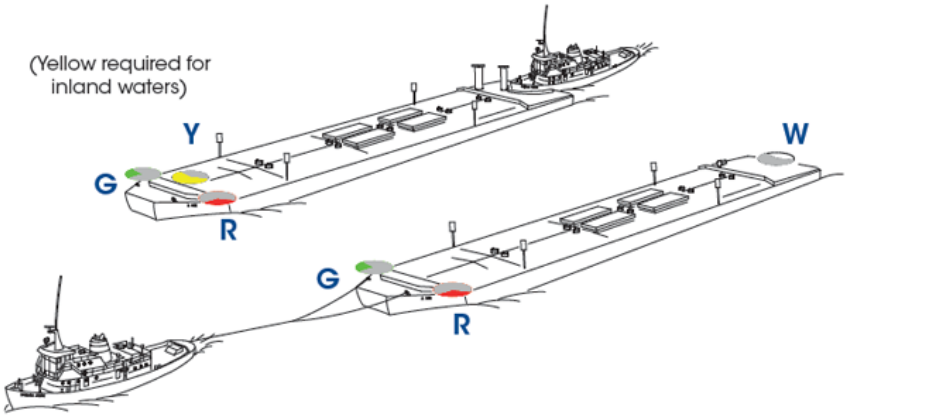


PUSHING - INLAND (<200 M)



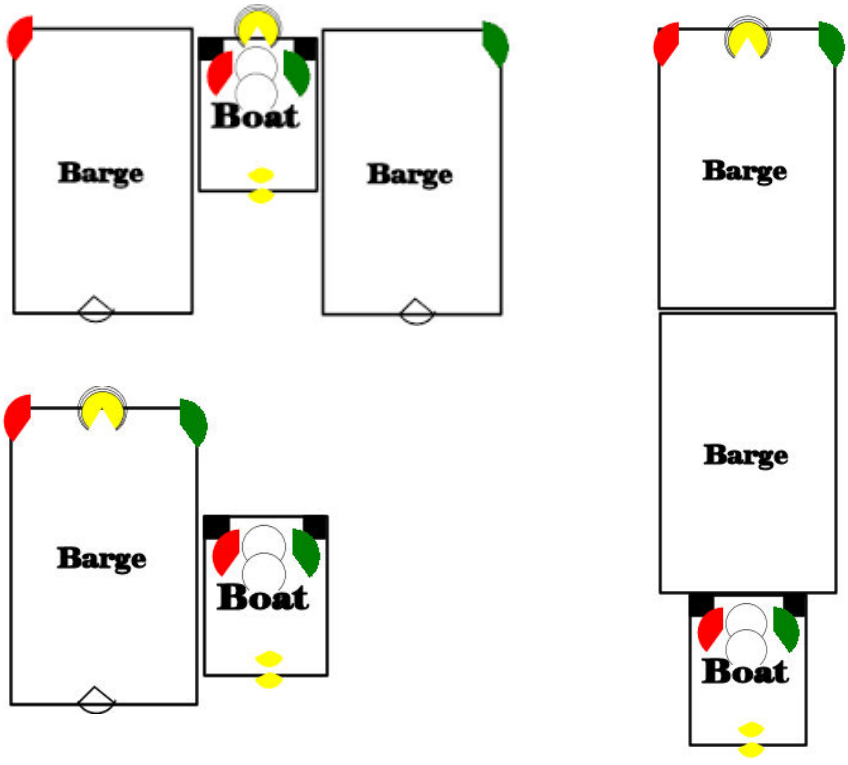


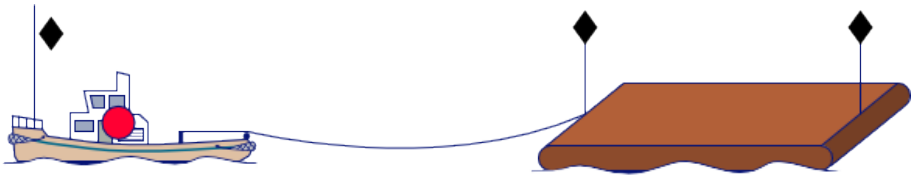


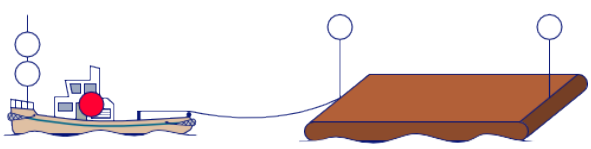


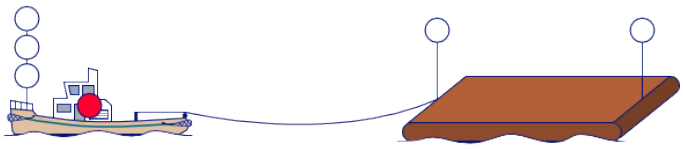
May be suitable on vessels of 50 meters or more in length.

INLAND

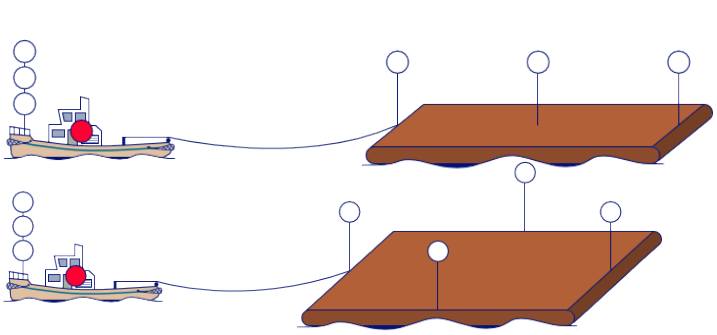


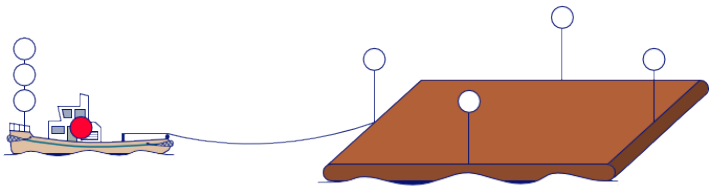


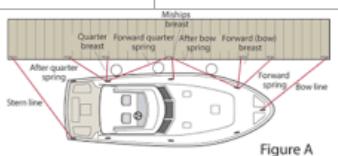


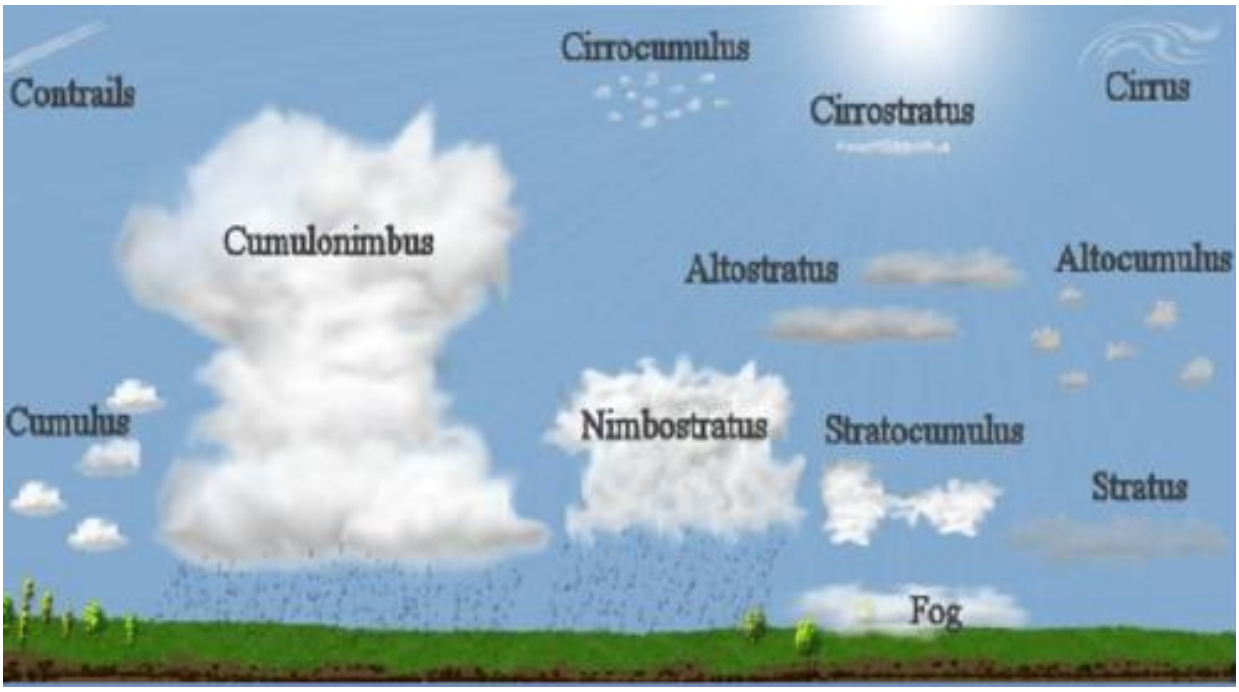


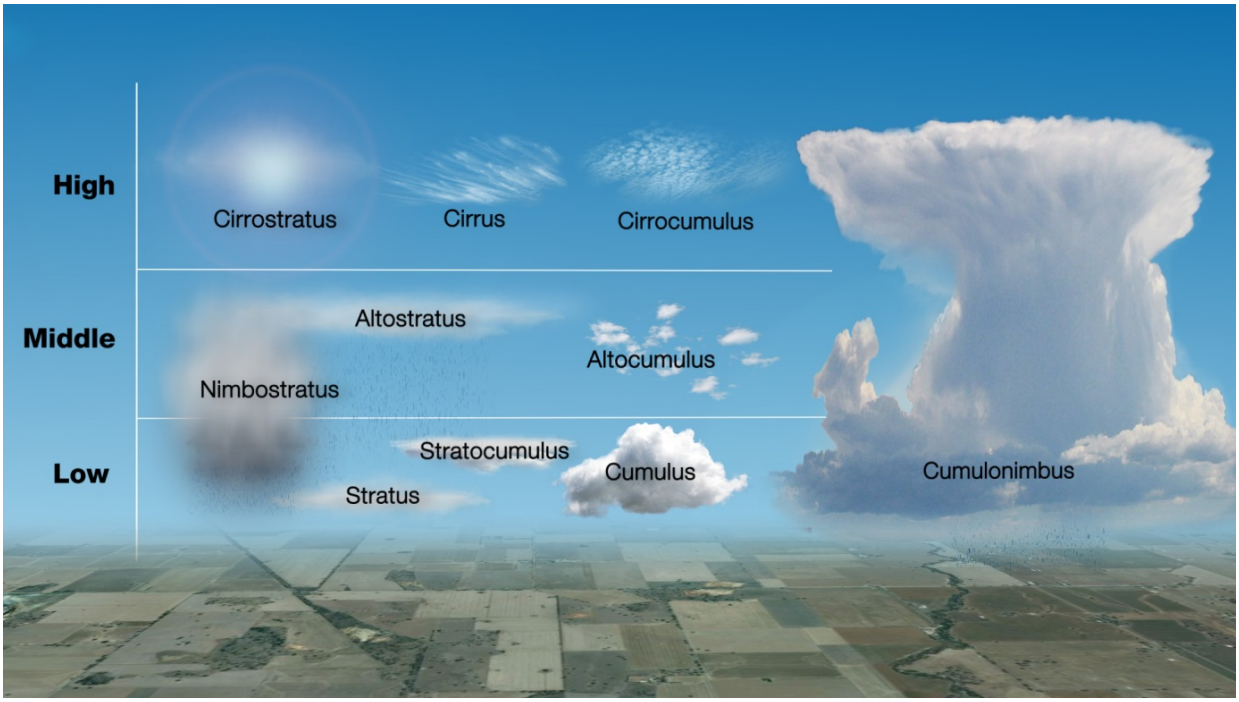
Wide barges with breath (width) over 25M must have a white all around light at each rorner large barges/vessels with length more than 100M must have white light on each side every 100M





3 MIN RULE	1kt = 1 NM / Hr	1 Kt = 2000 yards / 60 min	in 3 min a boat covers 100 yards @ 1 Kt	
			2 kts your boat covers 200 yards in 3 min	
			3 kts your boat covers 300 yards in 3 min	
			4 kts your boat covers 400 yards in 3 min	
			6 kts your boat covers 600 yards in 3 min	
			8 kts your boat covers 800 yards in 3 min	
			10 kts your boat covers 1/2 NM in 3 min	
1 NM	1 NM actually = 6076 FT	2 Statute Mile = 5280 FT	5280 x 1.15 = 6072 + 4.1 FT = 1 NM	
1 SHOT	1 SHOT = 15 Fathoms	15 Fathoms = 90 FT	1 Fathom = 6 FT	
TON	Short Ton = 2000 Lbs.	Long Ton = 2240 Lbs.		
BOAT GROSS TONNAGE	volume of all watertight spaces	**BOAT NET TONNAGE**	volume of all water tight spaces less all the volume of all operation spaces	
ROPE/LINE HANDLING	HOLD	make line fast as to not let it slip		
	CHECK	HOLD, but ease if required		
	SLACK	Remove tension from line but do not release		
	TAKE STRAIN	Put the line under tension		
	TAKE IN (line number)	Release and retrieve line (line number)		
	SINGLE UP	Remove doubled and unnecessary lines		
	 Figure A			


Contrails
Cirrocumulus
Cirrostratus
Cirrus
Cumulonimbus
Altostratus
Altocumulus
Cumulus
Nimbostratus
Stratocumulus
Stratus
Fog


High
Middle
Low
Cirrostratus
Cirrus
Cirrocumulus
Altostratus
Altocumulus
Nimbostratus
Stratocumulus
Cumulus
Cumulonimbus
Stratus

GEOGRAPHIC RANGE TABLE

The following table gives the approximate geographic range of visibility for an object which may be seen by an observer at sea level. It is necessary to add to the distance for the height of any object the distance corresponding to the height of the observer's eye above sea level.

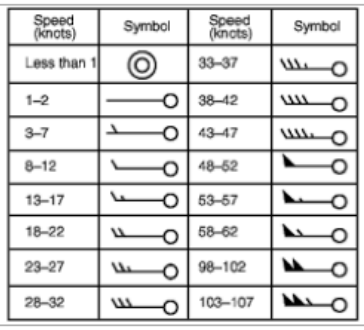
Height Feet / Meters	Distance Nautical Miles (NM)	Height Feet / Meters	Distance Nautical Miles (NM)	Height Feet / Meters	Distance Nautical Miles (NM)
5/1.5	2.6	70/21.3	9.8	250/76.2	18.5
10/3.1	3.7	75/22.9	10.1	300/91.4	20.3
15/4.6	4.5	80/24.4	10.5	350/106.7	21.9
20/6.1	5.2	85/25.9	10.8	400/121.9	23.4
25/7.6	5.9	90/27.4	11.1	450/137.2	24.8
30/9.1	6.4	95/29.0	11.4	500/152.4	26.2
35/10.7	6.9	100/30.5	11.7	550/167.6	27.4
40/12.2	7.4	110/33.5	12.3	600/182.9	28.7
45/13.7	7.8	120/36.6	12.8	650/198.1	29.8
50/15.2	8.3	130/39.6	13.3	700/213.4	31.0
55/16.8	8.7	140/42.7	13.8	800/243.8	33.1
60/18.3	9.1	150/45.7	14.3	900/274.3	35.1
65/19.8	9.4	200/61.0	16.5	1000/304.8	37.0

Example: Determine the geographic visibility of an object, with a height above water of 65 feet, for an observer with a height of eyeof 35 feet.

Enter above table;

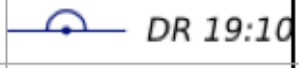
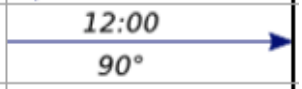
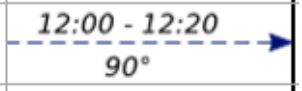
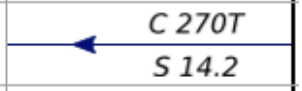
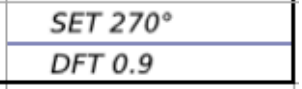
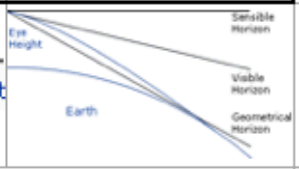
Height of object 65 feet= 9.4 NM
Height of observer 35 feet= 6.9 NM
Computed geographic visibility= 16.3 NM

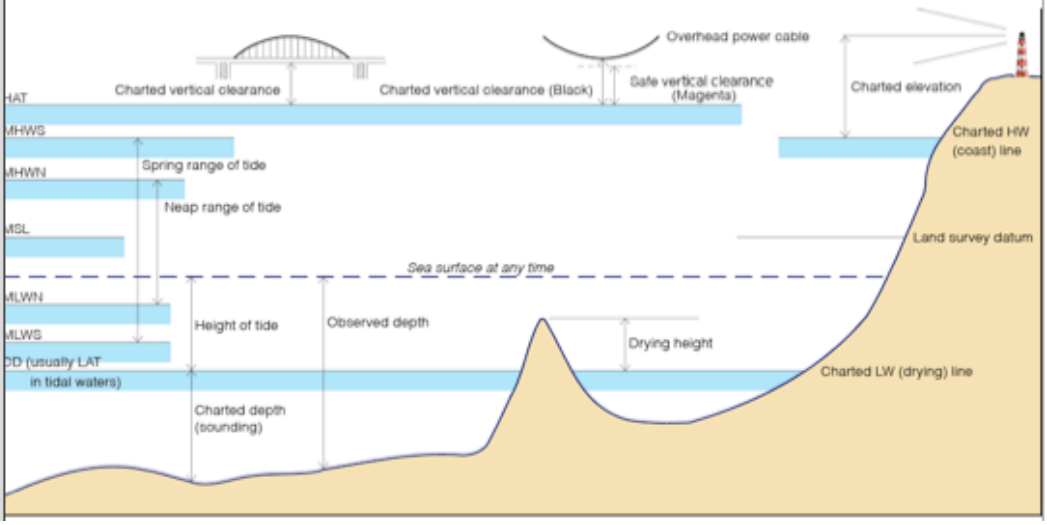
CODE	Weather	VISIBILITY Distance
0	DENSE FOG	less than 50 yards
1	THICK FOG	50 - 200 yards
2	MODERATE FOG	200 - 500 yards
3	LIGHT FOG	500 - 1000 yards
4	THIN FOG	1/2 to 1 NM
5	HAZE	1 - 2 NM
6	LIGHT HAZE	2 - 5 1/2 NM
7	CLEAR	5 1/2 - 11 NM
8	VERY CLEAR	11 - 27 NM
9	EXCEPTIONALLY CLEAR	27+ NM

FORCE	KTS	Description	Warnings	description
0	0-1	Calm		glassy sea
1	1-3	Light Air		Ripples
2	4-6	Light Breeze		small wavelets
3	7-10	Gentle Breeze	 small craft	larger wavelets
4	11-16	Moderate		small waves / some small white caps
5	17-21	Fresh		Longer moderate waves / white caps
6	22-27	Strong		Larger waves / more white caps
7	28-33	Near Gale		Breaking Waves
8	34-40	Gale	 gale warning	Large Breaking waves
9	41-47	Strong Gale		High Seas / Spray / Breaking waves
10	48-55	Storm	 Storm Warning	Very High Waves / Rolling / Breaking / Spray
11	56-63	Violent Storm	 can be Hurricane warning	Seas are white foam / Excessive waves / Spray / lack of visibility
12	64+	Hurricane	 Hurricane Warning	Air filled with spray / excessive arg seas, limited visibility
				

Speed (knots)	Symbol	Speed (knots)	Symbol
Less than 1		33–37	
1–2		38–42	
3–7		43–47	
8–12		48–52	
13–17		53–57	
18–22		58–62	
23–27		98–102	
28–32		103–107	

Meteorological Optical Range Table		
CODE NUMBER	Weather	Distance
0	Dense FOG	<50 M
1	Think FOG	50-200 M
2	Moderate FOG	200-500 M
3	Light FOG	500-1000 M
4	Thin FOG	1000-2000 M
5	HAZE	1 - 2 NM
6	Light HAZE	2 - 5.5 NM
7	CLEAR	5.5 - 11 NM
8	Very CLEAR	11 - 27 NM
9	Exceptionally CLEAR	>27 NM

MARKING A CHART	
FIX	
Running FIX	
Estimated Position	
Dead Recokoning	
Electronic Fix (GPS)	
Electronic Fix (RADAR)	
LOP (Line of position)	
LOP (advanced)	
Course & Speed	
Set (degree) and Drift (Speed) of current	
2.08 x √ Eye Height	



Compass

	T True			
	V Variation	subtract EAST	subtract WEST	Variation is difference between magnetic and True in a given area
	M Magnetic			
	D Deviation	add WEST	add EAST	Deviation is the error induced locally
	C Compass			

Navigators Quick Reference Card

(-) E
(+) W
UNCORRECTING
TRUE
VARIATION
MAGNETIC
DEVIATION
COMPASS
CORRECTING
(+) E
(-) W

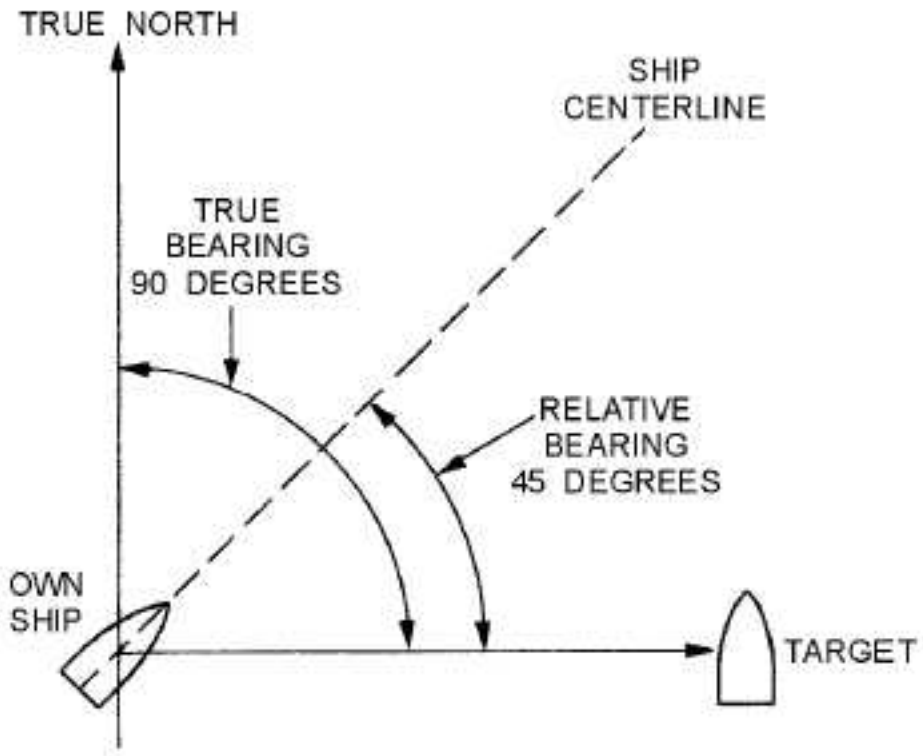
025 or 025T – TRUE
025M – MAGNETIC
025C – COMPASS
C 090T
S 10.5
TIME = 4 DIGITS (24HR)
COURSE = 3 DIGITS (000 (common) or 000.0)
S 10 or S 10.5 = SPEED (0.1 KTS MOST APPS)
RELATIVE BEARING + SHIPS HEADING = ACTUAL

60 D
S T
Distance
Speed
Time (Min)

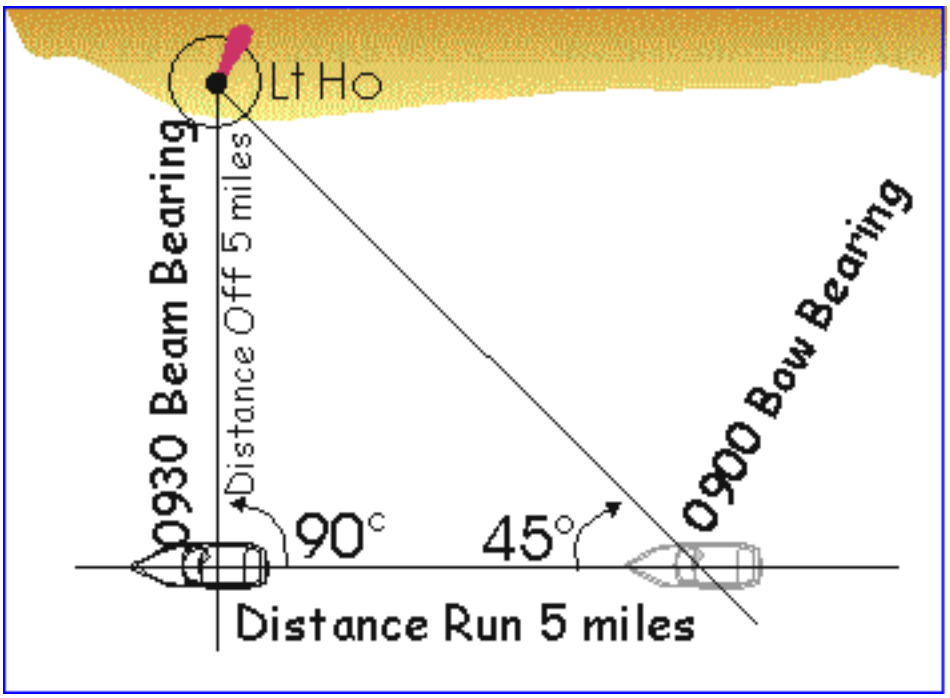
FIX
DR
ESTIMATED POSITION

Speed (S): S = (60 x D) / T
Speed in Knots or Nautical Miles per Hour
Time (T): T = (60 x D) / S
Time is always in minutes
Distance (D): D = (S x T) / 60
Distance is always nautical miles (nm)

1 nm = 1 Minute of Latitude = 6000 ft = 2000 yards (Many Calculations)
60 nm = 1 Degree of Latitude
1 nm = 1852 meters = 6076 ft (International Treaties)
1 nm = 6100 ft (some calculations)
1 meter / second = 1.94 knots



The Distance a ship runs on the same course to DOUBLE the angle of bearing on an object EQUALS it's distance away from the object at the time of the second bearing.



ONLY PLOT TRUE BEARINGS.. Then convert to Compass Bearing.

SPEED = DISTANCE / TIME
DISTANCE = SPEED X TIME
TIME = DISTANCE / SPEED

SET = DIrection of Current

DRIFT = Speed of Current

LEEWAY = wind acting on Ship

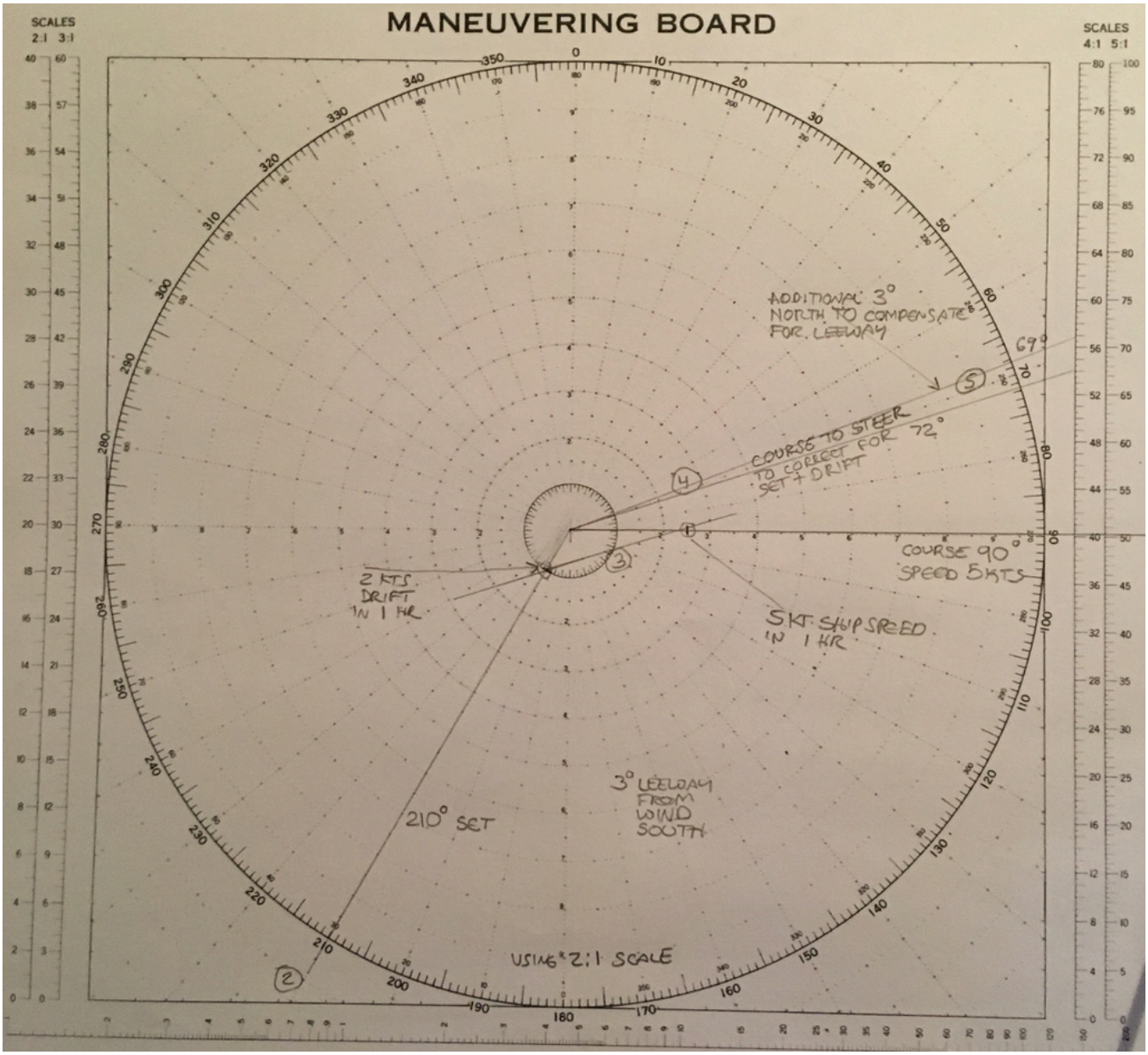
TRUE - TRUE BEARING
VARIATION - MAGNETIC VARIATION FROM CHART or other upto date info
MAGNETIC - ACTUAL MAGNETIC BEARING
DEVIATION - change in magnetic field local to compass
COMPASS - COMPASS BEARING

DETERMINING COURSE TO STEER

compensating for set and drift

example

boat speed: 5 Kts you want to sail Due East 90* TRUE
Current is setting 210* T at 2 Kts drift
Leeway of 3* from wind



New Channel Number	Old Channel Number	Ship Transmit MHz	Ship Receive MHz	Use
1001	01A	156.050	156.050	Port Operations and Commercial, VTS. Available only in New Orleans / Lower Mississippi area.
1005	05A	156.250	156.250	Port Operations or VTS in the Houston, New Orleans and Seattle areas.
06	06	156.300	156.300	Intership Safety
1007	07A	156.350	156.350	Commercial. VDSMS
08	08	156.400	156.400	Commercial (Intership only). VDSMS
09	09	156.450	156.450	Boater Calling. Commercial and Non-Commercial. VDSMS
10	10	156.500	156.500	Commercial. VDSMS
11	11	156.550	156.550	Commercial. VTS in selected areas. VDSMS
12	12	156.600	156.600	Port Operations. VTS in selected areas.
13	13	156.650	156.650	Intership Navigation Safety (Bridge-to-bridge). Ships >20m length maintain a listening watch on this channel in US waters.
14	14	156.700	156.700	Port Operations. VTS in selected areas.
15	15	--	156.750	Environmental (Receive only). Used by Class C EPIRBs.
16	16	156.800	156.800	International Distress, Safety and Calling. Ships required to carry radio, USCG, and most coast stations maintain a listening watch on this channel. See our Watchkeeping Regulations page.
17	17	156.850	156.850	State & local govt maritime control
1018	18A	156.900	156.900	Commercial. VDSMS
1019	19A	156.950	156.950	Commercial. VDSMS
20	20	157.000	161.600	Port Operations (duplex)
1020	20A	157.000	157.000	Port Operations
1021	21A	157.050	157.050	U.S. Coast Guard only
1022	22A	157.100	157.100	Coast Guard Liaison and Maritime Safety Information Broadcasts. Broadcasts announced on channel 16.
1023	23A	157.150	157.150	U.S. Coast Guard only
24	24	157.200	161.800	Public Correspondence (Marine Operator). VDSMS
25	25	157.250	161.850	Public Correspondence (Marine Operator). VDSMS
26	26	157.300	161.900	Public Correspondence (Marine Operator). VDSMS
27	27	157.350	161.950	Public Correspondence (Marine Operator). VDSMS
28	28	157.400	162.000	Public Correspondence (Marine Operator). VDSMS
1063	63A	156.175	156.175	Port Operations and Commercial, VTS. Available only in New Orleans / Lower Mississippi area.
1065	65A	156.275	156.275	Port Operations
1066	66A	156.325	156.325	Port Operations
67	67	156.375	156.375	Commercial. Used for Bridge-to-bridge communications in lower Mississippi River. Intership only.
68	68	156.425	156.425	Non-Commercial. VDSMS
69	69	156.475	156.475	Non-Commercial. VDSMS
70	70	156.525	156.525	Digital Selective Calling (voice communications not allowed)
71	71	156.575	156.575	Non-Commercial. VDSMS
72	72	156.625	156.625	Non-Commercial (Intership only). VDSMS
73	73	156.675	156.675	Port Operations
74	74	156.725	156.725	Port Operations
77	77	156.875	156.875	Port Operations (Intership only)
1078	78A	156.925	156.925	Non-Commercial. VDSMS
1079	79A	156.975	156.975	Commercial. Non-Commercial in Great Lakes only. VDSMS
1080	80A	157.025	157.025	Commercial. Non-Commercial in Great Lakes only. VDSMS
1081	81A	157.075	157.075	U.S. Government only - Environmental protection operations.
1082	82A	157.125	157.125	U.S. Government only
1083	83A	157.175	157.175	U.S. Coast Guard only
84	84	157.225	161.825	Public Correspondence (Marine Operator). VDSMS
85	85	157.275	161.875	Public Correspondence (Marine Operator). VDSMS
86	86	157.325	161.925	Public Correspondence (Marine Operator). VDSMS
87	87	157.375	157.375	Public Correspondence (Marine Operator). VDSMS
88	88	157.425	157.425	Commercial, Intership only. VDSMS
AIS 1	AIS 1	161.975	161.975	Automatic Identification System (AIS)
AIS 2	AIS 2	162.025	162.025	Automatic Identification System (AIS)

MAYDAY PROCEDURE

MAYDAY PROCEDURE

1. Ensure radio is switched on (turn VOL knob)
2. Lift red DISTRESS cover and press button ONCE
3. Press the ENT key, then use arrows to select nature of distress (fire, sinking, MOB etc.) followed by ENT key
4. Press and hold red DISTRESS key until alert is sent (approx. 5 secs)
5. Wait 15 secs, select Channel 16 and high power (H/L key on mic)
6. Hold down PTT button on mic and send the voice message on the right, slowly and clearly

MAYDAY, MAYDAY, MAYDAY

THIS IS YACHT LYSBETH, LYSBETH, LYSBETH

CALL SIGN 2GYL8 MMSI 235101558

MAYDAY YACHT LYSBETH CALL SIGN 2GYL8 MMSI 235101558

MY POSITION IS (distance and bearing from charted feature or lat/long position read from GPS)

NATURE OF DISTRESS (man overboard, fire, sinking etc.)

WE REQUIRE IMMEDIATE ASSISTANCE

NUMBER OF PERSONS ON BOARD

ANY OTHER INFORMATION (abandoning to liferaft etc.)

OVER

Release the PTT button and await a reply. If this message is not responded to promptly, repeat the above procedure

TURNING

- ADVANCE - Distance gained toward a direction of the original course AFTER the rudder is put over.
- TRANSFER - distance gained at RIGHT ANGLES to the original path of the boat when a 180* turn is completed.
- STANDARD RUDDER - normal rudder angle to turn boat in a prescripbed diameter
- FINAL DIAMETER - diamter of a complete circle
- DRIFT ANGLE - Angle at any point on a turning circle between intersection if a tagent point and the boats keel
- KICK - Momentary turn of a boats stern outward when initiating a turn
- PIVOT POINT - point where the boat piviots around (About 1/3 of the way aft from the bow)

DOCKING INTO A CURRENT

- DOCKING INTO A CURRENT V1. (PORT SIDE TO) - tie off a spring line about 1/4 of the way aft. ease the bow toward the dock. tie off the spring line further aft. Ease into the dock with light touch in forward and with hard right rudder. The boat stern will settle to the dock.

OR

- DOCKING INTO A CURRENT V2. (PORT SIDE TO) (If more room is available) - tie off a spring line about 1/4 of the way aft. ease the bow toward the dock. tie off the spring line on the dock ahead of the boat. . Ease into the dock with lquick KICK in forward and with hard right rudder. The boat stern will settle to the dock.

If docking to Starboard, use hard LEFT rudder.

DOCKING WITH A CURRENT (required more room than against current)

- DOCKING INTO A CURRENT V1. (PORT SIDE TO) - tie off a spring line about 1/4 of the way aft. ease the bow toward the dock. tie off the spring line further aft. Ease into the dock with light touch in forward and with hard right rudder. The boat stern will settle to the dock with the help of the current.

OR

- DOCKING INTO A CURRENT V2. (PORT SIDE TO) (If more room is available) - tie off a spring line about 1/4 of the way aft. ease the bow toward the dock. tie off the spring line on the dock ahead of the boat. . Ease into the dock with lquick KICK in forward and with hard right rudder. The boat stern will settle to the dock. Let Current help move you forward.

If docking to Starboard, use hard LEFT rudder.

DEPARTING FROM DOCK

back with left rudder with a forward spring line. Stern will turn out away, Wait for boat to have a relativly steep angle and let go the spring backing away from the dock, and shift rudder to amidships.

FIRE FIGHTING

Fire Classification Ratings:	
Class A:	Used for all combustible solid materials; wood, paper, cloth, rubber and some plastics
Class B:	Used on flammable liquids including grease, oil, gasoline, kerosene, and other flammable liquids
Class C:	Used on fires in "live" electrical equipment
Class D:	Used on combustible metals

CLASS A - paper, wood, cloth, plastic - extinguish with **WATER**

CLASS B - oil, gas, grease - extinguish with **DRY CHEMICAL**

CLASS C - electrical - extinguish with **CO2, DRY CHEMICAL**

CLASS D - potassium, sodium, zync, magnesium - require specialized agents

For the galley it is also advisable to have a FIRE BLANKET to assist in extungishing a small Gally fire.

Kidde 10 B-C Marine FIre Extinguisher is a good choice

Vessel length	Number of fixed systems	With approved fixed systems
Less than 26'	1 B-I	0
26' to less than 40'	2 B-I or 1-BII	1 B-I
40' to 65'	3 B-I or 1 B-II and 1 B-I	2 B-I or 1 B-II

STABILITY

G - CENTER OF GRAVITY

KG or **VCG** **-** Height of CENTER OF GRAVITY is measured from the keel (Baseline) (KG Keel Gravity) (Vertical Center of Gravity) **MOST IMPORTANT**

TCG - Transverse (so many feet Port or Starboard of centerline) (CENTERLINE to PORT or CENTERLINE to STARBOARD)

LCG - Longitudial Center of Gravity - from center of gravity to STERN

As **KG** (**VCG**) increases, Stability decreases. Boat becomes "topheavy" **G** moves toward the added weight.

As **KG** (**VCG**) decreases, Stability increases. Weight is lower. " **G** moves toward the added weight. in this case it drops down.

G will always move toward loaded weight, and away from off loaded weight,

G will always move in the opposite directon of shifted weight. Weight shits forward, G moves aft. Weight shifts down to port, G shifts up and to starboard.

G moves down - KG decreases TCG stays the same VCG stays the same
G moves up - KG increaes TCG stays the same VCG stays the same
G moves forward - KGstays the same TCG increases VCG stays the same

Free surface liquids decrease stability as they slosh around.
Free surface liquids in a tank affects the boat as if G in the tank has moved up increasing KG and reducing Stability.

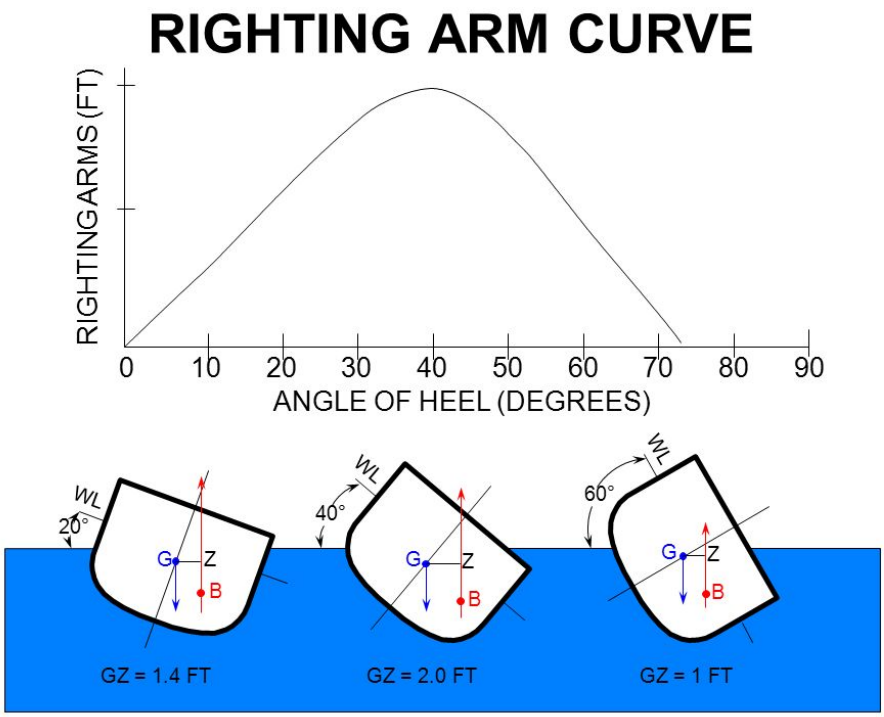
- Vessel with long rolling period (time to complete a roll) is said to be "TENDER" or "CRANK"
- Vessel with short rolling period is said to be "STIFF"
- Vessels that do not return to upright have NEGITIVE Stability
- Shape of a Vessel affects Stability along with weight and location of G
- Higher KG - Less stable
- Weight added to Vessel above G will make a vessel less stable

B - Bouyancy acts in the opposite direction as Gravity (geometric center of the underwater portion of vessel)

KB or **VCB** - Center of Bouyance - measured from Keel
LCB - Fore and Aft location (Longitudial)

Once load is stable **KG** won't move. But **B** moves with every roll. pitch, heel, trim, draft change etc **B** will always move toward the LOW section of the boat.

When a boat is properly balanced or liaded G and B are in line and equal. As the vessel is rolled to one side by wind or waves, G stays in the center and B shifts to the low side trying to push the boat back to center.



The HORIZONTAL distance between G and **B**
GZ **GZ** is the RIGHTING LEVER or RIGHTING ARM

The displacement (weight) of the vessel) X the Length (distance) of **GZ = RIGHTING MOMENT (or RIGHTING ARM)**

The LONGER **GZ** (longer RIGHTING ARM) the greater the RIGHTING MOMENT or Rlighting energy.

NOTE:
The LOWER the position of G (Center of Gravity) the more Righting Arm is INCREASED
The HIGHER the position of G (Center of Gravity) the more Righting Arm is DECREASED

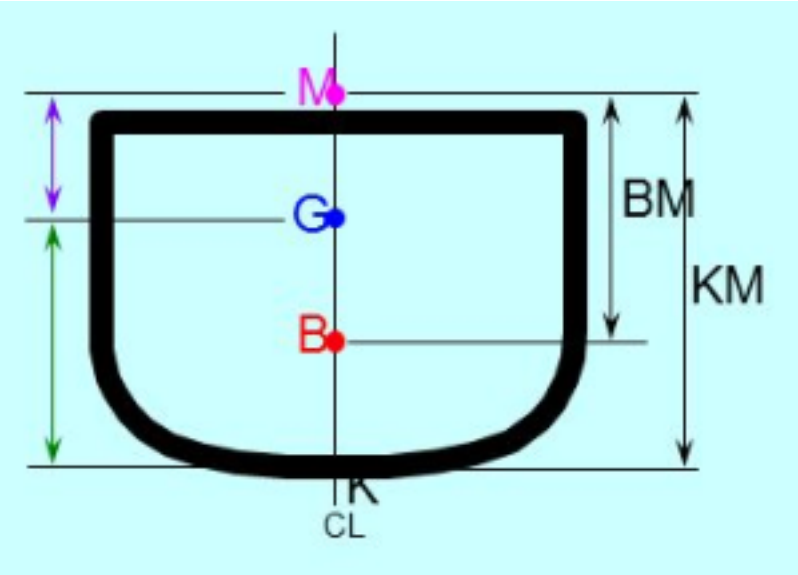
RIGHTING ARM will increase at first as a Vessel rolls… IF the vessel rolls too far over GZ starts to decrease as the CENTER OF GRAVITY lines up with B (Center of Bouyance) the Vessel has NEUTRAL STABILITY and is in danger of rollin over.

T - ROLLING PERIOD (in seconds) indicates Stability

T = .44 x (Beam in feet) / Squareroot of GM (Metricentre height)

GZ (Righting Moment) = Displacement X GZ (righting arm length)

METACENTER HEIGHT - GM **DISTANCE** from **G** to **M** (Center of gravity to MeterCenter
A line drawn upward from B (Center of Gravity) is called the **METACENTER - M**



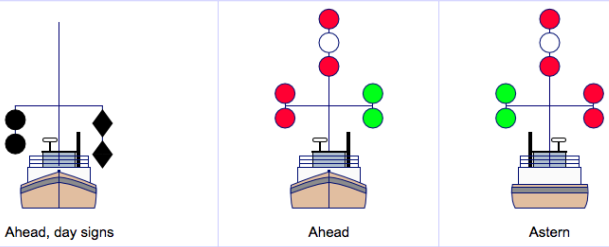
The larger GM (distance between G and M) the longer GZ becomes increasing the Righting Moment. If G (center of gravity) was above M (Metacenter) we would have a **negitive Righting Arm** **G MUST ALWAYS BE KEPT BELOW M**

KM - DIstance from **K (Keel)** to **M (Metacenter)** is the **HEIGHT OF THE METACENTER**
GM - DIstance from **G (Center of Gravity)** to **M (Metacenter)**

REDUCING GM REDUCES THE ABILITY OF THE VESSEL TO RIGHT ITSELF.

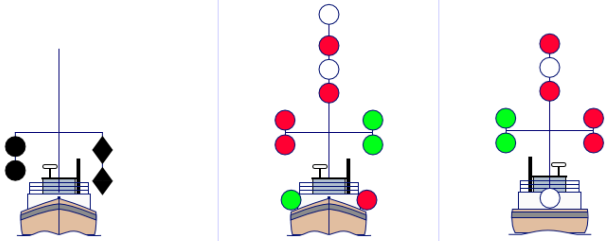
SOME ADDITIONAL LIGHT INFO

Dredging or underwater operations, shorter than 50 m, not making way



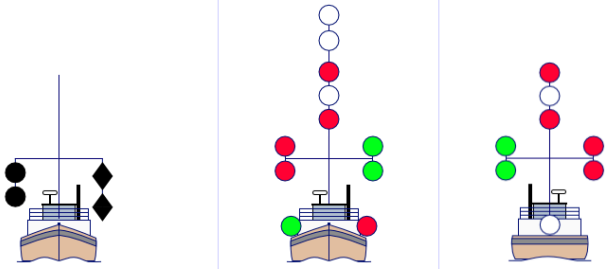
Ahead, day signs | Ahead | Astern

Dredging or underwater operations, shorter than 50 m, making way



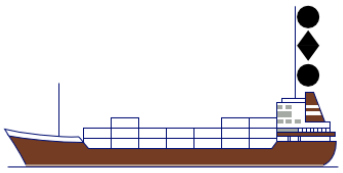
Ahead, day signs | Ahead | Astern

Dredging or underwater operations, longer than 50 m, making way

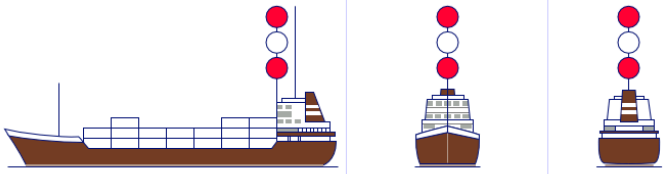


Ahead, day signs | Ahead | Astern

Restricted in her ability to manoeuvre, not making way through the water

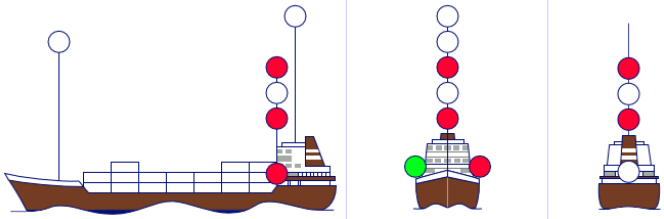


Day sign: two black spheres and in the middle a black diamond shape



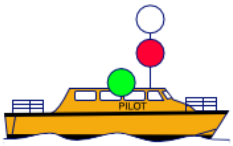
Abeam, port side | Ahead | Astern

Restricted in her ability to manoeuvre, making way through the water, longer than 50 m



Abeam, port side | Ahead | Astern

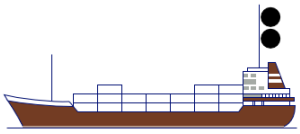
Pilot boat, shorter than 50 m



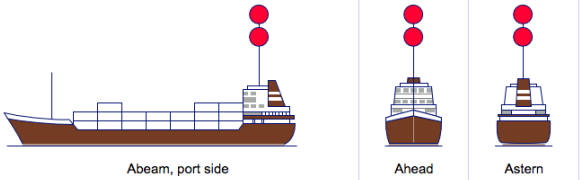
Abeam, starboard side

Ahead

Vessel not under command, not making way through the water



Day sign (two black spheres)

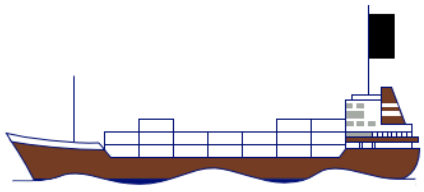


Abeam, port side | Ahead | Astern

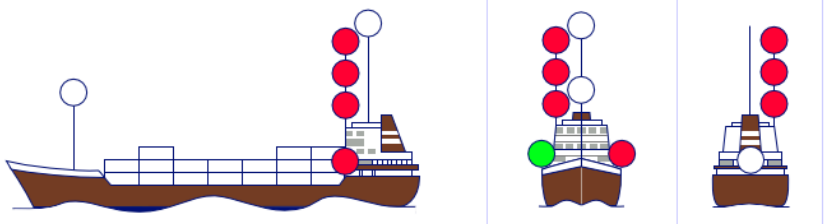
Sailing boat, no wind, no mechanical propulsion

Abeam, port side | Ahead | Astern

Power driven vessel, underway, constrained by her draught

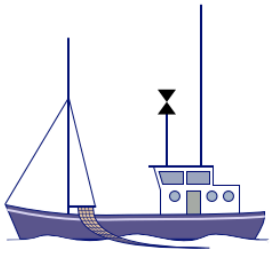


Day sign (black vertical cylinder)

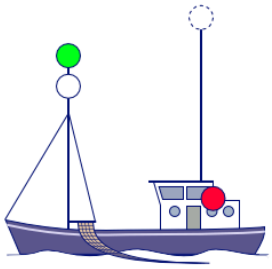


Abeam, port side | Ahead | Astern

Fishing vessel, trawling

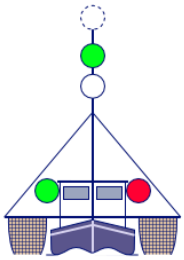


Day sign



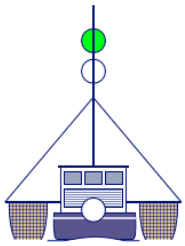
Abeam, port side

Optional white light if shorter than 50 m



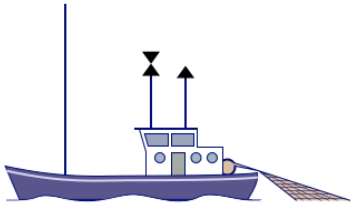
Ahead

Optional white light if shorter than 50 m

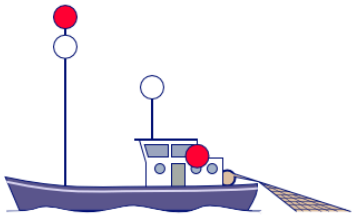


Astern

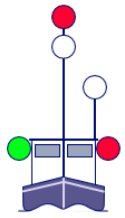
Fishing vessel, other than trawling



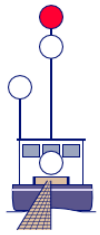
Day sign



Abeam, port side



Ahead

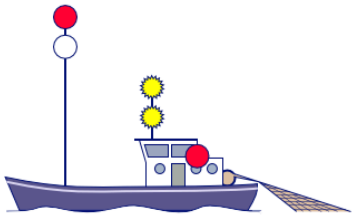


Astern

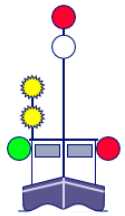
Purse seining

Purse Seiners will exhibit two all-round yellow lights in a vertical line, flashing alternately.

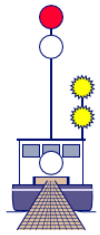
Purse Seiner



Abeam, port side



Ahead



Astern

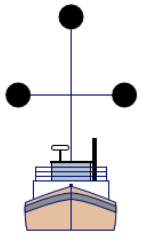
Hovercraft, longer than 50 m

Abeam, port side

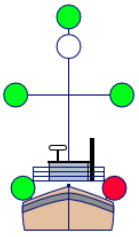
Ahead

Astern

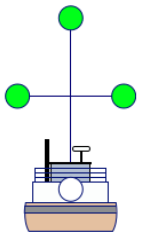
Minesweeper, shorter than 50 m



Ahead, day signs (3 black spheres)



Ahead



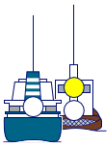
Astern

Tugboat longer than 50 m - tow longer than 200 m

Abeam, port side

Ahead, Day sign
(diamond shapes)

Ahead

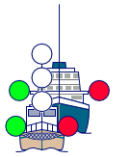


Astern

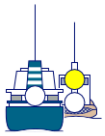
Tugboat shorter than 50 m - tow longer than 200 m

Abeam, port side

Ahead, Day sign
(diamond shapes)

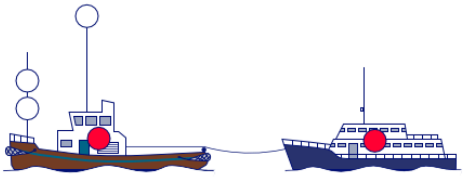


Ahead



Astern

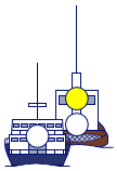
Tugboat longer than 50 m - tow shorter than 200 m



Abeam,
port side

Ahead, Day sign
(no shapes)

Ahead



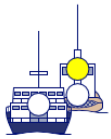
Astern

Tugboat shorter than 50 m - tow shorter than 200 m

Abeam,
port side

Ahead, Day sign
(no shapes)

Ahead



Astern

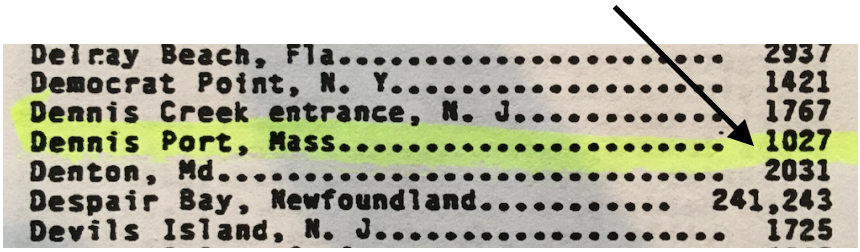
READING TIDE TABLES
Determining Tide at a given location and time:

STEP 1
Document Know information including CHARTED DEPTH (CD), DATE, TIME, PLANNED LOCATION (SUBSTATION)

EXAMPLE:
FInd the water depth at DENNIS PORT on OCT 28, 1983 at 0914 EST
Date: OCT 28, 1983
Time: 0914 EST
SubStation: Dennis Port (Planned location)
CHARTED DEPTH (CD) 14 Ft

STEP 2
Locate Tide differences by finding closest location (substation) number in INDEX for TABLE 2

EXAMPLE:
SubStation: Dennis Port index number : 1027

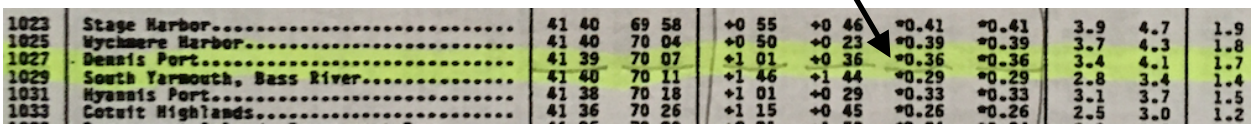


Delray Beach, Fla.	2937
Democrat Point, N. Y.	1421
Dennis Creek entrance, N. J.	1767
Dennis Port, Mass.	1027
Denton, Md.	2031
Despair Bay, Newfoundland	241,243
Devils Island, N. J.	1725

STEP 3
Document Differences noted in TABLE 2 for time/date of planned location
HIGH TIDE DIFFERENTIAL TIME and HIGH TIDE DIFFERENTIAL IN FT (including + - or *)
LOW TIDE DIFFERENTIAL TIME and LOW TIDE DIFFERENTIAL IN FT (including + - or *)

EXAMPLE:
High Water time differential: +1 01 (1 hour and 1 min)
*High Water height differential: *.36 (* means to multiple) .36 ft*
Low Water time differential: +0 36 (36 minutes)
*Low Water height differential: *.36 (* means to multiple) .36 ft*

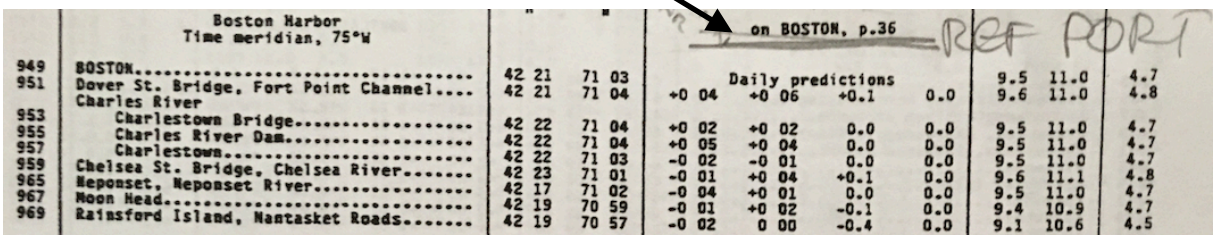
Reference Station: BOSTON (top of page)



1023	Stage Harbor	41 40	69 58	+0 55	+0 46	*0.41	*0.41	3.9	4.7	1.9
1025	Wychmere Harbor	41 40	70 04	+0 50	+0 23	*0.39	*0.39	3.7	4.3	1.8
1027	Dennis Port	41 39	70 07	+1 01	+0 36	*0.36	*0.36	3.4	4.1	1.7
1029	South Yarmouth, Bass River	41 40	70 11	+1 46	+1 44	*0.29	*0.29	2.8	3.4	1.4
1031	Hyannis Port	41 38	70 18	+1 01	+0 29	*0.33	*0.33	3.1	3.7	1.5
1033	Cotuit Highlands	41 36	70 26	+1 15	+0 45	*0.26	*0.26	2.5	3.0	1.2

STEP 4
Go to top of TABLE 2 PAGE Selected for planned location (substation) and Find REFERENCE STATION at top.
Go to REFERENCE STATION in table 1

EXAMPLE:
Reference Station: BOSTON (top of page)

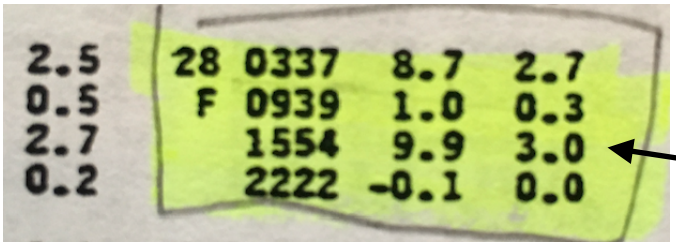


	Boston Harbor Time meridian, 75°W			on BOSTON, p.36 REF PORT					
949	BOSTON	42 21	71 03	Daily predictions				9.5	11.0	4.7
951	Dover St. Bridge, Fort Point Channel	42 21	71 04	+0 04	+0 06	+0.1	0.0	9.6	11.0	4.8
	Charles River									
953	Charlestown Bridge	42 22	71 04	+0 02	+0 02	0.0	0.0	9.5	11.0	4.7
955	Charles River Dam	42 22	71 04	+0 05	+0 04	0.0	0.0	9.5	11.0	4.7
957	Charlestown	42 22	71 03	-0 02	-0 01	0.0	0.0	9.5	11.0	4.7
959	Chelsea St. Bridge, Chelsea River	42 23	71 01	-0 01	+0 04	+0.1	0.0	9.6	11.1	4.8
965	Neponset, Neponset River	42 17	71 02	-0 04	+0 01	0.0	0.0	9.5	11.0	4.7
967	Moon Head	42 19	70 59	-0 01	+0 02	-0.1	0.0	9.4	10.9	4.7
969	Rainsford Island, Nantasket Roads	42 19	70 57	-0 02	0 00	-0.4	0.0	9.1	10.6	4.5

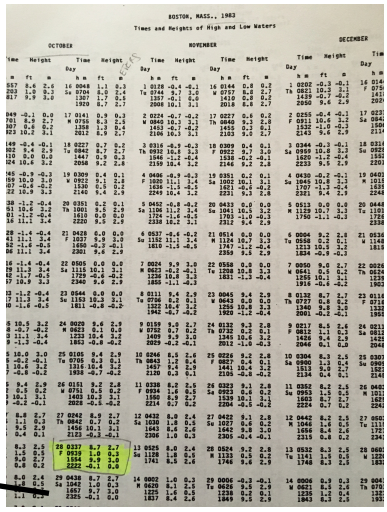
STEP 5
FIND REFERENCE STATION, DATE, TIME
Note and Document CLOSEST HIGHT and LOW TIDES to planned original time
(original time should be between the two tides)
DOCUMENT the two tide informamation
HIGH TIDE TIME and HEIGHT
LOW TIDE TIME and HEIGHT

EXAMPLE:
Reference Station: BOSTON
DATE: OCT 28, 1983
ETA: 0914
*Find the tides **before** and **after:***
Bracket 0914 between two tides:

HIGH TIDE time: 0337
HIGH TIDE height: + 8.7 ft
LOW TIDE time: 0939
LOW TIDE height + 1 ft



2.5	28	0337	8.7	2.7
0.5	F	0939	1.0	0.3
2.7		1554	9.9	3.0
0.2		2222	-0.1	0.0



STEP 6
DETERMINE ADJUSTED TIDE TIMES for planned Location (nearest substation)

ADD Time differential to HIGH and LOW TIDES

DETERMINE CORRECTED TIDE HEIGHTS for planned location & time
(using + - or (* multiply)) add, subtract or multiply the HIGH and LOW TIDES for the REFERENCE STATION with the Planned location DIFFERENTIALS

ADD THESE TO CD (Charted Depth) to find corrected HIGH and LOW TIDE HEIGHT

EXAMPLE:
HIGH TIDE time: 0337 + 1 hr 1min = 0438
HIGH TIDE height: 8.7 ft x .36 = 3.13 Ft
LOW TIDE time: 0939 + 36 min = 1015
LOW TIDE height 1 ft x .36 = .36 Ft

(charted depth) CD = 14 Ft

CD 14 + ADJ High Tide 3.13 Ft = 17.13 ft HIGH TIDE
CD 14 + ADJ Low Tide 0.36 Ft = 14.23 Ft LOW TIDE

STEP 7
DETERMINE DIFFERENTIALS for TIDE RANGE and TIDE DURATION (TIME)
HIGH TIDE HEIGHT - LOW TIDE HEIGHT = TIDE RANGE
HIGH TIDE TIME - LOW TIDE TIME = TIDE DURATION

EXAMPLE:
DURATION OF TIDE: Tide Time Differential 1015 - 0438 = 5 hours 37 min
TIde Height Differential 17.13 Ft - 14.23 Ft = 2.9 Ft

STEP 8
FIND Differential between our ETA and the nearest TIDE

EXAMPLE:
Original ETA: 0914
Closest Tide: 1015 (LOW Tide)
DIFFERENTIAL BETWEEN OUR ETA ARRIVAL and CLOSEST TIDE: 1 hour

STEP 9
USING TABLE 3
Find TNT - TIme to Nearest Tide (**TIME DIFFERENCE**) follow that COLUMN down until you find RANGE OF TIDES that cloest match our TIDE RANGE.
Using **TIDE DURATION** in table 3, follow row until you find the closest matched duration.

Note that cross referenced CORRECTION IN HEIGHT
IF nearest tide is HIGH TIDE **subtract** the **CORRECTION IN HEIGHT to HIGH TIDE**
IF nearest tide is LOW TIDE **add** the **CORRECTION IN HEIGHT to LOW TIDE**

USING THE CLOSEST TIDE TO OUR PLANNED TIME you now have the Tide Height at the planned location and planned time.

Some extrapoliation is required here:

EXAMPLE:

DIFFERENTIAL BETWEEN OUR ARRIVAL and CLOSEST TIDE: ***1 hour***
DURATION OF TIDE: ***5.5 Hours*** ***(5 hrs 37 min)***

RANGE OF TIDE: ***2.9 Ft***

CORRECTION FACTOR from table: ***.2***

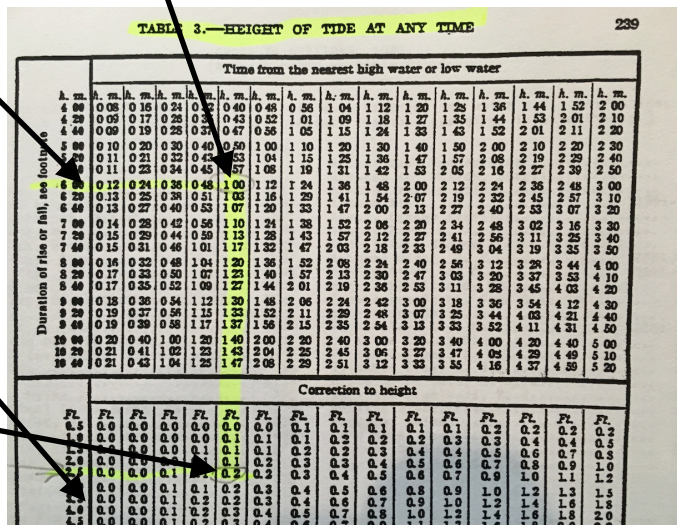
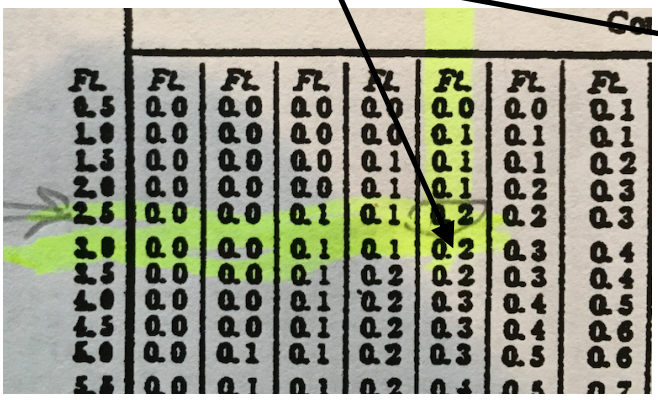


TABLE 3.—HEIGET OF TIDE AT ANY TIME 239

Time from the nearest high water or low water

Duration of rise or fall, see footnote 6

Correction to height

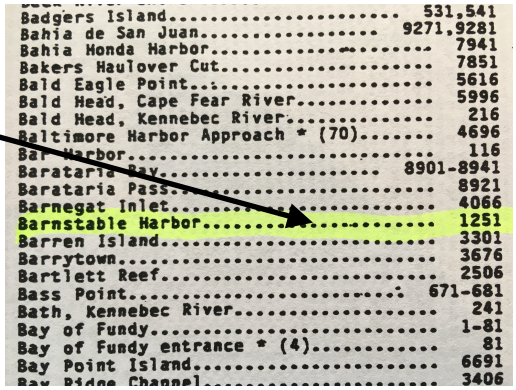


LOW TIDE 14.23 + .2 = 14.42 Ft
Answer: 14.42 Ft at 0914 on COT 28, 1983 at DENNIS PORT

DETERMINING CURRENT AT A GIVEN LOCATION AND TIME

STEP 1
Document Know information including DATE, TIME, PLANNED LOCATION (SUBSTATION) , PLANNED ARRIVAL TIME (ETA)
THEN FIND THE INDEX NUMBER for the SubStation (planned lcoation)

EXAMPLE:
FInd the current at BARNSTABLE HARBOR -
SubStation: (Planned location) :1251
Date: APRIL 3, 1983 at 13:43 EST
Time: 0914 EST



Badgers Island	531,541
Bahia de San Juan	9271,9281
Bahia Honda Harbor	7941
Bakers Haulover Cut	7851
Bald Eagle Point	5616
Bald Head, Cape Fear River	5996
Bald Head, Kennebec River	216
Baltimore Harbor Approach * (70)	4696
Bar Harbor	116
Barataria Bay	8901-8941
Barataria Pass	8921
Barnegat Inlet	4066
Barnstable Harbor	1251
Barren Island	3301
Barrytown	3676
Bartlett Reef	2506
Bass Point	671-681
Bath, Kennebec River	241
Bay of Fundy	1-81
Bay of Fundy entrance * (4)	81
Bay Point Island	6691
Bay Ridge Channel	3406

STEP 2
Goto TABLE 2 - find the INDEX number (planned location) and document the following:

TIME DIFERENCES (hours and minutes)
MINIMUM (SLACK WATER) BEFORE FLOOD
FLOOD (max FLOOD)
MINIMUM BEFORE EBB
EBB (Max EBB)

SPEED RATIO (multiply)
FLOOD
EBB

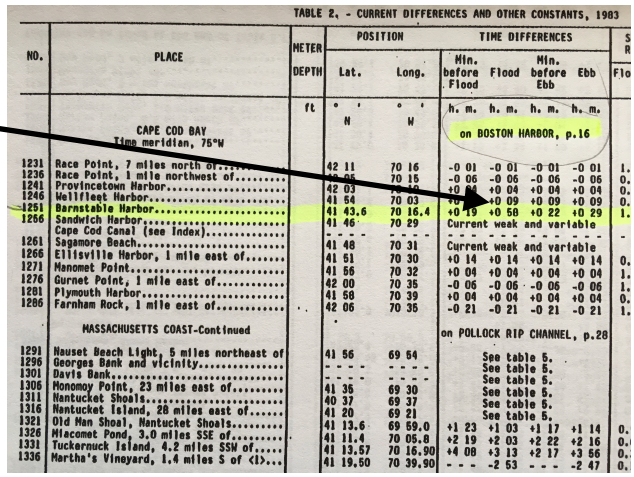


TABLE 2. - CURRENT DIFFERENCES AND OTHER CONSTANTS, 1983

NO.	PLACE	METER DEPTH	POSITION Lat.	POSITION Long.	TIME DIFFERENCES Min. before Flood	Flood	Min. before Ebb	Ebb	Flo
		ft	° ' N	° ' W	h. m.	h. m.	h. m.	h. m.	
	CAPE COD BAY Time meridian, 75°W				on BOSTON HARBOR, p.16				
1231	Race Point, 7 miles north of		42 11	70 16	-0 01	-0 01	-0 01	-0 01	1.
1236	Race Point, 1 mile northwest of		[illegible]	70 15	-0 06	-0 06	-0 06	-0 06	0.
1241	Provincetown Harbor		42 03	[illegible]	+0 04	+0 04	+0 04	+0 04	0.
1246	Wellfleet Harbor		41 54	70 03	[illegible]	+0 09	+0 09	+0 09	0.
1251	Barnstable Harbor		41 43.6	70 16.4	+0 19	+0 58	+0 22	+0 29	1.
1256	Sandwich Harbor		41 46	70 29	Current weak and variable				
	Cape Cod Canal (see index)		- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	-
1261	Sagamore Beach		41 48	70 31	Current weak and variable				
1266	Ellisville Harbor, 1 mile east of		41 51	70 30	+0 14	+0 14	+0 14	+0 14	0.
1271	Manomet Point		41 56	70 32	+0 04	+0 04	+0 04	+0 04	1.
1276	Gurnet Point, 1 mile east of		42 00	70 35	-0 06	-0 06	-0 06	-0 06	1.
1281	Plymouth Harbor		41 58	70 39	+0 04	+0 04	+0 04	+0 04	0.
1286	Farnham Rock, 1 mile east of		42 06	70 35	-0 21	-0 21	-0 21	-0 21	1.
	MASSACHUSETTS COAST-Continued				on POLLOCK RIP CHANNEL, p.28				
1291	Nauset Beach Light, 5 miles northeast of		41 56	69 54	See table 5.				
1296	Georges Bank and vicinity		- - - -	- - - -	See table 5.				
1301	Davis Bank		- - - -	- - - -	See table 5.				
1306	Monomoy Point, 23 miles east of		41 35	69 30	See table 5.				
1311	Nantucket Shoals		40 37	69 37	See table 5.				
1316	Nantucket Island, 28 miles east of		41 20	69 21	See table 5.				
1321	Old Man Shoal, Nantucket Shoals		41 13.6	69 59.0	+1 23	+1 03	+1 17	+1 14	0.
1326	Miacomet Pond, 3.0 miles SSE of		41 11.4	70 05.8	+2 19	+2 03	+2 22	+2 16	0.
1331	Tuckernuck Island, 4.2 miles SSW of		41 13.57	70 16.90	+4 08	+3 13	+2 17	+3 56	0.
1336	Martha's Vineyard, 1.4 miles S of <1>		41 19.50	70 39.90	- - -	-2 53	- - -	-2 47	0.

EXAMPLE:

MINIMUM (SLACK WATER) BEFORE FLOOD	*+19 minutes*
FLOOD (max FLOOD)	*+ 58 minutes*
MINIMUM BEFORE EBB	*+ 22 minutes*
EBB (Max EBB)	*+ 29 minutes*
SPEED RATIO - (multiple) FLOOD max	*X 1.1*
SPEED RATIO - (multiple) EBB max	*X1.0*

STEP 3
Document the following from TABLE 2

SPEED RATIO (multiplier) and DIRECTIONS (directions are in DEGREES)
MINIMUM BEFORE FLOOD
FLOOD (max FLOOD)
MINIMUM BEFORE EBB
EBB (Max EBB)

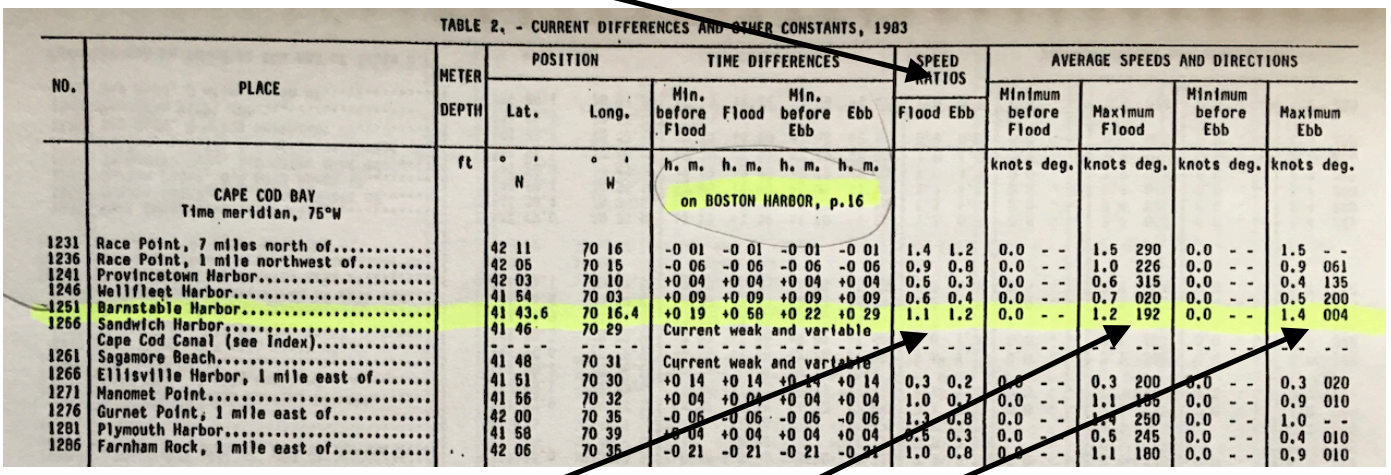


TABLE 2. - CURRENT DIFFERENCES AND OTHER CONSTANTS, 1983

NO.	PLACE	METER DEPTH	POSITION Lat.	POSITION Long.	TIME DIFFERENCES Min. before Flood	TIME DIFFERENCES Flood	TIME DIFFERENCES Min. before Ebb	TIME DIFFERENCES Ebb	SPEED RATIOS Flood	SPEED RATIOS Ebb	AVERAGE SPEEDS AND DIRECTIONS Minimum before Flood	Maximum Flood	Minimum before Ebb	Maximum Ebb
		ft	° ' N	° ' W	h. m.	h. m.	h. m.	h. m.			knots deg.	knots deg.	knots deg.	knots deg.
	CAPE COD BAY Time meridian, 75°W				on BOSTON HARBOR, p.16									
1231	Race Point, 7 miles north of		42 11	70 16	-0 01	-0 01	-0 01	-0 01	1.4	1.2	0.0 - -	1.5 290	0.0 - -	1.5 - -
1236	Race Point, 1 mile northwest of		42 05	70 15	-0 06	-0 06	-0 06	-0 06	0.9	0.8	0.0 - -	1.0 226	0.0 - -	0.9 061
1241	Provincetown Harbor		42 03	70 10	+0 04	+0 04	+0 04	+0 04	0.6	0.3	0.0 - -	0.6 315	0.0 - -	0.4 135
1246	Wellfleet Harbor		41 54	70 03	+0 09	+0 09	+0 09	+0 09	0.6	0.4	0.0 - -	0.7 020	0.0 - -	0.5 200
1251	Barnstable Harbor		41 43.6	70 16.4	+0 19	+0 58	+0 22	+0 29	1.1	1.2	0.0 - -	1.2 192	0.0 - -	1.4 004
1256	Sandwich Harbor		41 46	70 29	Current weak and variable									
	Cape Cod Canal (see Index)		- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- -	- -	- - - -	- - - -	- - - -	- - - -
1261	Sagamore Beach		41 48	70 31	Current weak and variable									
1266	Ellisville Harbor, 1 mile east of		41 51	70 30	+0 14	+0 14	+0 14	+0 14	0.3	0.2	0.0 - -	0.3 200	0.0 - -	0.3 020
1271	Manomet Point		41 56	70 32	+0 04	+0 04	+0 04	+0 04	1.0	0.7	0.0 - -	1.1 155	0.0 - -	0.9 010
1276	Gurnet Point, 1 mile east of		42 00	70 35	-0 06	-0 06	-0 06	-0 06	1.3	0.8	0.0 - -	1.4 250	0.0 - -	1.0 - -
1281	Plymouth Harbor		41 58	70 39	+0 04	+0 04	+0 04	+0 04	0.5	0.3	0.0 - -	0.6 245	0.0 - -	0.4 010
1286	Farnham Rock, 1 mile east of	. .	42 06	70 35	-0 21	-0 21	-0 21	-0 21	1.0	0.8	0.0 - -	1.1 180	0.0 - -	0.9 010

EXAMPLE:
SPEED RATIO for Substation
FLOOD X 1.1
EBB X 1.2

DIRECTION OF CURRENT
FLOOD 192 degrees
EBB 004 degrees

STEP 4
FInd the REFERENCE STATION at the top of the page and go to TABLE 1

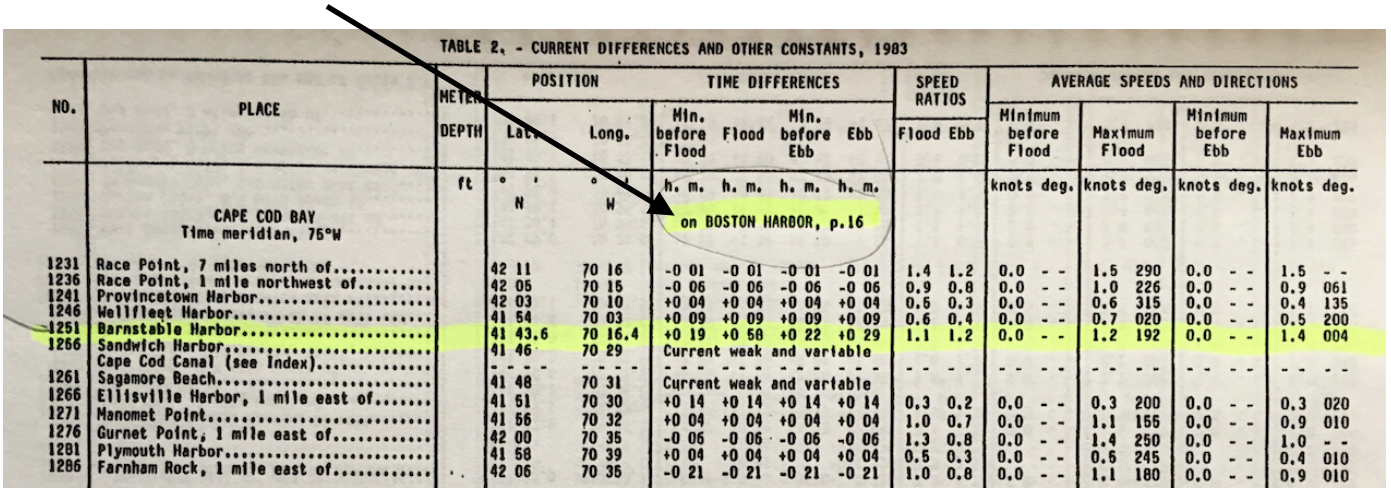


TABLE 2. - CURRENT DIFFERENCES AND OTHER CONSTANTS, 1983

NO.	PLACE	METER DEPTH	POSITION Lat.	POSITION Long.	TIME DIFFERENCES Min. before Flood	TIME DIFFERENCES Flood	TIME DIFFERENCES Min. before Ebb	TIME DIFFERENCES Ebb	SPEED RATIOS Flood	SPEED RATIOS Ebb	AVERAGE SPEEDS AND DIRECTIONS Minimum before Flood	Maximum Flood	Minimum before Ebb	Maximum Ebb
		ft	° ' N	° ' W	h. m.	h. m.	h. m.	h. m.			knots deg.	knots deg.	knots deg.	knots deg.
	CAPE COD BAY Time meridian, 75°W				on BOSTON HARBOR, p.16									
1231	Race Point, 7 miles north of		42 11	70 16	-0 01	-0 01	-0 01	-0 01	1.4	1.2	0.0 - -	1.5 290	0.0 - -	1.5 - -
1236	Race Point, 1 mile northwest of		42 05	70 15	-0 06	-0 06	-0 06	-0 06	0.9	0.8	0.0 - -	1.0 226	0.0 - -	0.9 061
1241	Provincetown Harbor		42 03	70 10	+0 04	+0 04	+0 04	+0 04	0.6	0.3	0.0 - -	0.6 315	0.0 - -	0.4 135
1246	Wellfleet Harbor		41 54	70 03	+0 09	+0 09	+0 09	+0 09	0.6	0.4	0.0 - -	0.7 020	0.0 - -	0.5 200
1251	Barnstable Harbor		41 43.6	70 16.4	+0 19	+0 58	+0 22	+0 29	1.1	1.2	0.0 - -	1.2 192	0.0 - -	1.4 004
1256	Sandwich Harbor		41 46	70 29	Current weak and variable									
	Cape Cod Canal (see Index)		- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- -	- -	- - - -	- - - -	- - - -	- - - -
1261	Sagamore Beach		41 48	70 31	Current weak and variable									
1266	Ellisville Harbor, 1 mile east of		41 51	70 30	+0 14	+0 14	+0 14	+0 14	0.3	0.2	0.0 - -	0.3 200	0.0 - -	0.3 020
1271	Manomet Point		41 56	70 32	+0 04	+0 04	+0 04	+0 04	1.0	0.7	0.0 - -	1.1 155	0.0 - -	0.9 010
1276	Gurnet Point, 1 mile east of		42 00	70 35	-0 06	-0 06	-0 06	-0 06	1.3	0.8	0.0 - -	1.4 250	0.0 - -	1.0 - -
1281	Plymouth Harbor		41 58	70 39	+0 04	+0 04	+0 04	+0 04	0.5	0.3	0.0 - -	0.6 245	0.0 - -	0.4 010
1286	Farnham Rock, 1 mile east of	. .	42 06	70 35	-0 21	-0 21	-0 21	-0 21	1.0	0.8	0.0 - -	1.1 180	0.0 - -	0.9 010

EXAMPLE:
REFERENCE STATION for Barnstable Harbor is BOSTON

STEP 5
Using table 1 FIND THE TWO TIDES THAT OCCUR **BEFORE** and **AFTER** OUR **ETA**
DOCUMENT the following:

SLACK WATER (Minimum) TIME
MAXIMUM CURRENT TIME (Flood)
SLACK WATER (Minimum) TIME
MAXIMUM CURRENT TIME (Ebb)
VELOCITY (Kts) (note E = Ebb F=Flood)
(SLACK WATER = minimum current)

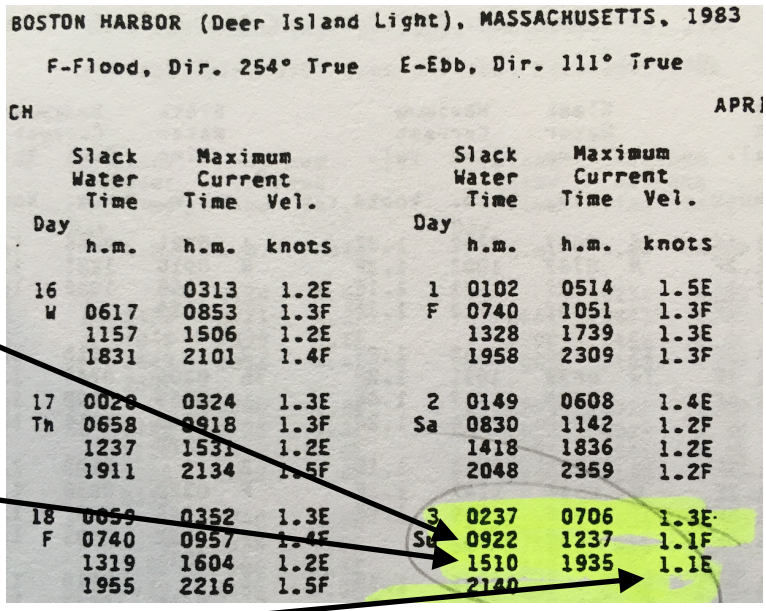
EXAMPLE:

SLACK WATER TIME *09:22*
MAX CURRENT TIME *12:37*

ETA *13:43*

SLACK WATER TIME *15:10*
MAX SURRENT TIME *19:35*

SPEED FLOOD max *1.1 F*
SPEED EBB max *1.1 E*



BOSTON HARBOR (Deer Island Light), MASSACHUSETTS, 1983

F-Flood, Dir. 254° True E-Ebb, Dir. 111° True

CH APR

Day	Slack Water Time h.m.	Maximum Current Time h.m.	Maximum Current Vel. knots	Day	Slack Water Time h.m.	Maximum Current Time h.m.	Maximum Current Vel. knots
16		0313	1.2E	1	0102	0514	1.5E
W	0617	0853	1.3F	F	0740	1051	1.3F
	1157	1506	1.2E		1328	1739	1.3E
	1831	2101	1.4F		1958	2309	1.3F
17	0028	0324	1.3E	2	0149	0608	1.4E
Th	0658	0918	1.3F	Sa	0830	1142	1.2F
	1237	1531	1.2E		1418	1836	1.2E
	1911	2134	1.5F		2048	2359	1.2F
18	0059	0352	1.3E	3	0237	0706	1.3E
F	0740	0957	1.4F	Su	0922	1237	1.1F
	1319	1604	1.2E		1510	1935	1.1E
	1955	2216	1.5F		2140		

STEP 6
ADD the TIME DIFFERENCE for the selected SUBSTATION (our planned location) to TIME AT REFERENCE STATION
MULTIPLY the SPEED RATION from the SUBSTATION to the SPEED AT REFERENCE STATION

NOTE: YOU MUST add or SUBTRACK Times as listed (- or +) and MULTIPLE RATIOS for SPEED

EXAMPLE:

STATION	*Min before Flood*	*Max Flood*	*Min before Ebb*	*Max Ebb*	*Speed Flood*	*Speed Ebb*
BOSTON (Reference)	*9:22*	*12:37*	*15:10*	*19:35*	*1.1*	*1.1*
Barnstable Harbor (dest)	*19*	*58*	*22*	*29*	*1.1*	*1.2*
	9:41	*13:35*	*15:32*	*20:04*	*1.2*	*1.3*
	time	*time*	*time*	*time*	*Kts*	*Kts*

STEP 7
Bracket OUR time between the two times that are closest
NOTE: For direction of CURRENT: IF START at Flood use **FLOOD** direction, if START at ebb use **EBB** direction

EXAMPLE:

MAX FLOOD 13:35 selected
Original ETA: 13:43
MIN BEFORE FLOOD 15:32 selected

DIRECTION OF CURRENT from Table 2
FLOOD 192 degrees
EBB 004 degrees

*Therefore: Direction will be **192 degrees upon arrival.***

STEP 8
Go to **TABLE 3** VELOCITY OF CURRENT AT ANY TIME

Determine DIfferential time between SLACK and MAX
Determine Differential time between SLACK and OUR ETA

Using closest available numbers ***(EXTRAPOLIATION IS REQUIRED HERE)***

CROSS REFERENCE to find **correction factor**
multply the CORRECTION FACTOR and the SELECTED MAX CURRENT SPEED

EXAMPLE:
DIFF between Slack and MAX: Slack 15:32 Maximun Flood 13:35 = 1 hr 57 min
DIFF between Slack and our ETA: Slack 15:32 Our ETA: 13:43 = 1. hr 49 min

CORRECTION FACTOR
1.0

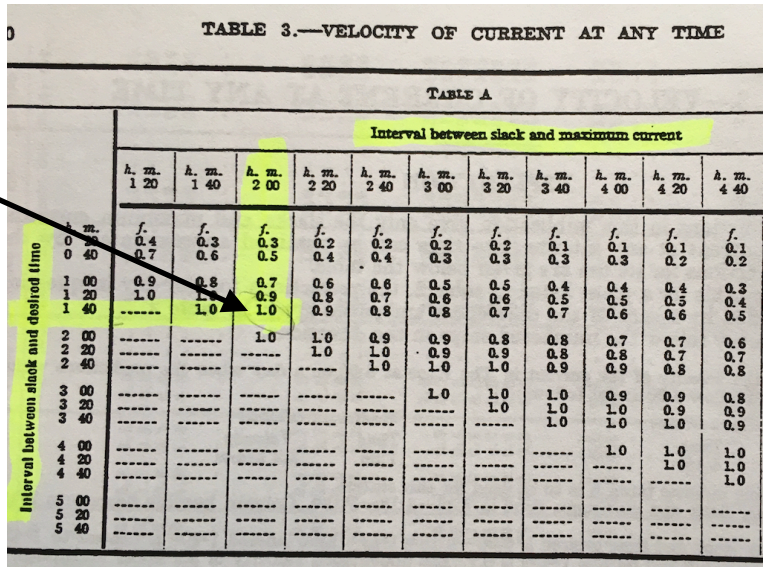


TABLE 3.—VELOCITY OF CURRENT AT ANY TIME

TABLE A

Interval between slack and maximum current

Interval between slack and desired time	h. m. 1 20	h. m. 1 40	h. m. 2 00	h. m. 2 20	h. m. 2 40	h. m. 3 00	h. m. 3 20	h. m. 3 40	h. m. 4 00	h. m. 4 20	h. m. 4 40
h. m.	f.	f.	f.	f.	f.	f.	f.	f.	f.	f.	f.
0 00	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
0 40	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2
1 00	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3
1 20	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.4
1 40	------	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5
2 00	------	------	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6
2 20	------	------	------	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7
2 40	------	------	------	------	1.0	1.0	1.0	0.9	0.9	0.8	0.8
3 00	------	------	------	------	------	1.0	1.0	1.0	0.9	0.9	0.8
3 20	------	------	------	------	------	------	1.0	1.0	1.0	0.9	0.9
3 40	------	------	------	------	------	------	------	1.0	1.0	1.0	0.9
4 00	------	------	------	------	------	------	------	------	1.0	1.0	1.0
4 20	------	------	------	------	------	------	------	------	------	1.0	1.0
4 40	------	------	------	------	------	------	------	------	------	------	1.0
5 00	------	------	------	------	------	------	------	------	------	------	------
5 20	------	------	------	------	------	------	------	------	------	------	------
5 40	------	------	------	------	------	------	------	------	------	------	------

STEP 9

MULTIPLE
CORRECTION FACTOR (step 8) X **MAX FLOOD VELOCITY** (from step 6) to get **SPEED** of **CURRENT** at our **ETA**

EXAMPLE:

Our original ETA: 13:43

Correction factor ***1.0*** *X Maximum Flood Speed* ***1.2*** *Kts =* ***1.2 kts***

(*Use direction of current from step 7) Flood current direction 192 degrees*

Therefore:
At our arrival to Barnstable Harbor on April 3, 1983 at 13:43 EST the direction of the current will be 192 degrees at a speed of 1.2 Kts.