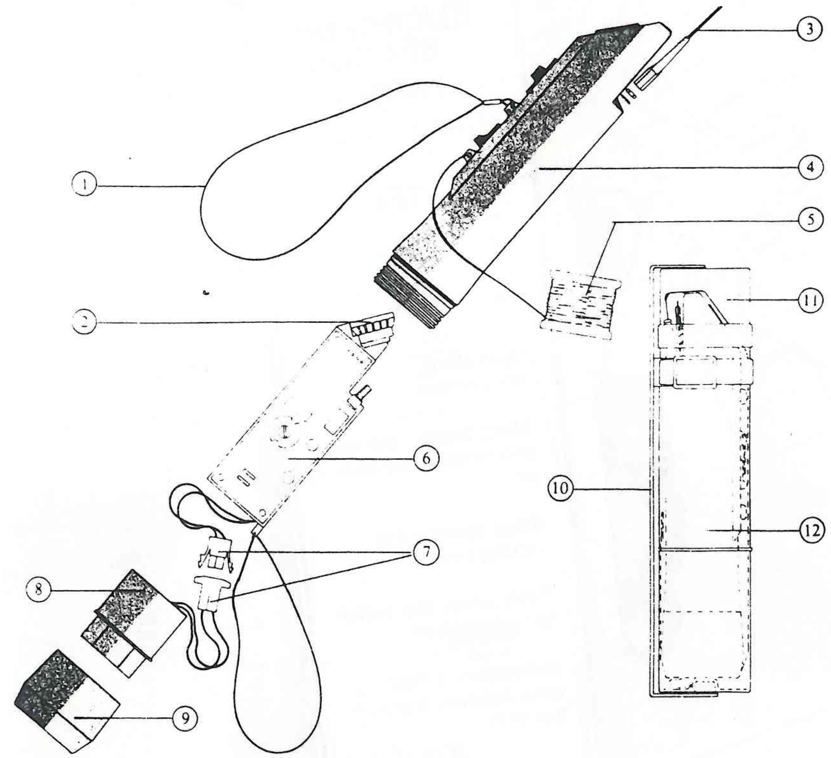
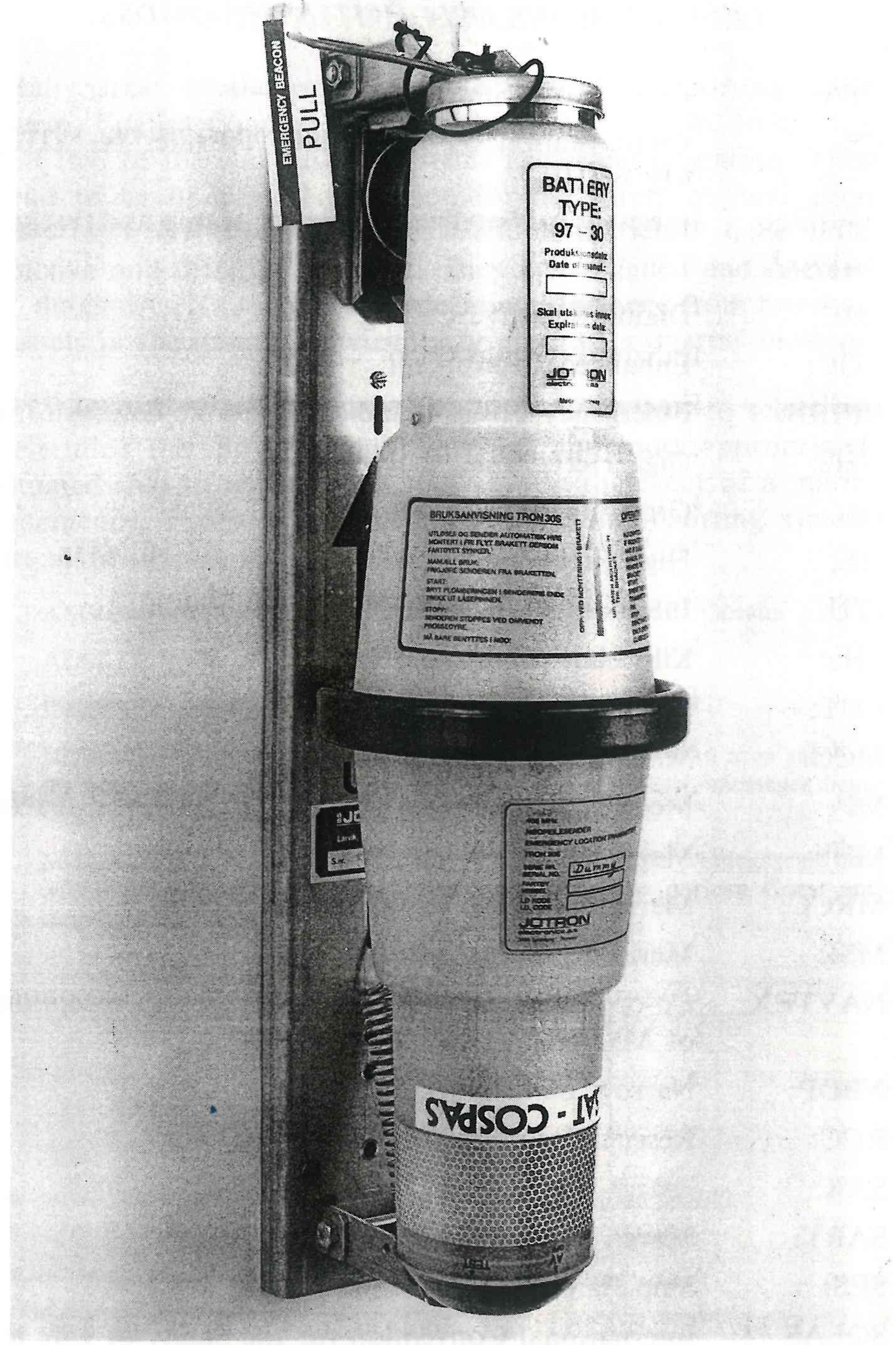
Transmitter/Receiver

Example shown is the 'TRON 2R'. It is battery operated and has the option of frequencies between 118 & 136 MHz.
Most commonly employed on the aircraft emergency frequency bands of 121.5 and 123.1 MHz.
It is buoyant and capable of single hand operation.



1. Neck Strap (Nylon)
2. Microphone – Loudspeaker
3. Antenna
4. Housing
5. Anchoring Line (25m-nylon)
6. Electronic Unit
7. Battery-plugs
8. Battery Unit
9. Battery Compartment
10. Mounting Bracket

11 & 12. Lid and Container.



TRON 30S Type E.P.I.R.B. manufactured by 'Jotron' Electronics AS operates on 121.5, 243 and 406 MHz and provides global location capability in conjunction with the SARSAT/COSPAS satellite systems. It may be fitted with a hydrostatic, float free mounting which allows release at approximately 2–3 metres.

ABBREVIATIONS USED WITH THE GMDSS

CES:	Coast Earth Station
CS:	Coast Station on land which operates on VHF, MF or HF
COSPAS-SARSAT:	International Satellite System for search and rescue
DSC:	Digital Selective Calling
EGC:	Enhanced Group Call
EPIRB:	Emergency Position Indicating Radio-Beacon
GHz:	Giga Hertz equal to 1000 MHz
grt:	Gross Registered Tons
HF:	High Frequency between 3 MHz and 30 MHz
ITU:	International Telecommunication Union
kHz:	Kilo Hertz equal to 1000 hertz
LUT:	Local User Terminal
MCC:	Mission Control Centre
MF:	Medium Frequency between 300 KHz and 3 MHz
MHz:	Mega Hertz equal to 1000 KHz
MRCC:	Maritime Rescue Co-ordination Centre
MSI:	Maritime Safety Information
NAVTEX:	Co-ordinated broadcast and automatic reception of MSI on 518 kHz using NBDP
NBDP:	Narrow Band Direct Printing
RCC:	Rescue Co-ordination Centre
SAR:	Search and Rescue
SART:	Search and Rescue Radar Transponder
SES:	Ship Earth Station
SOLAS 74:	International Convention for the Safety of Life at Sea 1974
VHF:	Very High Frequency between 30 MHz and 300 MHz

SHIP REPORTING SYSTEMS

Many areas of the world operate local ship reporting procedures, English Channel, River St. Lawrence Canada, to mention but two of the well known systems in current operation. These tend to be of a local operation for the safety of navigation. ship reporting systems like AMVER or AUSREP have a distinctive and different purpose. They are designed and operated to maximise efficiency in co-ordinating assistance from merchant vessels in the immediate vicinity or close to a distress incident.

Information supplied by vessels allows the system to select and determine the most suitably equipped and most appropriately situated ship to render early assistance in the event of a marine emergency. Probably the most popular ship reporting systems are:

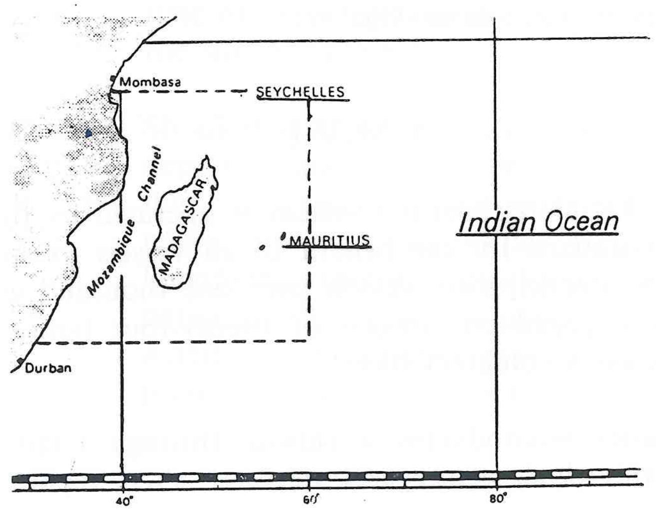
AMVER operated by U.S. Coast Guard Atlantic/Pacific Oceans

AUSREP operated within the Australian SAR area

INSPIRES operates within the Indian SAR area

NEW ZEALAND Ship Reporting Service operated over an area south of the equator between longitudes 140° west and 160° east, messages being sent through Auckland, Wellington and Awarua.

MADAGASCAR reporting service exists around the Madagascar area within latitudes 5° south to 30° south between the African Coast and longitude 60° east.



SHIP REPORTING SYSTEMS

AMVER AND AUSREP Systems

Principle of any ship reporting system is to utilise the resources of the many merchant vessels which are at sea at any one time, following a maritime incident. These ships very often have the potential to make an early arrival at an emergency scene. The purpose of AMVER is to maximise the efficiency in co-ordinating assistance in order to save life and property.

AMVER — the Automated Mutual-Assistance Vessel Rescue System

Participating vessels transmit their positions and intended future movements via the AMVER radio station.
(Obtained from the AMVER User's Manual).

Message format can be obtained from the Admiralty List of Radio Signals.

Additional information may be obtained from:

Commander Atlantic Area, U.S. Coastguard Governors Island New York, N.Y. 10004–5099 U.S.A.	Commander Pacific Coast Area U.S. Coastguard Government Island Alameda California 94501–5100	Commandant U.S. Coast Guard Washington DC 20593

A.M.V.E.R.

The AMVER ship reporting system is operated by the United States Coastguard for the benefit of all vessels irrespective of nationality. Participating vessels over one thousand gross tons which are engaged on voyages of twenty-four hours or more contribute on a voluntary basis.

The operation is conducted worldwide through a radio station network via which vessels can despatch their reports free of

charge (designated stations only).* The objectives are to co-ordinate mutual assistance for the purpose of distress or search and rescue activities.

AMVER centres are based in New York and San Francisco where automatic data processing is achieved. Initial ship's data regarding the vessel's size, speed, communications, equipment and facilities being kept on confidential record. No information being passed on except that relevant to SAR operations.

MESSAGES

Transmissions normally take place during the normal communications schedule of the ship:

Sailing Plan — This may be given days or even weeks prior to departure. Its content should include the ship's name and call sign. The time and port of departure, together with the port of destination, should also be included. A provisional ETA, with the proposed routeing track, should also be stated together with any special resources on board.

Departure Report — Despatched as soon as possible after departure. It should include the ship's name, time of departure and the port from which the ship is sailing.

Position Report — Should be despatched within 24 hours after departure and within every 48 hours after that. This report should include the ship's name, time and the position (latitude and longitude), together with the port of destination and ETA, at this port.
Additional information may include speed, present course or other relevant comments.

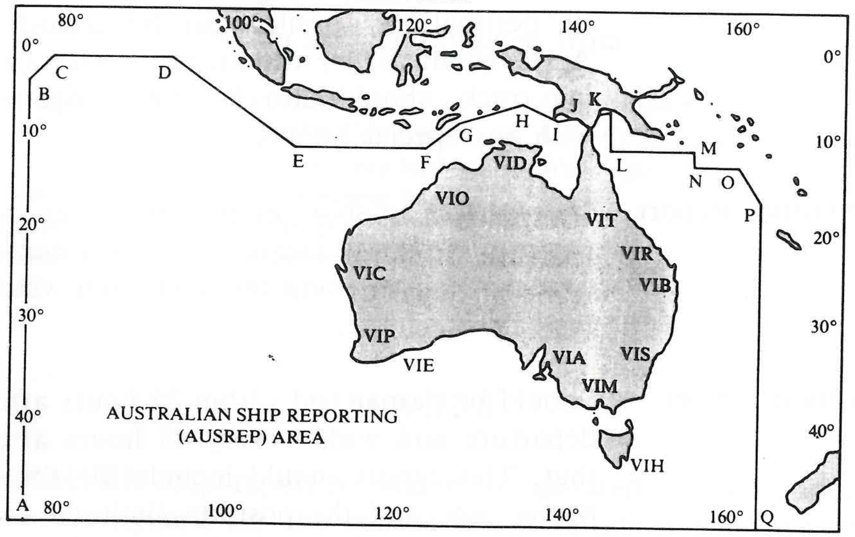
*UK stations now charge for AMVER communications Ref., M1551

Arrival Report	Despatched just prior to, or on arrival at, the port of destination. The report should include the ship's name and call sign, the relevant position and time.
Deviation Report	Used to report any changes to the sailing plan. Details of diversions, courses and speeds with revised ETA may be appropriate with deviation.

AUSREP – Ship Report System

Mandatory system for all Australian Ships when navigating inside the designated area, and for all foreign ships from arrival in their first Australian Port until their departure from the last Australian Port.

The ship reporting system became mandatory in Australian waters on 1st April 1982. For the purpose of AUSREP, Australian waters cover nearly ten per cent of the earth's surface.



Ships despatch their messages through any Australian Coast Radio Station addressed "Cosurcen Canberra". Schedules and frequencies are listed in the Admiralty List of Radio Signals Vol. I.

The system is operated by the Australian Coastal Surveillance Centre (ACSC) based in Canberra and its principle objectives are:

1. To limit the time between the loss of a vessel and the initiation of search and rescue action in cases where no distress signal is despatched.
2. To limit the search area for rescue action.
3. To provide up-to-date information on shipping in the event of a search and rescue incident developing.

To this end all vessels' navigating within the Ausrep area are requested to co-operate and respect the specific guidelines of the controlling centre.

AUSREP – Format of Reports

Sailing Plan (SP) Report

Despatched when entering the area or up to 2 hours after departure from port.

To include:

1. AUSREP SP
2. Ship's name
3. Call sign
4. Port of departure or if entering Ausrep area, ship's position
5. Date and time (GMT) of departure or of the time of position
6. Port of destination
7. Date and time of ETA (GMT). If leaving the area the ETA at the boundary limits.
8. Intended route
9. Estimated speed of vessel
10. A nominated daily reporting time (GMT)
11. Relevant remarks, e.g. intermediate port stops

Position Report (PR)

Despatched daily at a nominated time

To include:

1. AUSREP PR
2. Ship's name
3. Call sign
4. Position, course and speed
5. Date and time of ship's position given (GMT)
6. Remarks (i.e. any change in information previously passed in the sailing plan, or a change in the nominated reporting time, or revised routing information, any change in speed or destination etc.)

The last position report should also confirm ETA or, if leaving the area, then this should be indicated by adding "FINAL REPORT".

Arrival Report (AR)

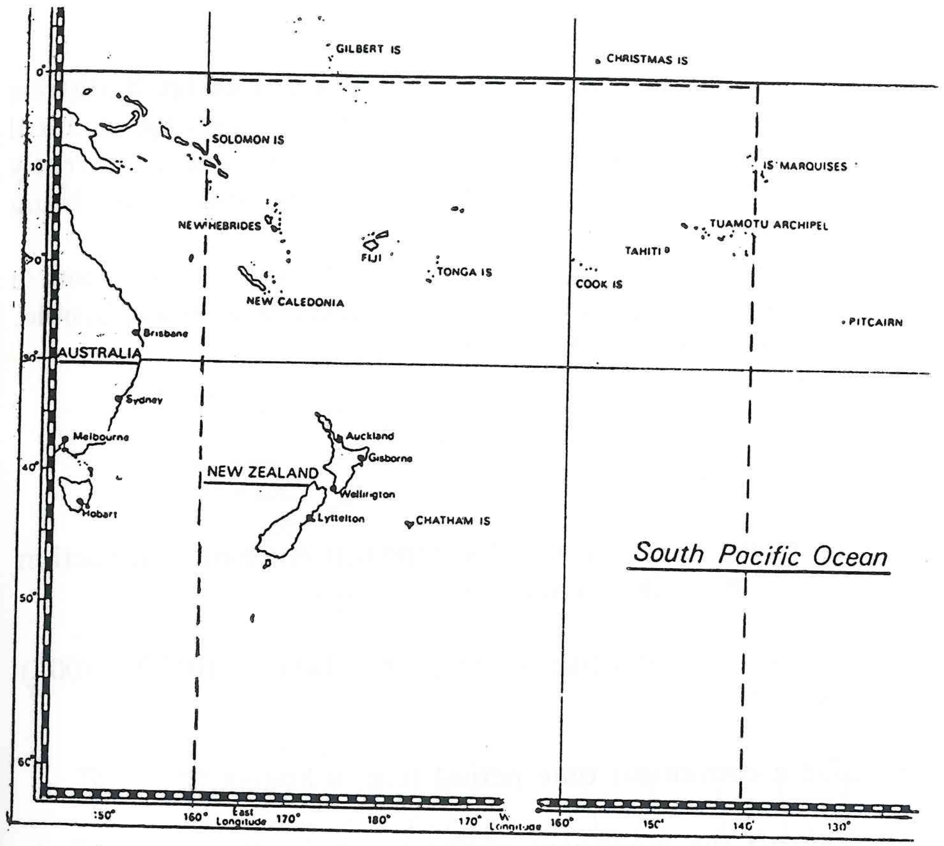
Despatched once a vessel is within 2 hours steaming of Pilot Station.

To include:

1. AUSREP AR
2. Ship's name
3. Call sign
4. Port of arrival
5. Date and time (GMT) of report

NB: If a report is 6 hours overdue, then the coast radio station will broadcast a priority signal within their traffic lists, requesting an IMMEDIATE RESPONSE.
Other vessels should report sightings and/or communications with the overdue vessel.
If the report is 21 hours overdue, the signal will be upgraded to an 'URGENCY SIGNAL'

New Zealand — Ship Reporting Area



Rendezvous Problems

The need for navigators to establish a course to rendezvous with another target is not an every day occurence at sea. However, any vessel could be called upon to contribute to an SAR operation and on that somewhat unusual occasion the need to be able to establish the course to steer and the closing speed to provide an ETA must be considered the navigators job.

For convenience the following examples have been illustrated on radar plotting sheets, and the reader should note that many of these problems could be equally resolved by calculation or alternative constructional methods.

Example 1.

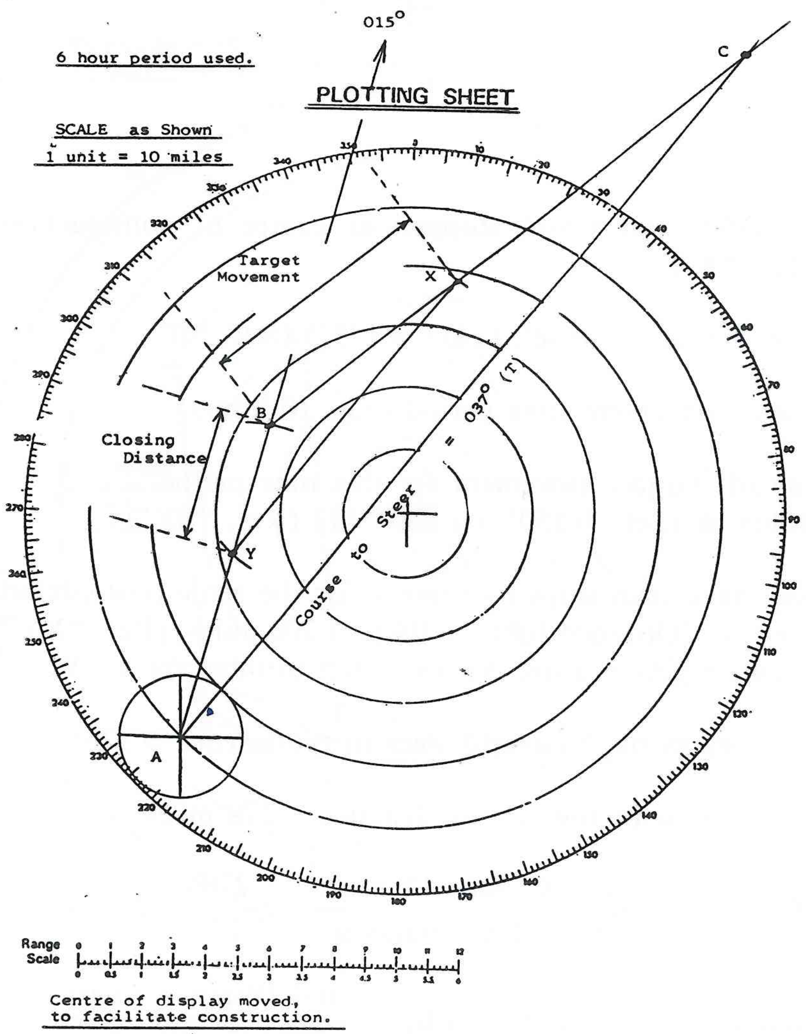
At 0800 hrs on the 16th July, your vessel receives a distress message from a vessel bearing 015° (T) distance 100 nautical miles. The distress vessel has a cargo hold fire and is currently steering 050° (T) at twelve knots. Course and speed being adopted to suit the prevailing wind conditions.
If your own ships maximum speed is 18 knots, what course must you steer to rendezvous with the target as soon as possible. What is your ETA at the rendezvous?

Method.

1. Consider your own vessel stopped. (Centre of construction — see page 285). (Ref. "A")
2. Plot the target vessel bearing and distance (015° × 100') (Ref. "B")
3. Use a convenient time period (e.g. 6 hours)
4. Lay off the movement of the target for this time period. (6hrs. at 12kts = 72' on 050° T.) (Ref. "BX")
5. Step back own ships movement (for the same time period), from 'X'. (Distance 6hrs × 18kts = 108') (Ref. "XY")
6. Construct course to steer from own ships centre 'A' so that AC parallels XY (AC//XY)
7. Extend target ships movement 'BX' to intercept own ships movement at 'C'.
8. Obtain the direction of the course to steer (AC) = 037° (T).
9. Obtain the closing distance, represented by "BY" = 41 miles.

10. Obtain the combined effective speed
$$\frac{41'}{6\ \text{hrs}} = 6.9\ \text{kts.}$$
11. Obtain the time to rendezvous by:
$$\frac{\text{Total Distance}}{\text{Eff/Speed}} = \frac{100}{6.9} = 14.49\ \text{hours (14hrs 30')}$$
12. ETA from 0800 hrs = 2230 hrs.

Example 1.



Rendezvous Problems

Example 2.

A medical emergency occurs aboard a target ship which bears 143° (T) at a distance of 175 nautical miles from you. The target ships course and speed are 280° (T) × 15 knots. Your vessel carries a doctor and has a maximum speed of 20 knots. Both vessels are effected by a current setting 200° (T) at 2 knots. What course must your vessel steer to make the rendezvous in the shortest possible time. What will be the ETA of the rendezvous if the time is now 0600 hours.

Method

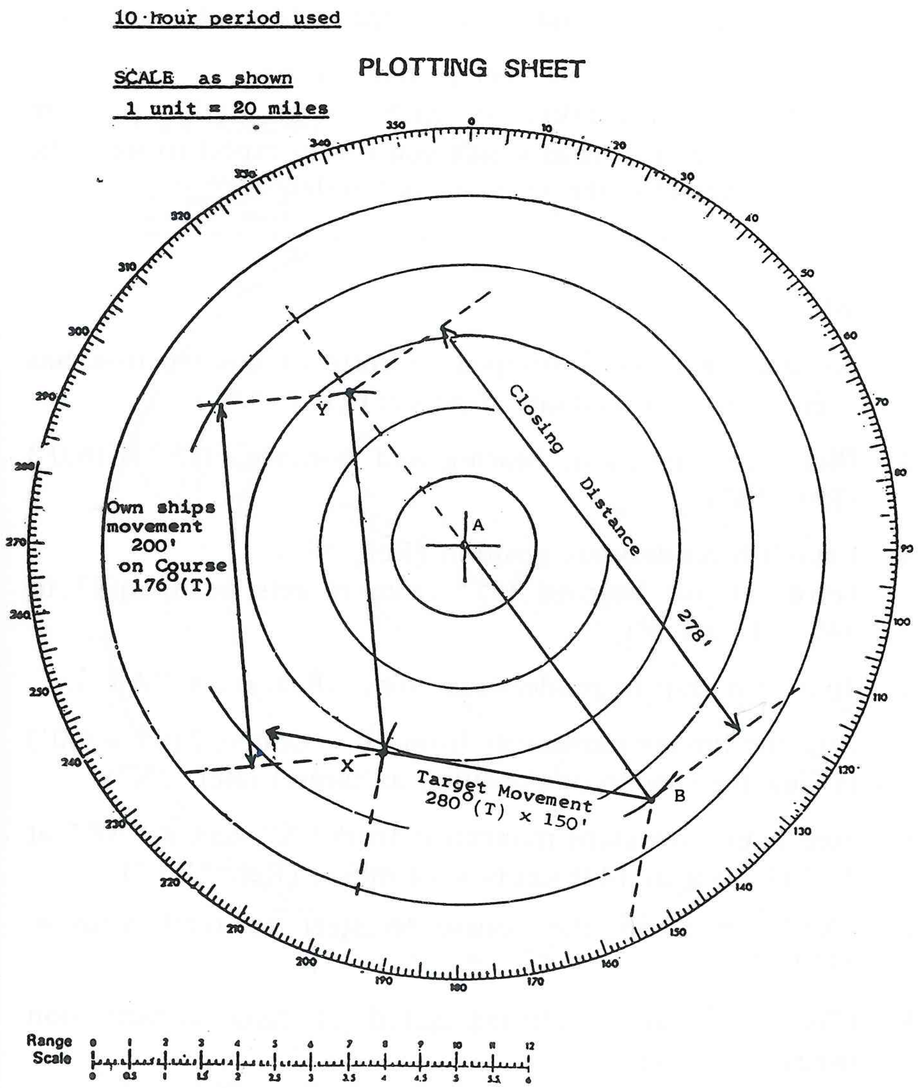
1. Consider own vessel stopped at centre of construction. (Ref. "A")
2. Plot the target vessel. (143° × 175') (Ref. "B").
3. Use a convenient time period (e.g. 10 hours)
4. Lay off targets movement for this time period. (10hrs at 15kts = 150' on 280° (T) (Ref. "BX")
5. Step back own ships movement for the same time period, from 'X' (Distance 10hrs × 20kts = 200 miles) (Ref. "XY") to cut targets bearing AR extended to intercept at 'Y'.
6. 'XY' represents course to steer to rendezvous = 176° (T)
7. 'BY' represents the closing distance = 278 miles.
8. Effective speed $= \dfrac{\text{Closing Distance}}{\text{Time Interval}} = \dfrac{278}{10} = 27.8$ kts
9. Time to rendezvous found by: $\dfrac{\text{Total Distance Apart}}{\text{Effective Speed}}$

$$= \frac{175}{27.8} = 6.3 \text{ hours (6 hrs 18')}$$

10. ETA of rendezvous = 1218 hrs same day

NB: The current in the question is effecting both vessels and can subsequently be ignored for the purpose of the construction.

Example 2.



Rendezvous Problems

Example 3.

You are requested to rendezvous and stand by another vessel which has been damaged by fire. The damaged vessel is heading for port on a course of 210° (T) at a speed of 6 knots. The radar bearing and range of this vessel from you is 115° (T) distance 16 miles.
Your orders are to take up station on the damaged vessel 1 mile off her starboard quarter on a bearing of 135° relative to his ships head. Own vessels maximum speed is 14 knots.

Obtain: a) the course to steer to rendezvous.
b) the time taken to reach the on station position
c) the bearing at which you would expect to sight the vessel if the visibility is 5 miles.

Method

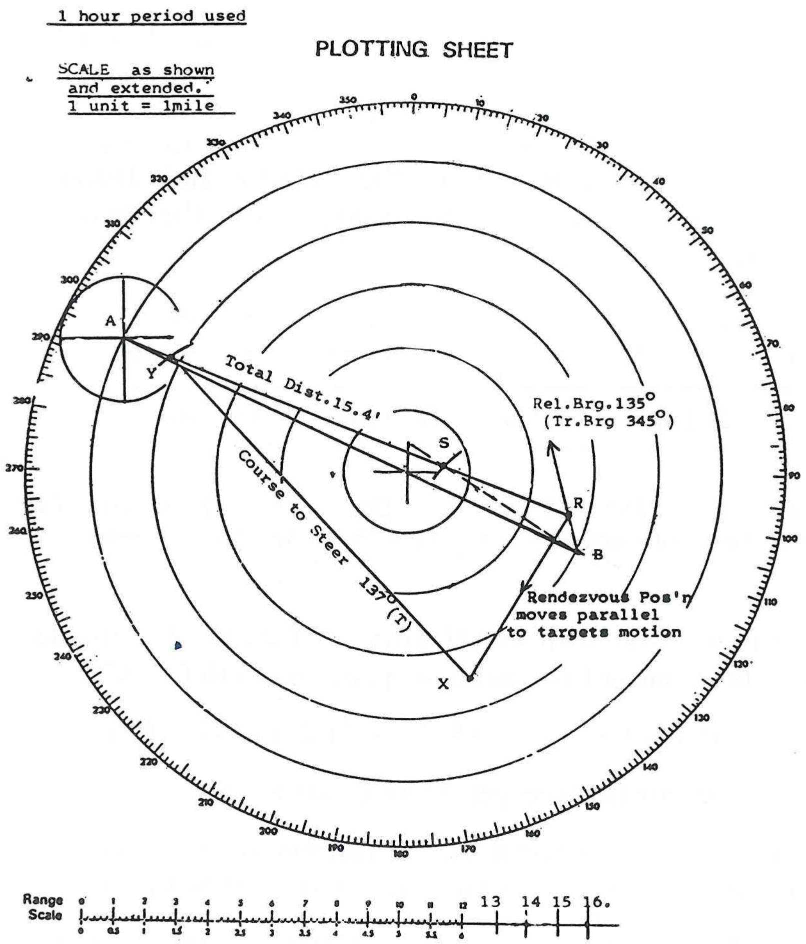
1. Assume own vessel stopped. (Centre of construction has been moved to facilitate page size) (Ref. "A")
2. Plot target position, bearing and distance (115° × 16.0') (Ref. "B")
3. Establish rendezvous position (Ref. "R") (Plot relative bearing 135° from targets head equal to 345° (T) × 1.0')
4. Join own ship to rendezvous point. (Ref. track "AR").
5. Plot the targets movement from "R" (Course 210° × 6.0') (Using the rendezvous position as target) (Ref. "X")
6. Step back own ships movement from "X", to cut "AR" at "Y" (1 hour at 14.0 knots = 14 miles) (Ref. "XY")
7. "XY" represents the course to steer to rendezvous = 137° (T)
8. Closing distance = Closing speed (1 hour construction used) = 13.7 kts.

9. Total distance to rendezvous position 'R', = 15.4 miles, therefore time to rendezvous =

$$\frac{\text{Total Dist}}{\text{Eff. Speed}} = \frac{15.4}{13.7} = 1.12 \text{ hours (1 hour 7')}$$

10. From target position 'B' step back a 5.0 mile range to cut and intercept track 'AR'. at "S".
Measure the bearing of when your vessel sights target vessel at 5.0' range = 123.5° (T).

Example 3.



NB. Own ships centre moved to facilitate page size.

Rendezvous Problems

Example 4.

Your vessel is in a position latitude 38° 40' S, longitude 120° 49' E, at 1700 hrs GMT, when a distress message is received. Your maximum speed is 14 knots and you are required to rendezvous with the distress in position latitude 37° 48' S longitude 119° 33' E. Her course is WNW at 8.0 knots. Find the gyro course to steer to meet the rendezvous if your ships gyro compass has an error of 2° High. Allow 4° for leeway if a strong easterly wind is blowing.

Find also the zone time of the rendezvous.

Method

NB: It is necessary to obtain the bearing and distance of the target vessel prior to proceeding with the rendezvous resolution.

Own Ship	Lat.	38°	40' S	Long.	120°	49'	E
Distress	Lat.	37°	48' S	Long.	119°	33'	E
	D.Lat.		52' N	D. Long.	1°	16'	W

Mean Lat. 38° 14' S. Dep. = 59.7' (By Traverse Table)
Bearing & Range of distress = 311° (T) × 79.2 miles (By Tr/Table)

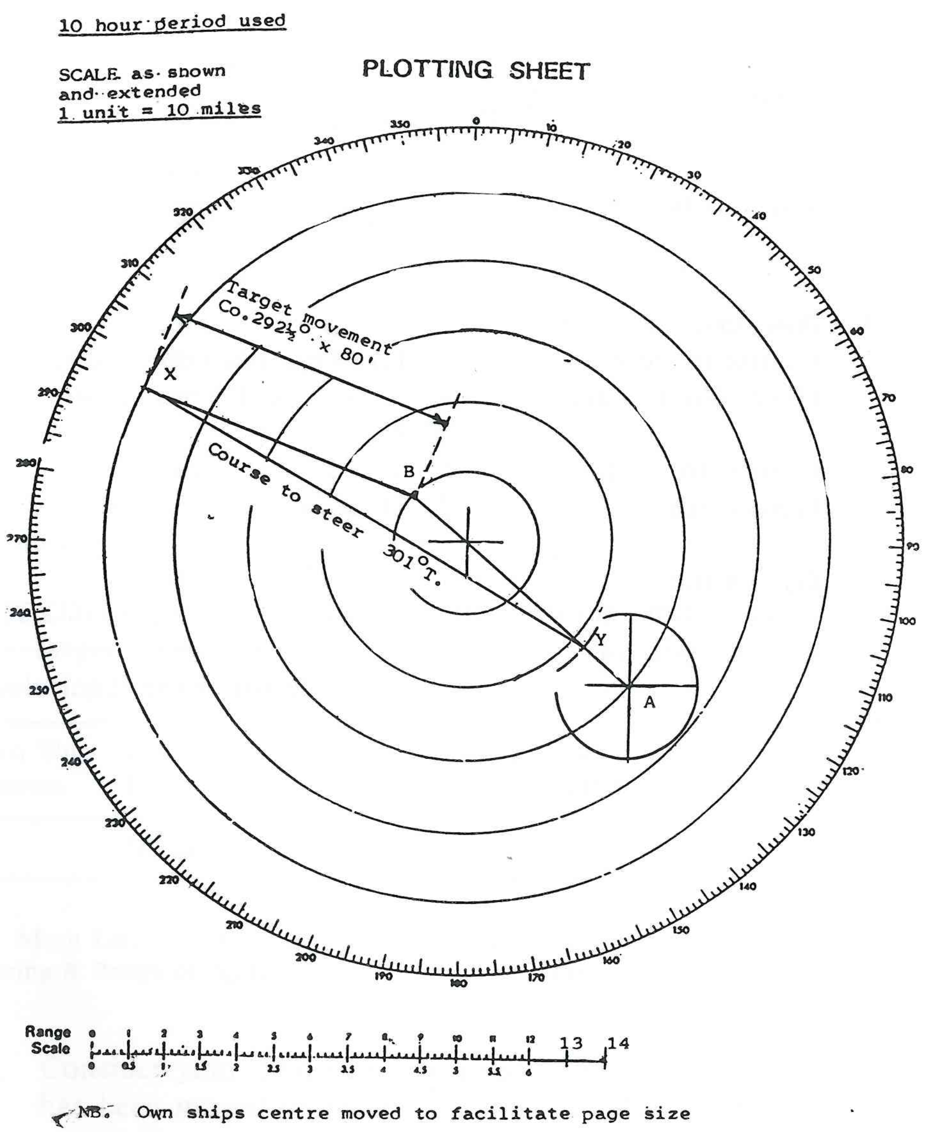
1. Consider your own vessel stopped (Centre of construction has been moved to facilitate page size) (Ref. "A")
2. Plot the distress vessel (311° × 79.2') (Ref. "B")
3. Use convenient time period (e.g. 10 hours)
4. Lay off the movement of the distress vessel. (Ref. "BX") (10 hrs at 8.0kts = 80 miles on course (WNW) 292½° T.)
5. Step back own ships movement (for same period of 10 hrs) from 'X'. (Distance of 140 miles to intercept 'AB' at "Y".)

6. 'XY' represents the course to steer to rendezvous = 301 °(T).
7. Measure closing distance 'BY' = 62 miles.
8. Effective speed $= \dfrac{\text{Closing Distance}}{\text{10 hr time period}} = \dfrac{62}{10} = 6.2$ knots.
9. Time to rendezvous $= \dfrac{\text{Tot. Distance}}{\text{Eff. Speed}} = \dfrac{79.2}{6.2}$

   = 12.77 hrs. (12hr.46')
10. Answers:

Course to steer	= 301° T.	Original Time	1700GMT
(East Wind) Leeway	= +4°	Time to R'vous	1246
Course to counter	= 305° T.	R'vous Time	0546
Gyro error	= 2° H	Zone (E.Long)	0800
Gyro Course	= 307° G.	R'vous Zone Time	1346 ZT.
		The following day.	

Example 4.



Rendezvous Problems

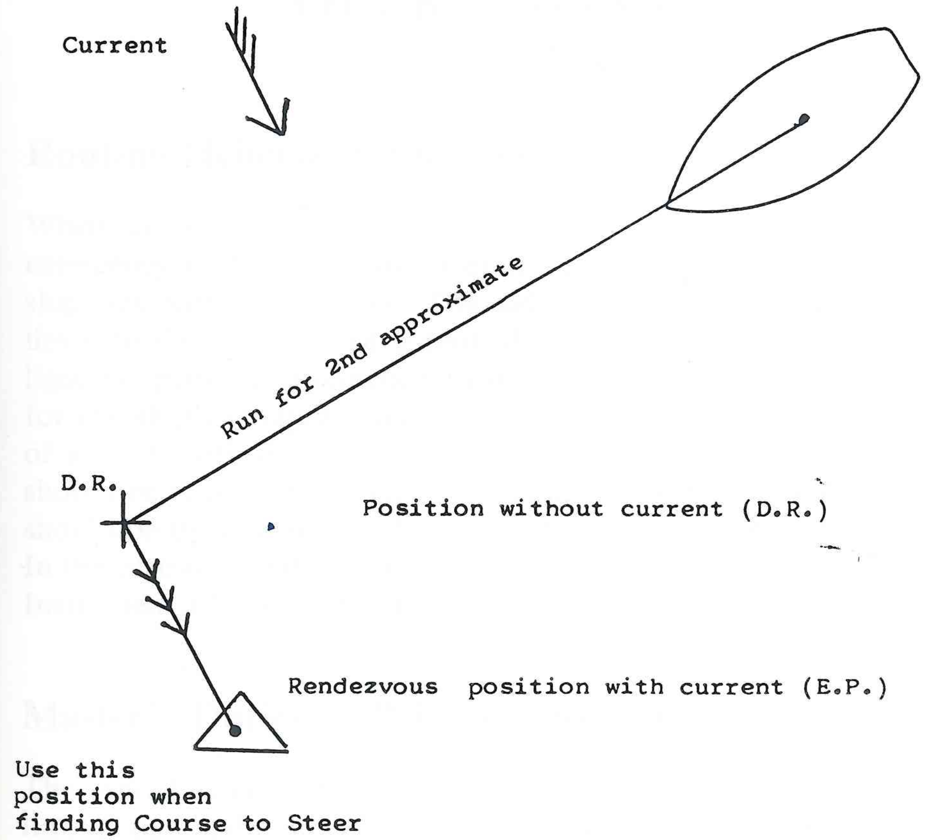
Many problems, especially those in examinations, involve the use of current. They may also, through lack of information require approximate positions to be established, prior to completing final answers. The following notations are meant as a

guide to obtaining the final solution, where problems may be particularly testing.

1) If a current is given and a first approximate position is required, then the current should be ignored when working the first approximate. Accuracy is questionable anyway and the time factor for resolving the problem may be critical.

2) A current if known should be introduced at the second approximate position. This will provide a more accurate final rendezvous position.

3) To find the course to steer, by the other vessel, the current should be ignored.
i.e. Use the 'D. R.' of the rendezvous, to find course and distance of the other ship.



Chapter Ten

MARINE HELICOPTER OPERATIONS

Routine Helicopter Engagement

When any vessel is to engage with an aircraft, whether it is for emergency or for a routine operation, the responsibility of the ship lies with the Master. The safe operation of the aircraft lies with the pilot and each rank should consider fully their obligations prior to commencing operations. It is normal practice for the ship's/company agents to arrange and contract the type of aircraft with the capabilities to carry out the engagement. It should be realised that helicopters engaged in marine operations should be twin engines and fitted with emergency flotation gear. In the case of a night engagement the aircraft would also require Instrument Flying Rating (IFR).

Master's Duties – Prior to Operation

The overall safety of the vessel should be of paramount concern throughout and to this end the Master would be expected to brief all operational personnel before rendezvous takes place.

The position of engagement should be plotted and the immediate area should be investigated. Adequate sea room clear of obstructions and preferably with little or no traffic movements is to be preferred.
An approach course towards the position should be appropriate to the general conditions. An approach speed in conjunction with this course should be proposed and the engine room informed accordingly.

Because of fuel limitations and the subsequent endurance of the aircraft, time is of the greatest importance to the pilot. Masters should therefore endeavour to assist in the conservation of fuel by steering towards the approaching aircraft whenever practical.
Identification of the vessel to the pilot is also a positive action by the target vessel. This can easily be achieved by flying the International code signal flags of the vessel's call sign. A radio homing signal is also recommended to help recognition.

The Master's duties will include the 'con' of the vessel and time spent on the bridge before engagement will ensure all safety elements and respective checks can be made in plenty of time.
Manual steering will need to be employed and lookouts posted in ample time. Deck parties for helicopter reception will need to be deployed to carry out various equipment checks.
Special signals (ball-diamond-ball) will need to be made ready for display when the aircraft is sighted.

The watch officer should be maintaining the navigational watch throughout this operation.
The ship's position should be plotted with regularity and traffic avoidance should be an ongoing activity under the supervision of the Master.
Radar should be operational and all targets plotted to establish a clear area of operation.
Communications with the aircraft will probably occur before visual contact is established and relevant information should be prepared beforehand. A VHF listening watch from the onset would be required.

Air to Surface Communications in Routine Helicopter Activity

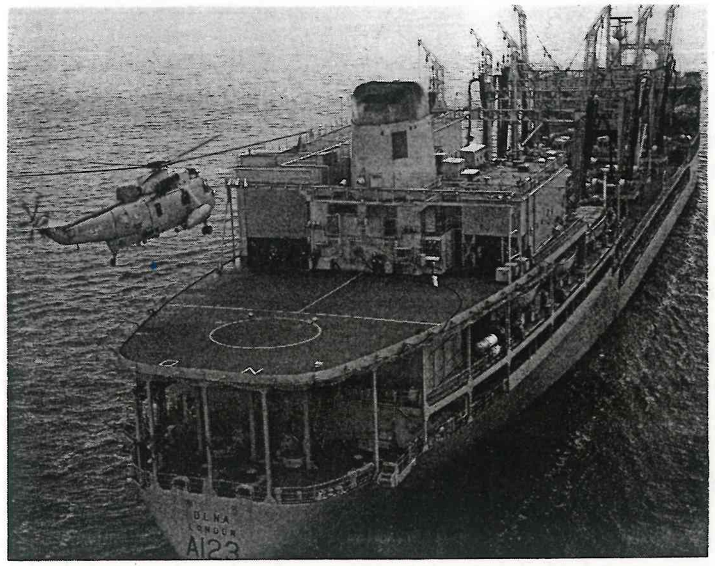
Pilots will expect an early radio contact which will identify the ship's name (or call sign). Confirmation of the rendezvous position, together with the vessel's course and speed and the ETA, would normally be passed between the two vehicles. Additional information with regard to the sea conditions, barometric pressure and wind direction at the site of engagement may be requested by the aircraft on approach. Clarification of the contact and engagement may also be sought. Such items as 'deck position' for either hoist or landing and details of relevant passenger/cargo being transferred, may also be required.

Pilots may request Masters to alter course or adjust speed for the actual period of engagement. The aircraft's approach, relative to the wind direction, could well dictate the need for a change of course by the vessel. It would be normal practice for the state of readiness of the vessel to be passed to the aircraft prior to the commencement of operations. Confirmation that the deck reception party was at a state of readiness and that fire parties were on stand-by would be expected.

NB: In the event of failure in radio communications, special light signals are prescribed as per the ICS 'Guide to Helicopter/Ship Operations'.

Pilotage delivery at sea on board a tanker.

Sikorsky S76 engaged in coastal operations

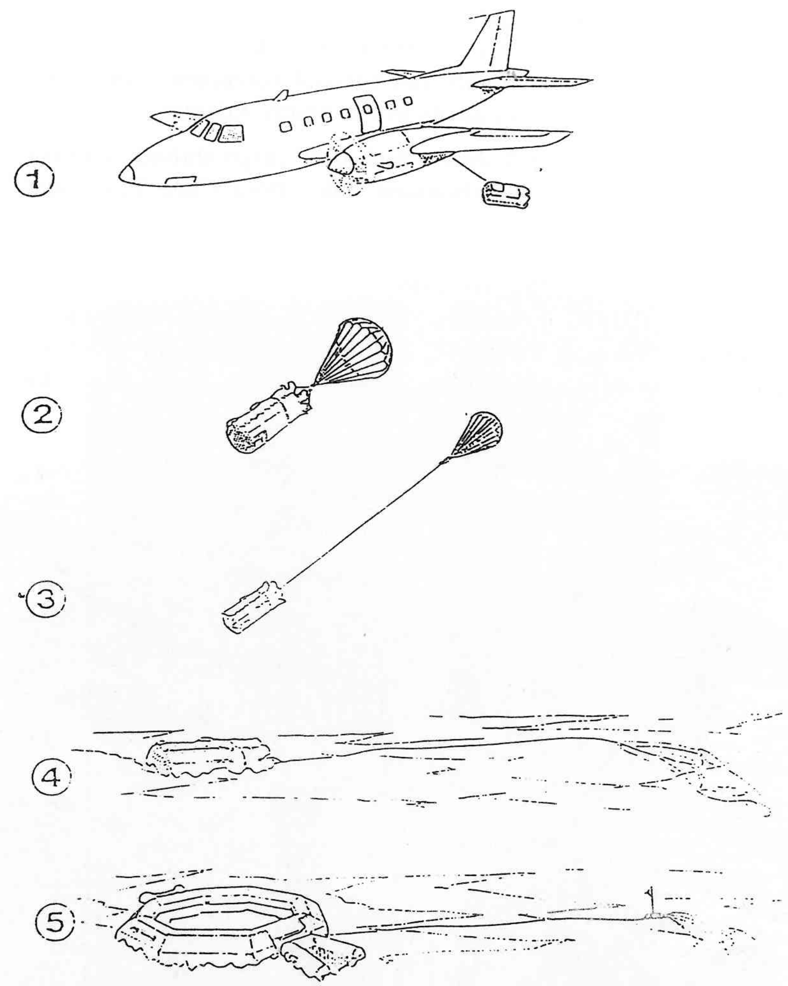


Routine land on procedure RFA tanker.

AIR SUPPORT

The use of helicopters in rescue operations has become an accepted norm. Their extensive use, together with commendable success, is possible only when incidents occur within their operational range. (Sea Kings are limited to 250 nautical miles radius without refueling). Additional air support is possible, some helicopters can refuel while in flight (Jolly Green Giants) but additional back up services are required in the way of tanker aircraft. Alternative support from the air could possibly be by dropping support material to a distress situation, e.g. life- rafts, pumps, rations, communication equipment etc. However, it is pointed out that any operation which involves helicopters or other air support is extremely expensive and would not be called upon unless all other methods had either been exhaustively tried or the situation had deteriorated to such an extent that air support was the only viable response.

A typical air drop is shown, where a fixed wing aircraft drops a heli-raft to a would be distress situation.



1. The liferaft is packed, complete with survival pack into a special valise fitted with a static line and hook, the hook being attached to an anchor point inside the aircraft.
   When the raft is ejected from the door of the aircraft, the static line draws an activation pin from one end of the valise (Fig. 1).
2. As the liferaft falls free, a spring vane parachute emerges and opens (Fig. 2).
3. The raft continues to fall in the same direction as the aircraft while a line is pulled from the valise against the drag of the parachute (Fig. 3).
4. The liferaft will strike the water first, to be followed by the 150 metres of line and then the chute (Fig. 4).
5. Once settled on the water, the raft will inflate automatically by the operation of a water activated unit.
   The parachute acts as a sea anchor with an attached float activated by a lifejacket operating head, a water activated light being secured to the float (Fig. 5).

* Incident Report September, 1993.

The RAF flew 3600 miles (round trip) from their base in the Falkland Islands to drop a 10 man liferaft and survival equipment from a Hercules transport, to Russian seaman adrift in the South Atlantic.

The seaman had abandoned their vessel after cargo shifted in heavy seas. The position was nearly two thousand miles from Cape Town and 1750 miles east of the Falklands.

** Jolly Green Giants — January 1989.

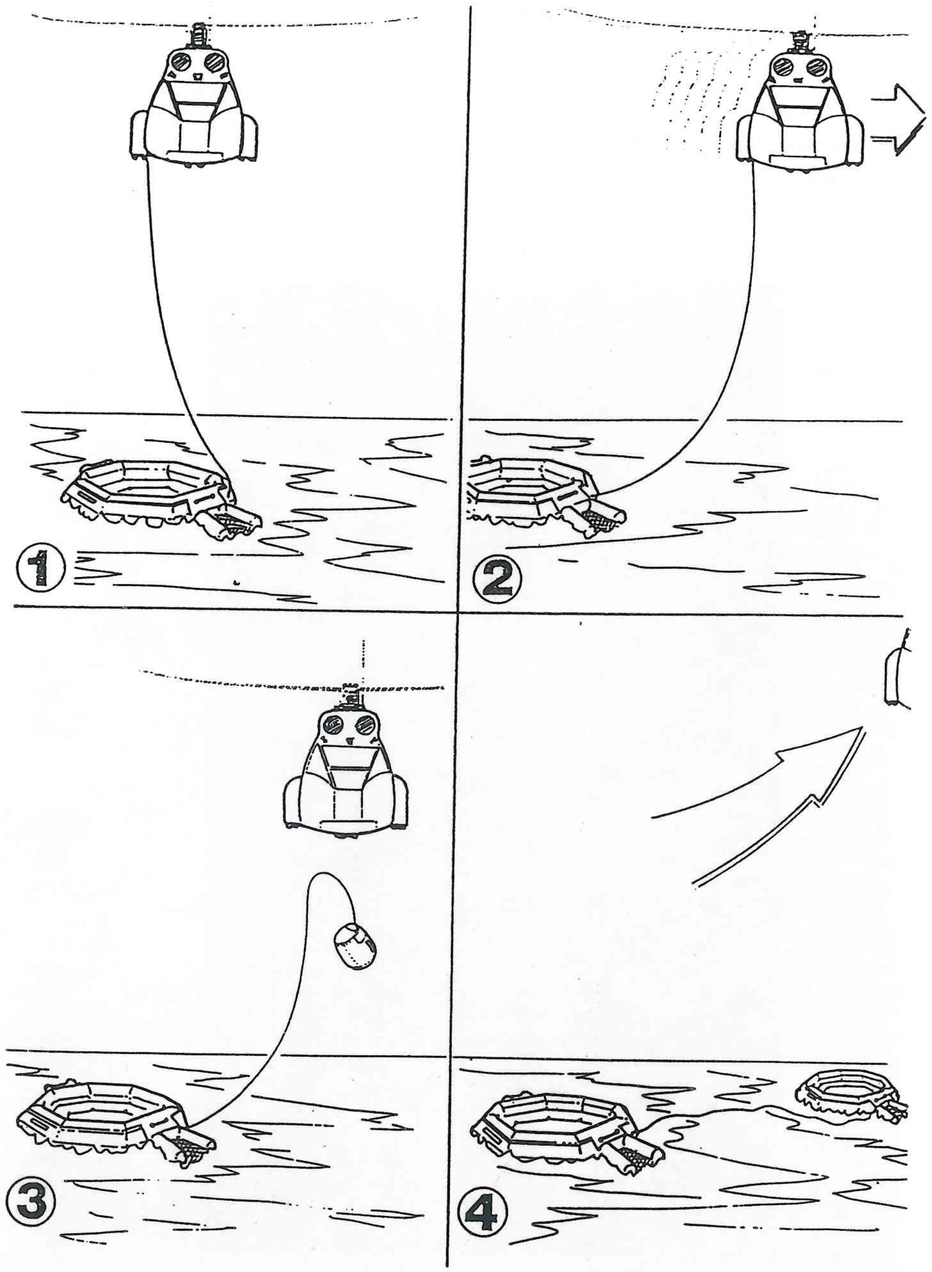
Two Sikorsky HH53C helicopters rescued 32 persons from the sinking bulk Carrier "YARRAWONGA" 750 miles west of Lands End. The operation required the aircraft to refuel while in flight, from hercules tanker transports.

Air sea rescue operation. A Sea King Mk 2, helicopter carrrying out winching procedure over the M.V. Craigantlet. (Reconstruction)

Air to Surface Hoist Operation

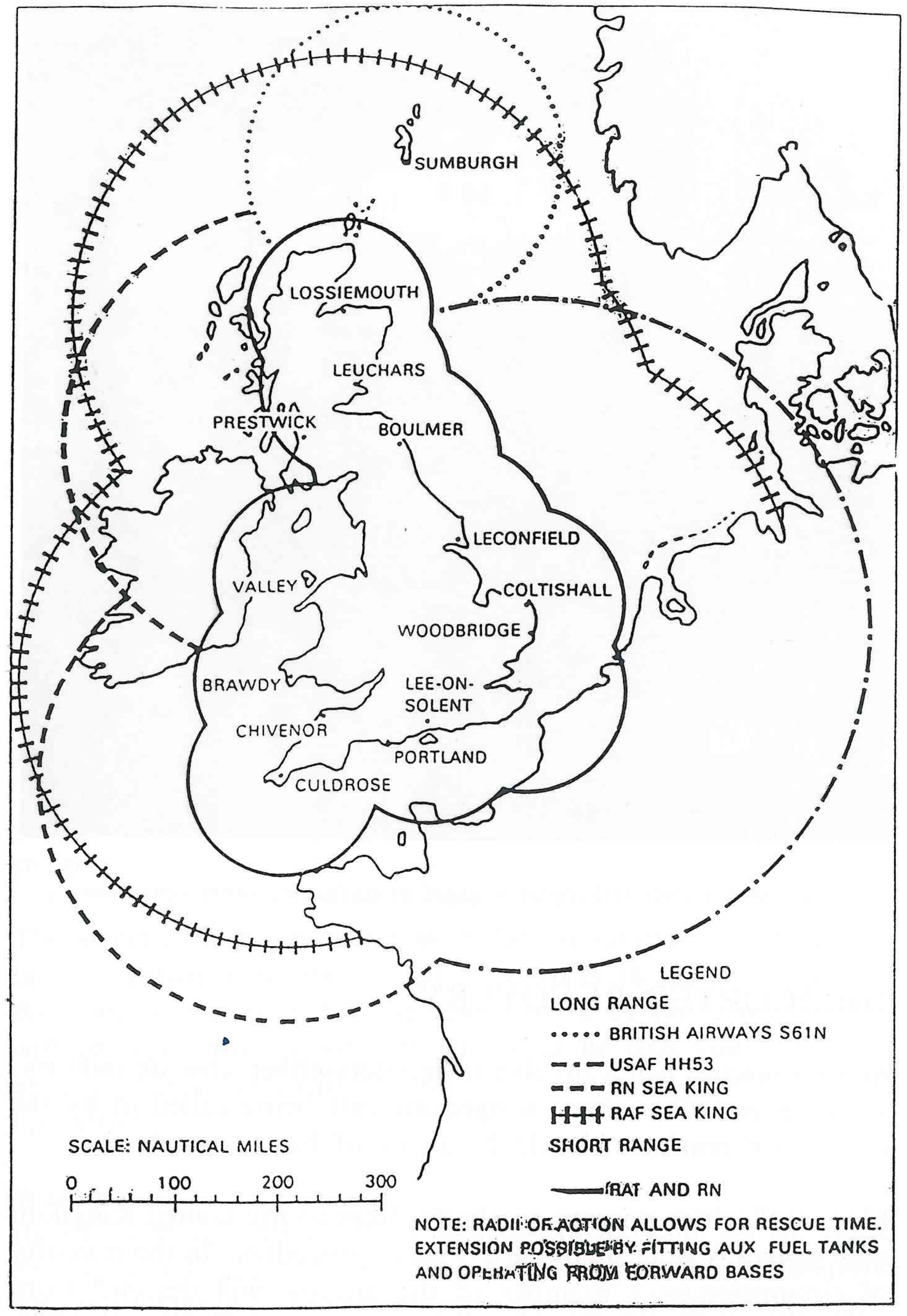
A Royal Navy Sea King Helicopter engages in a hoist operation. Small deck area and rigging obstructions are of natural concern to aircrew members.

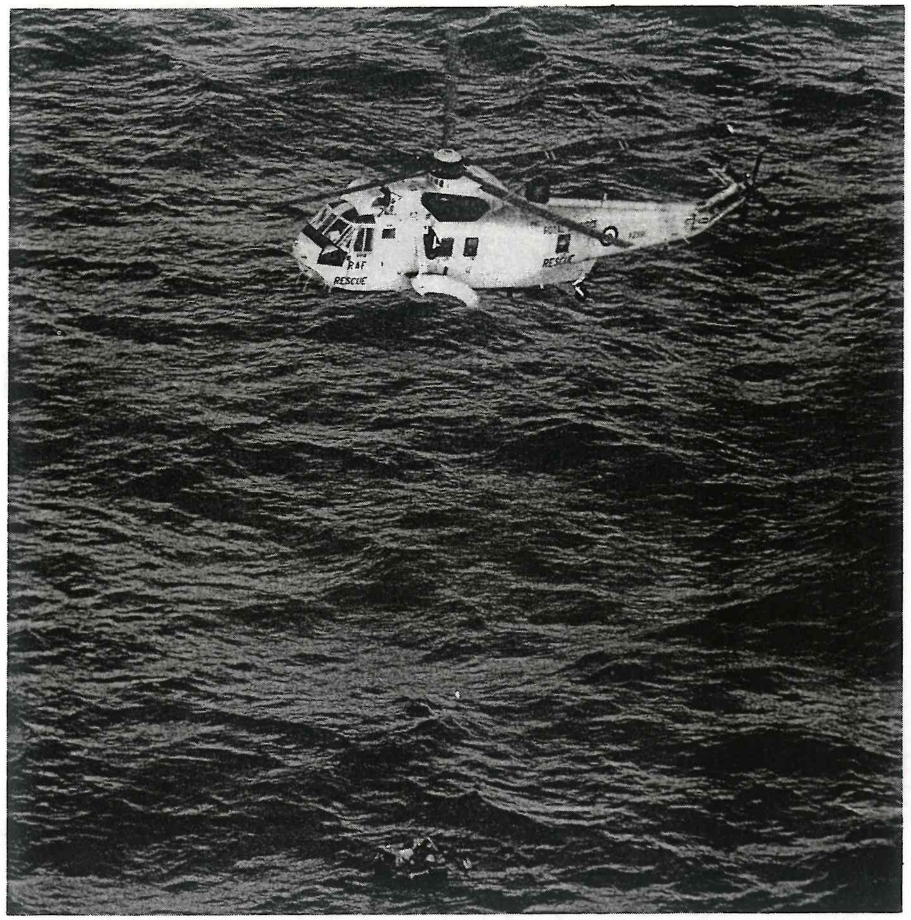
NB: Operational height of aircraft from the deck of the surface vessel and the existing weather conditions.



Aviation life rafts being dropped to the surface by support aircraft.

UK SAR HELICOPTER COVERAGE





RAF SEA KING Helicopter engages in surface recovery operations.

HELICOPTER RECOVERY

Marine rescues often involve helicopters either civil or military. In the event of a rotary winged aircraft being called in by the coastguard mariners should be aware of basic format.

Most authorities operate on similar lines to the United Kingdom with generally only slight variations in procedure. In the majority of circumstances a member of the aircrew will descend from the aircraft prior to co-ordinating hoist operations. It would be unlikely that the aircraft would attempt to touch the surface.

Landing on the surface would require an amphibious type aircraft and sea conditions would by necessity be ideal.

Would be survivors must obey the instructions of the airman/frogman. No possessions will be taken, the objective being to save life. Survivors should in no way hamper or try to assist the aircrew. If a passive attitude is adopted you would find that the hoist operation will proceed in a successful manner.

The rescue personnel are professionals and risk their own lives in rescue operations. Let them carry out their job with the minimum of aggravation. If you avoid panic and do what they tell you, your safety is virtually assured.

SINGLE HOIST

This will occur by means of the lifting strop lowered from the winch of the aircraft. Place the strop over the head and under the arm pits. Tighten up on the toggle clamp and ensure that the strop is comfortable across the back. Place your arms at the sides of the body after giving the thumbs up sign to the aircraft observer.

(Some authorities require survivors to hold the clamp of the strop).

The airman will be recovered with the last survivor. When reaching the entrance to the aircraft, survivors in the strop should do nothing but wait for the instructions of the observer. He will get you into the aircraft. Do what he tells you to do. In general, lifejackets will remain on throughout the period of operation.

Warning.
In all hoist operations from helicopters a build up of static electricity will occur prior to the wire being earthed. The pilot who is in charge of the aircraft throughout will earth this static charge by means of dipping into the sea or bouncing on the ship's deck, before commencing hoist procedures. Under no

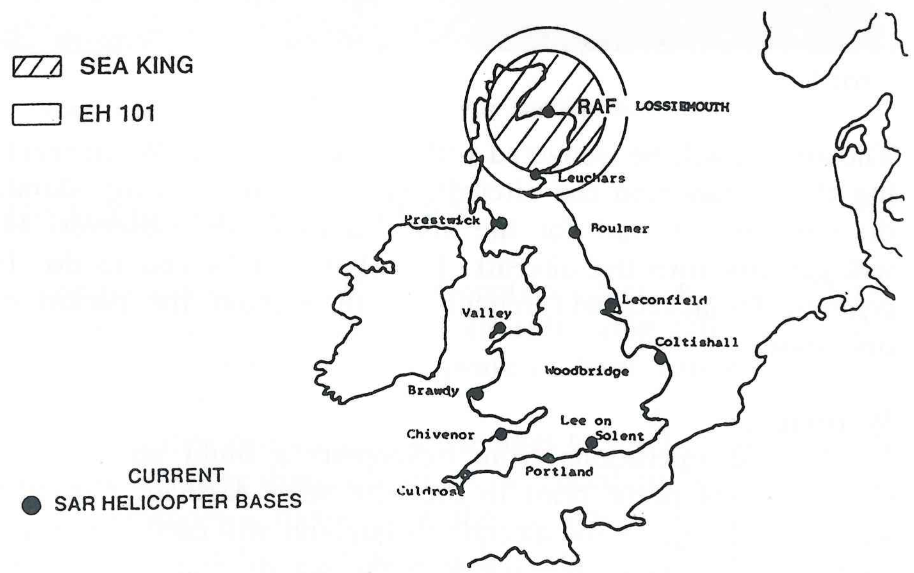
account should personnel attempt to touch the wire or strop before the static charge is removed.

DOUBLE HOIST

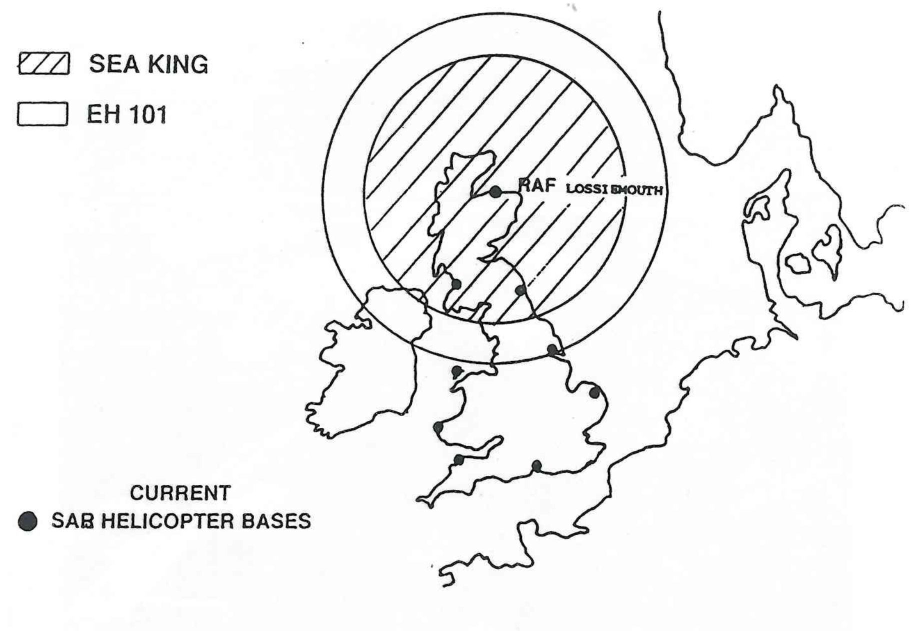
This will be the most common, where an aircrew member is hoisted with the survivor/casualty. Provided the survivor is conscious, a vertical lift will take place where the airman straddles the survivor. His legs, about the sides of the survivor, tend to act as a steadying influence during the hoist.

Again, attention is drawn to the fact that the person being rescued has little to do except assume a passive role. The airman will position the individual in the strop. When the hoist has attained the level of the access to the aircraft the aircrew will manoeuvre survivors from the wire into the aircraft. All the survivor has to do is follow the instructions of his/her rescuers.

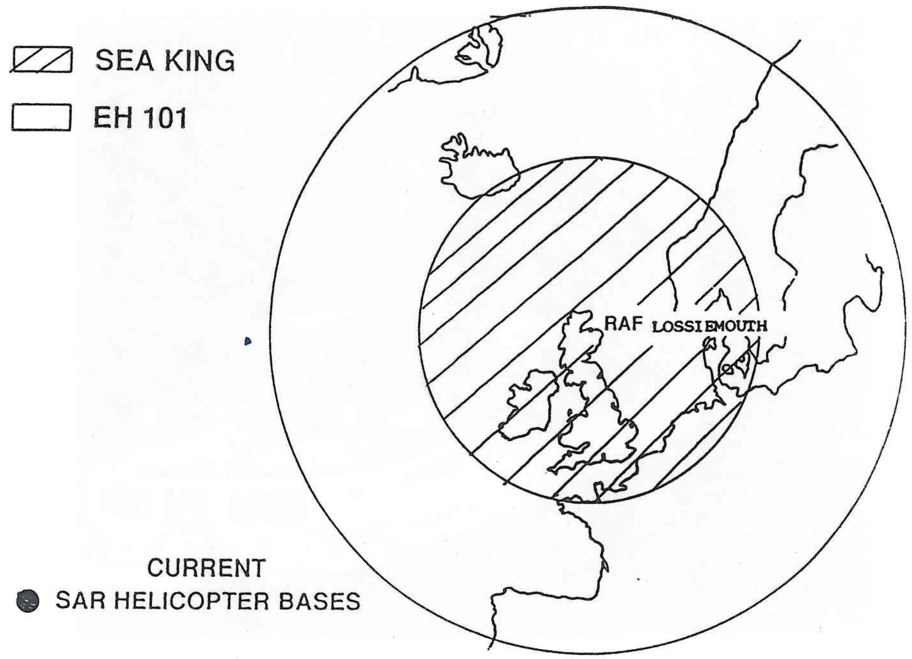
SAR Coverage 1 hour from call out *Sea King/EH 101*



SAR Coverage 2 hours from call out *Sea King/EH 101*



SAR Coverage (Fly throught with maximum fuel) *Sea King/EH 101*



HELICOPTER RECOGNITION

The new EH101 – Jointly developed by Westland in the U.K. and Augusta in Italy.

SAR Activity with aircraft from 819 Naval Air Squadron and a Sealink Ferry

Helicopter Types and Operational Abilities

Type	Range nm. Operational	Payload (Human)	Speed kts	Remarks
Sea King	270	22	125	Range may be increased by reserve tanks
Puma	300	19	145	
S76	202	14	155 max.	+ 30 minutes fuel reserve.
Seahawk	200 est.	15 max.	126	military.
Sea Dragon /Sea Stallion (Jolly Green Giants)	unlimited	55	150	Unlimited Rg with in flight re-fuelling
Dauphin 2 SA365	350	14	130	+ 30 minutes reserve fuel.
Chinook	575	44	135	Tandem rotors.
JayHawk	300	4 + 6	146	USCG operation.
Bell 214ST	250	20	145	Offshore/transport.
EH 101	550	30	160	SAR for the 1990's

Chapter Eleven

OFFSHORE NAVIGATION

Navigation in and Through Offshore Development Areas

Any vessel passing close too or through areas of 'offshore activity' either for oil or gas resources must expect to encounter particular navigational problems. The types of activities which tend to be continually ongoing are varied and could include any or all of the following:

Small boat activity, with or without divers, semi submersibles, anchor handling operations, either laying or recovering anchors. Helicopter movements to and from rigs and/or stand-by vessels. Mooring buoys, suspended well heads, towing movements or survey activity. 'No go' areas being prolific because of recommended safety clearance zones and rig moves causing concern with irregular position fixing duties.

When associated problems are also considered Masters and Navigators should take particular note that limitations on the use of anchors because of undersea pipelines, manifolds etc., could be problematical in an emergency. Since the advent of 'slant drilling techniques' the radius of activity around an offshore installation could well be extended beyond what one may normally expect.

It is not unusual to encounter fairways for vessels to follow when proceeding through these regions (e.g. Gulf of Mexico). The fact that considerable volumes of small traffic may also be using the same fairways or even crossing them to attain a position on station by an installation is to be expected. Should these conditions prevail with poor visibility then obvious caution when proceeding must be a major concern. The type of problems Masters can expect to encounter in the vicinity of offshore installations are as follows:

Type of Offshore Structure and Hazard to Navigation

Production Platform

Slant drilling, small traffic, safety zones, toxics, helicopter operations, manifolds and undersea working, limitations on use of anchors, back scattering light.

Exploration Rigs (Non-permanent)

Position changing, chart unmarked, navigational corrections to chart are required, unspecified safety zones, anchor operations ongoing, mooring and marker buoys being widely deployed, towing activities are possible.

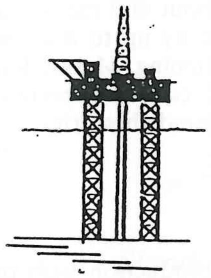
Seismic Survey Vessels

Restricted in ability to manoeuvre, possible diving operations or other undersea operations may require speed reductions by through vessels, marker or survey buoys on the surface, cables and other floating obstructions.

Well Heads

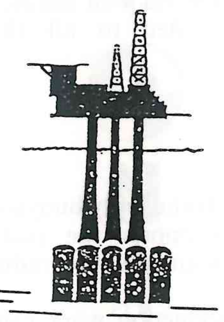
No anchoring because of submerged pipelines and undersea construction. Suspended well heads may or may not be charted. Some interference may be anticipated in use of echo sounder. Tanker activity and mooring of tankers may be ongoing.

Jack-Up Installation



Typical example of an exploration structure. It is fitted with movable legs which are 'jacked down' to the sea bed, once the rig has been towed into site position. As the legs are turned down the floating barge section is raised above the surface level. It is usually found in operation in comparatively shallow depths 100–150 metres and the depth of operation being dictated by the length of legs.

Fixed – Production Platform (Concrete Gravity)

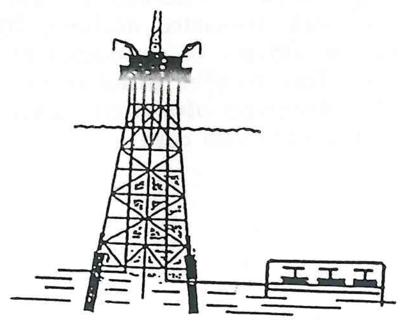


First designed for gas recovery at depths of 30 to 50 metres. They are generally a very large structure often towering as much as 350 metres in height and now engaged in both oil and gas recovery.

Helicopter operations could be anticipated with considerable surface traffic in and around the installation. Tanker activity could be close by.

Protection safety zones must be expected and positions would normally expect to be charted.

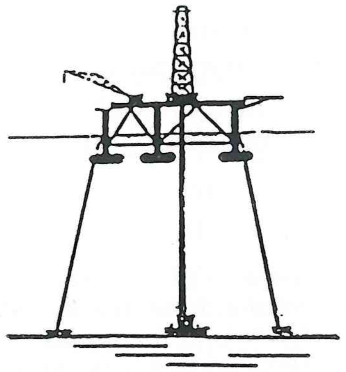
Fixed – Production Platform (Steel Piled)



Large structure probably with under water manifolds in the proximity of the installation. Safety zones will be in operation and sub-sea vehicles could be operating in the area on manifold or pipeline inspections.

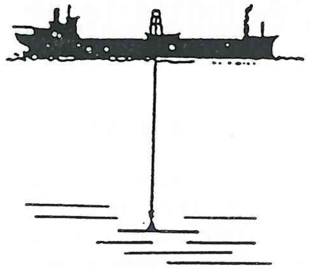
Sea-bed well heads are a normal feature of production platforms and the use of anchors by through vessels may be restricted.

Floating — Semi-submersible (Production)



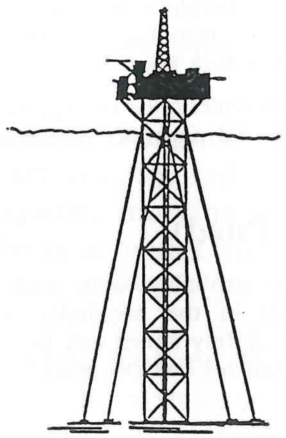
Self propelled platform supported on submerged pontoons. These pontoons can be ballasted to raise or lower the rig. Submerged pontoons beneath the surface are less influenced by wave action. The vertical movement is reduced and this generally allows continuous working of the rig.
Operating depth about 400 metres, and the position is held by up to 8 anchors or by dynamic positioning. Marker buoys and surface traffic can be expected to be encountered around these rigs.

Floating-Drill Ship



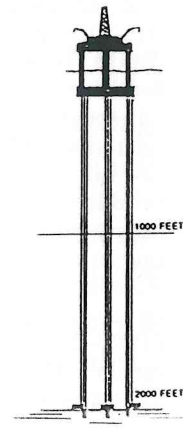
Combine product production with product storage. The tanks of the drill ship being employed to hold prior to transfer into tankers. Use of a sea-bed 'riser' in both the Drill Ship, and the Semi-Submersible via well heads. Wide berth recommended to all through traffic.

Guyed Tower



Lightweight and inherently buoyant steel tower which supports the platform. Position being maintained by radial guy lines.
Drilling and production work can take place from these types of installations. Depth of operation is approximately 400 metres.
Alternative securing may be in the form of widespread guys to sea-bed 'Clumps' (weights) with associated anchors, 20 guy lines would not be considered exceptional. This type of structure provides the advantages of a fixed 'jacket' without the additional cost.

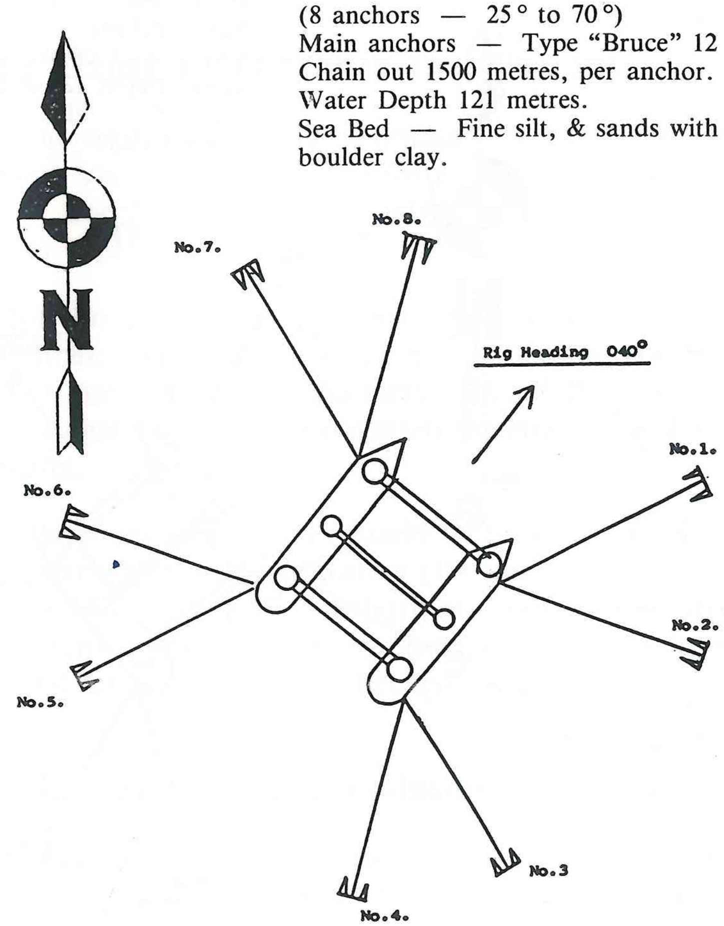
The Tension Leg Platform (TLP)



The tension leg platform is a tethered structure and can be encountered in depths between 120 metres and 1500 metres.
Oil process work is carried out and the operation is conducted by means of several sea-bed risers. Hydrocarbon products being pumped back down to an export pipeline. These rigs first came on line in the North Sea.
Position of the installation is held by excess buoyancy in the platform (15%–25% of the structures displacement). This virtually eliminates roll and pitch motions on the rig.

Standard Mooring Array for Offshore Installation

(8 anchors — 25° to 70°)
Main anchors — Type "Bruce" 12 tonnes.
Chain out 1500 metres, per anchor.
Water Depth 121 metres.
Sea Bed — Fine silt, & sands with exposed boulder clay.



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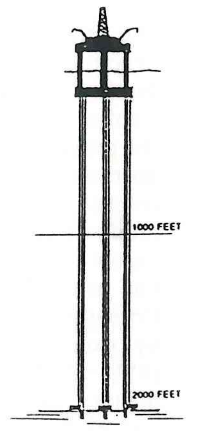

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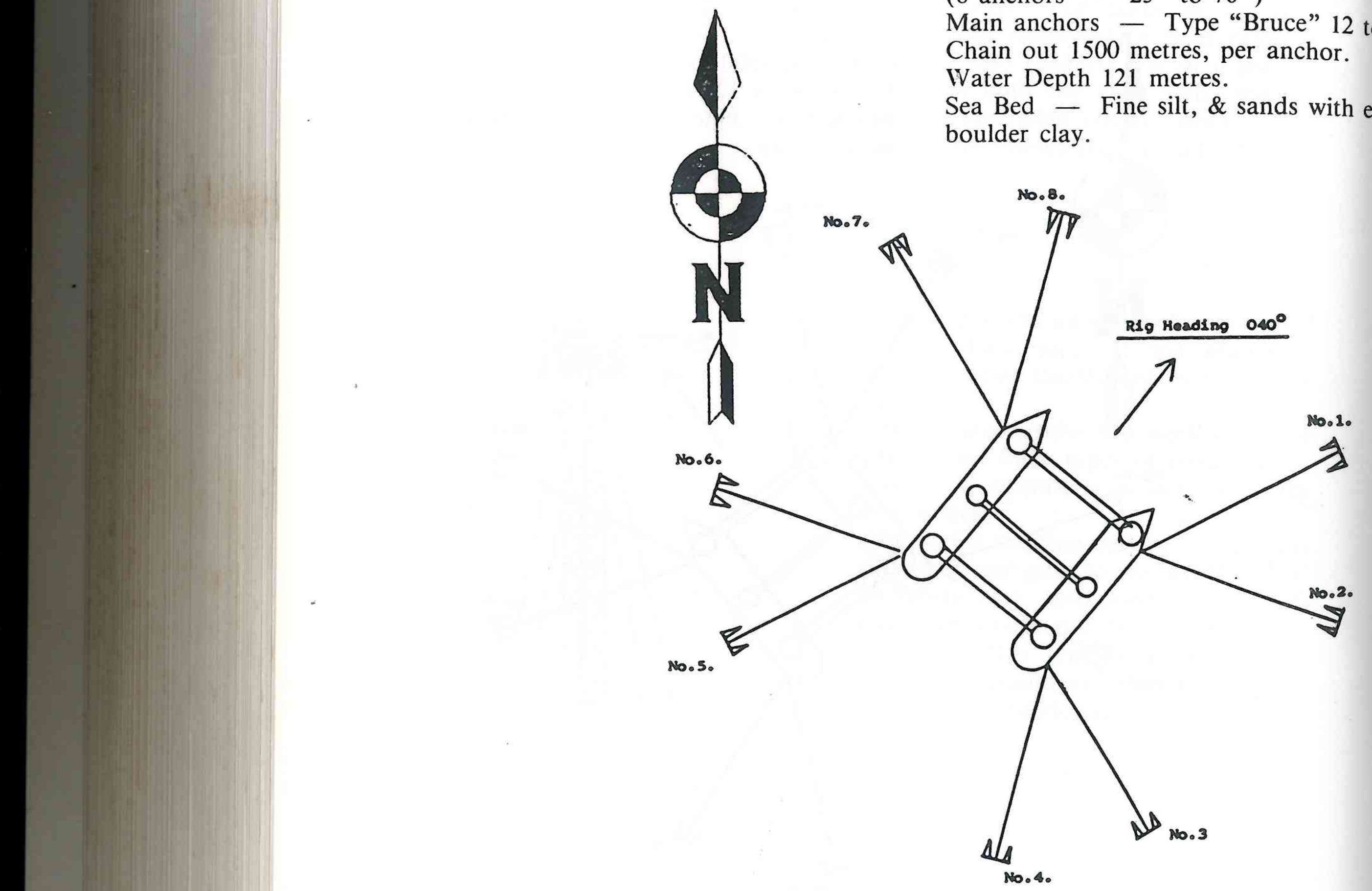


6. Emphasise monitoring points and radar conspicuous targets.
7. Use of appropriate publications and largest scale chart for the area.
8. Show focal points of heavy traffic density and where Master would be required to 'con' the vessel.
9. When allowing for contingency plans in the event of emergency or for poor visibility, that the use of anchors may not be a first option in offshore areas.
10. Early warning points for look-outs, use of engines, or for the purpose of doubling watches if required.

NB. At least two separate and distinct position fixing methods should be available to watch officers.
Navigation through fairways could be adversely effected by cross currents and both a primary and secondary position fixing method should be continuously available.

Position Fixing of Offshore Installations

The prudent navigator would investigate the positions of all installations, especially 'fixed platforms' like production platforms, and note the differences between these and moveable rigs such as exploration barges or drill rigs.

Information on production platforms being found in the following sources: Admiralty List of Lights, Sailing Directions, Annual Summary Notice to Mariners, Special Position Charts of a non navigational type. Navigation warnings regarding new developments.

Information on exploration rigs would be found in: Preliminary and Temporary Notices to Mariners (P's and T's), radio VHF warnings, Pilots and Port Authorities, local knowledge of company agents and from other shipping sources, also from the rig itself. All reports should be checked for variance.

Recognition of Offshore Installations

The sheer size of an offshore structure, together with skyline silhouette provides an easy target for the experienced mariners eye during the hours of daylight. However, during the hours of darkness the recognition may not be as simple without prior knowledge of the displayed navigational signals/lights.

Offshore installations should display red lights on each corner with an all round light (white), and these are associated with considerable background and working lights.

The red (corner) lights .... Range 2.0 miles.
All round white light .... Range 15.0 miles.

All these navigational lights are flashing 'U' in Morse code (·· –) at 15 second intervals.

In Poor Visibility

Installations are obliged to sound fog recognition signals just as other vessels on the high seas. Morse 'U' is sounded at 30 second intervals and must have an audible range of 2 nautical miles.

NB: In the event of failure of the all round white light, a back up light of the same characteristics, but visible for 10 miles is automatically brought into operation.

Additionally:
Identification panels are carried so as to be visible from any direction. These panels will be either illuminated or on a retro-reflective background and will display the name of the rig or other designated identification mark. Normal display is by black letters on a yellow background.

Flare Boom

Many operational platforms will, through the nature of their operations, accrue unwanted gases and this is often burnt off via an extended flare boom. The burn off is distinctive and clearly visible and vessels should not associate it with distress.

Radar Detection

All rigs and offshore installations usually provide an excellent radar target. However, where stand-by or supply boats are alongside these may not be clearly discernible from the installation itself. Additional small targets may also be prominent by way of marker buoys or moored lighters and close observation, especially when heavy levels of sea clutter are being experienced, is recommended.

Offshore Navigation – Summary of Miscellaneous Points

1. **Rig Positions** — Moveable drilling rigs and some fixed installations may have indicator buoys placed around the perimeter and extend towards the specified safety zone. These buoys may be frequently altered, and rarely if ever, will their positions be noted in navigation warnings.

NB: The position of the installation is specified in warnings but not necessarily all the relevant marker buoys.

2. **Development Sites** — New production jackets which are in the process of being constructed may not always project over and above the waterline. Approaching vessels may therefore experience little or no visual contact when navigating in close proximity to new developing positions.

3. **Large and Heavy Towing Operations** — Large offshore structures are often towed into position prior to establishing a permanent or semi-permanent position. Although normal anti collision regulations apply, watch officers should be aware of the need to provide a wide berth to these operations when appropriate.

   Several tugs could well be involved in towing moveable exploration rigs or similar structures. This could involve vessels having reduced sea room especially when navigating in or close to specified fairways. Early action to avoid approaching or creating a close quarters situation should be considered as a prudent action.

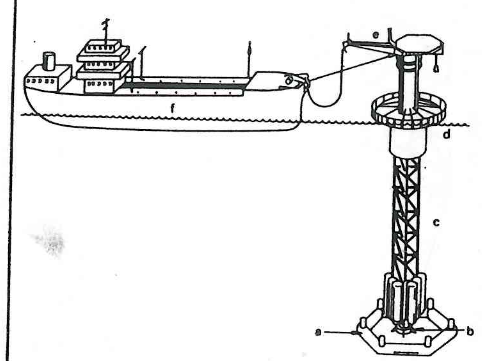
4. **The Use of Anchors** — In offshore regions anchor should be limited to emergency use only. Extensive pipelines, manifolds and undersea operations are well known features of offshore operations and the use of anchors should be in clear waters where there is an absence of obstructions.

5. **Tankers Off Loading/Loading** — The use of single buoy moorings, (SBM's) is a main feature of many offshore regions. The movement of the tanker will be greatly influenced by tides/currents, and/or weather. Vessels engaged on regular trade through the region should subsequently provide a wide berth to such operations. In adverse weather conditions tankers may have to disengage, abruptly from the 'SBM' and due regard to passing distances of such operations should be considered in the light of prevailing weather conditions.

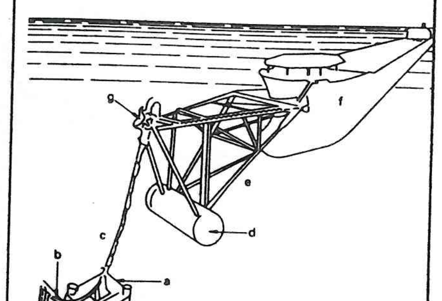
6. **Identification** — The majority of installations are well marked by name plates, navigational lights and/or specific markings. However, some unmanned structures may have limited markings or no markings at all. Following bad weather or stormy conditions navigational marks may be damaged or destroyed and mariners may experience some difficulty in identification.

7. **Radar Use** — It is recommended that a continual radar watch is maintained in poor visibility and at night when on passage through an offshore region. This may mean that a 'double watch' rota is employed for a short period of transit through any high density areas.

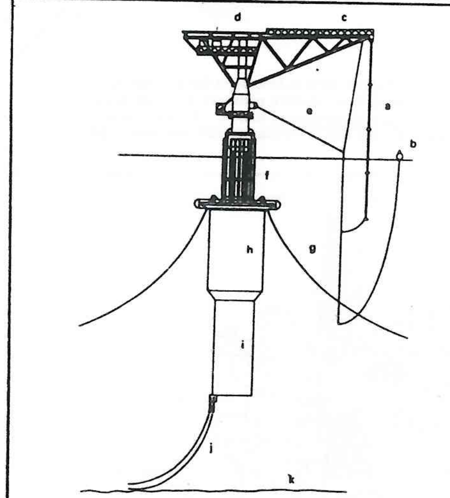
Offshore Mooring Operations



Articulated production and loading column: a – gravity or piled base; b – universal joint; c – tower; d – buoyancy tanks; e – loading and mooring arm; f – tanker with production equipment and storage

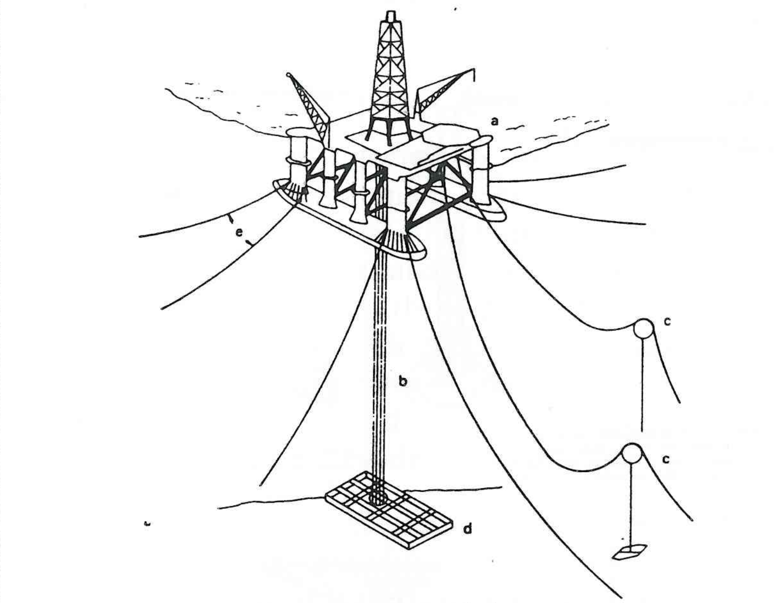


Single anchor leg production and storage system: a – riser base; b – jumper hose; c – tension and production risers; d – buoyancy tank; e – yoke; f – tanker with production equipment and storage; g – universal joint

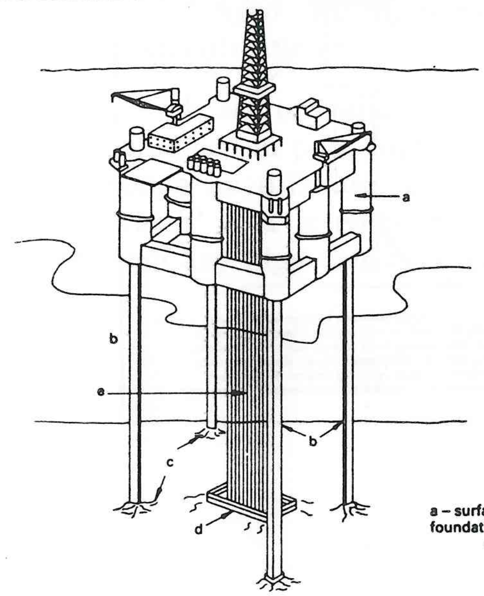


Typical exposed location single buoy mooring (ELSBM): a – oil loading hose; b – mooring hawser and loading hose pick up buoy; c – revolving loading arm; d – helicopter pad; e – mooring hawser; f – fenders; g – buoy mooring chains; h – buoyancy compartments; i – ballast compartments; j – oil transfer hose

Offshore Example Structures and Areas of Navigational Hazards

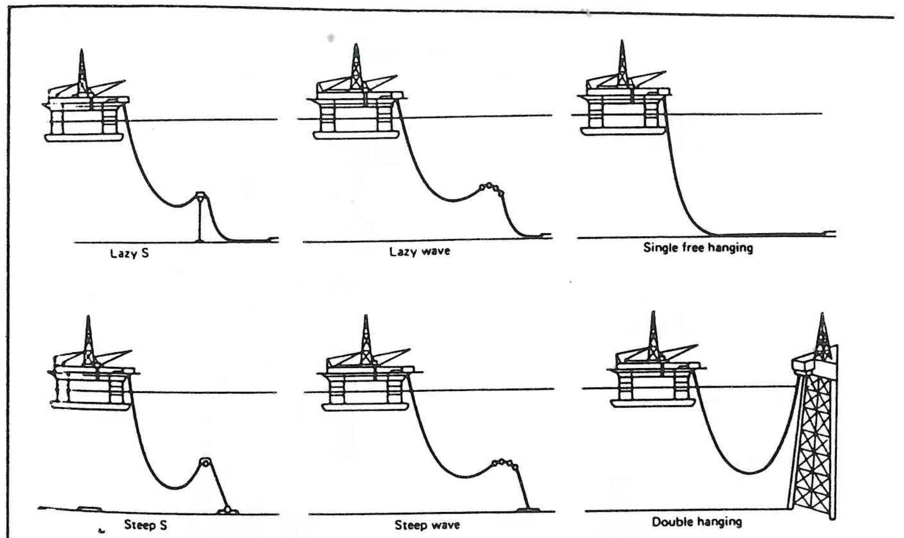


Typical semi-submersible based floating production system: a – surface platform; b – multi-tube vertical drilling and production riser; c – flexible production risers; d – sea bed template; e – catenary moorings

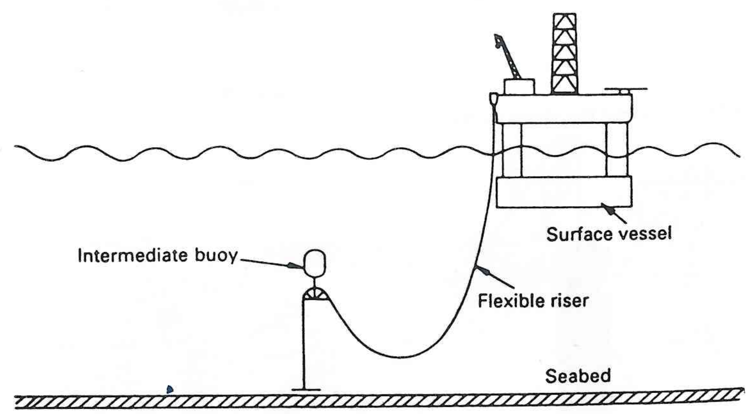


Typical tensioned buoyant platform: a – surface platform; b – tensioned tethers; c – tether foundations; d – template on sea bed; e – marine risers

Example Pipelines in and Around Offshore Installations

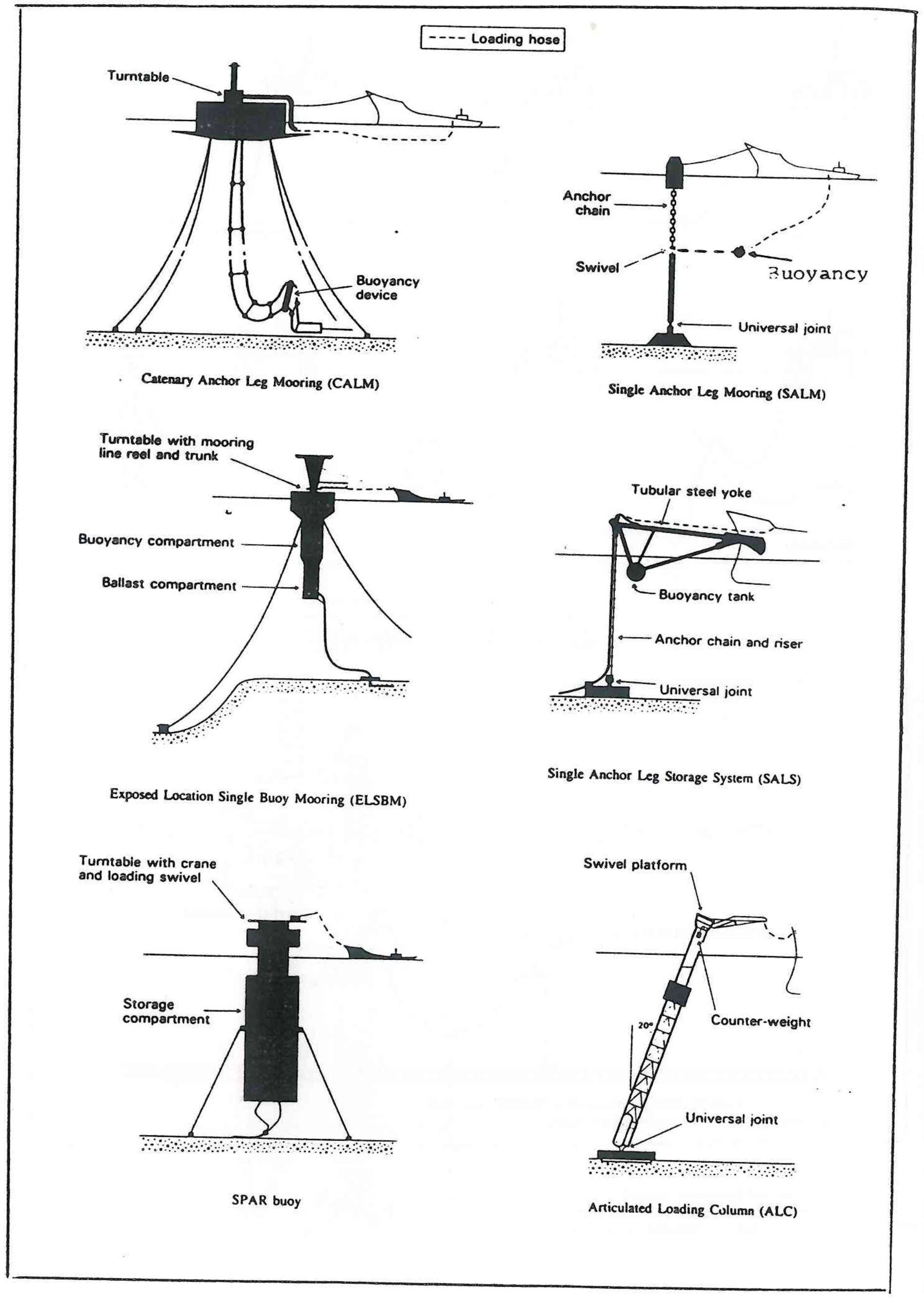


Flexible risers; an illustration of current configurations

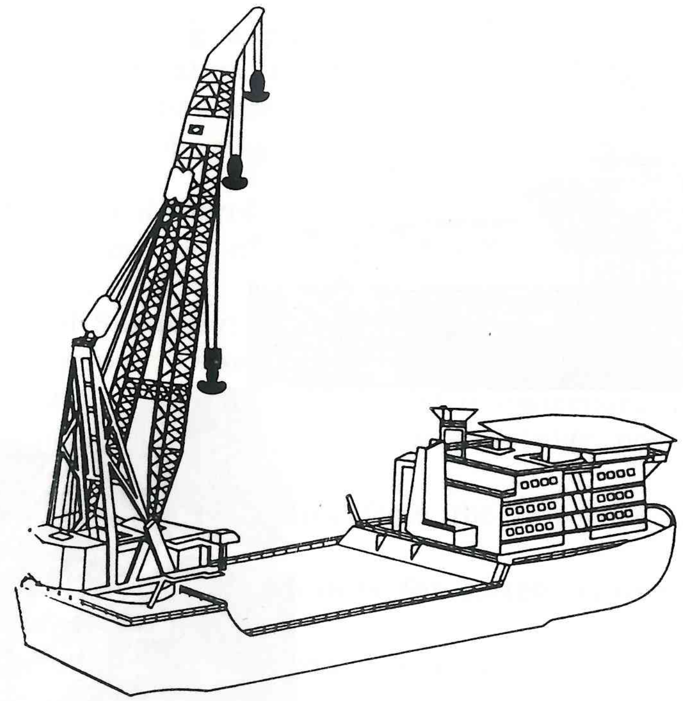


Typical configuration of a flexible riser with an intermediate mid water depth buoy

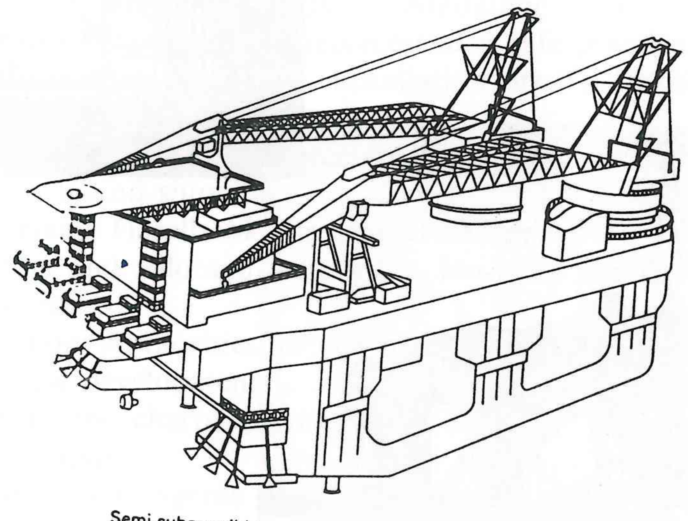
Offshore Mooring Systems



Examples of Offshore Traffic

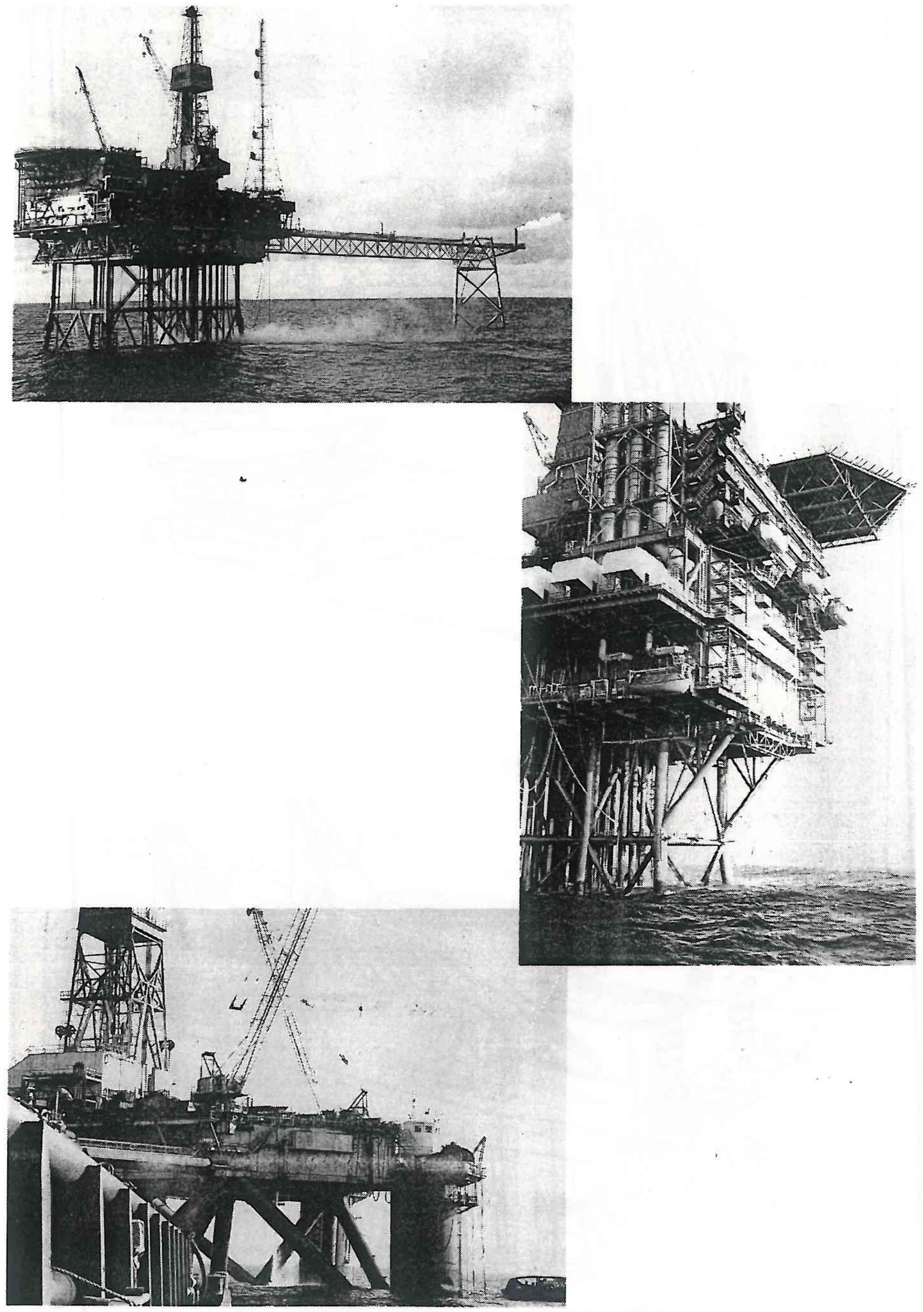


Ship shape crane vessel



Semi-submersible crane vessel

Navigation in and Around Offshore Installations



Structures and aspects of offshore installations.

Useful Sources of Offshore References and Information

When contemplating a passage through an offshore region, Masters and Navigators should seek out all relevant sources of information that may influence the required tracks. To this end reference to the following is highly recommended:

1. Navigational charts effecting the area in question.
2. Annual Summary of Notices to Mariners for current notices in force.
3. Annual Summary: Notice No 20 'Protection of Offshore Installations', Observance of Safety Zones.
4. Routing Manual for guidance on recommended tracks.
5. Sailing directions regarding local knowledge, positions and fairways.
6. Local by-laws obtainable from the respective territorial authorities.
7. Weekly Notices to Mariners for current movements and updates.
8. Navigational warnings via coast radio stations.
9. Relevant 'M' Notices:
   M1290 ...... Safety Zones
   M1040 ...... Use of Automatic Pilot.
10. Bridge Procedures for recommended safe practice.
11. Information from the installation itself. Position and movement.
12. Information (current) received from other outward/homeward bound shipping.
13. Mariners Handbook for general background.
14. Pilots and Pilotage Authorities for buoy movements and positions.
15. Harbour Authorities for new navigational hazards and areas of new development.
16. Operators charts (non-navigational) for limits of field operations.
17. Companies Agents for information current to arrival/departure.
18. Admiralty List of Lights for positions and light characteristics.

19. Old 'Log Books' from previous voyages through the same region may also contain useful information.
20. Current or tidal stream atlas for local areas. Especially important for current stream directions crossing fairways.

DEPARTMENT OF TRANSPORT MERCHANT SHIPPING NOTICE No. **M.1290**

OFFSHORE INSTALLATIONS—OBSERVANCE OF SAFETY ZONES

Notice to Shipowners, Masters, Officers and Seamen of Merchant Ships and Other Sea-going Vessels and to Owners, Skippers and Crews of Fishing Vessels

1. The attention of mariners is drawn to the 500 metre safety zones established around offshore oil and gas installations on the United Kingdom Continental Shelf. It is an offence, under Section 23(1) of the Petroleum Act 1987, to enter a safety zone except under the circumstances outlined in paragraph 5 below.

2. Safety zones exist not only to protect mariners by reducing the risk of collision but also to protect the lives and property of those working in the oil and gas industry, (divers and submersible vehicles are particularly vulnerable), and to reduce the risk of damage to the marine environment.

3. Under the Petroleum Act 1987 all oil and gas installations which project above the sea surface at any state of the tide are automatically protected by a safety zone.

4. Safety zones for subsea installations are established by Statutory Instrument in the form of Offshore Installations (Safety Zones) Orders, published by Her Majesty's Stationery Office. The existence of safety zones established by these Orders is promulgated by Admiralty Notices to Mariners, Radio Navigational Warnings and Fisheries Departments' fortnightly bulletins. Safety zones around subsea installations are invariably marked by light buoys on the surface laid as closely as practicable to the centre of the zone.

5. Safety zones can only be entered under the following conditions:
   (i) With the consent of the Secretary of State, or a person authorised by him;
   (ii) To lay, test, inspect, repair, alter, renew or remove a submarine cable or pipe-line;
   (iii) To provide services for an installation within the zone or to transport persons to or from it, or under authorisation of a government department to inspect it;
   (iv) For a general lighthouse authority vessel to perform duties relating to the safety of navigation;
   (v) To save life or property, owing to stress of weather or when in distress.

6. Entry into a safety zone by an unauthorised vessel makes the owner, master and others who have contributed to the offence liable on summary conviction to a fine not exceeding £2,000 at the present time, and on conviction on indictment, to imprisonment for a term not exceeding 2 years, or to a fine or to both.

7. Development areas are certain fields, marked on Admiralty Charts which are being developed or are currently producing oil or gas. Within these areas there are likely to be construction and maintenance vessels, including submarine craft, divers and obstructions possibly marked by buoys. Supply vessels and, in some cases, tankers, frequently manoeuvre within these fields. Mariners are strongly advised to keep outside such areas.

8. Vessels which are transitting or passing close to areas of offshore activity should navigate with care through or near these areas giving due consideration to safe speed and safe passing distances, taking into account the prevailing weather conditions and the presence of other vessels or dangers. A continuous listening watch should be maintained on VHF channel 16 when navigating in or near areas where offshore activities are taking place.

9. It is important for the safety of all those working in the hostile environment offshore that mariners respect the safety zones around offshore installations by keeping clear of them at all times. Mariners are advised always to assume the existence of a safety zone unless they have information to the contrary.

Department of Transport
Marine Directorate
London WC1V 6LP
September 1987

Dd 9610873 14,000 9/87 Ed(249751)

Chapter Twelve

TIDE CALCULATIONS

Introduction

All the following examples have been worked using the Admiralty Tide Tables. In the case of European Tides Volume I, European Waters 1987 has been employed. In the case of Pacific Tides Volume 3. Pacific Ocean 1988 has been employed.

NB: Alternative methods of resolving tidal problems may be used and if these are required the reader is directed to examples found in the front of the Admiralty Tables.

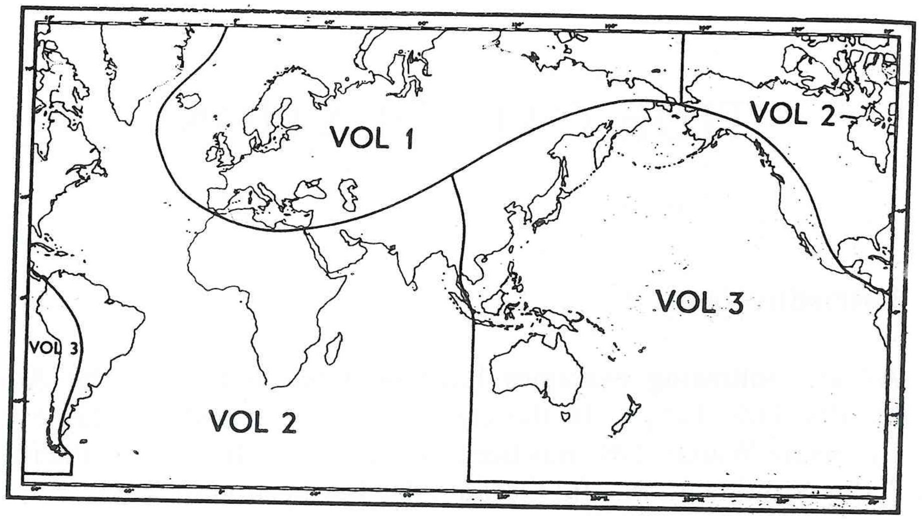
Prior to working through the following examples marine students are advised to make themselves familiar with the terms and definitions on the following pages.

For practical use the mariner is advised that the predictions are given for average meteorological conditions. In the event that conditions differ from the average, variations in tidal heights and times can be anticipated. Such changes can be caused by unusually high or low barometric pressure, strong winds causing 'storm surges', or 'negative surges'.

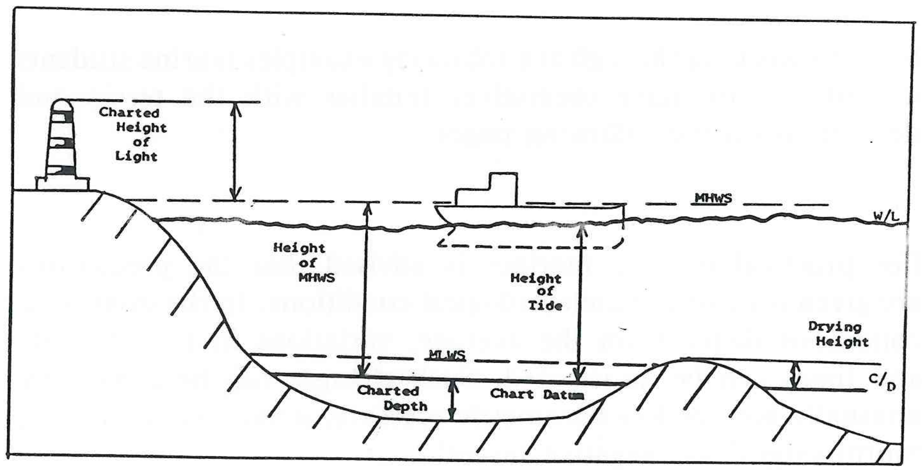
Attention is drawn to references in the Annual Summary of Notices to Mariners, specifically:

No's '1' '15' & '15A', regarding under keel clearance and allowance and negative surge warning services.

LIMITS OF ADMIRALITY TIDE TABLES



TIDAL HEIGHTS REFERENCE



Tidal/Tides — Definitions

(a) *SPRING TIDE* is a tide occurring twice a month, of maximum range, when the sun and moon are in conjunction or opposition.

(b) *NEAP TIDE* is a tide occurring twice a month, of minimum range, when the moon is in quadrature.

(c) *HEIGHT OF TIDE* is the height of the water level, at any particular time, measured above chart datum, by taking the height of low water, and adding the rise of the tide.

(d) *M.H.W.S.* is the height of *Mean High Water Spring* Tides, taken as an average, throughout a year when the average maximum declination of the moon is $23\frac{1}{2}°$, of two successive high waters in 24 hours when the range of tide is greatest.

(e) *M.L.W.S.* is the average height obtained by the two successive low waters during the same period.

(f) *M.H.W.N.* The height of *Mean High Water Neap* Tides, is the average of two successive high waters when the range of tide is least — same conditions as in (d).

(g) *M.L.W.N.* is the average height obtained from two successive low waters during the same period.

(h) *RANGES OF TIDES* are the differences in height between successive high waters and low waters or low waters and high waters.
NB: in most cases, the range of a tide will be slightly different to the tidal range before, and to the one after, as the time of spring or neap tides approaches.

(i) *SPRING RANGE* is the difference in height between M.H.W.S. and M.L.W.S. It is normally the greatest range experienced, occasionally exceeded when astronomical conditions cause L.A.T., and/or when meteorological conditions (wind) build up or reduce the water level.

(j) *NEAP RANGE* is the difference in height between M.H.W.N. and M.L.W.N. It is normally the smallest range experienced, under normal conditions.

(k) *CHART DATUM* is the standard depth, usually at the level of M.L.W.S. (or L.A.T. in some ports) from which to measure depths of shoals, or heights of rocks etc., which show above the water at low tide.

(l) *HEIGHT OF SHORE OBJECTS*, is charted above M.H.W.S. and to find correct height, add fall of tide below M.H.W.S.

Standard Port Tide Examples

Example 1.

Find the height of the tide off Liverpool at 1400 hrs on 20th May, 1987.

HW	1704	7.7m
LW	1112	2.0m
Range		5.7m Neaps

Extract from Table		
	MAY	
20th	0416	8.2
W	1112	2.0
	1704	7.7
	2342	2.7

Method: Plot heights of high and low water on graph.
Construct graph between these points.
Insert high water time in 'HW' box

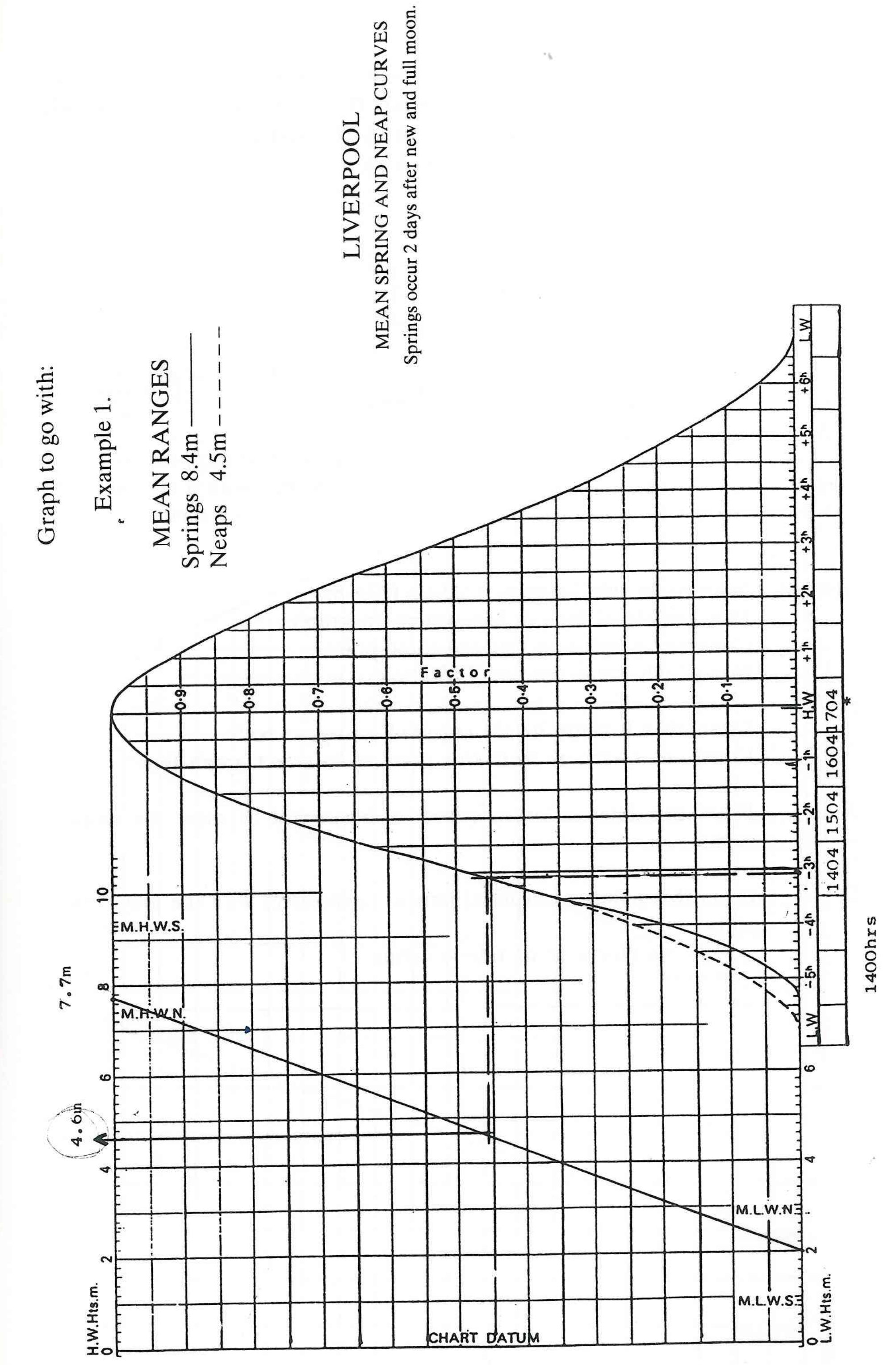
Apply the required time 1400 hrs to the HW time and insert the hourly rates into the remaining boxes.

Construct a vertical to intercept the curve from that point of 1400 hrs.

From the point of intersection with the curve construct a horizontal to intersect the graph line.

Construct a vertical towards the height scale, and read height off scale.

= 4.6 metres

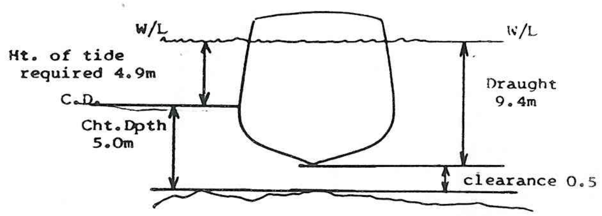


Example 2.

A vessel with a draught of 9.4 metres anchors off Liverpool, at 1030 hrs on the 6th June, 1987. At what time, on the next rising tide would she be able to cross a bar which is charted as 5.0 metres, with a clearance of 0.5 metres beneath the keel.

Extract from Tables

	0550	7.5
6th	1243	2.6
SA	1834	7.4



LW	1243	2.6m
HW	1834	7.4m
Range		4.8m Neaps

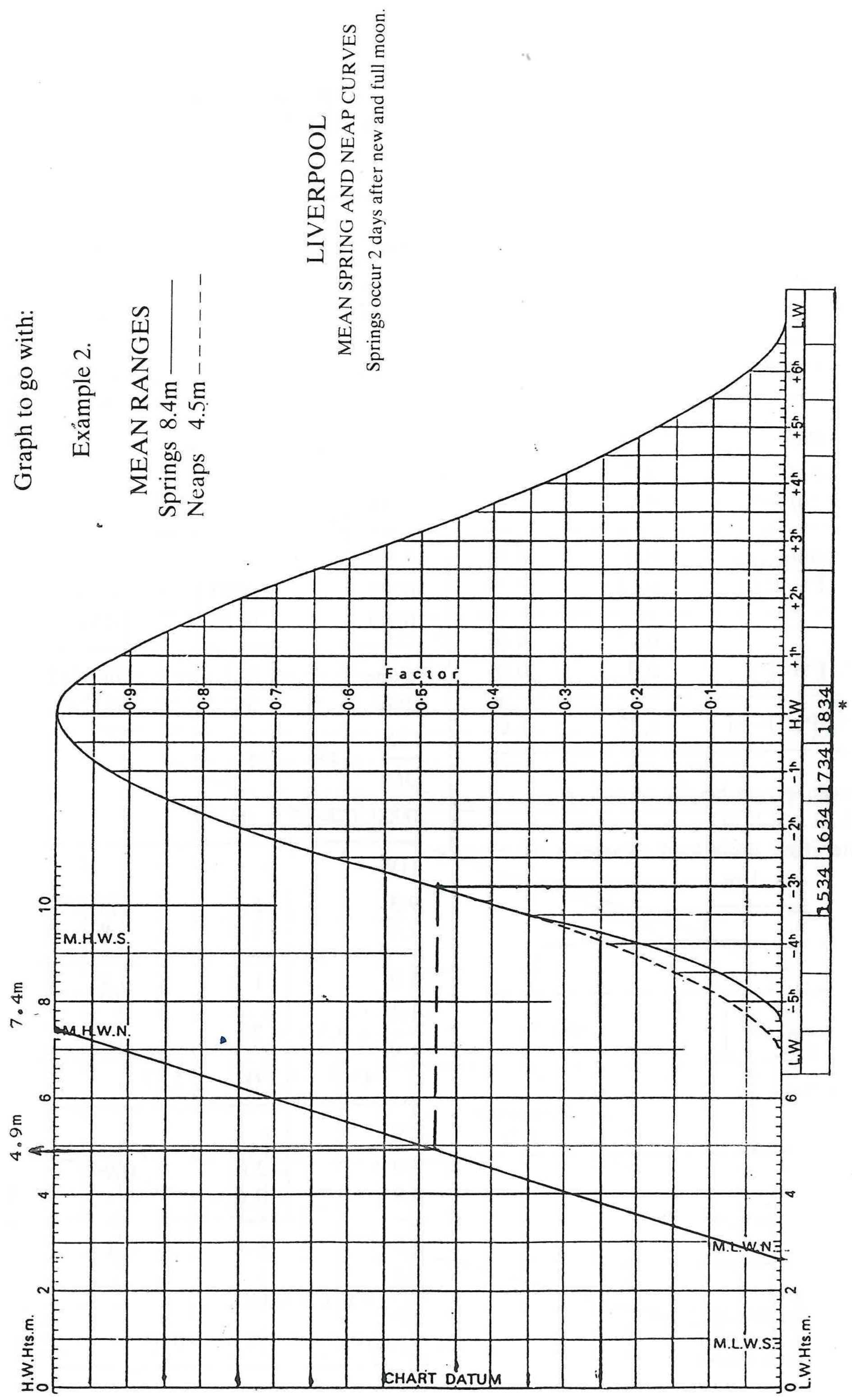
Height of tide required to pass over the bar with a clearance of 0.5 metres is 4.9 metres.

Method: Note rising tide between 1243 to 1834 hrs.
Plot heights of high & low waters on graph.
Construct graph line between these points.
Insert high water time in 'HW' box

Establish 4.9 metre height required on upper scale.
Construct a vertical from this point to intersect graph line.

From this intersection construct a horizontal to meet the rising curve.

From this point construct a vertical to intersect with the lower time scale
= 1534 hrs (for a ht of tide = 4.9m)



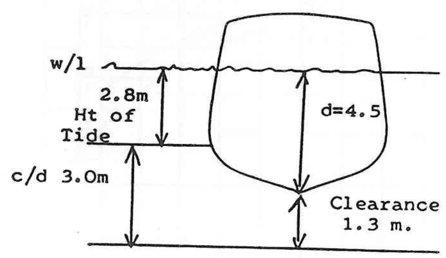
Example 3. *Secondary Port*

Calculate the underkeel clearance of a vessel whose draught is 4.5 metres at Portpatrick at 1130 GMT on 3rd March 87. When the charted depth is 3 metres.

Times	**LW**	**HW**
L'pool Pred	0751	1326
Pt. Pat Diff	−0034	+0020
Pt Pat Pred	0717	1346

Heights	LW	HW
L'pool	0.7	9.7
L'pool S/C	0.1	0.1
L'pool Pred	0.8	9.8
Pt Pat Diff	−0.53	−5.79
	0.27	4.01
Pt Pat S/C	0.0	0.0
Pt. Pat Pred	0.27	4.01

From graph height of tide at 1130 = 2.8 m.
therefore underkeel clearance = 1.3 m.



HW.

1200	+0018	1200
1800	+0026	1326
6 hrs	8'	1hr 26'
360'	8'	86'

$\frac{8}{360} \times 86 = 1.91 = 2'$

0018 + 2' = 0020

LW.

0200	0000	0200
0800	−0035	0751
6 hrs	35'	5hr 51'
360'	35'	351'

$\frac{35}{360} \times 351 = 34'$

0000 + 34 = −0034

HW.

9.3	−5.5	9.3
7.4	−4.4	9.8
1.9	1.1	0.5

$\frac{1.1}{1.9} \times 0.5 = 0.29$

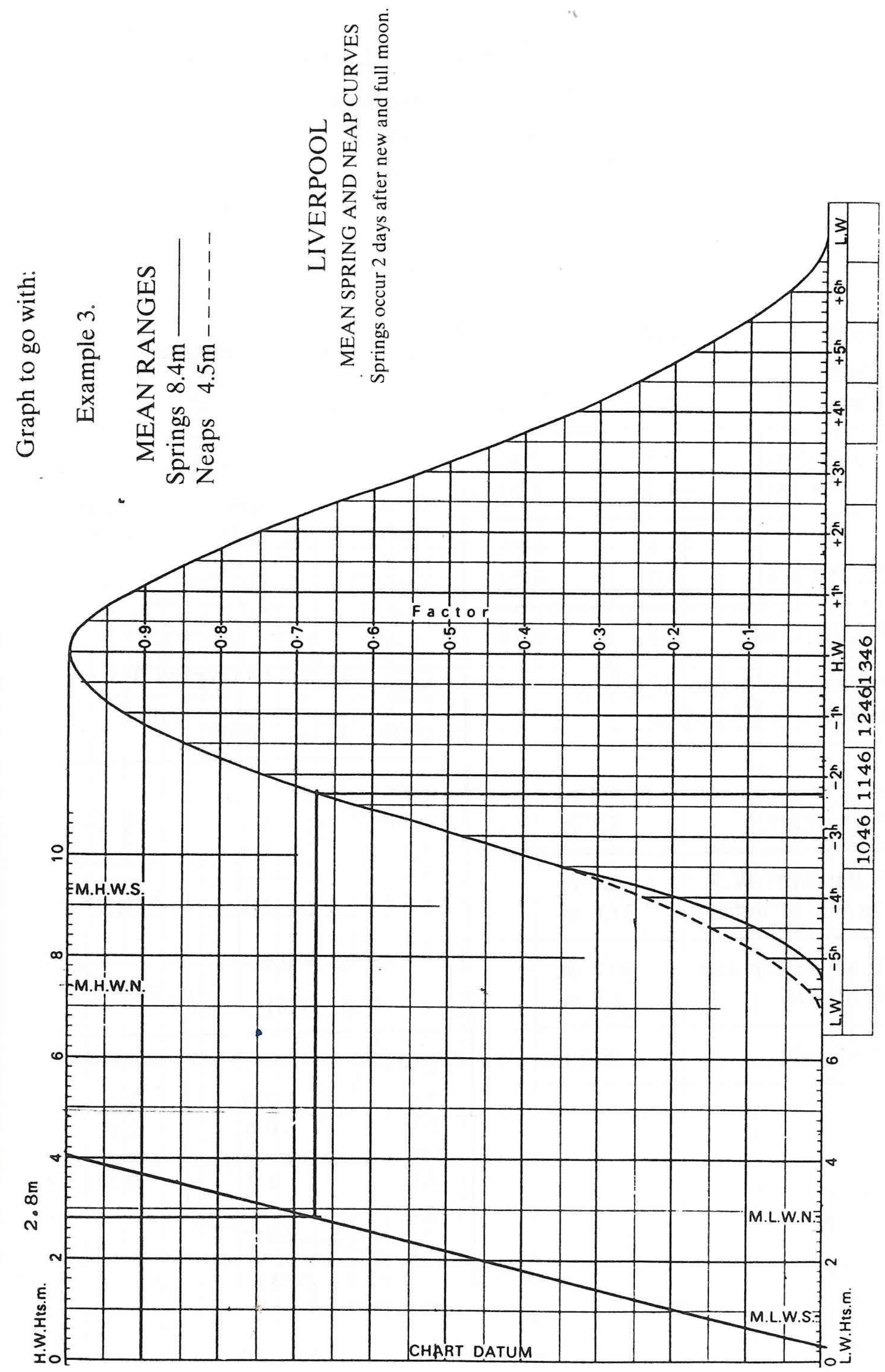
$-(5.5 + 0.29) = -5.79$

LW.

2.9	−2.0	0.9
0.9	−0.6	0.8
2.0	1.4	0.1

$\frac{1.4}{2.0} \times 0.1 = 0.07$

$-(0.6 + 0.07) = -0.53$



Example 4. *Secondary Port*

Find the height of a light at Portpatrick charted as 37 metres, at 2130 hrs on 21st June, 1987.

Times	**HW**	**LW**
L'pool Pred	1948	0227
Pt. Pat Diff.	+0024	−0003
Pt. Pat Pred	2012	0224

Heights	HW	LW
L'pool	7.8	2.4
L'pool s/c	0.0	0,0
L'pool Pred.	7.8	2.4
Pt. Pat Diff.	−4.7	−1.65
	3.1	0.75
Pt. Pat s/c	0.0	0.0
Pt. Pat Pred.	3.1	0.75

From graph height of tide at 2130 hrs = 2.8 metres

M.H.W.S. L'pool	9.3 m.
Pt.Pat Diff.	−5.5 m.
Pt.Pat M.H.W.S.	3.8 m.
Cht.Ht. of light	37.0 m.
Ht above Cht.Dat.	40.8 m.
Ht of tide.	2.8 m.
Ht of light	38.0 m.

Working

HW.

0000	+0018	2400
1800	+0026	1948
6 hrs	8'	4h 12'
360	8'	252'

$\frac{8}{360} \times 252 = 5.6$ (approx 6')

0018 + 6 = 24'

LW.

0200	0000	0200
0800	−0035	0227
6 hrs	35'	27'
360'	35'	27'

$\frac{35}{360} \times 27 = 2.62$ (approx 3')

0000 + 3' = −0003

HW.

9.3	−5.5	9.3
7.4	−4.4	7.8
1.9	1.1	1.5

$\frac{1.1}{1.9} \times 1.5 = 0.8$

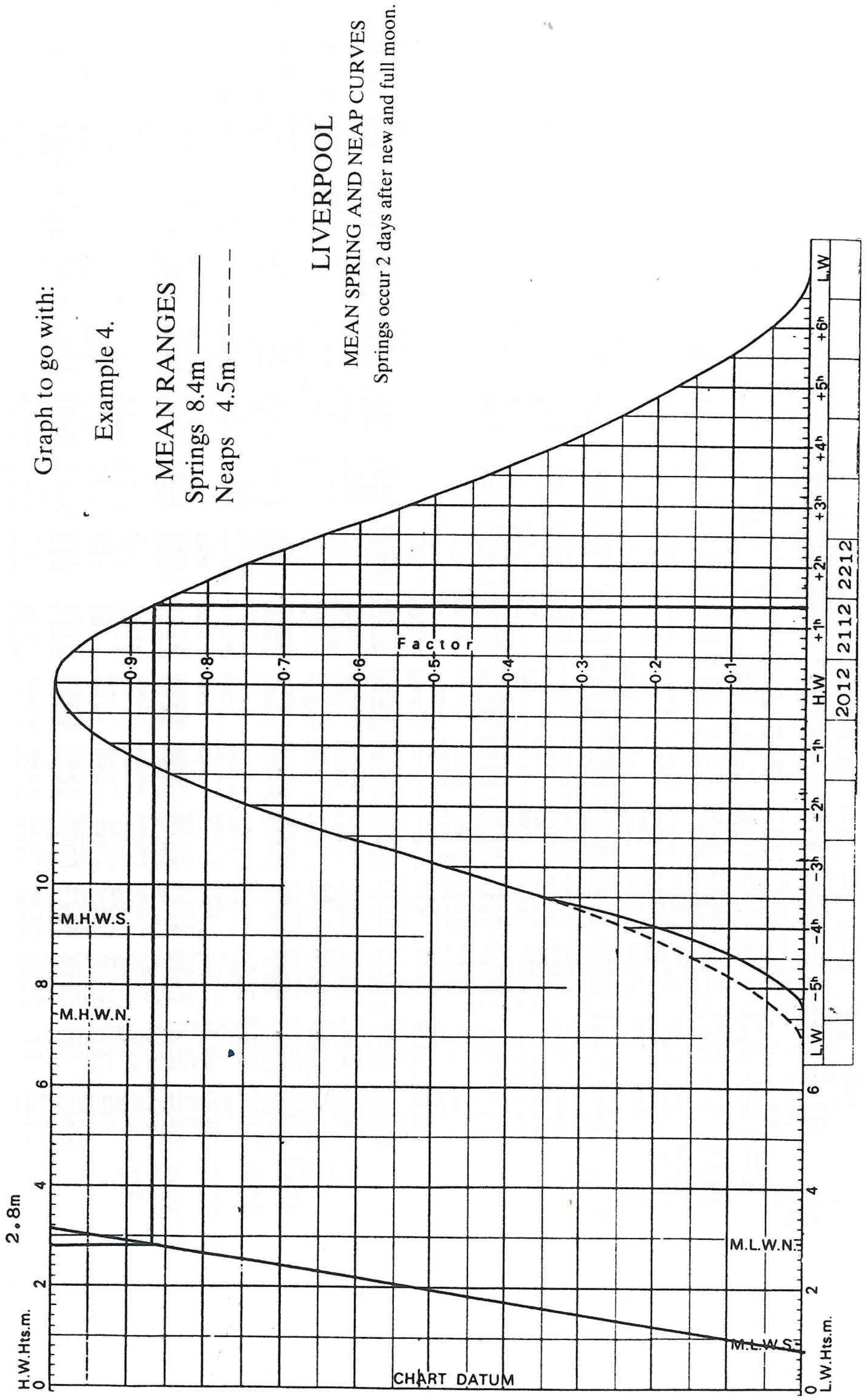
$-(5.5 - 0.8) = -4.7$

LW.

2.9	−2.0	2.9
0.9	−0.6	2.4
2.0	1.4	0.5

$\frac{1.4}{2.0} \times 0.5 = 0.35$

$-(2.0 - 0.35) = -1.65$



ENGLAND, WEST COAST - LIVERPOOL

LAT 53°25'N LONG 3°00'W

TIME ZONE GMT

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 1987

JANUARY

Day	Time	M	Day	Time	M
1 TH	0614 1150 1845	1.0 9.7 0.8	16 F	0614 1204 1848	1.9 8.9 1.7
2 F	0018 0703 1239 1935	9.5 1.0 9.7 0.7	17 SA	0022 0648 1236 1921	8.7 1.8 8.9 1.6
3 SA	0109 0749 1328 2025	9.3 1.1 9.6 0.8	18 SU	0056 0721 1310 1957	8.7 1.7 8.9 1.6
4 SU	0157 0836 1416 2112	9.1 1.4 9.4 1.0	19 M	0130 0758 1342 2032	8.6 1.8 8.8 1.7
5 M	0246 0924 1504 2159	8.7 1.7 9.1 1.4	20 TU	0204 0833 1418 2107	8.5 1.9 8.7 1.8
6 TU	0334 1012 1553 2248	8.3 2.1 8.6 1.9	21 W	0242 0911 1454 2145	8.3 2.1 8.5 2.1
7 W	0426 1105 1647 2342	7.9 2.6 8.2 2.4	22 TH	0322 0952 1539 2228	8.1 2.4 8.3 2.3
8 TH	0525 1205 1749	7.5 2.9 7.8	23 F	0413 1042 1633 2325	7.9 2.7 8.1 2.6
9 F	0042 0632 1314 1857	2.7 7.3 3.1 7.6	24 SA	0516 1149 1743	7.7 2.8 7.8
10 SA	0147 0741 1422 2005	2.9 7.4 3.0 7.6	25 SU	0042 0634 1312 1906	2.7 7.7 2.8 7.8
11 SU	0249 0842 1524 2104	2.8 7.6 2.8 7.8	26 M	0205 0751 1436 2025	2.6 7.9 2.5 8.1
12 M	0342 0932 1614 2153	2.6 8.0 2.5 8.0	27 TU	0318 0900 1549 2132	2.2 8.4 2.0 8.5
13 TU	0426 1016 1659 2237	2.4 8.3 2.2 8.3	28 W	0421 1000 1652 2231	1.7 8.9 1.4 9.0
14 W	0505 1055 1737 2313	2.2 8.6 2.0 8.5	29 TH	0518 1054 1750 ● 2323	1.3 9.4 0.8 9.3
15 TH	0540 1130 1814 ○ 2349	2.0 8.7 1.8 8.6	30 F	0608 1143 1839	0.9 9.7 0.4
			31 SA	0011 0655 1229 1926	9.5 0.7 9.9 0.3

FEBRUARY

Day	Time	M	Day	Time	M
1 SU	0055 0737 1312 2008	9.5 0.7 9.9 0.4	16 M	0035 0707 1249 1938	9.0 1.2 9.2 1.1
2 M	0137 0818 1354 2047	9.3 0.9 9.7 0.7	17 TU	0107 0740 1320 2009	9.0 1.2 9.2 1.2
3 TU	0216 0856 1433 2124	9.0 1.3 9.3 1.2	18 W	0140 0813 1352 2040	8.9 1.4 9.1 1.4
4 W	0256 0934 1514 2202	8.5 1.8 8.8 1.9	19 TH	0213 0846 1427 2112	8.8 1.6 8.9 1.7
5 TH	0336 1014 1557 2242	8.0 2.4 8.2 2.5	20 F	0251 0922 1507 2150	8.5 2.0 8.6 2.2
6 F	0423 1102 1651 2333	7.5 3.0 7.5 3.1	21 SA	0336 1009 1559 2244	8.1 2.4 8.1 2.6
7 SA	0523 1211 1801	7.1 3.4 7.0	22 SU	0438 1113 1712	7.7 2.8 7.6
8 SU	0046 0649 1340 1930	3.4 6.9 3.5 6.9	23 M	0004 0604 1248 1852	3.0 7.4 2.9 7.4
9 M	0211 0813 1500 2047	3.4 7.1 3.2 7.2	24 TU	0148 0737 1427 2022	2.9 7.6 2.6 7.8
10 TU	0319 0915 1600 2141	3.1 7.6 2.7 7.7	25 W	0310 0854 1546 2132	2.4 8.2 1.9 8.4
11 W	0410 1002 1647 2223	2.7 8.1 2.3 8.1	26 TH	0416 0955 1649 2227	1.8 8.9 1.2 9.0
12 TH	0451 1040 1725 2259	2.3 8.5 1.9 8.5	27 F	0509 1044 1742 2313	1.2 9.4 0.6 9.4
13 F	0527 1113 1800 ○ 2332	1.9 8.8 1.5 8.7	28 SA	0556 1129 1825 ● 2354	0.8 9.8 0.2 9.6
14 SA	0600 1147 1832	1.6 9.0 1.3			
15 SU	0004 0634 1218 1904	8.9 1.4 9.2 1.1			

MARCH

Day	Time	M	Day	Time	M
1 SU	0638 1210 1906	0.5 10.0 0.1	16 M	0611 1151 1841	1.1 9.3 0.8
2 M	0034 0716 1249 1941	9.6 0.5 9.9 0.3	17 TU	0008 0645 1222 1913	9.3 0.9 9.5 0.8
3 TU	0110 0751 1326 2015	9.4 0.7 9.7 0.7	18 W	0041 0719 1255 1945	9.3 0.9 9.5 0.9
4 W	0144 0825 1401 2046	9.1 1.1 9.3 1.3	19 TH	0113 0752 1328 2016	9.3 1.1 9.3 1.2
5 TH	0218 0856 1436 2115	8.7 1.7 8.7 1.9	20 F	0148 0826 1405 2049	9.0 1.4 9.0 1.6
6 F	0251 0929 1514 2146	8.2 2.3 8.1 2.6	21 SA	0227 0904 1449 2128	8.7 1.8 8.6 2.2
7 SA	0331 1007 1602 2226	7.6 2.9 7.4 3.3	22 SU	0315 0952 1543 2224	8.2 2.3 7.9 2.8
8 SU	0426 1106 1709 2336	7.0 3.5 6.7 3.8	23 M	0421 1102 1706 2351	7.6 2.8 7.3 3.2
9 M	0550 1252 1853	6.6 3.7 6.5	24 TU	0554 1245 1852	7.3 2.9 7.3
10 TU	0130 0740 1430 2025	3.8 6.8 3.4 6.9	25 W	0141 0730 1425 2020	3.0 7.6 2.4 7.8
11 W	0253 0850 1534 2119	3.4 7.3 2.8 7.5	26 TH	0303 0843 1539 2122	2.4 8.3 1.6 8.4
12 TH	0348 0936 1620 2159	2.8 7.9 2.2 8.1	27 F	0403 0939 1635 2212	1.7 8.9 1.0 8.9
13 F	0428 1013 1659 2234	2.3 8.4 1.7 8.5	28 SA	0452 1026 1722 2252	1.1 9.4 0.6 9.3
14 SA	0504 1047 1733 2305	1.8 8.8 1.3 8.8	29 SU	0536 1108 1801 ● 2330	0.8 9.7 0.4 9.4
15 SU	0537 1119 1807 ○ 2337	1.4 9.1 1.0 9.1	30 M	0614 1146 1838	0.6 9.8 0.4
			31 TU	0007 0649 1222 1910	9.4 0.6 9.7 0.6

APRIL

Day	Time	M	Day	Time	M
1 W	0039 0721 1256 1940	9.3 0.8 9.4 1.0	16 TH	0014 0657 1231 1921	9.5 0.8 9.5 0.9
2 TH	0112 0754 1330 2008	9.0 1.2 9.0 1.5	17 F	0050 0734 1310 1957	9.4 1.0 9.3 1.2
3 F	0142 0823 1404 2034	8.7 1.7 8.5 2.0	18 SA	0131 0813 1352 2034	9.1 1.3 8.9 1.7
4 SA	0215 0854 1440 2103	8.3 2.3 8.0 2.6	19 SU	0215 0857 1443 2119	8.8 1.7 8.4 2.3
5 SU	0253 0931 1524 2141	7.7 2.8 7.3 3.2	20 M	0310 0953 1546 2221	8.2 2.2 7.8 2.8
6 M	0342 1023 1628 2241	7.2 3.4 6.7 3.8	21 TU	0420 1111 1712 2353	7.8 2.5 7.4 3.1
7 TU	0459 1158 1807	6.7 3.6 6.5	22 W	0547 1245 1845	7.6 2.5 7.5
8 W	0032 0646 1341 1942	4.0 6.7 3.4 6.8	23 TH	0127 0712 1408 2002	2.8 7.9 2.0 7.9
9 TH	0206 0805 1449 2039	3.5 7.2 2.8 7.4	24 F	0240 0820 1515 2100	2.3 8.4 1.5 8.4
10 F	0305 0856 1538 2121	2.9 7.8 2.2 8.0	25 SA	0339 0914 1609 2146	1.7 8.8 1.1 8.8
11 SA	0350 0935 1620 2156	2.3 8.3 1.7 8.5	26 SU	0427 1000 1654 2227	1.3 9.2 0.9 9.0
12 SU	0430 1010 1658 2230	1.8 8.8 1.3 8.9	27 M	0508 1041 1732 2304	1.1 9.3 0.8 9.2
13 M	0506 1044 1734 2304	1.3 9.1 1.0 9.2	28 TU	0546 1119 1805 ● 2337	1.0 9.4 0.9 9.2
14 TU	0544 1119 1811 ○ 2339	1.0 9.4 0.8 9.4	29 W	0621 1154 1836	1.0 9.3 1.1
15 W	0621 1154 1846	0.8 9.5 0.7	30 TH	0011 0655 1229 1907	9.1 1.2 9.0 1.4

ENGLAND, WEST COAST - LIVERPOOL

LAT 53°25'N LONG 3°00'W

TIME ZONE GMT

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 1987

MAY

Day	Time	M	Day	Time	M
1 F	0042 0727 1303 1935	8.9 1.5 8.7 1.8	16 SA	0035 0724 1259 1944	9.4 0.9 9.2 1.3
2 SA	0114 0758 1337 2004	8.6 1.8 8.3 2.2	17 SU	0121 0809 1349 2029	9.2 1.1 8.9 1.7
3 SU	0148 0830 1415 2034	8.3 2.3 7.9 2.6	18 M	0212 0901 1444 2121	8.9 1.5 8.4 2.1
4 M	0226 0908 1458 2115	7.9 2.7 7.4 3.1	19 TU	0310 1002 1549 2224	8.5 1.8 8.0 2.5
5 TU	0314 0959 1556 2210	7.4 3.0 7.0 3.5	20 W	0416 1112 1704 2342	8.2 2.0 7.7 2.7
6 W	0419 1112 1713 2332	7.0 3.3 6.8 3.7	21 TH	0529 1227 1819	8.1 2.0 7.7
7 TH	0542 1238 1836	6.9 3.1 6.9	22 F	0057 0641 1337 1928	2.6 8.1 1.9 7.9
8 F	0100 0659 1347 1941	3.5 7.2 2.7 7.4	23 SA	0206 0747 1440 2026	2.3 8.3 1.7 8.2
9 SA	0208 0758 1444 2030	3.0 7.7 2.3 7.9	24 SU	0304 0843 1534 2115	2.0 8.6 1.5 8.5
10 SU	0300 0844 1534 2112	2.4 8.2 1.8 8.4	25 M	0355 0931 1620 2157	1.7 8.7 1.5 8.7
11 M	0348 0927 1619 2152	1.9 8.6 1.4 8.8	26 TU	0440 1014 1659 2237	1.6 8.8 1.5 8.8
12 TU	0433 1007 1701 2230	1.5 9.0 1.1 9.2	27 W	0519 1054 1734 ● 2313	1.5 8.8 1.5 8.8
13 W	0515 1048 1742 ○ 2311	1.2 9.3 0.9 9.4	28 TH	0557 1132 1807 2347	1.5 8.8 1.6 8.8
14 TH	0558 1130 1822 2351	0.9 9.4 0.9 9.5	29 F	0632 1207 1839	1.6 8.7 1.7
15 F	0641 1214 1903	0.9 9.4 1.0	30 SA	0021 0707 1243 1910	8.7 1.7 8.5 1.9
			31 SU	0055 0740 1319 1941	8.6 1.9 8.3 2.2

JUNE

Day	Time	M	Day	Time	M
1 M	0131 0816 1357 2016	8.4 2.1 8.0 2.5	16 TU	0208 0903 1440 2118	9.2 1.0 8.7 1.7
2 TU	0209 0854 1439 2058	8.1 2.4 7.7 2.7	17 W	0301 0957 1536 2213	9.0 1.3 8.4 2.0
3 W	0253 0941 1527 2146	7.8 2.6 7.4 3.0	18 TH	0357 1054 1637 2313	8.7 1.5 8.0 2.3
4 TH	0345 1036 1624 2245	7.6 2.7 7.2 3.2	19 F	0458 1153 1740	8.4 1.8 7.8
5 F	0445 1137 1729 2354	7.4 2.8 7.2 3.2	20 SA	0018 0601 1255 1846	2.4 8.2 2.0 7.7
6 SA	0550 1243 1834	7.5 2.6 7.4	21 SU	0123 0707 1358 1948	2.5 8.1 2.1 7.8
7 SU	0104 0653 1347 1933	2.9 7.7 2.4 7.8	22 M	0227 0808 1456 2044	2.4 8.1 2.2 8.0
8 M	0208 0751 1446 2026	2.6 8.1 2.0 8.2	23 TU	0324 0903 1548 2132	2.3 8.2 2.1 8.2
9 TU	0305 0844 1539 2115	2.2 8.4 1.7 8.7	24 W	0414 0952 1631 2216	2.1 8.3 2.1 8.4
10 W	0359 0935 1630 2202	1.8 8.8 1.4 9.0	25 TH	0501 1035 1711 2255	2.0 8.4 2.0 8.6
11 TH	0449 1024 1718 ○ 2249	1.4 9.1 1.2 9.3	26 F	0542 1116 1746 ● 2333	1.9 8.4 2.0 8.7
12 F	0540 1113 1804 2337	1.1 9.3 1.1 9.4	27 SA	0619 1154 1819	1.8 8.5 1.9
13 SA	0629 1204 1850	0.9 9.3 1.1	28 SU	0008 0655 1229 1853	8.7 1.8 8.4 2.0
14 SU	0025 0720 1255 1938	9.5 0.8 9.2 1.2	29 M	0043 0728 1304 1927	8.7 1.8 8.4 2.0
15 M	0116 0811 1347 2026	9.4 0.8 9.0 1.4	30 TU	0117 0804 1341 2002	8.6 1.8 8.3 2.1

JULY

Day	Time	M	Day	Time	M
1 W	0154 0840 1418 2040	8.4 1.9 8.1 2.3	16 TH	0242 0936 1510 2148	9.4 0.9 8.6 1.6
2 TH	0230 0918 1457 2122	8.3 2.1 7.9 2.5	17 F	0329 1021 1559 2237	9.0 1.4 8.2 2.1
3 F	0311 1000 1541 2207	8.1 2.3 7.7 2.7	18 SA	0419 1111 1652 2332	8.5 1.9 7.8 2.5
4 SA	0356 1048 1631 2301	7.9 2.4 7.6 2.8	19 SU	0516 1207 1756	8.0 2.4 7.5
5 SU	0449 1144 1732	7.8 2.6 7.6	20 M	0036 0622 1312 1907	2.8 7.6 2.8 7.4
6 M	0004 0554 1252 1839	2.9 7.8 2.6 7.7	21 TU	0151 0735 1420 2016	2.9 7.5 2.8 7.5
7 TU	0116 0703 1402 1945	2.8 7.9 2.4 8.0	22 W	0300 0843 1522 2114	2.8 7.6 2.7 7.9
8 W	0227 0811 1507 2047	2.5 8.1 2.1 8.4	23 TH	0400 0939 1613 2203	2.5 7.9 2.5 8.2
9 TH	0332 0914 1606 2143	2.0 8.5 1.7 8.8	24 F	0449 1026 1655 2244	2.2 8.1 2.3 8.5
10 F	0433 1012 1701 2237	1.6 8.9 1.4 9.2	25 SA	0532 1105 1733 ● 2320	2.0 8.4 2.1 8.7
11 SA	0530 1105 1753 ○ 2329	1.1 9.2 1.1 9.5	26 SU	0608 1140 1807 2354	1.8 8.5 1.9 8.8
12 SU	0624 1157 1843	0.8 9.3 1.0	27 M	0642 1214 1839	1.6 8.6 1.8
13 M	0018 0716 1248 1931	9.7 0.5 9.4 0.9	28 TU	0028 0713 1246 1912	8.9 1.5 8.7 1.7
14 TU	0107 0805 1337 2018	9.7 0.4 9.3 1.0	29 W	0100 0745 1319 1945	8.9 1.5 8.6 1.7
15 W	0155 0851 1423 2103	9.6 0.6 9.0 1.3	30 TH	0131 0818 1351 2019	8.8 1.5 8.5 1.8
			31 F	0204 0851 1425 2054	8.7 1.7 8.4 2.0

AUGUST

Day	Time	M	Day	Time	M
1 SA	0236 0925 1501 2132	8.5 2.0 8.2 2.3	16 SU	0338 1023 1602 2244	8.4 2.2 7.8 2.7
2 SU	0314 1004 1545 2217	8.3 2.3 7.9 2.6	17 M	0428 1112 1701 2350	7.8 2.9 7.3 3.2
3 M	0402 1052 1640 2315	8.0 2.6 7.7 2.9	18 TU	0537 1222 1822	7.2 3.4 7.0
4 TU	0505 1200 1754	7.7 2.8 7.5	19 W	0119 0709 1349 1954	3.4 7.0 3.5 7.2
5 W	0034 0628 1327 1917	3.0 7.6 2.8 7.7	20 TH	0244 0830 1504 2100	3.2 7.2 3.2 7.6
6 TH	0202 0752 1446 2030	2.7 7.8 2.5 8.1	21 F	0348 0928 1559 2148	2.7 7.7 2.8 8.1
7 F	0318 0905 1553 2134	2.2 8.2 2.0 8.7	22 SA	0435 1012 1641 2227	2.2 8.1 2.3 8.6
8 SA	0426 1006 1651 2228	1.6 8.8 1.5 9.3	23 SU	0515 1047 1716 2301	1.8 8.5 2.0 8.9
9 SU	0525 1059 1744 ○ 2319	1.0 9.2 1.0 9.7	24 M	0549 1120 1749 ● 2333	1.6 8.7 1.7 9.1
10 M	0617 1147 1832	0.5 9.5 0.7	25 TU	0619 1151 1819	1.4 8.9 1.5
11 TU	0005 0703 1232 1916	10.0 0.2 9.6 0.6	26 W	0004 0650 1221 1850	9.2 1.2 9.0 1.4
12 W	0049 0747 1316 1957	10.1 0.2 9.5 0.7	27 TH	0034 0721 1250 1923	9.2 1.2 9.0 1.4
13 TH	0131 0827 1357 2037	9.9 0.4 9.2 1.0	28 F	0103 0751 1321 1955	9.2 1.3 8.9 1.5
14 F	0213 0905 1436 2115	9.6 0.9 8.8 1.5	29 SA	0133 0822 1352 2027	9.0 1.5 8.7 1.8
15 SA	0254 0942 1517 2156	9.1 1.5 8.3 2.1	30 SU	0204 0853 1426 2101	8.8 1.9 8.5 2.2
			31 M	0240 0927 1508 2143	8.5 2.3 8.2 2.6

ENGLAND, WEST COAST - LIVERPOOL

LAT 53°25'N LONG 3°00'W

TIME ZONE GMT

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 1987

SEPTEMBER

Day	Time	M	Day	Time	M
1 TU	0328 1013 1603 2242	8.1 2.8 7.7 3.0	16 W	0455 1126 1736	6.9 3.8 6.8
2 W	0433 1125 1723	7.6 3.2 7.4	17 TH	0046 0641 1319 1926	3.7 6.6 3.9 7.0
3 TH	0011 0611 1307 1902	3.1 7.3 3.2 7.5	18 F	0220 0812 1442 2034	3.3 7.1 3.5 7.5
4 F	0151 0748 1436 2022	2.8 7.6 2.7 8.1	19 SA	0322 0905 1534 2121	2.8 7.6 2.9 8.1
5 SA	0314 0903 1545 2125	2.1 8.2 2.1 8.8	20 SU	0407 0946 1614 2159	2.2 8.2 2.4 8.6
6 SU	0419 0959 1641 2216	1.4 8.9 1.4 9.4	21 M	0444 1020 1648 2233	1.8 8.6 2.0 8.9
7 M	0513 1047 1729 O 2302	0.7 9.4 0.9 9.9	22 TU	0518 1051 1720 2304	1.4 8.9 1.6 9.2
8 TU	0600 1129 1812 2344	0.3 9.6 0.6 10.1	23 W	0550 1120 1753 ● 2333	1.2 9.1 1.4 9.3
9 W	0642 1210 1853	0.1 9.7 0.5	24 TH	0621 1150 1825	1.1 9.2 1.2
10 TH	0025 0720 1248 1930	10.1 0.2 9.6 0.7	25 F	0003 0652 1219 1857	9.4 1.1 9.2 1.3
11 F	0103 0755 1324 2006	9.9 0.6 9.3 1.0	26 SA	0034 0723 1252 1931	9.4 1.2 9.2 1.4
12 SA	0141 0829 1359 2042	9.5 1.2 8.9 1.6	27 SU	0104 0754 1324 2004	9.2 1.5 9.0 1.7
13 SU	0218 0901 1434 2118	8.9 1.8 8.4 2.2	28 M	0140 0825 1401 2040	8.9 1.9 8.7 2.1
14 M	0257 0935 1517 2200	8.3 2.6 7.8 2.9	29 TU	0219 0901 1446 2127	8.5 2.4 8.3 2.5
15 TU	0346 1016 1610 2304	7.5 3.3 7.2 3.5	30 W	0311 0952 1545 2231	8.0 2.9 7.8 3.0

OCTOBER

Day	Time	M	Day	Time	M
1 TH	0426 1111 1713	7.4 3.4 7.4	16 F	0001 0556 1227 1834	3.7 6.6 4.1 6.9
2 F	0007 0611 1259 1850	3.1 7.2 3.3 7.6	17 SA	0133 0728 1355 1949	3.4 6.9 3.7 7.4
3 SA	0147 0744 1425 2009	2.6 7.7 2.7 8.3	18 SU	0236 0826 1451 2040	2.9 7.5 3.1 7.9
4 SU	0303 0851 1529 2108	1.9 8.4 2.0 9.0	19 M	0324 0907 1534 2119	2.3 8.1 2.5 8.4
5 M	0403 0942 1621 2156	1.2 9.0 1.4 9.5	20 TU	0403 0942 1612 2155	1.9 8.5 2.1 8.8
6 TU	0452 1026 1706 2240	0.7 9.4 1.0 9.9	21 W	0440 1014 1647 2227	1.5 8.9 1.7 9.1
7 W	0534 1105 1747 O 2319	0.5 9.6 0.7 10.0	22 TH	0515 1045 1722 ● 2259	1.3 9.1 1.4 9.3
8 TH	0612 1143 1825 2358	0.4 9.6 0.7 9.9	23 F	0549 1118 1758 2332	1.1 9.3 1.3 9.4
9 F	0648 1218 1902	0.6 9.5 0.9	24 SA	0624 1151 1835	1.1 9.4 1.3
10 SA	0035 0721 1252 1937	9.7 1.0 9.2 1.3	25 SU	0007 0657 1227 1912	9.4 1.3 9.4 1.4
11 SU	0110 0752 1326 2011	9.2 1.5 8.9 1.8	26 M	0045 0731 1304 1949	9.2 1.5 9.2 1.6
12 M	0147 0822 1401 2046	8.7 2.1 8.4 2.4	27 TU	0124 0808 1347 2032	8.9 1.9 8.8 2.0
13 TU	0225 0853 1440 2125	8.1 2.8 7.9 3.0	28 W	0212 0850 1437 2125	8.5 2.4 8.4 2.4
14 W	0311 0931 1531 2224	7.4 3.4 7.3 3.5	29 TH	0311 0948 1543 2235	7.9 2.9 7.9 2.7
15 TH	0417 1033 1649	6.8 3.9 6.9	30 F	0430 1109 1706	7.5 3.2 7.7
			31 SA	0005 0603 1245 1832	2.7 7.4 3.1 7.9

NOVEMBER

Day	Time	M	Day	Time	M
1 SU	0128 0724 1401 1944	2.3 7.8 2.6 8.4	16 M	0131 0724 1348 1940	3.0 7.3 3.3 7.7
2 M	0239 0826 1503 2042	1.8 8.4 2.0 8.9	17 TU	0226 0813 1442 2027	2.6 7.8 2.8 8.1
3 TU	0335 0917 1555 2131	1.3 8.8 1.6 9.3	18 W	0314 0856 1527 2110	2.1 8.2 2.3 8.5
4 W	0423 0959 1640 2214	1.0 9.1 1.3 9.5	19 TH	0357 0934 1610 2148	1.8 8.7 1.9 8.9
5 TH	0505 1038 1720 O 2254	0.9 9.3 1.1 9.6	20 F	0438 1012 1652 2227	1.5 9.0 1.6 9.2
6 F	0543 1116 1800 2333	1.0 9.4 1.1 9.5	21 SA	0519 1049 1734 ● 2308	1.3 9.3 1.4 9.3
7 SA	0617 1151 1836	1.2 9.3 1.3	22 SU	0558 1129 1817 2349	1.3 9.4 1.3 9.4
8 SU	0010 0649 1225 1913	9.3 1.5 9.1 1.6	23 M	0638 1210 1859	1.3 9.4 1.3
9 M	0046 0721 1300 1948	8.9 1.9 8.8 2.0	24 TU	0034 0719 1255 1944	9.2 1.5 9.3 1.4
10 TU	0123 0751 1335 2023	8.5 2.3 8.5 2.4	25 W	0120 0801 1342 2034	9.0 1.8 9.0 1.7
11 W	0201 0823 1415 2103	8.0 2.8 8.1 2.9	26 TH	0213 0850 1437 2129	8.6 2.2 8.7 1.9
12 TH	0246 0901 1501 2153	7.5 3.2 7.6 3.2	27 F	0312 0948 1539 2235	8.2 2.5 8.4 2.1
13 F	0342 0953 1604 2304	7.1 3.7 7.2 3.4	28 SA	0421 1058 1648 2346	7.9 2.8 8.2 2.2
14 SA	0455 1112 1723	6.8 3.9 7.1	29 SU	0536 1214 1800	7.7 2.8 8.2
15 SU	0025 0617 1242 1839	3.3 6.9 3.7 7.3	30 M	0056 0649 1326 1909	2.1 7.9 2.5 8.4

DECEMBER

Day	Time	M	Day	Time	M
1 TU	0202 0752 1429 2009	1.9 8.1 2.2 8.6	16 W	0121 0707 1341 1927	2.8 7.5 3.1 7.8
2 W	0301 0846 1525 2103	1.7 8.4 2.0 8.8	17 TH	0222 0804 1442 2023	2.5 7.9 2.7 8.1
3 TH	0352 0934 1614 2150	1.6 8.7 1.8 8.9	18 F	0317 0854 1536 2114	2.2 8.3 2.2 8.5
4 F	0437 1016 1659 2234	1.6 8.9 1.6 9.0	19 SA	0407 0942 1627 2203	1.8 8.8 1.8 8.9
5 SA	0516 1055 1740 O 2315	1.6 9.0 1.6 9.0	20 SU	0454 1028 1716 ● 2251	1.6 9.1 1.5 9.1
6 SU	0551 1133 1819 2353	1.7 9.0 1.7 8.8	21 M	0540 1115 1805 2340	1.4 9.4 1.2 9.3
7 M	0625 1208 1856	1.8 8.9 1.8	22 TU	0627 1201 1855	1.2 9.5 1.0
8 TU	0031 0657 1243 1933	8.7 2.0 8.8 2.0	23 W	0029 0713 1250 1945	9.3 1.3 9.6 1.0
9 W	0106 0730 1320 2008	8.4 2.2 8.6 2.2	24 TH	0119 0759 1340 2034	9.2 1.4 9.5 1.0
10 TH	0144 0804 1357 2044	8.2 2.5 8.3 2.5	25 F	0209 0847 1430 2125	8.9 1.6 9.3 1.2
11 F	0223 0840 1439 2125	7.9 2.8 8.0 2.7	26 SA	0303 0938 1524 2217	8.6 1.9 9.0 1.5
12 SA	0308 0925 1525 2214	7.6 3.1 7.7 2.9	27 SU	0357 1033 1619 2313	8.3 2.2 8.7 1.8
13 SU	0400 1019 1619 2312	7.3 3.3 7.5 3.0	28 M	0458 1134 1720	7.9 2.5 8.4
14 M	0459 1122 1720	7.2 3.4 7.4	29 TU	0015 0603 1241 1827	2.1 7.7 2.6 8.1
15 TU	0017 0604 1234 1825	3.0 7.2 3.3 7.5	30 W	0120 0712 1351 1935	2.3 7.7 2.6 8.0
			31 TH	0226 0816 1458 2039	2.4 7.9 2.5 8.1

KALIMANTAN, WEST AND SOUTH COASTS, JAVA SEA

No.	PLACE		Lat. N.	Long. E.	TIME DIFFERENCES HHW (Zone −0800)	LLW	HEIGHT DIFFERENCES (IN METRES) MHHW	MLHW	MHLW	MLLW	M.L. Z_0 m.
4848	AIR MUSI (OUTER BAR)		see page 6				3·1	Δ	Δ	0·9	
5193	Pulau Temaju		0 30	108 50	−0220	−0117	−1·9	Δ	Δ	−0·5	0·80
5194	Pontianak Outer Bar (Kleine Kapoeas)	I	0 05	109 08	−0119	−0100	−1·7	Δ	Δ	−0·4	0·90
			S.	E.							
5195	Pontianak		0 01	109 20	−0021	+0002	−1·9	Δ	Δ	−0·4	0·80
5196	Tanjong Saleh		0 05	109 10	−0055	−0020	−2·1	Δ	Δ	−0·4	0·80
5147	MIRI		see page 33				1·6	Δ	Δ	0·5	
5200	Sukadana		1 14	109 57	−1145	−1105	+0·4	Δ	Δ	0·0	1·19
5201	Sungai Pawan		1 46	109 54	−1140	−1135	+0·2	Δ	Δ	0·0	1·10
	JAVA SEA										
5204	Tanjung Kuala Jelai		2 59	110 44	p	p	−0·9	Δ	Δ	−0·2	0·50
	Sungai Kota Waringin										
5205	Kuala Sapu	I	2 54	111 26	p	p	−0·2	Δ	Δ	+0·1	1·00
5207	Sungai Aru Tobal		3 10	111 48	p	p	−0·4	Δ	Δ	−0·2	0·70
5208	Kuala Pembuang		3 25	112 34	p	p	+0·3	Δ	Δ	+0·3	1·30
5214	SUNGAI BARITO		see page 39				2·2	1·5	1·2	0·3	
5209	Sampit Baai	I	3 00	113 03	p	p	+0·1	+0·1	0·0	+0·2	1·40
	Sungai Mendawai										
5210	Pegatan		3 17	113 21	+0019	+0035	0·0	−0·1	0·0	+0·2	1·30
	Sungai Kahajan										
5211	Tanjong Damaran		3 19	114 05	+0006	+0017	+0·1	+0·2	+0·3	+0·2	1·50
5212	Pangkoh		3 05	114 10	+0124	+0156	−0·1	+0·2	+0·2	+0·4	1·50
	Sungai Barito										
5214	OUTER BAR		3 34	114 29	STANDARD PORT		See Table V				1·30
5215	Banjermasin		3 20	114 36	+0116	+0117	−0·3	0·0	+0·2	+0·2	1·30
5216	Sungai Tabanio		3 45	114 36	+0019	+0014	−0·4	0·0	+0·2	+0·3	1·30
							MHWS	MHWN	MLWN	MLWS	
5228	BALIK PAPAN		see page 42		MHW	MLW	2·6	1·5	1·3	0·2	
	Selat Laut										
5219	Kampong Baru		3 25	116 01	p	p	−0·3	0·0	0·0	+0·3	1·40
	SELAT MAKASAR										
5221	Teluk Klumpang		3 01	116 13	p	p	−0·2	0·0	0·0	+0·2	1·40
5222	Tanjong Pamukan		2 34	116 29	+0004	+0003	−0·1	+0·1	−0·1	+0·1	1·40

SEASONAL CHANGES IN MEAN LEVEL

No.	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1	July 1	Aug. 1	Sep. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1
4718	+0·1	0·0	0·0	0·0	0·0	0·0	−0·1	−0·1	−0·1	0·0	+0·1	+0·1	+0·1
4848	+0·1	+0·2	+0·2	+0·1	0·0	−0·1	−0·1	−0·2	−0·2	−0·1	0·0	0·0	+0·1
4902	+0·2	+0·2	+0·1	0·0	−0·1	−0·1	−0·1	−0·1	−0·1	0·0	+0·1	+0·2	+0·2
5147	+0·1	0·0	−0·1	−0·1	−0·1	0·0	−0·1	0·0	0·0	0·0	+0·1	+0·1	+0·1
5167–5169	+0·1	0·0	0·0	0·0	0·0	−0·1	−0·1	−0·1	0·0	0·0	+0·1	+0·1	+0·1
5170, 5171	+0·2	+0·1	0·0	0·0	−0·1	−0·1	−0·1	−0·1	−0·1	0·0	+0·1	+0·1	+0·2
5172–5196	+0·1	0·0	0·0	0·0	0·0	−0·1	−0·1	−0·1	0·0	0·0	+0·1	+0·1	+0·1
5200–5214	+0·1	+0·1	+0·1	+0·1	0·0	0·0	−0·1	−0·1	−0·1	−0·1	0·0	0·0	+0·1
5215	+0·2	+0·2	+0·1	0·0	0·0	0·0	−0·1	−0·2	−0·2	−0·1	0·0	+0·1	+0·1
5216–5222	+0·1	+0·1	+0·1	+0·1	0·0	0·0	−0·1	−0·2	−0·2	−0·1	0·0	+0·1	+0·1
5228	+0·2	+0·2	+0·2	+0·2	+0·1	0·0	−0·2	−0·3	−0·3	−0·2	0·0	+0·1	+0·2
6938	+0·2	+0·1	0·0	0·0	0·0	−0·1	−0·2	−0·2	−0·1	0·0	+0·2	+0·2	+0·2
6996	0·0	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1	0·0

312

SCOTLAND, WEST COAST

No.	PLACE	Lat. N.	Long. W.	TIME DIFFERENCES High Water (Zone G.M.T.)		Low Water		HEIGHT DIFFERENCES (IN METRES) MHWS	MHWN	MLWN	MLWS	M.L. Z. m.
404	**GREENOCK**	(see page 86)		0000 and 1200	0600 and 1800	0000 and 1200	0600 and 1800	3·4	2·9	1·0	0·4	
	Firth of Clyde											
391	Southend, Kintyre	55 19	5 38	−0020	−0040	−0040	+0035	−1·3	−1·2	−0·5	−0·2	1·17
392	Sanda Island	55 17	5 35	−0040	−0040	⊙	⊙	−1·0	−0·9	⊙	⊙	⊙
393	Campbeltown	55 25	5 36	+0010	+0005	+0005	+0020	−0·5	−0·3	+0·1	+0·2	1·82
393a	Loch Ranza	55 43	5 18	−0015	−0005	−0005	−0010	−0·4	−0·3	−0·1	0·0	1·71
	Loch Fyne											
394	East Loch Tarbert	55 52	5 24	+0005	+0005	−0020	+0015	0·0	0·0	+0·1	−0·1	1·92
395	Inverary	56 14	5 04	+0011	+0011	+0034	+0034	−0·1	+0·1	−0·5	−0·2	⊙
	Kyles of Bute											
396	Rubha Bodach	55 55	5 09	−0020	−0010	−0007	−0007	−0·2	−0·1	+0·2	+0·2	1·78
396a	Tighnabruich	55 55	5 13	+0007	−0010	−0002	−0015	0·0	+0·2	+0·4	+0·5	2·08
	Firth of Clyde (cont.)											
398	Millport	55 45	4 56	−0005	−0025	−0025	−0005	0·0	−0·1	0·0	+0·1	1·94
399	Rothesay Bay	55 51	5 03	−0020	−0015	−0010	−0002	+0·2	+0·2	+0·2	+0·2	1·90
399a	Wemyss Bay	55 53	4 53	−0005	−0005	−0005	−0005	0·0	0·0	+0·1	+0·1	⊙
	Loch Long											
399b	Coulport	56 03	4 53	−0005	−0005	−0005	−0005	0·0	0·0	−0·1	−0·1	1·82
399c	Lochgoilhead	56 10	4 54	+0015	0000	−0005	−0005	−0·2	−0·3	−0·3	−0·3	1·71
401	Arrochar	56 12	4 45	−0005	−0005	−0005	−0005	0·0	0·0	−0·1	−0·1	⊙
	Gare Loch											
402	Rosneath (Rhu Pier)	56 01	4 46	−0005	−0005	−0005	−0005	0·0	−0·1	0·0	0·0	2·02
402a	Shandon	56 03	4 49	−0005	−0005	−0005	−0005	0·0	6·0	0·0	−0·1	⊙
402b	Garelochhead	56 05	4 50	0000	0000	0000	0000	0·0	0·0	0·0	−0·1	⊙
	River Clyde											
403	Helensburgh	56 00	4 44	0000	0000	0000	0000	0·0	0·0	0·0	0·0	⊙
404	GREENOCK	55 57	4 46	STANDARD PORT				See Table V				2·00
405	Port Glasgow	55 56	4 41	+0010	+0005	+0010	+0020	+0·2	+0·1	0·0	0·0	⊙
406	Bowling	55 56	4 29	+0020	+0010	+0030	+0055	+0·6	+0·5	+0·3	+0·1	⊙
406a	Renfrew	55 53	4 23	+0025	+0015	+0035	+0100	+0·9	+0·8	+0·5	+0·2	⊙
407	Glasgow	55 51	4 17	+0025	+0015	+0035	+0105	+1·3	+1·2	+0·6	+0·4	2·77
	Firth of Clyde (cont.)											
408	Brodick Bay	55 35	5 08	0000	0000	+0005	+0005	−0·2	−0·2	0·0	0·0	1·86
409	Lamlash	55 32	5 07	−0016	−0036	−0024	−0004	−0·2	−0·2	⊙	⊙	⊙
410	Ardrossan	55 38	4 49	−0020	−0010	−0010	−0010	−0·2	−0·2	+0·1	+0·1	1·86
411	Irvine	55 36	4 41	−0020	−0020	−0030	−0010	−0·3	−0·3	−0·1	0·0	⊙
412	Troon	55 33	4 41	−0025	−0025	−0020	−0020	−0·2	−0·2	0·0	0·0	1·91
413	Ayr	55 28	4 39	−0025	−0025	−0030	−0015	−0·4	−0·3	+0·1	+0·1	⊙
414	Girvan	55 15	4 52	−0025	−0040	−0035	−0010	−0·3	−0·3	−0·1	0·0	1·82
	Loch Ryan											
414a	Stranraer	54 55	5 03	−0020	−0020	−0017	−0017	−0·4	−0·4	−0·4	−0·2	⊙
452	**LIVERPOOL**	(see page 90)		0000 and 1200	0600 and 1800	0200 and 1400	0800 and 2000	9·3	7·4	2·9	0·9	
415	Portpatrick	54 50	5 07	+0018	+0026	0000	−0035	−5·5	−4·4	−2·0	−0·6	2·08
	Wigtown Bay											
420	Drummore	54 41	4 53	+0030	+0040	+0015	+0020	−3·4	−2·5	−0·9	−0·3	3·32
420a	Port William	54 43	4 40	+0030	+0030	+0025	0000	−2·9	−2·2	−0·8	⊙	⊙
421	Isle of Whithorn	54 42	4 22	+0020	+0025	+0025	+0005	−2·4	−2·0	−0·8	−0·2	3·74
422	Garliestown	54 47	4 21	+0025	+0035	+0030	+0005	−2·3	−1·7	−0·5	⊙	⊙
	Solway Firth											
422a	Kirkcudbright Bay	54 48	4 04	+0015	+0015	+0010	0000	−1·8	−1·5	−0·5	−0·1	⊙
424	Hestan Islet	54 50	3 48	+0025	+0025	+0020	+0025	−1·0	−1·1	−0·5	0·0	4·21
425	Southerness Point	54 52	3 36	+0030	+0030	+0030	+0010	−0·7	−0·7	⊙	⊙	⊙
426	Annan Waterfoot	54 58	3 16	+0050	+0105	+0220	+0310	−2·2	−2·6	−2·7	⁞	⊙ •
430	Torduff Point	54 58	3 09	+0105	+0140	+0520	+0410	−4·1	−4·9	⁞	⁞	⊙ •
431	Redkirk	54 59	3 06	+0110	+0215	+0715	+0445	−5·5	−6·2	⁞	⁞	⊙ •

⊙ No data.
§ Dries out except for river water.
⁞ The tide does not normally fall below Chart Datum.
• See notes on page 344.
c For intermediate heights, use harmonic constants (see Part III) and N.P.159.
x M.L. inferred.

ENGLAND, WEST COAST; ISLE OF MAN; WALES

No.	PLACE	Lat. N.	Long. W.	TIME DIFFERENCES High Water (Zone G.M.T.)		Low Water		HEIGHT DIFFERENCES (IN METRES) MHWS	MHWN	MLWN	MLWS	M.L. Z. m.
452	**LIVERPOOL**	(see page 90)		0000 and 1200	0600 and 1800	0200 and 1400	0700 and 1900	9·3	7·4	2·9	0·9	
	England											
	Solway Firth											
432	Silloth	54 52	3 24	+0030	+0040	+0045	+0055	−0·1	−0·3	−0·6	−0·1	⊙
433	Maryport	54 43	3 30	+0017	+0032	+0020	+0005	−0·7	−0·8	−0·4	0·0	⊙
434	Workington	54 39	3 34	+0020	+0020	+0020	+0010	−1·1	−1·0	−0·1	+0·3	4·42
435	Whitehaven	54 33	3 36	+0005	+0015	+0010	+0005	−1·3	−1·1	−0·5	+0·1	4·53
436	Tarn Point	54 17	3 25	+0005	+0005	+0010	0000	−1·0	−1·0	−0·4	0·0	⊙
437	Duddon Bar	54 09	3 20	+0003	+0003	+0008	+0002	−0·8	−0·8	−0·3	0·0	⊙
	Morecambe Bay											
440	Barrow (Ramsden Dock)	54 06	3 12	+0015	+0015	+0020	+0020	−0·2	−0·3	−0·1	+0·1	4·97
440a	Hawe Point	54 03	3 10	+0010	+0010	+0010	+0010	−0·1	−0·3	−0·1	+0·1	4·89
440b	Ulverston	54 11	3 04	+0020	+0040	⊙	⊙	0·0	−0·1	⊙	⊙	⊙
440c	Arnside	54 12	2 51	+0100	+0135	⊙	⊙	+0·5	+0·2	⊙	⊙	⊙
440d	Morecambe	54 04	2 52	+0005	+0010	+0030	+0015	+0·2	0·0	0·0	+0·2	⊙
441	Heysham	54 02	2 55	+0005	+0005	+0015	0000	+0·1	0·0	0·0	+0·2	5·10
	River Lune											
442	Glasson Dock	54 00	2 51	+0020	+0030	+0220	+0240	−2·7	−3·0	⊙	⊙	⊙
442a	Lancaster	54 03	2 49	+0110	+0030	⊙	⊙	−5·0	−4·9	§	§	⊙ •
	River Wyre											
443	Wyre Lighthouse	53 57	3 02	−0010	−0010	+0005	0000	−0·1	−0·1	⊙	⊙	⊙
444	Fleetwood	53 56	3 00	0000	0000	+0005	0000	−0·1	−0·1	+0·1	+0·3	4·98
445	Blackpool	53 49	3 04	−0015	−0005	−0005	−0015	−0·4	−0·4	−0·1	+0·1	⊙
	River Ribble											
446	Preston	53 46	2 45	+0010	+0010	+0335	+0310	−4·0	−4·1	−2·8	−0·8	⊙ •
	Liverpool Bay											
447	Southport	53 39	3 01	−0020	−0010	⊙	⊙	−0·3	−0·3	⊙	⊙	⊙
448	Formby	53 32	3 07	−0015	−0010	−0020	−0020	−0·3	−0·1	0·0	+0·1	5·15
450	Rock Channel	53 27	3 07	−0030	−0030	−0030	−0030	−0·4	−0·2	−0·2	0·0	⊙
	River Mersey											
452	LIVERPOOL	53 25	3 00	STANDARD PORT				See Table V				5·14
453	Eastham	53 19	2 57	+0003	+0006	+0015	+0030	+0·4	+0·3	−0·1	−0·1	5·3 x
455	Hale Head	53 19	2 48	+0030	+0025	⊙	⊙	−2·4	−2·5	⊙	⊙	⊙
456	Widnes	53 21	2 44	+0040	+0045	+0400	+0345	−4·2	−4·4	−2·5	−0·3	⊙
456a	Fiddler's Ferry	53 22	2 39	+0100	+0115	+0540	+0450	−5·9	−6·3	−2·4	−0·4	⊙
	River Dee											
461	Hilbre Island	53 23	3 13	−0015	−0012	−0010	−0015	−0·3	−0·2	+0·2	+0·4	5·14
462	Mostyn Quay	53 19	3 16	−0020	−0015	−0020	−0020	−0·8	−0·7	⊙	⊙	⊙
463	Connah's Quay	53 13	3 03	0000	+0015	+0355	+0340	−4·6	−4·4	§	§	⊙ •
464	Chester	53 12	2 54	+0105	+0105	+0500	+0500	−5·3	−5·4	§	§	⊙ •
	Isle of Man											
466	Peel	54 14	4 42	−0015	+0010	0000	−0010	−4·0	−3·2	−1·4	−0·4	2·90
467	Ramsey	54 19	4 22	−0003	+0012	0000	−0015	−2·1	−1·7	−0·3	+0·1	4·05
468	Douglas	54 09	4 28	−0004	−0004	−0022	−0032	−2·4	−2·0	−0·5	−0·1	3·78
468a	Port St. Mary	54 04	4 44	+0005	+0015	−0010	−0030	−3·4	−2·7	−1·2	−0·3	3·21
469	Calf Sound	54 04	4 48	+0005	+0005	−0015	−0025	−3·2	−2·6	−0·9	−0·3	⊙
469a	Port Erin	54 05	4 46	−0005	+0015	−0010	−0050	−4·1	−3·2	−1·3	−0·5	2·73
	Wales											
470	Colwyn Bay	53 18	3 43	−0035	−0025	⊙	⊙	−1·5	−1·3	⊙	⊙	⊙
471	Llandudno	53 20	3 50	−0035	−0025	−0025	−0035	−1·9	−1·5	−0·5	−0·2	4·03
478	**HOLYHEAD**	(see page 94)		0000 and 1200	0600 and 1800	0500 and 1700	1100 and 2300	5·7	4·5	2·0	0·7	
471a	Conwy	53 17	3 50	+0020	+0020	⊙	+0050	+2·1	+1·6	+0·3	⊙	⊙
	Menai Strait											
472	Beaumaris	53 16	4 05	+0025	+0010	+0055	+0035	+2·0	+1·6	+0·5	+0·1	4·22
473	Menai Bridge	53 13	4 09	+0030	+0010	+0100	+0035	+1·7	+1·4	+0·3	0·0	4·05
474	Port Dinorwic	53 11	4 13	−0015	−0025	+0030	0000	0·0	0·0	0·0	+0·1	3·38

SEASONAL CHANGES IN MEAN LEVEL

No.	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1	July 1	Aug. 1	Sep. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1
391–398	+0·1	0·0	−0·1	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1
399–407	+0·2	+0·1	0·0	−0·1	−0·1	−0·1	−0·1	−0·1	0·0	0·0	+0·1	+0·2	+0·2
408–414a	+0·1	0·0	−0·1	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1
415–444	0·0	0·0	0·0	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1
445–464	0·0	0·0	−0·1	−0·1	0·0	0·0	0·0	0·0	0·0	0·0	+0·1	+0·1	0·0
466–478	+0·1	0·0	0·0	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1

Co-Tidal/Co-Range Charts

The purpose of these charts is to obtain the times and heights of high water in offshore areas and between places between secondary ports. The use of the charts will be enhanced if the mariner is aware of the following definitions:

Co-Tidal Lines These are lines joining places which all have the same Mean High Water Interval (MHWI)

Co-Range Lines These are lines which join places having the same Mean Spring Range (MSR)

M.H.W.I. Is the interval between the moons meridian passage at Greenwich and the next high water time at a particular place.
NB: A comparison between the MHW Intervals is a direct comparison between the Mean High Water Times.

M.S.R. Is the range between Mean High Water Springs and Mean Low Water Springs.

Examples in the use of Co-Range/Co-Tidal Charts:

Co-Tidal Chart Exercise (All examples use 1987 ATT)

Example 1.

Find the time and the height of high water at a position:
latitude 53° 10' N, Longitude 01° 50' E, during the morning of 10th October, 1987.

Standard Port *IMMINGHAM*

Extract from Tables: —

	October	
10	0127	1.0
SA	0724	7.5
	1349	1.2
	1951	7.0

Predictions: —
HW = 0724 ht. = 7.5 m.

	MHWI	MSR
Required Position	6hr 10'	3.0
Immingham	5hr 36'	6.4
Time Difference	0hr 34'	Ht.Ratio = $\frac{3.0}{6.4}$

HW. Immingham = 0724
Time Difference = 34'

Required HW Time = 0758 hrs

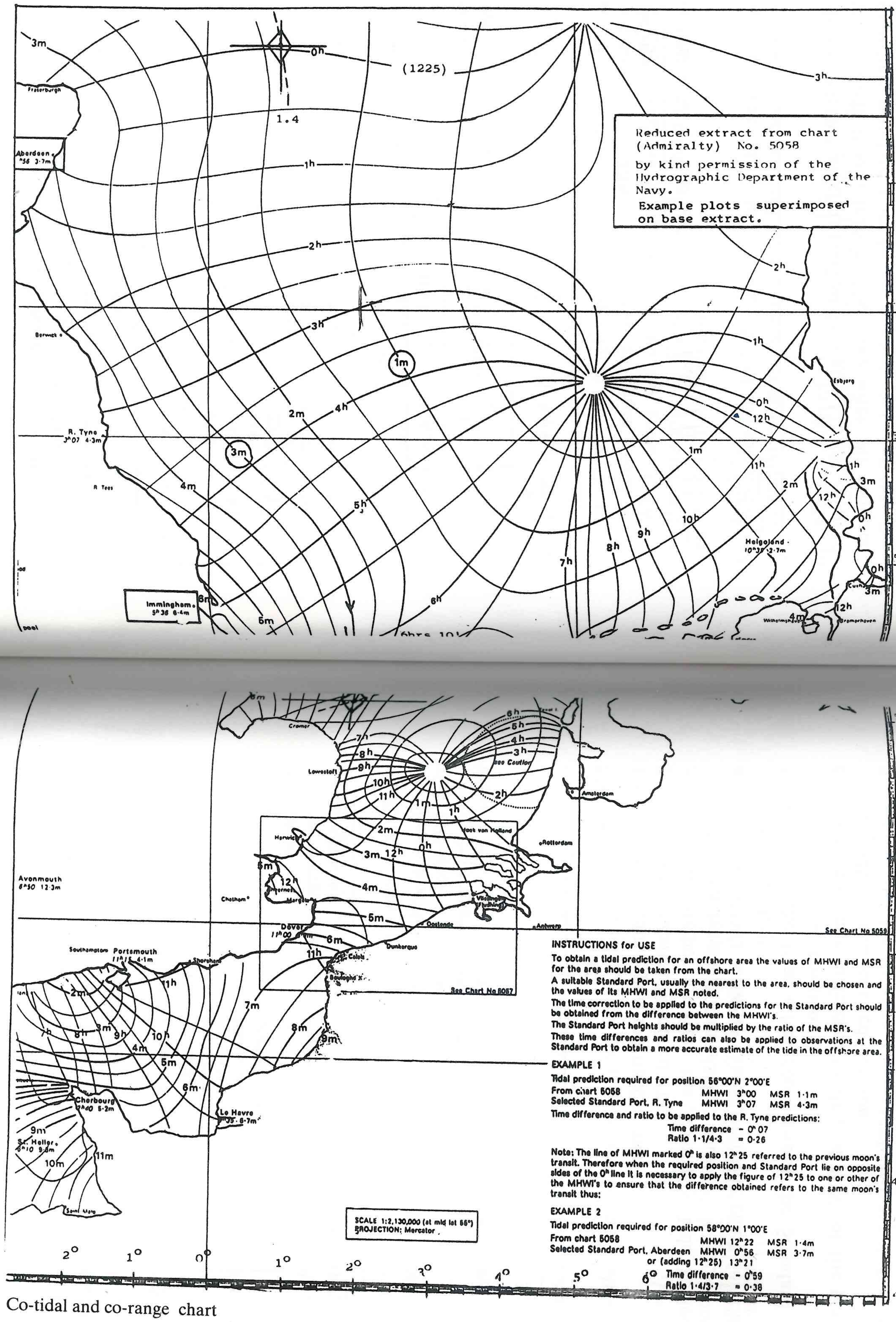
Height 7.5 m.

Required Ht. $= 7.5 \times \frac{3.0}{6.4}$

$= 3.52$ m.

Method:

1. Plot the required position on the chart.
2. Obtain the nearest Standard Port.
3. Take the predictions from the Admiralty Tide Tables for high water height and time.
4. Extract MHWI & MSR values from the chart for the required position.
5. Calculate the time difference between the Standard Port and the actual position.
6. Apply the time difference to time of HW, of the port, to give HW at the required position.
7. Obtain the height ratio (from MSR values) and multiply against Standard Ports height of HW to give HW at position.



Co-tidal and co-range chart

Example 2.

Find the height and time of evening high water in a position: latitude 58° 00' N, longitude 01° 00' E, on the 8th May, 1987.

Standard Port *ABERDEEN*

Extract from Tables: —

	0312	1.9
8	0907	3.2
F	1548	1.3
	2209	3.3

Predictions: —

HW = 2209 ht. = 3.3 m.

	MHWI	MSR
Required Position	1222	1.4
Aberdeen *(1225 + 0056)	= 1321	3.7
Time Difference	59'	Ht.Ratio = $\frac{1.4}{3.7}$

HW. Aberdeen	=	2209
Time Difference	=	−59'
Required HW Time	=	2110 hrs

Height 3.3 m.

Required Ht. $= 3.3 \times \frac{1.4}{3.7}$

= 1.25 m.

* The line of MHWI which is marked 0^h is also 12h 25' referred to the previous moons transit. Therefore when the required position and standard port lie on opposite sides of this line it is necessary to apply the figure 12H 25' to one or other of the MHWI's to ensure that the differences obtained refer to the same moons transit.

Pacific Tidal Calculations

All the following examples have been worked using the Admiralty Tide Tables Vol. 3 for the year 1988, covering the Pacific Ocean. The mariner should be aware of certain differences in terminology employed and methods used when working Pacific Tides as compared with European Tides.

Main differences include:

1) In some Ports

   MHWS may be represented as Mean High High Water (MHHW)
   MHWN may be represented as Mean Low High Water (MLHW)
   MLWN may be represented as Mean High Low Water (MHLW)
   MLWS may be represented as Mean Low Low Water (MLLW)

2) Only one tidal curve is used for all ports.
   (As opposed to each Standard European Port having its own curve)

3) Not all ports have two high waters/two low waters per day.

4) If the duration of rise or fall is less than 5 hours or greater than 7 hours, then the tidal curve cannot be used.
   i.e. Times and heights between predicted HW & LW cannot be found using the curve.
   When using the curve: — Three curves are available for the durations 5, 6 and 7 hours. Use the appropriate curve or interpolate between curves.

5) When dealing with Secondary Ports, the 'seasonal change' is employed in the same way as for European Ports.

6) Height differences may require Interpolation/extrapolation in a similar manner as employed with European Ports.

7) Time differences do not require interpolation. Use MHW or MLW differences where zone time changes if any are included.

Pacific Tides

Example 1.

Find the times and heights of high water and low water at Tebon (5187) on the 25th May, 1988.

Times	HW	LW
Cua Cam	2124	1019
Cua Cam	+56	+56
Tebon Times	2220	1115
Heights		
Cua Cam	1.9	1.6
Cua Cam Sea/Corr'n	0	0
Cua Cam	−1.15	−0.96
Tebon	0.75	0.64
Tebon Sea/Corr'n	0	0
Tebon Heights	0.75 m	0.64 m

Method: *To obtain times*

a) Look up port name in geographical index and obtain respective number. (e.g. Tebon = 5187)

b) By inspection of Standard Port List obtain the page number of the port being used. (e.g. Tebon used in conjunction with the Standard Port — Cua Cam)

c) Inspect tables for Cua Cam and extract relevant HW & LW data for the respective date. Namely heights and times.

d) Apply the time differences between Standard/ Secondary Ports as specified. (ref., Pg 310 Cua Cam/ Tebon = + 56' HW/LW)
Tebon times for HW & LW are 2220 & 1115 respectively.

To obtain heights

e) Apply seasonal correction to HW & LW values obtained for Cua Cam.

f) Obtain and apply height differences between Standard/ Secondary Ports: —

Obtain range at Cua Cam: —

(i)	(HW-LW)	2.9 − 0.9 = 2.0
(ii)	(HW & Pred. HW)	2.9 − 1.9 = 1.0
(iii)	(LW & Pred. LW)	0.9 − 1.6 = −0.7

Interpolate Ht. Difference × Tebon Range (−0.5 −1.8) = 1.3

$$HW\ Diff\ \ -1.8 - \left(\frac{1.0}{2.0} \times 1.3\right) \qquad LW\ Diff\ \ -0.5 + \left(-\frac{0.7}{2.0} \times 1.3\right)$$

$$= -1.15 \qquad\qquad = -0.96$$

g) Obtain Tebon values without seasonal correction.

h) Apply Sea/Corr'n to obtain Tebon values 0.75m & 0.64m for HW & LW respectively.

SARAWAK, TUDJUH GROUP, KALIMANTAN, WEST COAST

No.	PLACE		Lat. N.	Long. E.	TIME DIFFERENCES MHW	LLW (Zone −0800)	HEIGHT DIFFERENCES (IN METRES) MHHW	MLHW	MHLW	MLLW	M.L. Z_0 m.	
5172	SUNGAI SARAWAK (PULAU LAKEI)		see page 36		MHW	LLW	4·8	4·4	2·1	1·2		
	Batang Sadong											
5167	Kuala Sadong		1 33	110 46	+0020	+0105	+0·2	+0·4	−0·2	−0·2	3·20	d
5168	Sungai Ensengie		1 25	110 39	+0050	+0235	+0·8	+1·0	−0·2	−0·2	3·54	*d
5169	Simunjan		1 24	110 45	+0115	+0325	+1·0	+1·1	−0·4	−0·2	3·54	*d
	Sungai Sarawak											
5170	Pending	S	1 33	110 23	+0023	+0018	+0·4	+0·5	+0·2	+0·1	3·42	
5171	Kuching	MS	1 34	110 21	+0100	+0100	−0·1	0·0	+0·1	0·0	3·13	*
5171a	Batu Kitang		1 27	110 17	+0234	+0300	−2·1	−2·0	−1·0	−0·6	1·75	*
5172	PULAU LAKEI		1 45	110 30	STANDARD PORT			See Table V			3·10	*
5173	Santubong	S	1 43	110 19	+0005	+0007	−0·5	−0·3	0·0	−0·1	2·90	*
5174	Pulau Satang		1 47	110 10	−0001	−0001	−0·9	−0·7	−0·2	−0·3	2·58	*
	Sungai Lundu											
5174a	Kuala Lundu	S	1 42	109 55	+0019	+0023	−0·8	−0·5	+0·1	+0·1	2·43	*
5174b	Pasar Lundu		1 40	109 51	+0052	+0106	−1·0	−0·7	−0·1	0·0	2·66	*
5175	Sematan		1 48	109 47	+0005	−0005	−0·8	−0·7	−0·1	−0·2	2·66	*
5176	Telok Serabang		2 00	109 40	−0005	−0007	−1·1	−0·8	−0·2	−0·2	2·53	*
4902	TRENGGANU		see page 15		HHW	LLW	1·7	1·0	1·0	0·4		
	Tudjuh Kepulauan				(Zone −0700)							
	Anambas Kepulauan											
5177	Selat Peninting		3 14	106 15	−0045	−0009	−0·1	Δ	Δ	+0·1	1·0	x
5177a	Impul Passage		3 04	105 40	−0052	−0032	−0·2	Δ	Δ	0·0	1·0	tx
	Natuna Kepulauan											
5178	Pulau Laut		4 45	108 00	p	p	−0·7	Δ	Δ	−0·1	0·7	x
5179	Sedanau		3 48	108 02	p	p	−0·3	+0·2	+0·2	0·0	1·0	x
6938	MUI VUNG TAU		see page 159				3·5	3·3	2·2	0·9		
5180	Subi Kecil		3 03	108 51	−0024	−0022	−1·5	−1·4	−0·9	−0·4	1·4	x
							MHWS	MHWN	MLWN	MLWS		
4718	SINGAPORE		see page 3		MHW	MLW	2·7	2·0	1·1	0·5		
5181	Pulau Serasan		2 30	109 00	−0833	−0825	−0·4	−0·2	−0·1	0·0	1·4	tx
5182	South Haycock		2 16	108 54	−0826	−0825	−1·3	−0·9	−0·6	−0·3	0·8	tx
							MHHW	MLHW	MHLW	MLLW		
4848	AIR MUSI (OUTER BAR)		see page 6		HHW	LLW	3·1	Δ	Δ	0·9		
	Tambelan Kepulauan											
5185	Tambelan Bay		0 59	107 34	−0349	−0311	−2·2	Δ	Δ	−0·5	0·6	x
6996	CUA CAM		see page 165				2·9	Δ	Δ	0·9		
	Badas Kepulauan											
5187	Tebon		0 35	107 06	+0056	+0056	−1·8	Δ	Δ	−0·5	0·7	x
5172	SUNGEI SARAWAK (PULAU LAKEI)		see page 36		MHW	LLW	4·8	4·4	2·1	1·2		
	Kalimantan				(Zone −0800)							
5189	Tanjong Datu		2 05	109 39	+0011	+0008	−1·9	−1·7	−0·9	−0·5	1·9	x
							MHWS	MHWN	MLWN	MLWS		
4718	SINGAPORE		see page 3		MHW	MLW	2·7	2·0	1·1	0·5		
5190	Sungai Paloh		1 46	109 16	−0733	−0731	−0·5	−0·3	−0·2	0·0	1·30	
5191	Pemangkat	I	1 11	108 59	p	p	−1·8	−1·2	−0·7	−0·2	0·60	

Δ Tide is usually diurnal.
* See notes on page 388.
M Tides predicted in Malaysian Tide Tables.
S Tides predicted in Sarawak Tide Tables.
I Tides predicted in Indonesian Tide Tables.
p For predictions use harmonic constants (Part III) and N.P.159.
t Time differences approximate.
x M.L. inferred.

Extract from Pacific tide tables.

Example 2.

To what draught can a vessel load in Hong Kong Harbour in order to pass over a 4.0 metre shoal with 1.5 metre under keel clearance at 1830 hrs ZT, on 25th January, 1988.

Extract from Tables: —

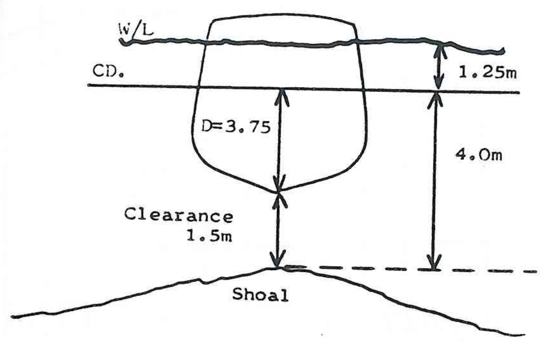
	0107	1.9
25th	0740	0.8
M	1503	1.7
	2015	1.1

HW	1503	1.7
LW	2015	1.1
Duration	5h.12'	

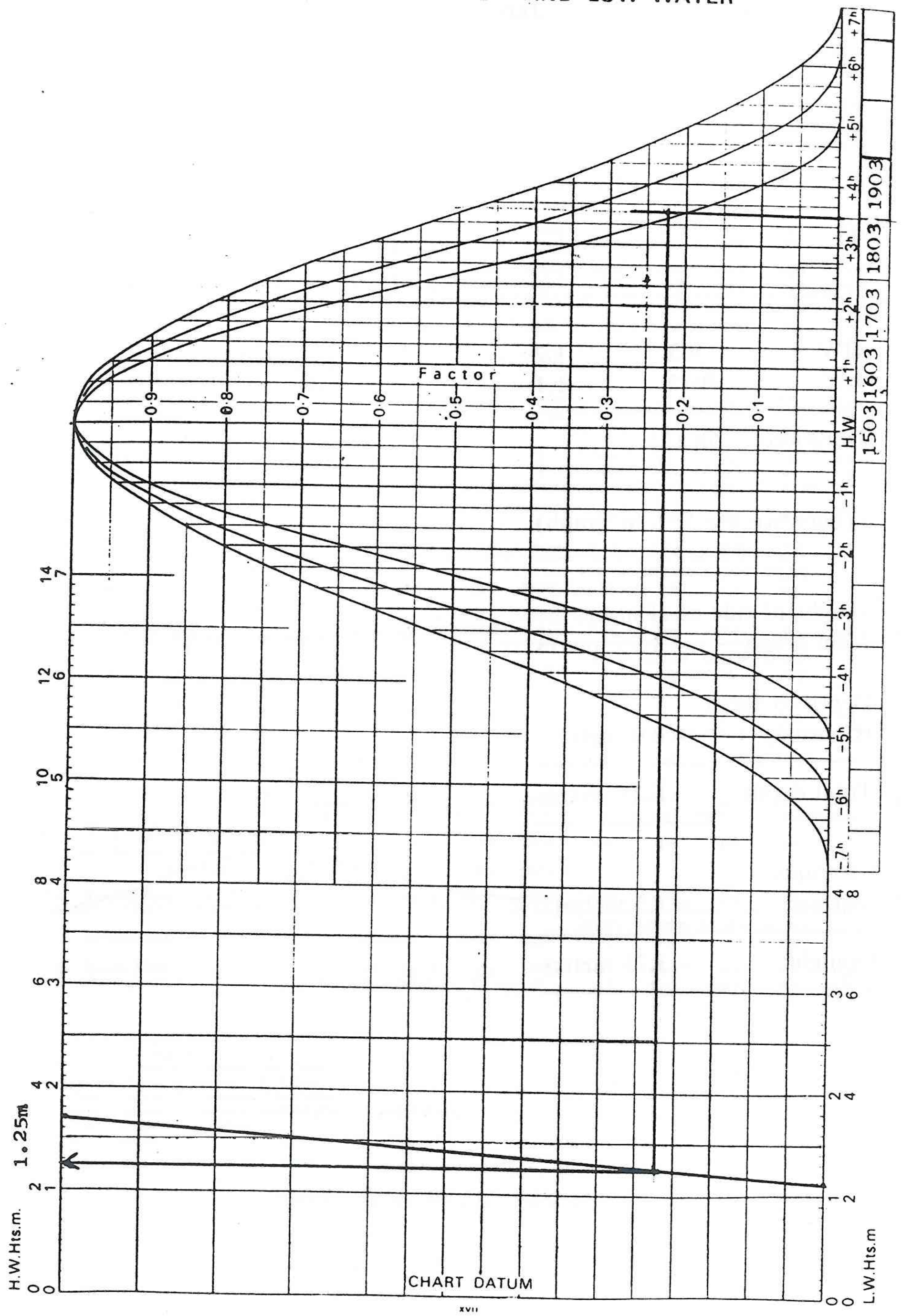
Required time	1830
HW time	1503
Interval	3h 07'

(Therefore use 5–6 hr graph)

Height of tide at 1830 hrs from graph	= 1.25 metres
Depth to shoal (Charted)	= 4.0 metres
Total depth	= 5.25 metres
Clearance required	= 1.5 metres
Draught	⇒3.75 metres



FOR FINDING THE HEIGHT OF THE TIDE AT TIMES BETWEEN HIGH AND LOW WATER



PACIFIC TIDAL STREAM EXAMPLES

(All examples used are based on Admiralty Tide Tables Vol. 3, Pacific Ocean 1988)

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1) (i) State what the times of ‘slack water’ will be at San Francisco entrance (Golden Gate) on 23rd May, 1988.

(ii) State also the maximum directions and rates of tidal stream and the times that they occur?

Extract from tables:
Positive (+) Direction 065 Negative (−) Direction 245

	Slack	Maximum	Rate
	0127	0345	1.1
23	0621	0932	−2.8
M	1341	1653	2.4
	2006	2234	−1.8

(i) Slack Water times: 0127, 0621, 1341 & 2006

(ii)	0345	065°	at 1.1 knots
	0932	245°	at 2.8 knots
	1653	065°	at 2.4 knots
	2234	245°	at 1.8 knots

Method:

Inspect the tables and locate Part 1A-Tidal stream predictions

a) Extract the relevant page number for the required port from the index list of ports.
b) Turn to the respective port and date required.
c) Extract times of slack water from table for the date.
d) Extract times for the maximum tidal stream for the date required.
e) Extract the rates for the obtained maximum times.
f) Compare the positive and negative values with the directions given in the table.

U.S.A. - SAN FRANCISCO BAY ENTRANCE (GOLDEN GATE)

LAT 37°49'N LONG 122°29'W

TIDAL STREAM PREDICTIONS (RATES IN KNOTS)

TIME ZONE +0800 POSITIVE (+) DIRECTION 065 NEGATIVE (-) DIRECTION 245 YEAR 1988

APRIL

Day	SLACK TIME	MAXIMUM TIME	RATE
1	0032	0320	-3.7
	0656	0948	3.3
F	1253	1535	-3.5
	1907	2156	3.1
2	0056	0350	-4.0
	0729	1023	3.3
SA	1335	1612	-3.3
O	1933	2223	2.9
3	0119	0425	-4.3
	0804	1059	3.3
SU	1418	1647	-2.9
	1958	2254	2.7
4	0143	0502	-4.4
	0841	1141	3.2
M	1504	1728	-2.5
	2024	2329	2.4
5	0210	0543	-4.3
	0923	1226	3.0
TU	1556	1813	-2.1
	2055		
6		0008	2.1
	0242	0629	-4.2
W	1013	1317	2.8
	1658	1904	-1.7
	2135		
7		0055	1.8
	0323	0720	-4.0
TH	1115	1421	2.6
	1809	2004	-1.3
	2232		
8		0152	1.5
	0417	0819	-3.9
F	1226	1537	2.6
	1923	2113	-1.2
9	0004	0304	1.3
	0532	0926	-3.8
SA	1339	1653	2.8
	2028	2224	-1.3
10	0147	0423	1.5
	0700	1036	-3.9
SU	1444	1800	3.2
	2120	2336	-1.8
11	0301	0540	2.0
	0822	1139	-4.1
M	1540	1851	3.6
	2203		
12		0036	-2.6
	0400	0647	2.7
	0934	1241	-4.3
	1629	1934	3.9
	2241		
13		0125	-3.4
	0452	0744	3.4
	1038	1336	-4.3
	1714	2014	4.0
	2316		
14		0207	-4.2
	0540	0837	3.9
	1137	1427	-4.2
	1757	2052	4.0
	2351		
15		0249	-4.9
	0626	0926	4.3
	1234	1514	-3.9
	1837	2128	3.9
16	0025	0331	-5.3
	0712	1015	4.5
SA	1328	1557	-3.5
●	1917	2208	3.6
17	0100	0411	-5.4
	0758	1059	4.4
SU	1421	1643	-3.0
	1956	2247	3.2
18	0135	0454	-5.3
	0846	1148	4.1
M	1515	1729	-2.5
	2037	2328	2.7
19	0213	0537	-5.0
	0936	1239	3.6
TU	1611	1815	-2.0
	2122		
20		0011	2.2
	0253	0626	-4.5
W	1031	1338	3.1
	1711	1908	-1.5
	2216		
21		0102	1.7
	0341	0717	-3.9
TH	1133	1441	2.7
	1816	2007	-1.1
	2329		
22		0206	1.3
	0439	0812	-3.4
F	1239	1603	2.5
	1922	2119	-1.0
23	0055	0317	1.1
	0552	0916	-3.1
SA	1345	1712	2.5
	2021	2317	-1.1
24	0213	0446	1.2
	0710	1029	-2.9
SU	1443	1806	2.6
	2108		
25		0020	-1.6
	0314	0559	1.5
M	0821	1139	-2.9
	1533	1851	2.8
	2146		
26		0055	-2.1
	0403	0654	2.0
TU	0925	1231	-2.9
	1616	1926	2.9
	2219		
27		0116	-2.6
	0445	0739	2.4
W	1021	1312	-3.0
	1654	1955	2.9
	2248		
28		0145	-3.2
	0524	0818	2.8
TH	1112	1355	-3.0
	1727	2024	2.9
	2316		
29		0214	-3.8
	0600	0853	3.2
F	1159	1433	-2.9
	1759	2050	2.9
	2343		
30		0246	-4.2
	0635	0931	3.5
SA	1244	1510	-2.8
	1829	2119	2.8

MAY

Day	SLACK TIME	MAXIMUM TIME	RATE
1	0009	0322	-4.6
	0710	1009	3.6
SU	1329	1549	-2.7
O	1858	2151	2.7
2	0036	0359	-4.8
	0746	1047	3.7
M	1414	1628	-2.4
	1927	2225	2.6
3	0105	0438	-4.9
	0825	1129	3.6
TU	1503	1713	-2.2
	1959	2302	2.4
4	0138	0521	-4.9
	0910	1214	3.5
W	1555	1801	-1.9
	2037	2347	2.1
5	0217	0608	-4.8
	1000	1306	3.3
TH	1653	1850	-1.6
	2125		
6		0038	1.8
	0304	0701	-4.5
F	1058	1406	3.1
	1755	1949	-1.5
	2234		
7		0138	1.6
	0404	0759	-4.2
SA	1201	1511	3.1
	1856	2054	-1.5
8	0009	0249	1.5
	0520	0902	-3.9
SU	1306	1620	3.1
	1950	2203	-1.8
9	0139	0412	1.7
	0649	1007	-3.7
M	1407	1717	3.3
	2037	2312	-2.5
10	0250	0529	2.1
	0814	1116	-3.5
TU	1503	1812	3.4
	2119		
11		0010	-3.2
	0350	0640	2.8
W	0930	1218	-3.4
	1555	1857	3.5
	2158		
12		0058	-4.0
	0442	0739	3.4
TH	1038	1319	-3.2
	1643	1939	3.5
	2236		
13		0144	-4.7
	0530	0833	4.0
F	1138	1411	-3.1
	1727	2021	3.4
	2313		
14		0227	-5.2
	0616	0920	4.3
SA	1234	1502	-2.9
	1811	2102	3.3
	2350		
15		0308	-5.5
	0701	1005	4.4
SU	1327	1543	-2.6
●	1852	2143	3.1
16	0028	0351	-5.5
	0746	1052	4.3
M	1417	1629	-2.3
	1933	2221	2.8
17	0106	0432	-5.3
	0831	1135	4.0
TU	1506	1711	-2.0
	2015	2301	2.5
18	0145	0515	-5.0
	0918	1224	3.7
W	1556	1756	-1.8
	2059	2347	2.1
19	0227	0601	-4.6
	1007	1312	3.3
TH	1647	1845	-1.5
	2150		
20		0036	1.7
	0312	0645	-4.1
F	1058	1407	2.9
	1740	1934	-1.3
	2254		
21		0133	1.4
	0403	0738	-3.6
SA	1152	1504	2.6
	1833	2032	-1.3
22	0010	0234	1.2
	0506	0831	-3.2
SU	1247	1559	2.5
	1922	2136	-1.4
23	0127	0345	1.1
	0621	0932	-2.8
M	1341	1653	2.4
	2006	2234	-1.8
24	0234	0504	1.3
	0738	1032	-2.5
TU	1431	1742	2.4
	2045	2330	-2.3
25	0329	0609	1.7
	0851	1129	-2.3
W	1518	1821	2.4
	2120		
26		0017	-2.9
	0415	0707	2.2
TH	0956	1224	-2.2
	1600	1857	2.5
	2154		
27		0100	-3.5
	0457	0752	2.7
F	1054	1315	-2.2
	1641	1936	2.5
	2226		
28		0135	-4.0
	0536	0837	3.1
SA	1147	1403	-2.2
	1718	2009	2.5
	2258		
29		0216	-4.5
	0614	0915	3.5
SU	1236	1446	-2.2
	1755	2044	2.6
	2331		
30		0256	-4.9
	0653	0953	3.8
M	1323	1531	-2.2
	1830	2125	2.6
31	0005	0336	-5.2
	0733	1037	3.9
TU	1409	1614	-2.1
O	1907	2206	2.6

JUNE

Day	SLACK TIME	MAXIMUM TIME	RATE
1	0043	0421	-5.4
	0815	1120	4.0
W	1457	1659	-2.1
	1946	2248	2.5
2	0124	0506	-5.4
	0900	1206	4.0
TH	1546	1748	-2.0
	2032	2335	2.4
3	0209	0554	-5.3
	0949	1255	3.8
F	1636	1839	-2.0
	2129		
4		0028	2.2
	0301	0645	-5.0
SA	1040	1346	3.7
	1726	1933	-2.0
	2239		
5		0127	2.0
	0403	0740	-4.5
SU	1133	1441	3.5
	1816	2031	-2.2
6	0000	0235	1.9
	0517	0837	-3.9
M	1229	1538	3.3
	1903	2133	-2.6
7	0120	0355	2.0
	0642	0941	-3.3
TU	1326	1635	3.2
	1948	2235	-3.1
8	0231	0515	2.3
	0807	1048	-2.8
W	1423	1727	3.0
	2032	2337	-3.7
9	0334	0630	2.8
	0927	1156	-2.4
TH	1519	1821	2.9
	2116		
10		0031	-4.3
	0429	0733	3.4
F	1038	1302	-2.2
	1613	1912	2.9
	2159		
11		0122	-4.8
	0520	0828	3.8
SA	1140	1401	-2.1
	1704	1955	2.8
	2243		
12		0208	-5.1
	0608	0921	4.1
SU	1235	1454	-2.0
	1752	2043	2.8
	2326		
13		0252	-5.3
	0653	1005	4.1
M	1324	1537	-2.0
	1837	2124	2.7
14	0008	0335	-5.3
	0737	1048	4.1
TU	1409	1618	-1.9
●	1919	2207	2.6
15	0049	0418	-5.2
	0819	1129	3.9
W	1452	1659	-1.9
	2000	2248	2.4
16	0130	0457	-4.9
	0901	1207	3.7
TH	1534	1735	-1.8
	2042	2330	2.2
17	0210	0538	-4.6
	0942	1248	3.4
F	1616	1819	-1.8
	2128		
18		0013	2.0
	0252	0620	-4.3
SA	1023	1327	3.1
	1657	1901	-1.8
	2220		
19		0058	1.8
	0338	0705	-3.8
SU	1104	1409	2.9
	1737	1949	-1.9
	2321		
20		0154	1.5
	0431	0752	-3.3
M	1145	1448	2.6
	1817	2038	-2.0
21	0030	0254	1.4
	0536	0844	-2.7
TU	1228	1533	2.4
	1856	2129	-2.3
22	0139	0402	1.4
	0653	0939	-2.2
W	1314	1620	2.2
	1935	2222	-2.6
23	0242	0516	1.6
	0813	1036	-1.8
TH	1404	1709	2.1
	2014	2318	-3.1
24	0336	0625	2.0
	0929	1139	-1.6
F	1457	1758	2.0
	2055		
25		0010	-3.6
	0425	0725	2.5
SA	1035	1238	-1.5
	1550	1847	2.1
	2136		
26		0058	-4.1
	0510	0814	3.0
SU	1133	1336	-1.6
	1639	1934	2.2
	2218		
27		0147	-4.6
	0554	0902	3.4
M	1224	1425	-1.7
	1726	2018	2.4
	2302		
28		0233	-5.1
	0637	0945	3.8
TU	1312	1512	-1.9
	1809	2105	2.6
	2346		
29		0318	-5.5
	0720	1026	4.1
W	1357	1559	-2.1
O	1853	2150	2.8
30	0031	0407	-5.7
	0803	1109	4.3
TH	1440	1646	-2.3
	1939	2239	2.9

Extract from Pacific tide tables.

Chapter Thirteen

SOURCES OF NAVIGATIONAL INFORMATION CHARTS & PUBLICATIONS

The Navigational Chart

If the history of charts is investigated the origins will probably lie in and around the 1st century A.D. and for todays mariners to even remotely consider using a chart of this period for navigation would be quite unthinkable. The experienced mariner has come to realise that no chart is infallible and for one or more of several reasons an element of caution should always be exercised. Absolute reliability because of age of survey or imperfect survey immediately come to mind as reasons for exercising caution when employing any navigational aid.

The first Admiralty chart was published in 1801, and since that beginning technical innovation has improved accuracy and detail to give the maritime world a comparatively high standard of navigational chart. The date of survey of each chart is therefore a major consideration when placing reliability and accuracy on the content. Examples of this are easy to see if soundings are considered which were charted by means of the hand lead line, as compared with today where electronics can be more precisely employed.

Reliability of charts (Reasons for caution in their use)

1) Date of survey	—	Methods of early survey are not as efficient as modern techniques.
2) Survey detail	—	May be incomplete or incorporate mistakes from old survey methods.
3) Topographical alterations	—	Changes in topography are ongoing and will continue to occur subsequent to survey.
4) Magnetic variation	—	Will continue to change with the passing of time.
5) Nature of sea bottom	—	In many areas of the world the nature of the sea-bed is unstable, very often due to volcanic action and soundings may not be a true representation.
6) Scale of chart	—	Although the largest scale of chart is always recommended for use, this scale may impose restrictions and limitations on information displayed. Caution advised with small scales.
7) Corrections and updates	—	The time in obtaining corrective information and applying revisions to the chart can mean vessels could encounter new uncharted dangers.

Information Contained on the Chart

Admiralty Chart Agents — These are world wide and keep fully corrected stocks of charts capable of meeting day to day requirements. Addresses of chart agents can be found in the Annual Summary of Admiralty Notices to Mariners and also

in the catalogue of Admiralty Charts. This catalogue also provides a total listing of all Admiralty and some Australian/New Zealand charts together with respective prices.

Each chart will have the following notations and titles:

Title of chart	—	Usually placed on a land mass area so as not to effect navigation. The title generally describes the geographic extremities of the charted area.
The Number of the chart	—	Shown at the bottom right hand corner and the top left hand corner (inverted). Also found on the label on the back of the chart.
The date of publication	—	Shown in the bottom margin, in the middle of the chart. The notation will also carry the place where publication takes place. e.g. (Published at Taunton 28th May 1976)
Dates of new editions	—	New edition dates are shown to the right of the date of publication. (All previous corrections and previous copies of the chart are cancelled)
Dimensions of the chart	—	Shown in millimetres is displayed in the margin at the bottom right hand corner.
Date of printing	—	This is shown on the reverse on the label of the chart.
The units used for depth	—	Stated in bold letters under the title of the chart. e.g. (DEPTHS in METRES)

The Scale of the Chart	—	This is carried under the stipulated units of depth, close to the region of the title.
Date of Survey	—	This is a notation form, under the title block naming the survey authorities.
Heights (for charted objects)	—	A notation under the title block which stipulates the units for which heights have been calibrated (e.g. metres). Also a reference from which heights are measured above. e.g. (MHWS)
Tidal Information (extensive)	—	Information relevant to various ports on the chart is printed in tabular form and placed in a suitable position on the chart.
Tidal Stream Information	—	Indicated by tidal diamonds or by tidal stream arrows when information suitable for the tabular format is not available. Additional cautions and notations in respective positions may highlight anomalies in tidal predictions and possible depths which could effect under keel clearance.

When ordering or describing a particular chart:

1) Stipulate the chart number.
2) State the title of the chart.
3) State the date of publication.
4) State the date of printing.
5) State the date of last new edition. (if any)
6) Provide the number or date of the last small correction (if known)

Updating Charts and Publications

Admiralty Notices to Mariners

Prior to any voyage it is the Masters responsibility to ensure that all charts and relevant publications are on board the vessel and that they are corrected to date, corrections being obtained from the weekly editions of notices to mariners. These are consecutively numbered from the beginning of each year providing fifty-two (52) issues.

Each weekly notice is comprised of six sections:—

I Index to Section II together with explanatory notes.

II Notices for the correction of charts. These include all notices effecting navigational charts and are listed consecutively from the onset of the year. The section also includes temporary (T) and preliminary (P) notices relevant to the week. The last weekly notice of each month will also list the temporary and preliminary notices which are remaining current.
Any new editions of charts published, together with new publications issued are listed in this section. Typical examples of publications include:- Sailing directions or light lists etc., Latest editions of publications are listed at the end of March, June, September and December.

III Navigational warnings are reprinted in this section. All warnings which are in force are included in the first weekly notice of each year. Additionally, all long-range warnings issued during the week are included in this section and listed on a monthly basis.
Lists of NAVAREA, HYDROLANT, & HYDROPAC messages.

IV All corrections effecting Admiralty sailing directions which are published that week. A cumulative list of those corrections in force is also published on a monthly basis.

V All corrections required for the Admiralty list of lights and fog signals. (Mariners are advised that these corrections may not be coincident with any chart correcting information.)

VI Corrections to the Admiralty list of radio signals, are contained in this last section.

Cumulative List of Admiralty Notices to Mariners

For the purpose of checking and up dating charts a list of the serial numbers of permanent notices is published. These notices will have been issued in the previous 2 years and will affect Admiralty Charts together with Australian and New Zealand Charts which have been re-published within the Admiralty series.

Annual Summary of Admiralty Notices to Mariners

This is published at the beginning of each year and contains the regular and important notices which cover the same topic or subject annually. It also contains all the temporary and preliminary notices affecting sailing directions which are in force at the end of the previous year.

The annual summary covers many diverse subjects from information on tidal surges to actions of the Master in the event of collision. Distress procedures and marine operations with aircraft and military are detailed features. The work of the Coast Guard, and the Royal National Lifeboat Institution are included together with virtually any navigational safety advice. e.g. offshore installations — positions and safety zones.

Chart Corrections

The main source of corrective material for Admiralty Charts is generally obtained from the issue of the weekly notices

to mariners as issued by the Hydrographic Department of the Navy. (Canadian Charts — Canadian Notice to Mariners) (United States Charts — U.S. Weekly Notices as published by the U.S. Defence Mapping Agency) also U.S. Coast Guard local notice to mariners.

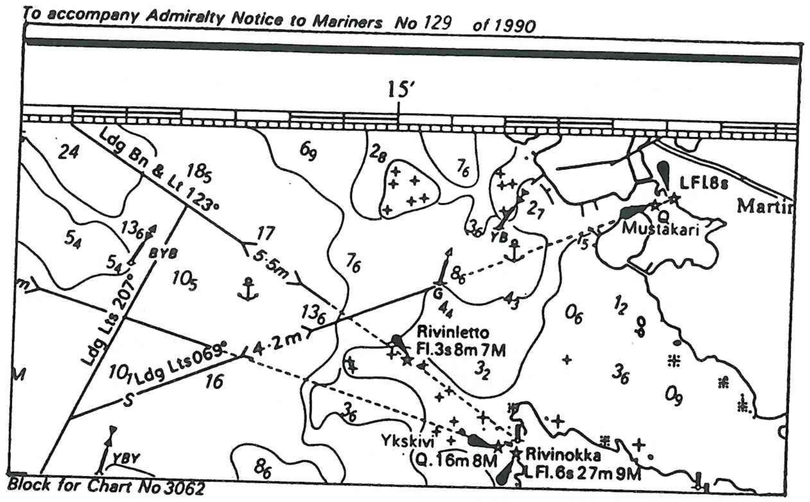
Charts stocked and supplied by the Hydrographic Department are not corrected for temporary or preliminary notices, and mariners are advised that these should be applied to affected areas in pencil, by the mariner, as appropriate. Weekly notices provide confirmation of temporary and preliminary notices in effect and a list of the notices in force is also included in the annual summary of notices to mariners.

The Hydrographic Department also publish a chart correction log. This contains a summary of correction sheets for the corrections which effect each chart folio. The charts being listed in numerical order with the relevant notices listed. Australian and New Zealand charts contained in Admiralty folios are also indicated together with listed new charts and new editions.

Block Corrections

Weekly notices often include areas of charts, which have been reproduced for affixing to the chart in the form of a corrected portion. These areas are known as 'blocks'. The purpose of the block may be twofold, not only to indicate new information but also to obliterate or delete items previously shown. Some distortion can be expected when adjoining the block to the chart and this can be minimised by pasting the charted area, as opposed to pasting the cut out block. (The paste can cause excessive distortion to the small area of the block).

Block examples are shown overleaf.



129. BALTIC SEA – Gulf of Bothnia – Finland, west coast – Approaches to Oulu – Martinniemi – leading lights and buoyage amended.

The accompanying block shows changes to leading lights and buoyage in the approach to Martinniemi (65° 12' 7N., 25° 17'.5E).

Chart [*Last correction*]. – **3062 (plan, approaches to Oulu)** [*3057/89*].

Light list Vol. C/88.4121, 4121.1.

Finnish notices 25/454/89 & 26/480/89. (*H. 3348/87*).

Overlay Correction Tracings

A more modern method of chart correction which is now used extensively by all chart depots and agents. Precise corrections can be transferred from a tracing directly onto the chart by the mariner.

Compiling and Maintaining Charts

Sources of Information: In order to provide not only a safe but efficient service, the hydrographic departments of the various authorities around the world correct and update the navigational charts supplied. These corrections are obtained by information from original surveys and from re-surveys. In the case of the United Kingdom the Royal Navy operate survey vessels for this particular task.

Other governments carry out similar activities and an exchange of information is possible through the 'International Hydrographic Bureau' in Monaco. The title has now become known as the International Hydrographic Organisation (IHO)

Information is also gleaned from port & harbour authorities and independent surveying organisations regarding plans and surveys of local areas. Especially important in the case of expansion of port and harbour facilities. Breakwaters being extended, new buildings and/or specific landmarks being constructed, etc.,

Additional information is also obtained from a variety of persons within the marine environment via the use of 'Hydrographic Notes'. These note formats are contained in blank form within the Weekly Notices to Mariners (Form Ref H.102 Admiralty Notices). Instructions of forwarding information are included in the Weekly Notice.

H.102 (October, 1985)

HYDROGRAPHIC NOTE

(*for instructions, see overleaf*)

Date ....

Ref. No ....

Name of ship or sender: ....

Address: ....

....

....

General locality ....

Subject ....

Approx. Position. Lat. .... Long. ....

British Admiralty Charts affected ....

Latest Notice to Mariners held ....

Publications affected (Edition No., date of latest supplement, page and Light List No. etc.)

....

Details: –

(To accompany Form H.102)

Name of ship or sender: ....

Address: .... Ref. No. ....

.... Date: ....

....

1. NAME OF PORT	
2. GENERAL REMARKS Principal activities and trade. Latest population figures and date. Number of ships or tonnage handled per year. Maximum size of vessel handled. Copy of Port Handbook if available.	
3. ANCHORAGES Designation, depths, holding ground, shelter afforded.	
4. PILOTAGE Authority for requests. Embarkation position. Regulations.	
5. DIRECTIONS Entry and berthing information. Tidal Streams. Navigational aids.	
6. TUGS Number available and max. hp.	
7. WHARVES Names, numbers or positions. Lengths. Depths alongside. Heights above Chart Datum. Facilities available.	
8. CARGO HANDLING Containers, lighters, Ro-Ro etc.	

9. CRANES Brief details and max. capacity.	
10. REPAIRS Hull, machinery and underwater. Ship and boat yards. Docking or slipping facilities. Give size of vessels handled or dimensions. Hards and ramps. Divers.	
11. RESCUE AND DISTRESS Salvage, lifeboat, Coastguard, etc.	
12. SUPPLIES Fuel with type and quantities available. Fresh water with rate of supply. Provisions.	
13. SERVICES Medical. De-ratting. Consuls. Ship chandlery, compass adjustment, tank cleaning, hull painting.	
14. COMMUNICATIONS Road, rail and air services available. Nearest airport or airfield. Port radio and information service with frequencies and hours of operating.	
15. PORT AUTHORITY Designation, address and telephone number.	
16. SMALL CRAFT FACILITIES Information and facilities for small craft (eg yachts) visiting the port. Yacht Clubs, berths, etc.	
17. VIEWS Photographs (where permitted) of the approaches, leading marks, the entrance to the harbour, etc. Picture postcards may also be useful.	