

INTERNATIONAL HYDROGRAPHIC ORGANIZATION



**STANDARDIZATION
of
LIST OF LIGHTS
and
FOG SIGNALS**

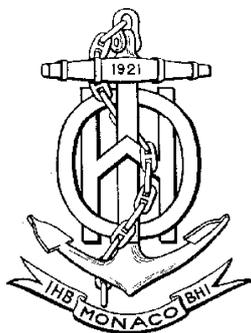
June 2004

**Published by the
INTERNATIONAL HYDROGRAPHIC BUREAU**

MONACO

S-12

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FOREWORD

IHO Publication S-12 provides a standardized structure for the publication of List of Lights and Fog Signals.

The text of this document (S-12) was prepared by a working group of the North Sea Hydrographic Commission (NSHC). After discussion at the XIVth International Hydrographic Conference in 1992, a revised draft was circulated to Member States under cover of CL 3/1996. Further amendments were made under cover of CL 51/1996 and CL 17/1997. Approval to publish was agreed at the XVth IHC in 1997.

Due to the long delay in publishing S-12, IHB staff reviewed the text in order to make some presentational improvements and follow the format of other IHO publications.

This revised draft was passed to Member States for approval under cover of CL 12/2004.

The Geographical Range Table (Pages A-18 to A-19) and the Luminous Range Diagram (Page A-21) are © Crown Copyright; reproduced by permission of the Controller of Her Majesty's Stationery Office and the UK Hydrographic Office (www.ukho.gov.uk).

CONTENTS OF LIST OF LIGHTS AND FOG SIGNALS

The contents of the List of Lights and Fog Signals will be as follows:

- Map – Index (see § 1)
- Preface (see § 2)
- Introduction to the Tables – Foreword (see § 3)
- List of symbols and abbreviations (see § 4)
- Glossary of foreign terms (see § 5)
- Regional information (see § 6)
- Table of Lights (see § 7)
- Table of equivalent light numbers (see § 8)
- Alphabetic index (see § 9)

1. Map – Index

It is recommended that countries that publish Lists of Lights and Fog Signals in more than one volume, insert in each volume an index chart showing the geographical limits of all the volumes.

2. Preface

The optional *Preface* is not standardised. Its content is to be decided by each country in order to introduce the publication to users and to inform them of the means by which it can be updated. It is published in the national language. An English version of this text is given in Appendix A.

3. Introduction to the Tables – Foreword

This introduction is intended to be a guide to the reading and use of information in the *Table of Lights*, and is a standard text published in the national language.

Introduction to the Tables – Foreword covers:

- the rules and conventions adopted for editing the *Table of Lights* (cf. § 7);
- definitions and cautions

4. List of symbols and abbreviations

The international symbols, terms and abbreviations used in the *Table of Lights* are included in a list containing their legend in English and in the national language.

5. Glossary of foreign terms

Each List of Lights and Fog Signals includes a glossary of the geographic terms and descriptions mentioned in the national language in the *Table of Lights*.

The glossary uses the national language, English or French and optionally any other languages.

6. Regional Information

Those characteristics specific to the area covered by the publication which therefore are not described in the *Introduction to the Tables* are collected together in *Regional information* giving:

- information common across the area;
- national information, by country.

This information specifically deals with times, references (ranges – elevations) and any arrangements contrary to the general rules described in the *Introduction to the Tables*.

Regional Information is not to be standardised and is published in the national language.

7. Table of Lights

Note: Details of the content of the *Table of Lights* appear in the *Introduction to the Tables* (see Appendix A).

The *Table of Lights* is subject to a standardisation as stringent as possible, using the following layouts:

- a/ Tables in 8 columns. The column titles given in the national language do not require translation into another language.
- b/ Complete standardisation of Columns 1 to 6 by the use:
 - column 1: of national and international numbers
 - column 2: of international toponymic rules
 - column 3: of latitudes and longitudes accurate to at least one tenth of a minute
 - column 4: of international abbreviations for the description of lights (character, colour, period). Intensity/candelas is optional – see 4.4.
 - column 5: of elevation in metres
 - column 6: of nominal range (Not geographical, luminous or mean) in nautical miles

Within these columns neither national terms nor national abbreviations are used.

- c/ Partial standardisation of columns 7 and 8 by the use:
 - of structure height in metres above the ground – see 4.7.
 - of international symbols

- of international abbreviations
- of terms in the national language written out in full.

8. Table of equivalent light numbers

A *Table of equivalent light numbers* should be included in each volume and contain the national number corresponding to each of the international numbers appearing in the volume.

9. Alphabetical index

An *Alphabetical index* is inserted at the end of the volume, giving the national number of lights against their name or the name of the geographic feature to which they belong when it appears in the *Table of Lights*, column 2.

INTRODUCTION TO THE TABLES - FOREWORD

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INTRODUCTION TO THE TABLES - FOREWORD

1. GENERAL

The List of Lights and Fog Signals describe maritime signal installations on land or afloat producing light or sound signals (fog signals). Some secondary lights of low power and range situated within ports or zones where pilotage is obligatory and certain waterways installations may be omitted or are only briefly described. Aeronautical lights and air obstruction lights are included when visible from seaward.

In addition, these volumes contain information relating to certain other navigational aids: buoyage (day and night); signals (port signals, rescue signals, tide signals, etc.), radio-based aids (radio beacons, radar, radio navigation systems), etc.

In order to obtain descriptions of these aids and details of their mode of operation, users must consult appropriate publications (radio signal publications) or more general ones (Sailing Directions, etc.).

2. FINDING MARITIME SIGNAL INSTALLATIONS

2.1 Lights and fog signals are listed in the geographic sequence normally used in the Sailing Directions, in ascending order of numbers (cf. § 4.1). Area (chapter) and sub-area (chapter parts) designations quoted at the top of each page are complemented by the name of the area appearing within the tables.

Certain long range lights may exceptionally be described twice under two different numbers, first when describing the lights visible from seaward following a direct route and second when describing the lights visible during coastal navigation.

Maritime radio beacons operating from lights or in their immediate neighbourhood are shown at the corresponding geographic positions.

2.2 Searching for a light or fog signal is simplified by using:

- a table giving corresponding international and national numbers of lights (cf. § 4.1).
- an alphabetical index.

3. **DEFINITIONS**

3.1 **Light Signals**

- *General Terms*

Character – distinctive combination of various aspects of a light (i.e. when lit, extinguished, coloured or white) which appear regularly or rhythmically allowing it to be identified (for example, fixed, flashing, group flashing, alternating).

Fixed Light – a light exhibiting without interruption or change of character and of constant colour.

Rhythmic Light - is a light exhibiting its character in recurring regular cycles (flashes, group flashes, alternating).

Alternating Light – a rhythmic light exhibiting different colours during each cycle.

Period – time interval between the beginnings of two successive cycles of a rhythmic light.

Phase – each successive element of a rhythmic light's cycle (i.e. flash, eclipse).

Bearings – the limits of light sectors and areas of visibility of lights and the alignments of leading lights and directional lights are given as bearings from seaward. The bearings of sectors are given in clockwise order.

- *Descriptive Terms*

Aeronautical Light - a light generally of great intensity and elevation principally for aircraft navigation. Because of their intensity, these are often the first lights to be seen when approaching land.

Aeromarine Light – marine light in which the upper edge of the beam has been deflected at an angle of 10° to 15° above the horizon, so that the light is usable for aircraft navigation.

Air Obstruction Light – light marking obstruction to aircraft; they are usually red.

Daytime Light – light operating 24 hours a day without change of character (except in specific cases which will be mentioned in the text). The intensity may be increased by day.

Direction Light – light illuminating a very narrow sector, used to mark a direction to be followed. This sector may be flanked by sectors of greatly reduced intensity or by sectors of different colour or character.

Elevation of a Light – vertical distance between the focal point of the light and mean sea level (where there is little appreciable tide at the adjacent shoreline) or (elsewhere) MHWs or another appropriate high water datum.

Fog Detector Light – light positioned in order to detect fog automatically. There are various types: some are visible only over a narrow arc; some exhibit a bluish-white flash lasting approximately one second; others sweep back and forth.

Fog Light – light which is operated only when visibility is reduced.

Height of the Structure – vertical distance between ground level and the top of the light structure, including any finial but excluding all aerials, antennas and arrays.

Leading Lights – two or more lights associated so as to form a leading line to be followed.

Lights in Line – lights associated to form an alignment used to indicate the limit of an area, cable runs, alignments for mooring, etc. They do not mark alignments to be followed.

Loom – diffused light resulting from atmospheric effects observed when a light is below the horizon or is hidden by an obstacle.

Luminous Intensity – luminous flux emitted by a light source in a given direction in one unit of solid angle; the luminous intensity is expressed in candelas.

Main Light – the most important light in a group of two or more lights on the same support or on neighbouring supports.

Occasional Light – shown only in certain circumstances; for example shown when vessels are expected or fishing lights.

Passing Light – A low intensity light which may be mounted on a structure of another light to enable the mariner to keep the latter light in sight when passing out of its beam during transit.

Sector Light – a light presenting differing appearances (particularly in colour) over various parts of the horizon of interest to marine navigation.

Subsidiary Light – a secondary light placed on or near to a main light's support and having a special navigational function; for example a passing light on a leading light structure.

Unwatched Light – light which operates automatically and which is controlled automatically over a considerable period of time, with only periodic maintenance visits.

3.2 Sound Signals

- *General Terms*

Sound Signal – sound transmitted to convey information.

Fog Signal – sound signal to warn or guide ships in conditions of poor visibility.

Morse Code Fog Signal – fog signal emitting one or more characters of the Morse Code.

True Range – maximum distance, measured from the place of emission, at which the information carried by the signal can be understood, in existing propagation and listening conditions.

- ***Fog Signals and sound producing systems***

Bell – equipment producing a characteristic sound by striking a metal bell-shape.

Diaphone – equipment producing a characteristic sound using a reciprocating piston with vents operated by compressed air. Output can be in the form of two tones at different sound levels, the second tone being at a lower frequency. If there is only one tone, it ends in a suddenly lowered pitch known in English as a “grunt”.

Explosive Signals – sound fog signals produced by detonating explosive charges.

Gong – a flat disc or tray producing a distinctive resonant sound.

Horn – equipment consisting of a tube of varying transverse dimensions producing a characteristic sound:

- Klaxon is a nautophone of smaller size sometimes operated by hand.
- Membrane Horn produces its sound by means of a membrane vibrated by compressed air, steam or electricity.
- Nautophone is a horn in which the membrane is activated electrically.
- Reed is a horn in which the membrane is replaced by a steel reed vibrated by compressed air.
- Typhon is a horn in which the membrane is vibrated by steam or compressed air.

Siren – a deep sounding fog warning in which the sound is produced by the passage of air across slits or holes in a rotating disc. It can emit a wailing sound.

Underwater acoustic signals – low frequency sound emitted in water by large-sized membranes vibrated by electricity. Their range (up to 50 nautical miles) is far greater than that of signals in air and using specialised hydrophones, bearings can be obtained with sufficient accuracy.

Hooter – equipment in which the frequency of sound varies periodically about a mean value.

Whistle – equipment producing a shrill sound by releasing compressed air or steam across an opening.

4. READING THE TABLE OF LIGHTS

The lights and fog signals are listed and described in an eight-column table. The contents and principal conventions are used as follows:

4.1 Column 1 – National and international numbers

National Number

National light numbers are four, five or six figure numbers in upright type. These numbers may change between successive editions of the List of Lights and Fog Signals.

International Number

In the first column, under the majority of national numbers, is listed an alpha-numeric group in *italic type*, with one capital letter followed by four, five, six or seven figures, including up to 3 decimal places.

These alpha-numeric groups are the international numbers assigned to lights to avoid confusion when referring to them. These numbers correspond to the numbers given in the Admiralty List of Lights and Fog Signals (ALL). Where changes to these International Light numbers are needed this will normally only be done when a new edition of the ALL is published. Such changes will be announced as a free text Section V entry in Admiralty Notice to Mariners.

4.2 Column 2 – Area, name and position

Information designed to allow unambiguous description of each light is contained in this column.

- on occasion, the place or geographic feature (area, port, roadstead, island...) and/or the feature (alignment...) to which the lights belong, particularly when the light has no specific place name associated with it.
- name of the light
- on occasion, an abbreviated description of the location of the equipment.

The toponymic form used follows the official rules. Differences may exist between the listed forms and those on earlier editions of nautical charts and other marine publications. The superseded toponymic form may then be shown in brackets.

The typographic elements employed allow the following distinctions to be made:

CAPITALS	:	geographic entities
lowercase upright and bold	:	land based lights with nominal range of at least 15 nautical miles
lowercase upright and light	:	other land based lights, resilient and buoyant beacons
<i>ITALIC CAPITALS</i>	:	light vessels
<i>lowercase italic</i>	:	<i>light floats and all other floating lights/buoys</i>

Where an area includes lights belonging to different countries, the light names or locations are followed by the abbreviated names of the countries in brackets.

4.3 Column 3 – Geographic positions

Geographic positions are shown in degrees minutes and at least tenths of a minute (latitude and longitude).

However, in the case of leading or transit lights, the position of the rear light may be given by bearing and distance from the front leading light.

Longitudes are referred to the International Meridian (Greenwich).

Positions given are approximate. They are included only to help in the identification of features on charts. It is possible to find differences, especially in longitude, of several tenths of a minute between these positions and those on charts in use, as a result of the variations between geodetic reference systems.

4.4 Column 4 – Characteristics of lights and fog signals

The following information is given for lights:

- the character
- the rhythm (for rhythmic lights)
- the colour (white included)
- the period in seconds (the symbol “s” is used)
- on occasion:
 - . a complimentary term (Dir, Aero, etc.)
 - . the luminous intensity, given in candelas (in *italics* beneath the characteristics). For lights having phases of different luminous intensities, the maximum intensity is indicated (intensity of the longest flash in the case of group or MORSE code lights).

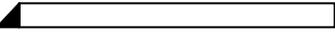
Ex. : Dir F1.W4s
170

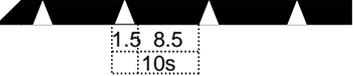
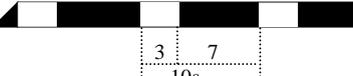
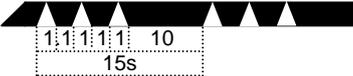
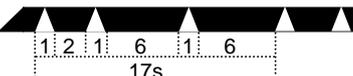
The following information is given for fog signals:

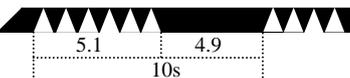
- the type of signal source
- the rhythm
- the period

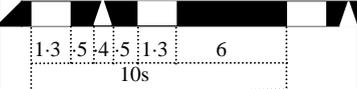
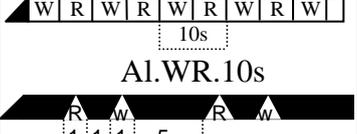
All this information is given using standardised international abbreviations.

The following tables give descriptions of the various light characters with examples illustrating each one of them.

Description	International Abbreviation	Example	Remarks
<p>1. FIXED</p> <p>A light which appears continuous and steady and of constant colour to an observer whose position remains unchanged in relation to it.</p>	F	 <p>F.W</p>	
<p>2. OCCULTING</p> <p>A light in which the total duration of light in each period is clearly longer than the total duration of darkness, and the intervals of darkness (eclipses) are usually of equal duration.</p>			
<p>2.1. Occulting</p> <p>An occulting light in which an eclipse is regularly repeated.</p>	Oc	 <p>2 10 12 Oc.W.12s [2]</p>	
<p>2.2. Group Occulting</p> <p>A light in which a number of eclipses are regularly repeated. The total duration of light in each period may be equal to the total duration of darkness.</p>	Oc(..)	 <p>1 1 1 10 13 Oc(2)W.13s [1;1;1;10]</p>	
<p>2.3. Composite Group Occulting</p> <p>A light similar to a group occulting light, except that successive groups in a period have different numbers of eclipses. The total duration of light in each period may be equal to the total duration of darkness.</p>	Oc(.. + ..)	 <p>1 1 4 4 12 Oc(2+1)W.12s [1;1;1;4;1;4]</p>	
<p>3. ISOPHASE</p> <p>A light in which all the durations of light and darkness are clearly equal.</p>	Iso	 <p>5 5 10 Iso. W. 10s</p>	

Description	International Abbreviation	Example	Remarks
<p>4. FLASHING</p> <p>A light in which the total duration of light in a period is shorter than the total duration of darkness and the appearances of light (flashes) are usually of equal duration.</p>			
<p>4.1. Flashing</p> <p>A flashing light in which a flash is regularly repeated at a rate of less than 50 flashes per minute.</p>	Fl	 <p>Fl.W.10s [1.5]</p>	<p>1/ The convention is to show the length of a flash to 0.1s</p> <p>2/ When the length of a flash is too brief to be expressed, it is shown as Fl and the duration of the eclipse is equal to the period.</p>
<p>4.2. Long Flashing</p> <p>A flashing light in which an appearance of light of not less than 2s duration (long flash) is regularly repeated.</p>	L Fl	 <p>LFl.W.10s [3]</p>	
<p>4.3. Group Flashing</p> <p>A flashing light in which a group of flashes, specified in number, is regularly repeated.</p>	Fl(..)	 <p>Fl(3)W.15s [1;1;1;1;10]</p>	
<p>4.4. Composite Group Flashing</p> <p>A light similar to a group flashing light except that successive groups in a period have different numbers of flashes.</p>	Fl(..+..)	 <p>Fl(2+1)W.17s [1;2;1;6;1;6]</p>	
<p>5. QUICK</p> <p>A light in which flashes are repeated at a rate not less than 50 flashes per minute but less than 80 flashes per minute.</p>			
<p>5.1. Quick</p> <p>A quick light in which a flash is regularly repeated</p>	Q	 <p>Q.W</p>	

Description	International Abbreviation	Example	Remarks
<p>5.2 Group Quick</p> <p>A quick light in which a specified group of flashes, specified in number, is regularly repeated.</p>	<p>Q(..)</p>	 	<p>An exceptional light character reserved to indicate a South cardinal mark.</p>
<p>5.3 Interrupted Quick</p> <p>A quick light in which the sequence of flashes is interrupted by regular repeated eclipses of constant and long duration.</p>	<p>I Q</p>		
<p>6. VERY QUICK</p> <p>A light in which flashes are repeated at a rate of not less than 80 flashes per minute but less than 160 flashes per minute.</p>			
<p>6.1. Very Quick</p> <p>A very quick light in which a flash is regularly repeated</p>	<p>V Q</p>	 <p>VQ.W</p>	
<p>6.2. Group Very Quick</p> <p>A very quick light in which a specified group of flashes, specified in number, is regularly repeated.</p>	<p>V Q(..)</p>	 	<p>An exceptional light character reserved to indicate a South Cardinal mark</p>
<p>6.3. Interrupted Very Quick</p> <p>A very quick light in which the sequence of flashes is interrupted by regularly repeated eclipses of constant and long duration.</p>	<p>I V Q</p>		

Description	International Abbreviation	Example	Remarks
7. ULTRA QUICK A light in which flashes are repeated at a rate of not less than 160 flashes per minute.			
7.1. Ultra Quick An ultra quick light in which a flash is regularly repeated.	U Q	 UQ.W	
7.2. Interrupted Ultra Quick An ultra quick light in which the sequence of flashes is interrupted by eclipses of long duration.	I U Q	 IUQ.W.12s	
8. MORSE CODE A light in which appearances of light of two clearly different durations are grouped to represent a character or characters in the Morse Code.	Mo(..)	 Mo(K)W.10s [1.3;0.5;0.4;0.5;1.3;6]	
9. FIXED AND FLASHING A fixed light varied, at regular intervals, by a flash of higher luminous intensity.	F Fl	 FFl.W.5s	The flashing light may have any of the characters in (4)
10. ALTERNATING A light showing <i>different</i> colours alternately.	Al	 Al.WR.10s Al.Fl(2)RW.8s [1;1;1;5]	An alternating light may be occulting, isophase, flashing or fixed and flashing

4.5 Column 5 – Elevation of light

The elevation of the light is its altitude above sea level. It is given in metres. The reference datum in most cases is mean sea level. When it is otherwise, the adopted reference datum is given under *Regional information*.

4.6 Column 6 – Range

Ranges of lights are given in nautical miles (M): in **bold type** if equal to or greater than 15 M, in normal type if less. When a light has differing ranges depending on its sector colours, these are given against the corresponding colours.

Ranges should be nominal (*see page 2 paragraph 7 - Table of lights*).

- *Definitions*

To be seen at a given distance, the light must:

- a/ be above the apparent horizon of the observer
- b/ have a sufficient luminous intensity
- c/ not be obscured by meteorological conditions between it and the observer.

One can define various types of range when considering the largest distance at which a light would be visible if one took account of only one or other of the conditions given above.

Geographic range

The geographic range depends on the elevation of the light, the height of the observer's eye and the atmospheric refraction. The table at the end of this *Introduction* (Page A-18) gives the geographic range in nautical miles as a function of the height of the observer's eye and of the elevation of the light in meters. In some cases, the elevation of the light must be adjusted for tide. The formula used to determine the geographic range is given below the table.

Luminous range

The luminous range of a light depends primarily upon its luminous intensity and the clarity of the air and, to a lesser degree, upon the character, the length of flashes and the intervals between them.

The luminous intensity in candelas may be included in *italics* beneath the characteristics in column 4.

Meteorological stations broadcast information relating to horizontal visibility at the surface in kilometres on a ten point scale from 0 to 9 (code VV) for a given time in a given area.

The *luminous range* diagram at the end of this *Introduction* (Page A-19) allows the luminous range of a light in nautical miles to be determined as a function of its luminous intensity (in

candelas) and its horizontal visibility (in nautical miles). To enter the diagram, the luminous intensity may be replaced by the nominal range (see below) shown in column 6.

For example, for a nominal range of 10 M (or an intensity of 1300 candelas) and a meteorological visibility of 7 M the luminous range will lie between 7 M and 8 M.

It should be noted that determination of the luminous range using this diagram is imprecise as the transparency of the atmosphere is not necessarily constant between the observer and the light.

Nominal range

The International Association of Lighthouse Authorities (IALA – AISM) has recommended the adoption of a nominal range in nautical miles (M) defined as the luminous range in a homogeneous atmosphere with a standard meteorological visibility of 10 M.

4.7 Column 7 – Description of structures – topmarks - heights

The structure carrying a light or fog signal is described in the national language: nature (and function for buoys) – form and material used in construction – colours. The topmark, if one exists, is shown by its symbol, accompanied by its colour using the international abbreviation. However, colours of cardinal marks are not included (neither are colours of cardinal structures) as these are strictly controlled. The height is the vertical distance, above ground level, of the top of the structure, including any finial, but excluding aerials, antennas and arrays, given in metres.

Note: To avoid ambiguity, only INT abbreviations are used. Terms in national languages are always written out in full.

4.8 Column 8 – Complementary information

In this column is found:

a/ with respect to light character (column 4):

- the limits of intensified sectors and corresponding width.
Example: Intens 136,5 – 146,5 (10).
- the full descriptions of the phases for rhythmic lights (except those for cardinal marks) by enumeration of all lights and eclipses durations in conformity with the bracketed group of characteristic numbers in column 4 (examples are given in the table of section 4.4.).
- the colour sectors of a sectors light. The sectors are described clockwise, either from the North if the light is seen all round, or following the most important obscured sector if one exists.
Example: 015 – **W** – 078 – **R** – 154 – **Obscd** – 282 **Unintens W** – 336 – **G** – 015.

or

W015° -078° (63°), R078° - 154° (76°), W(unintens)282° - 336° (54°), G336° - 015° (39°)

- the visible sectors when an obstacle partly masks the light.

Example: **Vis** 050 – 280 (230), or if there are multi-coloured sectors W050° - 280° (230°), R280° - 290° (10°)

Bearings are given from seaward, in degrees and, if required, in tenths of a degree or degrees and minutes. The abbreviations for colours and descriptions such as **Vis**, **Obscd**, **Intens**, are in **bold type**.

With the exception of the very narrow sectors of directional lights, sector limits and sector widths are not precise and should not be used for positioning.

- b/ with respect to fog signal characters (column 4), the description of the phases of the sound signals should be shown in column 8 in the same way as the phases of a light.
- c/ other information.

Such information may relate to the light or fog signal:

- circumstances of activation (control, times, seasonal alterations, provisional characteristics, temporary interruption, “destroyed”, “private” light, etc.).
- reference to a mention of the light under another number, or reference to other light numbers.

Mention may also be made of additional features of the station which relate to navigation (radar reflector, radar beacons, radio beacons, radio buoys, AIS or D/F stations, various signals), and which are carried by the same structure or near to it. Detailed descriptions of these features appear in the List of Radio Aids and in Sailing Directions.

Associated secondary lights with summary description, and nearby air obstruction lights may also be included in this column.

Lastly one also finds provisional or temporary information thought to be of use to the navigator.

Note: All information in this column is in the national language. However, the only abbreviations used are the international ones also used on charts.

5. INFORMATION RELATING TO LIGHTS

5.1 General – detection – type and position

- lights at high elevations are more frequently obscured by clouds than are those at or near sea level.

- light floats may be removed without warning for repair and not be replaced.
- the positions and status of lit buoys are to be treated with caution.
- aeronautical lights are often very powerful and as a result of their high elevation, may be visible at much larger distances than ordinary navigational lights. However, they are positioned only approximately on charts, and they may at times be switched off without warning. In addition, these lights, being administered by organisations other than those dealing with marine lights, may have their colours or character altered before it is possible to notify navigators through Notices to Mariners.
- as with aeronautical lights, air obstruction lights are not meant for marine navigation and the same reservations apply equally to them.

5.2 Visibility – range

- the distance between a light and an observer cannot be estimated using the apparent brightness of the light.
- fog, mist, dust, smoke and rain are amongst factors which considerably reduce the range at which a light is visible.
- a brightly-lit area behind a light can have a big influence on a light's visibility.
- in cold weather, and especially when there are sudden temperature changes, ice, rime or condensation may form on light glasses considerably reducing visibility and turning certain colours to white.

5.3 Colours

- colour differences should be treated with caution. Atmospheric light propagation conditions and eye strain can contribute to a considerable reduction in the ability to distinguish colours. At night, it is particularly difficult to distinguish a white light from a yellow or a blue one seen in isolation except when close up. In certain atmospheric conditions, a white light can take on a reddish hue. By day, colours are unclear when looking toward the sun, and a bright red has a tendency to appear orange. In particular, the alternating character of a light may be altered.

5.4 Characters

- the apparent characters of lights having phases of varying luminous intensities can vary, depending upon the distance from which they are viewed, because certain phases may not be distinguishable.
- lights with very short flashes may not be visible at expected distances.

- the length of a short flash seems to be reduced when it is observed at a distance close to its maximum range and in poor atmospheric conditions.
- the apparent characters of floating lights should be treated with care, as they can be totally different from the actual characters, due to the variations of the height and orientation of the optical device.

5.5 Sectors

- in most cases, sector limits should be treated with care. They are in general ill-defined, with lit and unlit sectors merging gradually into each other. Colour changes between sectors are also gradual, sometimes occurring over several degrees (the angle of uncertainty).
- when a light is masked by sloping ground, the bearing on which it disappears or appears varies with the distance and height of the observer's eye.

GEOGRAPHICAL RANGE TABLE

Elevation in	Height of Eye of Observer in feet/metres																							
	3	7	10	13	16	20	23	26	30	33	39	46	52	59	66	72	79	85	92	98	115	131	148	
ft	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	22	24	26	28	30	35	40	45	
m	Range in Sea Miles																							
0	0	2.0	2.9	3.5	4.1	4.5	5.0	5.4	5.7	6.1	6.4	7.0	7.6	8.1	8.6	9.1	9.5	10.0	10.4	10.7	11.1	12.0	12.8	13.6
3	1	4.1	4.9	5.5	6.1	6.6	7.0	7.4	7.8	8.1	8.5	9.1	9.6	10.2	10.6	11.1	11.6	12.0	12.4	12.8	13.2	14.0	14.9	15.7
7	2	4.9	5.7	6.4	6.9	7.4	7.8	8.2	8.6	9.0	9.3	9.9	10.5	11.0	11.5	12.0	12.4	12.8	13.2	13.6	14.0	14.9	15.7	16.5
10	3	5.5	6.4	7.0	7.6	8.1	8.5	8.9	9.3	9.6	9.9	10.6	11.1	11.6	12.1	12.6	13.0	13.5	13.9	14.3	14.6	15.5	16.4	17.1
13	4	6.1	6.9	7.6	8.1	8.6	9.0	9.4	9.8	10.2	10.5	11.1	11.7	12.2	12.7	13.1	13.6	14.0	14.4	14.8	15.2	16.1	16.9	17.7
16	5	6.6	7.4	8.1	8.6	9.1	9.5	9.9	10.3	10.6	11.0	11.6	12.1	12.7	13.2	13.6	14.1	14.5	14.9	15.3	15.7	16.6	17.4	18.2
20	6	7.0	7.8	8.5	9.0	9.5	9.9	10.3	10.7	11.1	11.4	12.0	12.6	13.1	13.6	14.1	14.5	14.9	15.3	15.7	16.1	17.0	17.8	18.6
23	7	7.4	8.2	8.9	9.4	9.9	10.3	10.7	11.1	11.5	11.8	12.4	13.0	13.5	14.0	14.5	14.9	15.3	15.7	16.1	16.5	17.4	18.2	19.0
26	8	7.8	8.6	9.3	9.8	10.3	10.7	11.1	11.5	11.8	12.2	12.8	13.3	13.9	14.4	14.8	15.3	15.7	16.1	16.5	16.9	17.8	18.6	19.4
30	9	8.1	9.0	9.6	10.2	10.6	11.1	11.5	11.8	12.2	12.5	13.1	13.7	14.2	14.7	15.2	15.6	16.0	16.4	16.8	17.2	18.1	18.9	19.7
33	10	8.5	9.3	9.9	10.5	11.0	11.4	11.8	12.2	12.5	12.8	13.5	14.0	14.5	15.0	15.5	15.9	16.4	16.8	17.2	17.5	18.4	19.3	20.0
36	11	8.8	9.6	10.3	10.8	11.3	11.7	12.1	12.5	12.8	13.2	13.8	14.3	14.9	15.4	15.8	16.3	16.7	17.1	17.5	17.9	18.8	19.6	20.4
39	12	9.1	9.9	10.6	11.1	11.6	12.0	12.4	12.8	13.1	13.5	14.1	14.6	15.2	15.7	16.1	16.6	17.0	17.4	17.8	18.2	19.1	19.9	20.7
43	13	9.4	10.2	10.8	11.4	11.9	12.3	12.7	13.1	13.4	13.7	14.4	14.9	15.4	15.9	16.4	16.8	17.3	17.7	18.1	18.4	19.3	20.2	20.9
46	14	9.6	10.5	11.1	11.7	12.1	12.6	13.0	13.3	13.7	14.0	14.6	15.2	15.7	16.2	16.7	17.1	17.6	18.0	18.3	18.7	19.6	20.4	21.2
49	15	9.9	10.7	11.4	11.9	12.4	12.8	13.2	13.6	14.0	14.3	14.9	15.5	16.0	16.5	17.0	17.4	17.8	18.2	18.6	19.0	19.9	20.7	21.5
52	16	10.2	11.0	11.6	12.2	12.7	13.1	13.5	13.9	14.2	14.5	15.2	15.7	16.2	16.7	17.2	17.7	18.1	18.5	18.9	19.2	20.1	21.0	21.7
56	17	10.4	11.2	11.9	12.4	12.9	13.3	13.7	14.1	14.5	14.8	15.4	16.0	16.5	17.0	17.4	17.9	18.3	18.7	19.1	19.5	20.4	21.2	22.0
59	18	10.6	11.5	12.1	12.7	13.2	13.6	14.0	14.4	14.7	15.0	15.7	16.2	16.7	17.2	17.7	18.1	18.6	19.0	19.4	19.7	20.6	21.5	22.2
62	19	10.9	11.7	12.4	12.9	13.4	13.8	14.2	14.6	14.9	15.3	15.9	16.5	17.0	17.5	17.9	18.4	18.8	19.2	19.6	20.0	20.9	21.7	22.5
66	20	11.1	12.0	12.6	13.1	13.6	14.1	14.5	14.8	15.2	15.5	16.1	16.7	17.2	17.7	18.2	18.6	19.0	19.4	19.8	20.2	21.1	21.9	22.7
72	22	11.6	12.4	13.0	13.6	14.1	14.5	14.9	15.3	15.6	15.9	16.6	17.1	17.7	18.1	18.6	19.1	19.5	19.9	20.3	20.7	21.5	22.4	23.2
79	24	12.0	12.8	13.5	14.0	14.5	14.9	15.3	15.7	16.0	16.4	17.0	17.6	18.1	18.6	19.0	19.5	19.9	20.3	20.7	21.1	22.0	22.8	23.6
85	26	12.4	13.2	13.9	14.4	14.9	15.3	15.7	16.1	16.4	16.8	17.4	18.0	18.5	19.0	19.4	19.9	20.3	20.7	21.1	21.5	22.4	23.2	24.0
92	28	12.8	13.6	14.3	14.8	15.3	15.7	16.1	16.5	16.8	17.2	17.8	18.3	18.9	19.4	19.8	20.3	20.7	21.1	21.5	21.9	22.8	23.6	24.4
98	30	13.2	14.0	14.6	15.2	15.7	16.1	16.5	16.9	17.2	17.5	18.2	18.7	19.2	19.7	20.2	20.7	21.1	21.5	21.9	22.2	23.1	24.0	24.7
115	35	14.0	14.9	15.5	16.1	16.6	17.0	17.4	17.8	18.1	18.4	19.1	19.6	20.1	20.6	21.1	21.5	22.0	22.4	22.8	23.1	24.0	24.9	25.6
131	40	14.9	15.7	16.4	16.9	17.4	17.8	18.2	18.6	18.9	19.3	19.9	20.4	21.0	21.5	21.9	22.4	22.8	23.2	23.6	24.0	24.9	25.7	26.5
148	45	15.7	16.5	17.1	17.7	18.2	18.6	19.0	19.4	19.7	20.0	20.7	21.2	21.7	22.2	22.7	23.2	23.6	24.0	24.4	24.7	25.6	26.5	27.2
164	50	16.4	17.2	17.9	18.4	18.9	19.3	19.7	20.1	20.5	20.8	21.4	22.0	22.5	23.0	23.4	23.9	24.3	24.7	25.1	25.5	26.4	27.2	28.0
180	55	17.1	17.9	18.6	19.1	19.6	20.0	20.4	20.8	21.2	21.5	22.1	22.7	23.2	23.7	24.1	24.6	25.0	25.4	25.8	26.2	27.1	27.9	28.7
197	60	17.8	18.6	19.3	19.8	20.3	20.7	21.1	21.5	21.8	22.2	22.8	23.3	23.9	24.3	24.8	25.3	25.7	26.1	26.5	26.9	27.7	28.6	29.4
213	65	18.4	19.2	19.9	20.4	20.9	21.4	21.7	22.1	22.5	22.8	23.4	24.0	24.5	25.0	25.5	25.9	26.3	26.7	27.1	27.5	28.4	29.2	30.0
230	70	19.0	19.9	20.5	21.1	21.5	22.0	22.4	22.7	23.1	23.4	24.0	24.6	25.1	25.6	26.1	26.5	26.9	27.4	27.7	28.1	29.0	29.8	30.6
246	75	19.6	20.5	21.1	21.7	22.1	22.6	23.0	23.3	23.7	24.0	24.6	25.2	25.7	26.2	26.7	27.1	27.5	27.9	28.3	28.7	29.6	30.4	31.2
262	80	20.2	21.0	21.7	22.2	22.7	23.1	23.5	23.9	24.3	24.6	25.2	25.8	26.3	26.8	27.3	27.7	28.1	28.5	28.9	29.3	30.2	31.0	31.8
279	85	20.8	21.6	22.2	22.8	23.3	23.7	24.1	24.5	24.8	25.1	25.8	26.3	26.9	27.3	27.8	28.3	28.7	29.1	29.5	29.9	30.7	31.6	32.4
295	90	21.3	22.1	22.8	23.3	23.8	24.2	24.6	25.0	25.4	25.7	26.3	26.9	27.4	27.9	28.4	28.8	29.2	29.6	30.0	30.4	31.3	32.1	32.9
312	95	21.8	22.7	23.3	23.9	24.3	24.8	25.2	25.5	25.9	26.2	26.8	27.4	27.9	28.4	28.9	29.3	29.7	30.1	30.5	30.9	31.8	32.6	33.4
328	100	22.3	23.2	23.8	24.4	24.9	25.3	25.7	26.1	26.4	26.7	27.3	27.9	28.4	28.9	29.4	29.8	30.3	30.7	31.1	31.4	32.3	33.2	33.9
361	110	23.3	24.2	24.8	25.4	25.8	26.3	26.7	27.0	27.4	27.7	28.3	28.9	29.4	29.9	30.4	30.8	31.3	31.7	32.1	32.4	33.3	34.1	34.9
394	120	24.3	25.1	25.8	26.3	26.8	27.2	27.6	28.0	28.3	28.7	29.3	29.8	30.4	30.9	31.3	31.8	32.2	32.6	33.0	33.4	34.3	35.1	35.9
427	130	25.2	26.0	26.7	27.2	27.7	28.1	28.5	28.9	29.2	29.6	30.2	30.8	31.3	31.8	32.2	32.7	33.1	33.5	33.9	34.3	35.2	36.0	36.8
459	140	26.1	26.9	27.6	28.1	28.6	29.0	29.4	29.8	30.1	30.5	31.1	31.6	32.2	32.6	33.1	33.6	34.0	34.4	34.8	35.2	36.0	36.9	37.7
492	150	26.9	27.7	28.4	28.9	29.4	29.9	30.2	30.6	31.0	31.3	31.9	32.5	33.0	33.5	34.0	34.4	34.8	35.2	35.6	36.0	36.9	37.7	38.5

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525	160	27.7	28.6	29.2	29.8	30.2	30.7	31.1	31.4	31.8	32.1	32.7	33.3	33.8	34.3	34.8	35.2	35.6	36.0	36.4	36.8	37.7	38.5	39.3
558	170	28.5	29.4	30.0	30.5	31.0	31.5	31.9	32.2	32.6	32.9	33.5	34.1	34.6	35.1	35.6	36.0	36.4	36.8	37.2	37.6	38.5	39.3	40.1
591	180	29.3	30.1	30.8	31.3	31.8	32.2	32.6	33.0	33.3	33.7	34.3	34.9	35.4	35.9	36.3	36.8	37.2	37.6	38.0	38.4	39.3	40.1	40.9
623	190	30.0	30.9	31.5	32.1	32.5	33.0	33.4	33.7	34.1	34.4	35.0	35.6	36.1	36.6	37.1	37.5	37.9	38.4	38.7	39.1	40.0	40.8	41.6
656	200	30.8	31.6	32.2	32.8	33.3	33.7	34.1	34.5	34.8	35.1	35.8	36.3	36.8	37.3	37.8	38.3	38.7	39.1	39.5	39.8	40.7	41.6	42.3
722	220	32.2	33.0	33.6	34.2	34.7	35.1	35.5	35.9	36.2	36.5	37.2	37.7	38.3	38.7	39.2	39.7	40.1	40.5	40.9	41.4	42.1	43.0	43.8
787	240	33.5	34.3	35.0	35.5	36.0	36.4	36.8	37.2	37.6	37.9	38.5	39.1	39.6	40.1	40.4	41.0	41.4	41.8	42.2	42.6	43.5	44.3	45.1
853	260	34.8	35.6	36.3	36.8	37.3	37.7	38.1	38.5	38.8	39.2	39.8	40.4	40.9	41.4	41.8	42.3	42.7	43.1	43.5	43.9	44.8	45.6	46.4
919	280	36.0	36.9	37.5	38.0	38.5	39.0	39.4	39.7	40.1	40.4	41.0	41.6	42.1	42.6	43.1	43.5	43.9	44.3	44.7	45.1	46.0	46.8	47.6
984	300	37.2	38.1	38.7	39.2	39.7	40.2	40.6	40.9	41.3	41.6	42.2	42.8	43.3	43.8	44.3	44.7	45.1	45.5	45.9	46.3	47.2	48.0	48.8
1050	320	38.4	39.2	39.9	40.4	40.9	41.3	41.7	42.1	42.4	42.8	43.4	43.9	44.5	45.0	45.4	45.9	46.3	46.7	47.1	47.5	48.3	49.2	50.0
1115	340	39.5	40.3	41.0	41.5	42.0	42.4	42.8	43.2	43.5	43.9	44.5	45.1	45.6	46.1	46.5	47.0	47.4	47.8	48.2	48.6	49.5	50.3	51.1
1181	360	40.6	41.4	42.1	42.6	43.1	43.5	43.9	44.3	44.6	45.0	45.6	46.1	46.7	47.2	47.6	48.1	48.5	48.9	49.3	49.7	50.6	51.4	52.2
1247	380	41.6	42.5	43.1	43.7	44.1	44.6	45.0	45.3	45.7	46.0	46.6	47.2	47.7	48.2	48.7	49.1	49.5	50.0	50.3	50.7	51.6	52.1	53.2
1312	400	42.7	43.5	44.1	44.7	45.2	45.6	46.0	46.4	46.7	47.0	47.7	48.2	48.7	49.2	49.7	50.1	50.6	51.0	51.4	51.7	52.6	53.5	54.2

Range (n.miles) = 2.03 x [square root (e) + square root (h)]

Where e = elevation in m. of the object

h = height in m. of the observer's eye.

LUMINOUS RANGE DIAGRAM

