



**IALA GUIDELINE**

1116

SELECTION OF RHYTHMIC CHARACTERS AND SYNCHRONISATION OF LIGHTS FOR AIDS TO NAVIGATION

**Edition X.X**

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***Revokes IALA Guideline 1069***



# DOCUMENT REVISION

Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

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| **Date** | **Page / Section Revised** | **Requirement for Revision** |
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**IALA Guideline 1116 – Selection of Rhythmic Characters and Synchronisation of Lights for Aids to Navigation**

**Edition 1.0 Revokes IALA Guideline 1069 P 2**

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**IALA Guideline 1116 – Selection of Rhythmic Characters and Synchronisation of Lights for Aids to Navigation**

**Edition 1.0 P 3**

## INTRODUCTION

This document is intended for the provision of guidance to the technical aspects of selecting the rhythmic characters as defined in Recommendation E‐110 [1]. It includes temporal considerations, selection of colours, the use of the fixed and flashing character, user considerations, synchronisation and sequencing.

While the selection of a rhythmic character for floating AtoN is a straightforward process strictly guided by E‐110, there are many options for selection of a rhythmic character for a fixed AtoN. When selecting a rhythmic character for a fixed AtoN, one should first consider the navigational aspects (significant difference from nearby marks; conspicuity, terrain and the background lighting, etc.). Then the technical aspects, such as, power requirements must be considered which may require a second iteration of the character selection.

## BACKGROUND

Historically, there were technical limitations in the achieving the characters available in E‐110. However, in the foreseeable future the majority of AtoN lights on fixed and floating AtoN will be converted to Light‐Emitting Diode (LED) or other emerging light sources. There is much more scope in the selection of rhythmic characters to exploit with these new technologies.

## SCOPE AND PURPOSE

This document applies to marine aids to navigation signal lights on fixed and floating applications. It is intended for provision of integrated guidance on the following topics:

* general temporal considerations;
* selection of colours;
* flash duration;
* character length;
* use of simultaneous fixed and flashing signals;
* synchronisation and sequencing;
* sharing of good practice by inclusion of examples in appendices.

## GENERAL TEMPORAL CONSIDERATIONS

### CONSIDERATIONS FOR PERIOD SELECTION

The persistence of vision of a light, after extinction of the light, can reach 0.15 second. If the duration of an interval of darkness in a rhythmic character is made too short, the flashes may merge, obstructing identification of an AtoN. Therefore, duration of an eclipse should not be reduced to under 0.15 second.

The periods of the characters of rhythmic lights should be selected in accordance with location specific navigational requirements and results of corresponding risk assessments. Restricted areas, heavier traffic and higher vessel speeds need shorter periods and longer or more flashes in characters allowing more rapid and frequent identification. In less demanding areas with little traffic and slower speeds, it is more acceptable to use longer characters.

Historically, periods of up to 30 seconds have been used for major landfall lights. Where possible in new installations, a shorter period should be considered in order to reduce the time necessary to identify the AtoN.

In order to maintain spatial awareness in demanding areas, consideration should be given to limiting the eclipse length. Trials have shown that limiting the eclipse length to 8 seconds has proved to be effective [23]. When longer eclipse is required to avoid confusion with other lights, introduction of a fixed and flashing character can be used to retain spatial awareness at close ranges. Fixed flashing can also be considered for shorter eclipses when high‐speed craft or close manoeuvring to the aid to navigation is expected.

### CONSIDERATIONS FOR FLASH LENGTH SELECTION

To ensure that their quick lights can be discriminated, an authority should preferably choose the rates for all its quick lights to be 60, very quick lights 120, and ultra‐quick lights 240 flashes per minute. The repetition rate for ultra‐quick lights should not exceed 300 flashes per minute because at faster rates the sequence of flashes might resemble appearances of steady light in some circumstances.

Discrimination of different rates of flashing is not immediately easy unless there is a ratio of at least three to one between the rates. If this ratio cannot be attained, particular care will be required if flashing, quick, very quick and ultra‐quick lights of the same colour in the same area are to be correctly and readily identified. Other distinctions should be made, if possible, between the characters, such as making periods clearly dissimilar or the numbers in groups different.

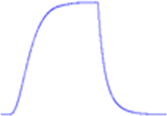
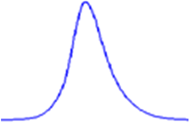
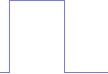
The term ‘long flash’, which is used in the descriptions of the long‐flashing light and of the light characters reserved for south cardinal marks, means an appearance of light of not less than 2 seconds duration. The term ‘short flash’ is not commonly used and does not appear in the Classification [1]. If an authority requires discrimination between two flashing lights that only differ in having flashes of different durations, then the longer flash should be described as ‘long flash’ and be of not less than 2 seconds duration, and the shorter flash may be described as ‘short flash’, but its length is no more than one third of the duration of the longer flash.

Several countries have defined specific rhythmic character subsets for use mainly on their floating marks. Examples of national flash characters are provided in [11], [12] and [13]. An example of implementing different rhythmic characters for a channel is to increase the number of flashes in accordance with the distance along the channel. Another example would be to use a different flash character of lateral buoy lights at a change in channel direction.

### CONSIDERATIONS FOR FLASH SHAPE SELECTION

Traditionally, flash shape has been confined by technology, resulting in flash profile that cannot be precisely controlled. Gaussian flash profiles produced by rotating optics and incandescent sources had a side effect of perception of the flash length changing in accordance with the viewing distance that provided certain ranging capability at the far end. Standard rectangular flash shapes produced by LED light sources retain same temporal perception regardless of the viewing distance.

However, with the use of modern control technics and LED light sources, bespoke flash profiles can be achieved which may assist in conspicuity and ranging. Impact of flash profile manipulation on effective luminous intensity of the flash pulse is explained in [3].

***Figure 1 Typical flash shapes (pulse profiles) produced by flashing incandescent light sources (left), any light sources in rotating optics (middle), and rectangular LED pulse (right)***

## SELECTION OF COLOUR

It is safer to assume that a confusion between white and yellow as colours for lights is liable to occur, and therefore the rhythmic character of a yellow light should always be chosen with the understanding that the colour of the light might be mistaken for white.

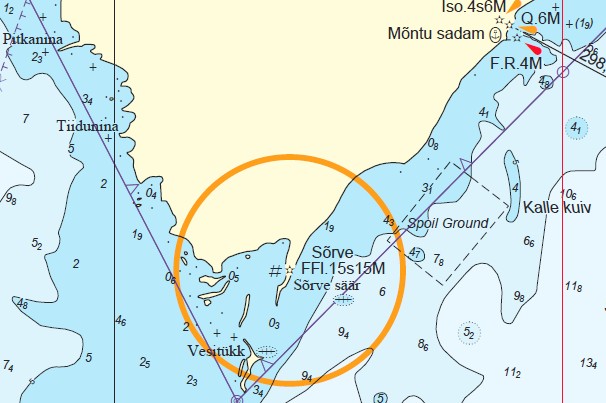
A green or blue light that is showing flashes of very short duration can be mistaken for a white light. Therefore, authorities should take care that the colour of a green or blue light is clearly recognizable at the maximum required range if the duration of a flash in the rhythmic character is very short. It is advisable for authorities to avoid choosing rhythmic characters with high rates of flashing for blue or green lights.

Use of colour in AtoN signalling is described in detail in the IALA Maritime Buoyage System.

## USE OF FIXED AND FLASHING SIGNALS

Replacing an eclipse of a rhythmic character of AtoN light with a low‐intensity light signal enhances the ability of the mariner to maintain spatial awareness and improves identification at close range. In cases when traditional rotating optics of a lighthouse are replaced with flashing LED lights, implementation of fixed and flashing character creates the effect similar to the residual light between flashes of rotating optics. Trials have shown that a fixed light signal component of 1% of peak luminous intensity can be considered sufficient for majority of fixed and flashing character applications. Careful consideration of conspicuity implications is necessary to avoid reduction of fixed/flashing component contrast by fixed luminous intensity level above 5% (up to 10% in high background lighting conditions).

The fixed component can be applied to a number of rhythmic characters, if the low intensity phase (longest eclipse in the group character) is longer than the high intensity phase (flash). Nevertheless, fixed phase can be also used with occulting characters. For charting purposes, placement of an ‘F’ in front of the character abbreviation signifies application of a combination of the low intensity fixed light signal with the main character, shown in Figure 2. For example, the following abbreviations are already in use: FFl, FIso, FLFl.



***Figure 2*** *Chart fragment showing a 15 NM FFl light (Estonian AtoN 935, Sõrve Lighthouse)*

This class of light character should be used with care because the fixed component of the light may not be visible at all times over the same distance as the rhythmic component due to environmental factors.

Some results of trials and application examples are provided in [9] and [10].

## SYNCHRONISATION AND SEQUENCING OF AtoN LIGHTS

### INTRODUCTION TO SYNCHRONISATION AND SEQUENCING

Synchronisation and sequencing of AtoN lights are useful methods of increasing spatial awareness of mariners by improving the overall conspicuity of AtoN lights especially in built‐up areas and areas with background lighting.

Both can be combined with fixed and flashing rhythmic characters.

Where possible, effect of sequencing of lights can be tried out on an AtoN lights simulator before deployment to evaluate the benefits.

Improved availability of GNSS timing signals provides a cost efficient method for synchronisation and sequencing of AtoN lights. AtoN light units with integrated GNSS receiver modules are offered at relatively low cost by a number of manufacturers.

In addition to the objective of this Guideline, there are other applications where synchronisation may apply, as reflected in corresponding IALA documentation addressing marking of manmade structures [21], wind farms[22], or on other types of objects, such as wrecks, or when the identification of the ‘geometry’ is relevant to the mariner.

### APPLICATION OF SYNCHRONISATION AND SEQUENCING

In seeking to meet the navigational requirement as identified by risk assessment, the option of using synchronised and/or sequential lights provides a useful augmentation/enhancement to conventional AtoN lights when viewed against background lighting.

Synchronising of two or more flashing lights is already in use in signalling systems for various transport systems, including road, rail, aviation, and maritime. Historically, synchronisation has been used in the maritime world for leading lights. The purpose of synchronising is to increase the conspicuity of the signal, and/or to indicate that the two or more lights are associated in some manner. For example, if two buoys form a ‘gate’ in a channel, the lights on them might be synchronised to make that gate pair more conspicuous, improving spatial awareness.

Sequencing of lights occurs when a series of lights are flashed in a time sequence to show the geographical relationship between them. Such a set of lights is sometimes likened to a so‐called ‘flare path’ or ‘runway’ effect. In certain applications the number of flashes in the rhythmic characters of associated AtoN lights is increased (decreased) in progression along the fairway while only two of such lights are visible to a mariner at a time.

It is also possible to combine the two effects, so that, for example, if there is a channel marked by pairs of buoys, the lights on each pair are synchronised, and in addition, the paired lights are set to be in a time sequence along the length of the channel.

In each case, the objective is to help the mariner distinguish which lights are pairs of buoys (or beacons) marking a channel, and in addition to indicate which pairs are closest and which are more distant.

Following extensive trials [14] and experience gained with both synchronised and sequential AtoN, it is clear that two key benefits can result from their use:

* synchronised lights provide high impact conspicuity;

They draw the observer’s eye to their presence and overcome background lighting due to their regular and combined effect.

* sequential lights provide directional awareness and improve positioning within a system, e.g. fairway. The observer experiences visual movement in the horizontal plane.

The results of a number of these trials are available at the IALA Wiki.

### CONSIDERATIONS FOR IMPLEMENTATION OF SYNCHRONISATION

The flashing sequences of AtoN can be synchronised in a number of different ways. The devices should flash in a particular order for the fairway to be the most conspicuous to the mariner. Guidance based on current best practice is provided below.

* + 1. **TESTING CONFIGURATION FOR OPTIMUM CONSPICUITY**

It is important to test or simulate the synchronisation of flashing lights on one fairway in different conditions before making decisions on the synchronisation method to be introduced. This will allow an assessment to be made as to the extent that the visibility of the fairway can be improved. Tests should also involve affected mariners in order to ensure that the optimum system of synchronisation is implemented for a particular application.

* + 1. **LOGICAL GROUPING OF LIGHTS**

Fairway turning points can be used to divide the fairway into sections. Lateral marks of the same fairway section could be synchronised, after which the aids marking the next section could be turned on. In order for the various fairway sections to stand out they should have similar characters. If this is not possible, the flashing sequences should be in multiples of each other's light periods.

Another possible option would be to follow the example of airport runway lights, which are turned on in sequence (consecutively). This alternative could also be utilised to guide vessels to port, however, this may look peculiar when leaving port. In this alternative, the flashing sequences at the ends of the fairway should be different from those in the middle. This method is not advisable in a shipping lane where the AtoN are not placed at equal intervals. As the distances vary, it is not possible to create an ‘approach effect’ similar to an airport.

A third option would be to synchronise the different sides of the fairway. Using this method, the direction of the fairway could be highly visible but detecting its width could be difficult.

* + 1. **USE OF DIFFERENT CHARACTERS**

Different characters can be used effectively to identify the beginning of a fairway or change in the fairway. For example, the first two buoys or channel markers could have a different character from the rest of the channel, whilst remaining synchronised.

The character period of synchronised lights should be sufficiently short such that the observer can see those aids as frequently as possible.

* + 1. **SEQUENTIAL FLASHING**

For lights flashing sequentially, the sync delay needs to be determined taking into account the geometry of the channel and in particular the paired buoy spacing. As a guide – ‘the closer the buoys are together the shorter the delay may be’.

The geographical spacing between synchronised lights within a group, on fixed or floating aids, should be such that the group as a whole is normally within the observer’s field of view.

When selecting flash character of sequencing lights and/or pairs, effect of sync failure on identification of such lights should be considered.

* + 1. **LEADING LIGHTS**

Selection of characters and management of synchronised leading lights ([20], [15]) should be such that the front and rear lights can be identified easily, and an overlap of their flash ‘on’ time can still occur in the event of sync failure.

Special consideration should be taken in the design of synchronised leading lights to ensure that in the event of the failure of one lead, a single light is not mistakenly paired with an apparently synchronised external source such as its reflection on water. This consideration could include an automatic disabling of the second light if after risk assessment this is required.

* + 1. **OTHER CONSIDERATIONS**

1. The geographical layout and mix of the aids to navigation, channel or port approach where synchronised aids are deployed should be considered as a whole before decisions are made to establish such aids.
2. The likely sea state and prevailing visibility – i.e. local conditions – should be considered when planning to use synchronised or sequential lights in a waterway.
3. At dusk when the lights first turn on, and on occasion due to synchronisation signal loss, there may be a period of time where one of more of the lights will not be in synch, therefore, consideration should be made to the general layout of the aids to navigation to ensure the mariner can still identify the channel.
4. The preference of using grouped synchronisation over sequential synchronisation may be made to avoid confusion to the mariner when transiting in an opposite direction to the sequential flashing.
5. Promulgation of information by way of notice to mariners must be carried out informing the mariners when a synchronised system is put in place.
6. Affected stakeholders should be consulted when designing the synchronised system.

### LIMITATIONS OF SYNCHRONISATION

* + 1. **ENVIRONMENTAL LIMITATIONS**

The application of synchronised and/or sequential aids to navigation does not necessarily provide the mariner with positional information. Synchronised lights provide spatial awareness and orientation within a channel or system of aids to navigation.

There are physical limitations with regard to the installation of equipment required for synchronisation systems,

e.g. lights synchronised using the GNSS must ensure that the GNSS sensor has an un‐obscured view of the sky in order to receive regular timing signal updates. Atmospheric conditions may affect the signal strength for radio synchronisation systems.

It should be considered that power requirements to provide a synchronised light system will in general, be a little greater.

The impact of synchronised/sequential lights can be adversely affected by: buoy stability, visibility, excessive height of eye vis‐à‐vis vertical divergence, and general adverse weather and sea conditions (in a manner similar to conventional marking).

* + 1. **MAXIMUM SLIPPAGE TIME**

To ensure the mariner can clearly ascertain synchronised groupings the timing error between synchronised lights should not be greater than 50 ms [12].

* + 1. **MINIMUM ANGULAR SEPARATION**

To ensure clear separation of individual synchronised lights can still be made, it is recommended that there should be a minimum angular separation of 5 minutes of arc, subtended at the observer [12]. Lights too close together may be appearing as a single light of a unique and different colour.

## ACRONYMS

AtoN Aid to Navigation

FFl Fixed and Flashing

FIso Fixed and Isophase

FLFl Fixed and Long Flashing

GNSS Global Navigation Satellite System

GPS Global Positioning System. Operated by the Government of the United States

IALA International Association of Marine Aids to Navigation and Lighthouse Authorities ‐ AISM LED Light‐Emitting Diode

ms millisecond(s)

## REFERENCES

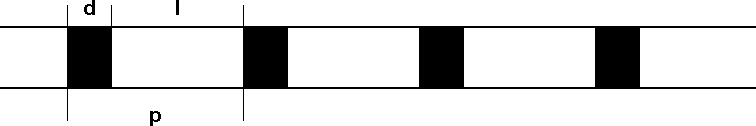
1. IALA Recommendation E‐110 on Rhythmic Characters of Lights on Aids to Navigation
2. IALA Recommendation E‐200‐0 on Marine Signal Lights ‐ Overview
3. IALA Recommendation E‐200‐1 on Marine Signal Lights Part 1 – Colours
4. IALA Recommendation E‐200‐2 on Marine Signal Lights ‐ Calculation, Definition and Notation of Luminous Range
5. IALA Recommendation E‐200‐4 on Marine Signal Lights, Part 4 – Determination and Calculation of Effective Intensity
6. IALA Recommendation E‐200‐4 on Marine Signal Lights ‐ Determination and Calculation of Effective Intensity
7. IALA Recommendation E‐200‐5 on Marine Signal Lights ‐ Estimation of the Performance of Optical Apparatus
8. IALA Guideline 1069 – Synchronization of Lights
9. Fixed Flashing Lights Viewing Trial. Malcolm Nicholson. Presentation at IALA ENG1
10. Trials and Implementation of the Fixed and Flashing Rhythmic Character on Estonian AtoN. Aivar Usk. IALA ENG1 input paper ENG1‐9.4.4
11. National AtoN character list (German list). Frank Hermann. IALA ENG2 input paper ENG2‐9.5
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14. GLA R&RNAV Technical Report No. RPT‐09‐03‐MN‐IT‐07, Synchronised Lights Viewing Trial, August 2007
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16. IALA Guideline 1033 on the Provision of AtoN for different classes of vessels, including high speed craft
17. IALA Guideline 1041 on Sector Lights
18. IALA Guideline 1051 on the Provision of AtoN in Built‐up Areas
19. IALA Recommendation E‐112 for Leading Lights
20. IALA Recommendation O‐138 on the Use of GIS and Simulation by AtoN Authorities
21. IALA Recommendation O‐139 on Marking of Manmade Structures
22. IALA Recommendation O‐117 on The Marking of Offshore Wind Farms
23. Group Flashing Light Viewing Trial. Pärtel Keskküla. IALA ENG4 input paper ENG4‐9.13

***Table 1 Maximum periods***

|  |  |
| --- | --- |
| **Class** | **Maximum period** |
| Isophase light | 12 s |
| Single-occulting light Single-flashing light  Group very quick light | 15 s |
| Group-occulting light of two eclipses | 20 s |
| Long-flashing light |  |
| Group-flashing light of two flashes |  |
| Group quick light |  |
| Group-occulting light of three or more eclipses Group-flashing light of three or more flashes Composite group-flashing light  Morse Code light | 30 s |

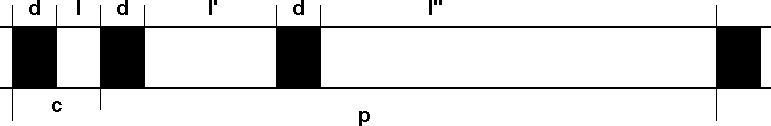
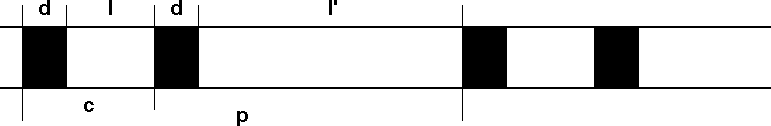
Notes:

1. A rhythmic light is described as a light showing intermittently with a regular periodicity. The rhythmic character of such a light is the sequence of different appearances presented by the light during a period.
2. In Table 2 each class or sub-class of light character is described in general terms by a statement in the third column, which is headed ‘General description’. These statements have been adopted by the International Hydrographic Organization and national hydrographic organizations for use in their publications, and they are written so as to include, in one class or another, the light characters that exist on aids to marine navigation. Therefore, the classes that are recommended by IALA are not fully described in the third column of the table, and further necessary details for the design of recommended light characters are given in the fourth column, which is headed ‘IALA Specification’. It is essential that the third and fourth columns are read together, and the rhythmic characters of lights conform with the requirements of the ‘IALA's Specification’ if they are to conform with these Recommendations.
3. This Recommendation classifies the rhythmic characters of the lights for the marks in the IALA Maritime Buoyage System with some remarks and further recommendations.
4. Lights of different colours are used to assist identification of the marks in the IALA Maritime Buoyage System: Red and Green lights for the lateral marks, White lights for the cardinal, isolated-danger and safe-water marks, Yellow lights for the special marks, and Blue/Yellow lights for wreck marking buoys.
5. Identification of any one of the four cardinal marks does not require knowledge of which of the two rates is being shown unless two similar marks are in the same area, and even then the periods of the rhythmic characters will be different.

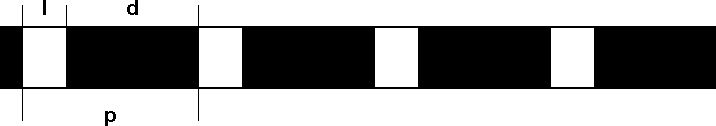
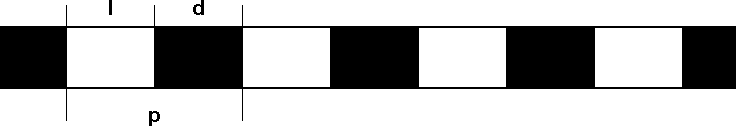
***Table 2 Rhythmic character of lights***

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| --- | --- | --- | --- | --- | --- |
|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 1 | FIXED LIGHT | F | A light showing continuously and steadily. | A single fixed light should be used with care because it may not be recognized as an aid to navigation light. | A single fixed light shall not be used. |
| 2 | OCCULTING LIGHT |  | A light in which the total duration of light in a period is longer than the total duration of darkness and the intervals of darkness (eclipses) are usually of equal duration. | A light in which the total duration of light in a period *is clearly* longer than the total duration of darkness and all the eclipses are of equal duration. |  |
| 2.1 | Single- occulting light | Oc | An occulting light in which an eclipse is regularly repeated | The duration of an appearance of light should not be less than three times the duration of an eclipse. The period should not be less than 2 s  l ≥ 3 d p ≥ 2 s  Example: l = 3 s; d = 1 s; p = 4 s | A single-occulting *White* light indicates a safe-water mark. |

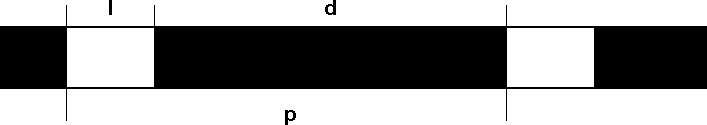
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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 2.2 | Group-occulting light | Oc(#)  e.g. Oc(2) | An occulting light in which a group of eclipses, specified in number, is regularly repeated. | The appearances of light between the eclipses in a group are of equal duration, and this duration is clearly shorter than the duration of the appearance of light between successive groups.  The number of eclipses in a group should not be greater than four in general, and should be five only as an exception.  The duration of an appearance of light within a group should not be less than the duration of an eclipse.  The duration of an appearance of light between groups should not be less than three times the duration of an appearance of light within a group.  In a group of two eclipses, the duration of an eclipse together with the duration of the appearance of light within a, group should not be less than 1 s.  In a group of three or more eclipses, the duration of an eclipse together with the duration of an appearance of light within the group should not be less than 2 s.  l' ≥ 3 l  Oc(2) l ≥ d  c ≥ 1 s  Example: l’ = 6 s; l = 2 s; d = 1 s; c = 3 s; p = 10 s | A group-occulting *Yellow* light indicates a special mark. |
| 2.3 | Composite group-occulting light | Oc(#+#)  e.g. Oc(2 + 1) | A light similar to a  group-occulting light except that successive groups in a period have different numbers of eclipses. | This class of light character is not recommended because it is difficult to recognize.  l’’ ≥ l’  Oc(2+1) l’ ≥ 3 l  l ≥ d  Example: l’’ = 9 s; l’ = 3 s; l = 1 s; d = 1 s; c = 2 s; p = c ≥ 1 s 16 s |  |



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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 3 | ISOPHASE LIGHT | Iso | A light in which all the durations of light and darkness are clearly equal. | The period should never be less than 2 s, but preferably it should not be less than 4 s in order to reduce the risk of confusion with occulting or flashing lights of similar periods.  l = d  p ≥ 2 s  Example: l = d = 2 s; p = 4 s | An isophase *White* light indicates a safe-water mark. |
| 4 | FLASHING LIGHT |  | 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. | A light in which the total duration of light in a period is *clearly* shorter than the total duration of darkness and all the flashes are of equal duration. |  |
| 4.1 | Single flashing light | Fl | A flashing light in which a flash is regularly repeated (at a rate of less than 50 flashes per minute). | The duration of the interval of darkness (eclipse) between two successive flashes should not be less than three times the duration of a flash.  The period should not be less than 2 s (or not less than 2.5 s in those countries where a quick rate of 50 flashes per minute is used).  d ≥ 3 l p ≥ 2 s  Example: d = 3 s; l = 1 s; p = 4 s | A single-flashing *Yellow* light indicates a special mark. |

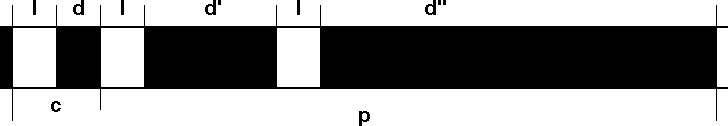


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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 4.2 | Long flashing light | LFI | A single-flashing light in which an appearance of light of not less than 2 s duration (long flash) 1 is regularly repeated. | d ≥ 3 l l ≥ 2 s  Example: d = 8 s; l = 2 s; p = 10 s | A long-flashing *White* light with a period of 10 s indicates a safe-water mark. |
| 4.3 | Group flashing light | Fl(#)  e.g. Fl(2) | A flashing light in which a group of flashes, specified in number, is regularly repeated. | The eclipses between the flashes in a group are of equal duration, and this duration is clearly shorter than the duration of the eclipse between successive groups.  The number of flashes in a group should not be greater than five in general, and should be six only as an exception.  The duration of an eclipse within a group should not be less than the duration of a flash.  The duration of an eclipse between groups should not be less than three times the duration of an eclipse within a group.  In a group of two flashes, the duration of a flash together with the duration of the eclipse within the group should not be less than 1 s.  In a group of three or more flashes, the duration of a flash together with the duration of an eclipse within a group should not be less than 2 s (or not less than 2.5 s in those countries where a quick rate of 50 flashes per minute is used).  d’ ≥ 3 d  Fl(2) d ≥ l  Example: d’ = 6 s; d = 2 s; l = 1 s; c = 3 c ≥ 1 s s; p = 10 s | A group-flashing *White* light with a group of two flashes, in a period of 5 s or 10 s, indicates an isolated-danger mark.  A group-flashing *Yellow* light with a group of four, five or (exceptionally) six flashes indicates a special mark |

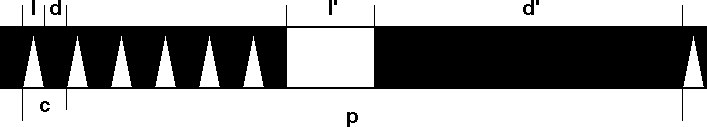
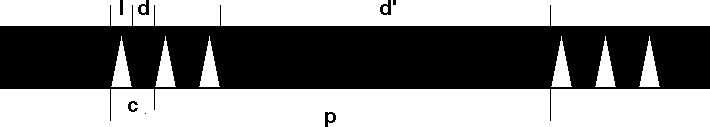


1 The term “long flash”, which is used in the descriptions of the long-flashing light and of the light characters reserved for south cardinal marks, means an appearance of light of not less than 2 seconds duration. The term “short flash” is not commonly used and does not appear in the Classification. If an Authority requires discrimination between two flashing lights that only differ in having flashes of different durations, then the longer flash should be described as “long flash” and be of not less than 2 seconds duration, and the shorter flash may be described as “short flash” and should be of not more rhythmic character of such a light is than one third of the duration of the longer flash.

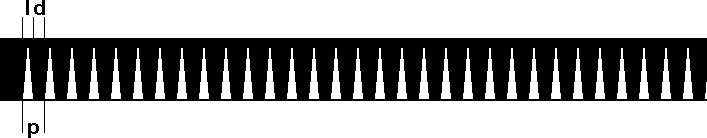
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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 4.4 | Composite | Fl(# + #) | A light similar to a | Light characters should be restricted to (2 + 1) flashes in general, and should be (3 + 1) flashes only as an exception.  d’’ ≥ d’  Fl(2+1) d’ ≥ 3 d  d ≥ l Example: d’’ = 9 s; d’ = 3 s; d = 1 s; l = 1 c ≥ 1 s  s; c = 2 s; p = 16 s | A composite |
|  | group-flashi  ng light | e.g.  Fl(2 + 1) | group-flashing light  except that successive  groups in a period have | group-flashing *Red* or  *Green* light with a group of  (2 + 1) flashes indicates a |
|  |  |  | different numbers of | modified lateral |
|  |  |  | flashes. | (preferred-channel) mark. |
|  |  |  |  | A composite |
|  |  |  |  | group-flashing *Yellow* light |
|  |  |  |  | indicates a special mark. |
| 5 | QUICK |  | A light in which flashes | A light in which identical flashes are repeated at the rate of 60 flashes |  |
|  | LIGHT | are repeated at a rate of | per minute. |
|  |  | not less than 50 flashes |  |
|  |  | per minute but less than |  |
|  |  | 80 flashes per minute. |  |
| 5.1 | Continuous quick light | Q | A quick light in which a flash is regularly repeated. | d ≥ l  l s ≤ p ≤ 1.2 s  Example: l = d = 0.5 s; p = 1 s | A continuous quick *White* light indicates a north cardinal mark. |



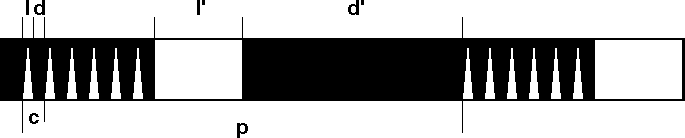
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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 5.2 | Group quick light | Q(#)  e.g. Q(3)  e.g. Q(9)  e.g. Q(6) + LFl | A quick light in which a specified group of flashes is regularly repeated. | The number of flashes in a group should be three or nine. An exceptional light character is reserved for use in the IALA Maritime Buoyage System to indicate a south cardinal mark.  Q(3)  d ≥ l d’>d  Example: d’ = 7.5 s; l = d = 0.5 s; c = 1 s ; 1 s ≤ c ≤ 1.2 s  p = 10 s  Q(9)  d ≥ l d’>d  Example: d’ = 6.5 s; l = d = 0.5 s; c = 1 s; 1 s ≤ c ≤ 1.2 s  p = 15 s  Q(6) d' ≥ 3 l’  +LF1 l’ ≥ 2 s  d ≥ l  1 s ≤ c ≤ 1.2 s  Example: d’ = 7 s; l’ = 2 s; l = d = 0.5 s;  c = 1 s.; p = 15 s | A group quick *White* light with a group of three flashes, in a period of 10 s, indicates an east cardinal mark.  A group quick *White* light with a group of nine flashes, in a period of 15 s, indicates a west cardinal mark.  A group quick *White* light with a group of six flashes followed by a long flash of not less than 2 s duration, in a period of 15 s, indicates a south cardinal mark. |



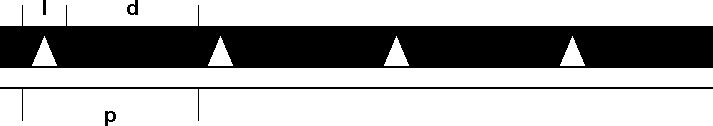
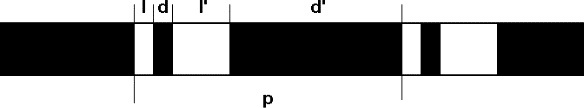
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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 6 | VERY QUICK LIGHT |  | A light in which flashes are repeated at a rate of not less than 80 flashes per minute but less than 160 flashes per minute. | A light in which identical flashes are repeated at the rate of 120 flashes per minute. |  |
| 6.1 | Continuous very quick light | VQ | A very quick light in which a flash is regularly repeated. | d ≥ l  0.5 s ≤ p ≤ 1.6 s  Example: l = d = 0.25 s; p = 0.5 s | A continuous very quick *White* light indicates a north cardinal mark. |
| 6.2 | Group very quick light | VQ(#)  e.g. VQ(3)  e.g. VQ(9) e.g. VQ(6)+LFl | A very quick light in which a specified group of flashes is regularly repeated. | The number of flashes in a group should be three or nine. An exceptional light character is reserved for use in the IALA Maritime Buoyage System to indicate a south cardinal mark.  VQ(3) d' ≥ 1,5 s  d ≥ l  0.5 s ≤ c ≤ 0.6 s  Example: d’ = 3.75 s; l = d = 0.25 s; c =  0.5 s; p = 5 s  VQ(9) d' ≥ 1.5 s  d ≥ l  0.5 s ≤ c ≤ 0.6 s  Example: d’ = 5.75 s; l = d = 0.25 s; c =  0.5 s; p = 10 s | A group very quick *White* light with a group of three flashes, in a period of 5 s, indicates an east cardinal mark.  A group very quick *White* light with a group of nine flashes, in a period of 10 s, indicates a west cardinal mark. |



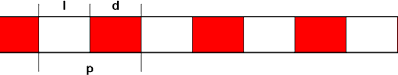
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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | | | **Particular use in the IALA Maritime Buoyage System** |
|  |  |  |  | VQ(6) |  | d' ≥ 1.5 l’ | A group very |
| +LFl |  | l’ ≥ 2 s | quick *White* light |
|  |  | d ≥ l | with a group of six |
|  | Example: d’ = 5 s; l’ = 2 s; l = d = 0.25 s; c = 0.5 s; p = 10 s | 0.5 s ≤ c ≤ 0.6 s | flashes followed  by a long flash of  not less than 2 s |
|  | | | duration, in a |
|  | | | period of 10 s, |
|  | | | indicates a south |
|  | | | cardinal mark. |
| 7 | ULTRA QUICK |  | A light in which | A light in which identical flashes are repeated at the rate of 240 flashes per | | |  |
|  | LIGHT | flashes are repeated | minute. | | |
|  |  | at a rate of not less |  | | |
|  |  | than 160 flashes per |  | | |
|  |  | minute and not more |  | | |
|  |  | than 300 flashes per |  | | |
|  |  | minute. |  | | |
| 7.1 | Continuous ultra quick light | UQ | An ultra quick light in which a flash is regularly repeated. |  | | |  |



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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 8 | MORSE CODE LIGHT | Mo(#)  e.g. Mo(A) | A light in which appearances of light of two clearly different durations are grouped to represent a character or characters in the Morse Code. | Light characters should be restricted to a single letter in the Morse Code in general, and should be two letters only as an exception.  The duration of a "dot" should be about 0.5 s, and the duration of a "dash" should not be less than three times the duration of a "dot".  Mo(A) l' ≥ 3 l  d ≥ l  l = 0.5 s  Example: l’ = 1.5 s; l = 0.5 s; d = 0.5 s; d’ = 4.5 s; p = 7 s | A Morse Code White light with the single character "A" indicates a  safe-water mark.  A Morse Code Yellow light, but not with either of the single characters "A" or "U"\*, indicates a special mark. |
| 9 | FIXED AND FLASHING LIGHT | F+  relevant character abbreviation,  e.g. FFl, FIso | A light in which a low intensity fixed light phase is combined with a flashing phase of higher luminous intensity compliant with preceding classes of rhythmic characters in this table. | Implementation of an FFl rhythmic character is shown below. Other combinations may be implemented as necessary.  d ≥ 3 l l ≤ 1 s  Example: d = 3 s; l = 1 s; p = 4 s |  |



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|  | **Class** | **Abbreviation** | **General description** | **IALA Specification** | **Particular use in the IALA Maritime Buoyage System** |
| 10 | ALTERNATING LIGHT | Al##  e.g. AlWR | A light showing different colours alternately. | This class of light character should be used with care, and efforts should be made to ensure that the different colours appear equally visible to an observer.  AlWR l  d  Example: l = d = 2 s; p = 4 s |  |
| 11 | OCCULTING ALTERNATING LIGHT | OcAl | A light showing different colours alternately and a light in which the total duration of light in an period is longer than the total duration of darkness and the intervals of darkness (eclipses) are of equal duration | OcAlBY This class of light is particular to the use of Emergency Wreck Marking, and efforts should be made to ensure that the different colours appear equally visible to an observer.  I d I d I = 1s d = 0.5s p = 3s | An Occulting- Alternating Blue and Yellow light indicates an Emergency Wreck Marking Buoy mark. |



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***Table 3 Rhythmic characters of the lights in the IALA Maritime Buoyage System***

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| **Mark** | **Rhythmic character of the light** | **Remarks and further recommendations** |
| LATERAL | All recommended classes of rhythmic character2, but a composite group flashing light with a group of (2+1) flashes is solely assigned to modified lateral marks that indicate preferred channels. | Only the colours Red and Green are used. |
| Modified lateral (preferred channel) | Composite group flashing light with a group of (2+1) flashes, in a period of not more than 16 s. |  |
| CARDINAL |  | Only the colour White is used. |
| North cardinal | 1. Continuous very quick light. 2. Continuous quick light. |  |
| East cardinal | 1. Group very quick light with a group of three flashes, in a period of 5 s. 2. Group quick light with a group of three flashes, in a period of 10 s. |  |
| South cardinal | 1. Group very quick light with a group of six flashes followed by a long flash of not less than 2 s duration, in a period of 10 s. 2. Group quick light with a group of six flashes followed by a long flash of not less than 2 s duration, in a period of 15 s. | The duration of the eclipse immediately preceding a long flash should be equal to the duration of the eclipses between the flashes at the very quick rate.  The duration of a long flash should not be greater than the duration of the eclipse immediately following the long flash.  The duration of the eclipse immediately preceding a long flash should be equal to the duration of the eclipses between the flashes at the quick rate.  The duration of a long flash should not be greater than the duration of the eclipse immediately following the long flash. |

2 A single fixed light shall not be used on a mark within the scope of the IALA Maritime Buoyage System because it may not be recognized as an aid to navigation light.

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| **Mark** | **Rhythmic character of the light** | **Remarks and further recommendations** |
| West cardinal | 1. Group very quick light with a group of nine flashes, in a period of 10 s. 2. Group quick light with a group of nine flashes, in a period of 15 s. |  |
| ISOLATED DANGER | 1. Group-flashing light with a group of two flashes, in a period of 5 s. 2. Group-flashing light with a group of two flashes, in a period of 10 s. | Only the colour White is used.  The duration of a flash together with the duration of the eclipse within the group should be not less than 1 s and not more than 1.5 s. The duration of a flash together with the duration of the eclipse within the group should be not less than 2 s and not more than 3 s. |
| SAFE-WATER | 1. Long-flashing light with a period of 10 s. 2. Isophase light. 3. Single-occulting light. 4. Morse Code light with the single character "A". | Only the colour White is used. |
| SPECIAL | 1. Group-occulting light. 2. Single-flashing light, but not a long-flashing light with a period of 10 s. 3. Group-flashing light with a group of four, five or (exceptionally) six flashes. 4. Composite group-flashing light. 5. Morse Code light, but not with either of the single characters "A" or “U”`3. | Only the colour Yellow is used.  A group-flashing light with a group of five flashes at a rate of 30 flashes per minute, in a period of 20 s, is assigned to Ocean Data Acquisition Systems (ODAS) buoys. |
| EMERGENCY WRECK MARKING BUOY | Occulting Alternating light with a period of 3s | Only the colours Blue and Yellow are used |

3 A Morse Code white light with the single character "U" is assigned to offshore structures.